# RADIOCARBON DATING AS A TOOL FOR HYDROGEOLOGICAL INVESTIGATIONS IN THE PALOUSE BASIN

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by Alyssa A. Douglas

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Major Professor: James Osiensky, Ph.D.

**AUTHORIZATION TO SUBMIT THESIS**

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## ABSTRACT

Radiocarbon dating is an important tool for understanding residence time, or "age" of ground water in an aquifer system. This thesis presents the results of a radiocarbon dating study completed in the Palouse Basin of eastern Washington and northern Idaho.

The ground water age or residence time, implies the amount of time elapsed between ground water recharge and the time when the ground water sample was collected. Estimates of ground water age typically require extensive interpretations of physical, chemical and biological processes that act on $^{14}C$ and should not be considered as a true age, but rather as a "model age." Thirty-one samples were collected throughout the Palouse Basin between 2001 and 2003, in the loess, granite, Wanapum basalts, and primarily the Grande Ronde basalts. In the Palouse Basin, $^{14}C$ concentrations indicate generally increasing age with increasing depth below the land surface.

Relative ages of the ground water in the four major pumping centers range from oldest in the Palouse and Moscow areas to youngest in the Pullman and Colfax areas. Historically, nonpumping water levels throughout the basin have shown relatively flat horizontal gradients compared to steep, vertical gradients, suggesting relatively high horizontal hydraulic conductivity in the basalt aquifers, and very low vertical hydraulic conductivity in the interiors of basalt flows. It is conceptualized that the Palouse Basin is characteristically shaped like a "bathtub" filled with basalt lava flows and interbedded sediments. Vertical ground water recharge to the deep basalt aquifers is dominated by extremely slow vertical migration rates relative to current pumping withdrawals.

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# CHAPTER I:

# INTRODUCTION

## Justification

The communities of the Palouse Basin located in northern Idaho and eastern Washington, including the cities of Moscow, Idaho, and Pullman, Colfax, and Palouse, Washington all rely entirely on ground water from two basalt aquifer systems for municipal water supplies. Decades of basin wide water level declines at a rate of about 1.5 feet per year in the basalt aquifers have drawn attention to the unanswered questions of recharge rates within the Palouse Basin. Determining the ages of ground water resources that are several thousands of years old can be very important in the evaluation of long-term sustainability under pumping conditions. Carbon isotopes were used to provide information on the relative ages of the ground water pumped from various locations within the basin. An understanding of the residence times for ground water in the basalts is an important component to the assessment of recharge mechanisms and sustainability of the aquifer systems.

## Overview of Carbon-14 Age Dating of Ground Water

The radioactive isotope of carbon, $^{14}C$, is produced continuously in the earth's atmosphere through the nuclear reaction: $\mathbf{^{14}N + n \rightarrow {}^{14}C + p.}$ The $^{14}C$ atoms oxidize to form $^{14}CO_2$ molecules, which become mixed with inactive atmospheric $CO_2$. Consequently, $^{14}CO_2$ mixes with potential ground water recharge water under atmospheric conditions, and the radiocarbon is incorporated into vegetation by photosynthesis. In unsaturated soil zones, gaseous $^{14}CO_2$ is released by root respiration and microbial oxidation of organic matter,

where it builds up to super atmospheric concentrations and dissolves into infiltrating soil water. Once this water becomes recharge and enters the zone of saturation, it becomes isolated from the atmosphere; and dissolved $^{14}CO_2$ will diminish unidirectionally due to radioactive decay at a rate of one-half of the radiocarbon every 5730 years (Clark and Fritz, 1997).

Measurements of $^{14}C$ in dissolved $CO_2$ in ground water have been used routinely since the 1970's to estimate the age of ground water. $^{14}CO_2$ data can be used as a record of ground water recharge, and measurements of $^{14}CO_2$ can be used to assess the ground water age. The ground water age or residence time, implies the length of time elapsed between entry of the recharge water into a ground water flow system and the time when the ground water sample is collected. For age determination, the initial radiocarbon concentration must be known, and the chemical reactions and physical processes affecting the concentration within the ground water system must be understood and be predictable. Thus estimates of ground water age involve interpretation of physical, chemical and biological processes that act on $^{14}C$ and should not be considered as true ages but rather as "model ages."

The objectives of this study are to estimate the residence times of ground water at various locations in ground water systems of the Palouse Basin through the use of radiocarbon dating. These "age dates" will then be applied to conceptual hydrogeologic models for the basin in an attempt to delineate recharge mechanisms and locations in the basin. In particular, this study focuses on expanding the radiocarbon age date database developed by Crosby and Chatters (1965), while concentrating primarily on the Grande Ronde aquifer system.

**Organization of the Thesis**

This thesis is organized in journal style format that can be considered to consist of two main parts. First, analysis of the radiocarbon dates are presented in full with all supporting materials. Second, analyses of NETPATH modeling simulations and adjustment models applicable to the age dates are described.

# CHAPTER II:

# IMPLICATIONS OF RADIOCARBON DATING IN A BASALT AQUIFER SYSTEM

**(Paper to be submitted for journal publication)**

## ABSTRACT

Defining the ages of ground water resources that are several thousands of years old can be very important in the evaluation of long-term sustainability under pumping conditions. Decades of continual water level declines in the basalt aquifers of the Palouse Basin in Idaho and Washington have drawn attention to the unanswered questions of recharge rates within the systems. Apparent nonrenewability of the primary ground water resources in the Palouse Basin relative to the current rate of withdrawal suggests that ground water mining is taking place. Average water level declines in the deep basalt aquifers of the basin have been on the order of 0.46 m (1.5 feet) per year for the past 40 years. Carbon-isotopic measurements on dissolved inorganic carbon were used to provide information on the relative ages of the ground water pumped from various locations within the basin. Deep basalt ground water derived from depths greater than 180 m (600 feet) generally yield $^{14}C$ values between 20.77 and 4.1 pmc, while relatively shallow basalt ground water yields $^{14}C$ values between 58.59 and 15.38 pmc. Mass balance modeling of hydrochemical reactions was completed to evaluate potential flow paths and compare adjustment models for the given age dates. Current annual water level measurements show that relatively flat horizontal gradients exist within the basin; however, steep, downward vertical gradients are common throughout the basin. These conditions suggest that recharge within the Palouse Basin occurs

as extremely slow, vertical movement of the ground water through the sequence of several basalt flows.

**INTRODUCTION**

The Palouse Basin is a ground water basin located in northern Idaho and eastern Washington (Figure 1). Local communities in the area depend entirely on two basalt aquifer systems for their water resources. The deeper aquifer system has been developed more heavily in recent decades because of the better quality of the water, and the more reliable supply. The deeper aquifer system has experienced continually declining water levels which historically reflected a transient response to increases in pumpage due to growth. However, despite success by the four major pumping centers in stabilizing annual pumping rates over the past decade, water levels have continued to decline throughout the basin. This has raised concerns about ground water mining.

Potential interrelationships between ground water chemistry, geology of the catchment area, and hydrologic properties of the aquifers are important relative to understanding the processes that control ground water occurrence and movement. Hydrological isotope analysis has recently become an important tool used for assessing these relationships. Where timeframes of interest are thousands to tens of thousands of years, radiocarbon dating provides a way to estimate the age or residence time of ground water at specific locations within a ground water basin (Clark and Fritz, 1997).

A previous radiocarbon age dating study was conducted in the basin by Crosby and Chatters (1965). That investigation was concentrated primarily in the upper basalt aquifer system. This study focuses on estimation of the residence time of ground water at various

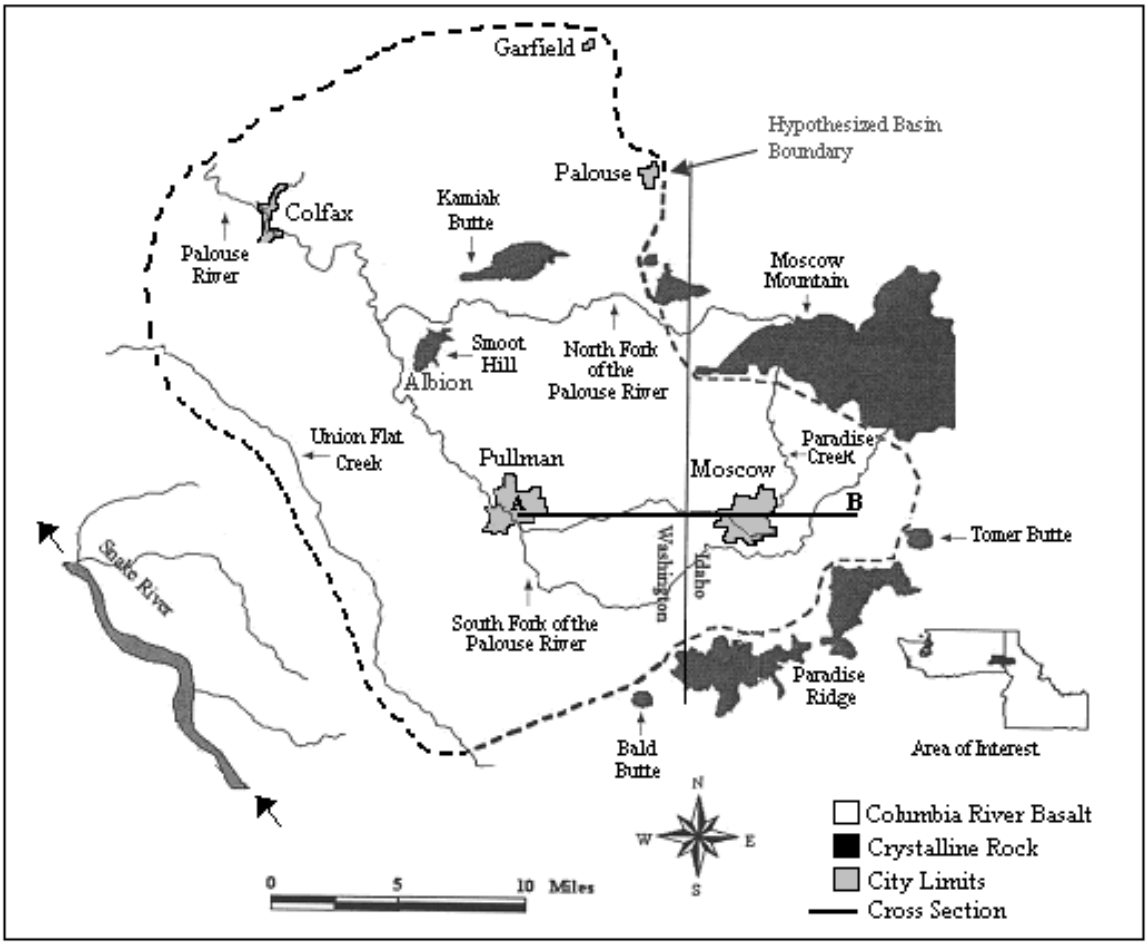


**Figure 1. Bedrock-geologic and hydrographic map of the study. The Palouse Basin is located in northern Idaho and eastern Washington, in and around the towns of Moscow, Idaho and Pullman, Colfax, and Palouse, Washington. The bold line A-B represents the approximate trace of the generalized geologic cross-section shown in Figure 2 (modified after Hopster, 2003).**

locations in the Palouse Basin, and correlation of these "age dates" to specific geologic and hydrogeologic conditions that controlled residence time prior to development of the basin beginning in the 1890's. Ground water samples for isotope ratios of carbon ($^{14}C$ and $^{13}C$ in dissolved $CO_2$), oxygen ($^{18}O$), and general water chemistry were collected from the basalt aquifer systems, specifically concentrating on the deeper system. Samples were collected from existing municipal and domestic wells, and therefore, the spatial distribution of sampling points was predetermined. These data were used to evaluate potential recharge mechanisms to help explain the apparent lack of recharge to the deep aquifer system in the basin. The general conceptual, hydrogeologic model that water ages along flow paths in both the vertical and horizontal directions was inferred throughout the study.

**Hydrogeologic Setting**

The Palouse Basin is situated on the eastern margin of the Columbia Plateau, encompassing an area of about 608.6 $km^2$ (235 $mi^2$). The basin is drained by the South and North Forks of the Palouse River, and their tributaries (Figure 1). The geology in the area consists of crystalline basement rock (granite and metasediments), overlain unconformably by basalt flows and interbedded sediments of the Columbia River Basalt Group (CRBG). The CRBG is overlain unconformably by fluvial deposits and thick units of loess (Figure 2). These Miocene basalts are part of an extensive sequence of lava flows that flowed into the Palouse Basin from the west and south, and filled in the pre-existing topography. The CRBG is divided into four formations from the base upward: Imnaha, Grande Ronde, Wanapum and Saddle Mountains (Figure 2). Stream and lacustrine sediments were deposited as interbeds throughout the sequence of basalt flows due to damming of drainages as individual basalt flows advanced. These sedimentary interbeds are thickest near the city of Moscow and pinch

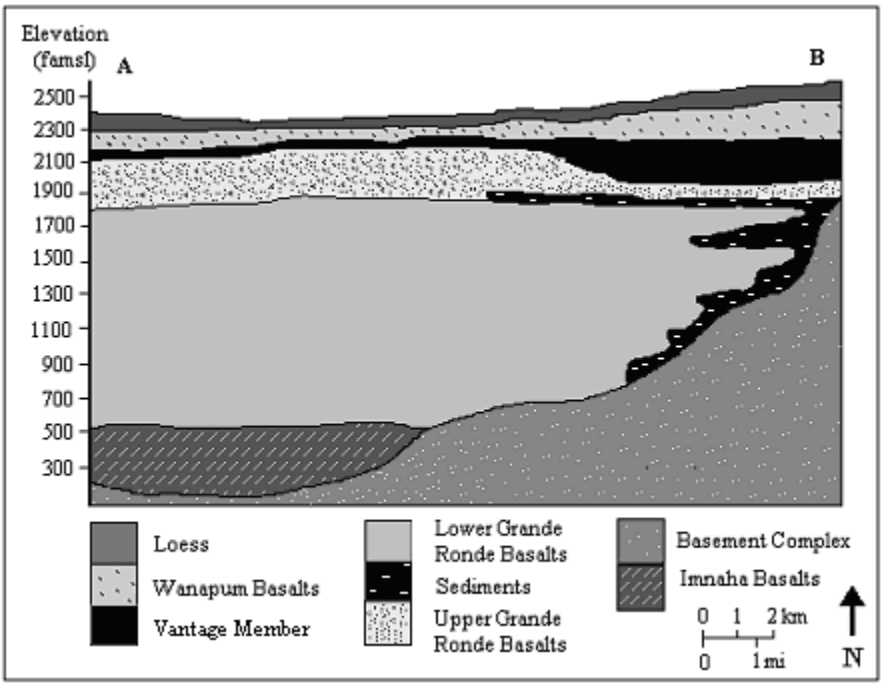


**Figure 2. Generalized geological cross-section of the Palouse Basin. Note: The Upper Grande Ronde is differentiated from the Lower Grande Ronde by a change in magnetic polarity. See Figure 1 for location of cross section (modified after Owsley, 2003).**

out completely to the west. The Vantage Member is a thick sedimentary interbed consisting of clay, silt, sand, and gravel that separates the Wanapum Formation from the Grande Ronde Formation under most of the eastern half of the basin.

The ground water basin boundaries to the east are formed by granite of the Palouse Range, including Moscow Mountain. Granite and metasediments of Bald Butte, Paradise Ridge and Tomer Butte form the boundaries to the south and southeast, respectively. Metasediments and granite of Kamiak Butte, Smoot Hill, and other prominent hills form discontinuous boundaries to the north and northwest. The western boundary of the basin is undefined. No ground water discharge from the deep Grande Ronde aquifers in the Moscow

and Pullman areas has been identified along the Snake River Canyon based on $^{18}O$ data (Hopster, 2003).

Two major aquifer systems in the basin exist within the Wanapum and Grande Ronde Formations (Figure 2). The primary ground water resource system in the Palouse Basin is the Grande Ronde aquifer system. The Grande Ronde exists at depths between 0 and 700 m (2300 feet) below land surface. Individual flows range in thickness from less than one meter (three feet) to more than 50 m (160 feet) (Bush and Seward, 1992). The Wanapum aquifer system is the primary ground water resource for rural residents within the basin limits. Thickness of the Wanapum Formation ranges from 0 to 76 m (250 feet) within the basin (Hooper and Webster, 1982).

Ground water in the layered basalts occurs in perched zones as well as in unconfined and confined multiple aquifer systems. Ground water flow occurs through intraflow structures within the sparsely fractured interiors of single flow units, and within the highly fractured, vesicular, interflow zones between successive flow units (DOE, 1981; Long, 1978). Figure 3 illustrates the physical characteristics of Columbia River Basalt flows. Interiors of the lava flows generally have low porosity and low hydraulic conductivity while interflow zones have high porosity and high hydraulic conductivity (DOE, 1981). Basalt interiors typically form confining layers between successive confined interflow zones. These multiple aquifer/aquitard systems generally are poorly connected vertically (DOE, 1986). Within the Palouse Basin, aquifers characteristically exhibit lateral hydraulic connections over several kilometers in response to pumping in the major municipal pumping centers (Owsley, 2003).

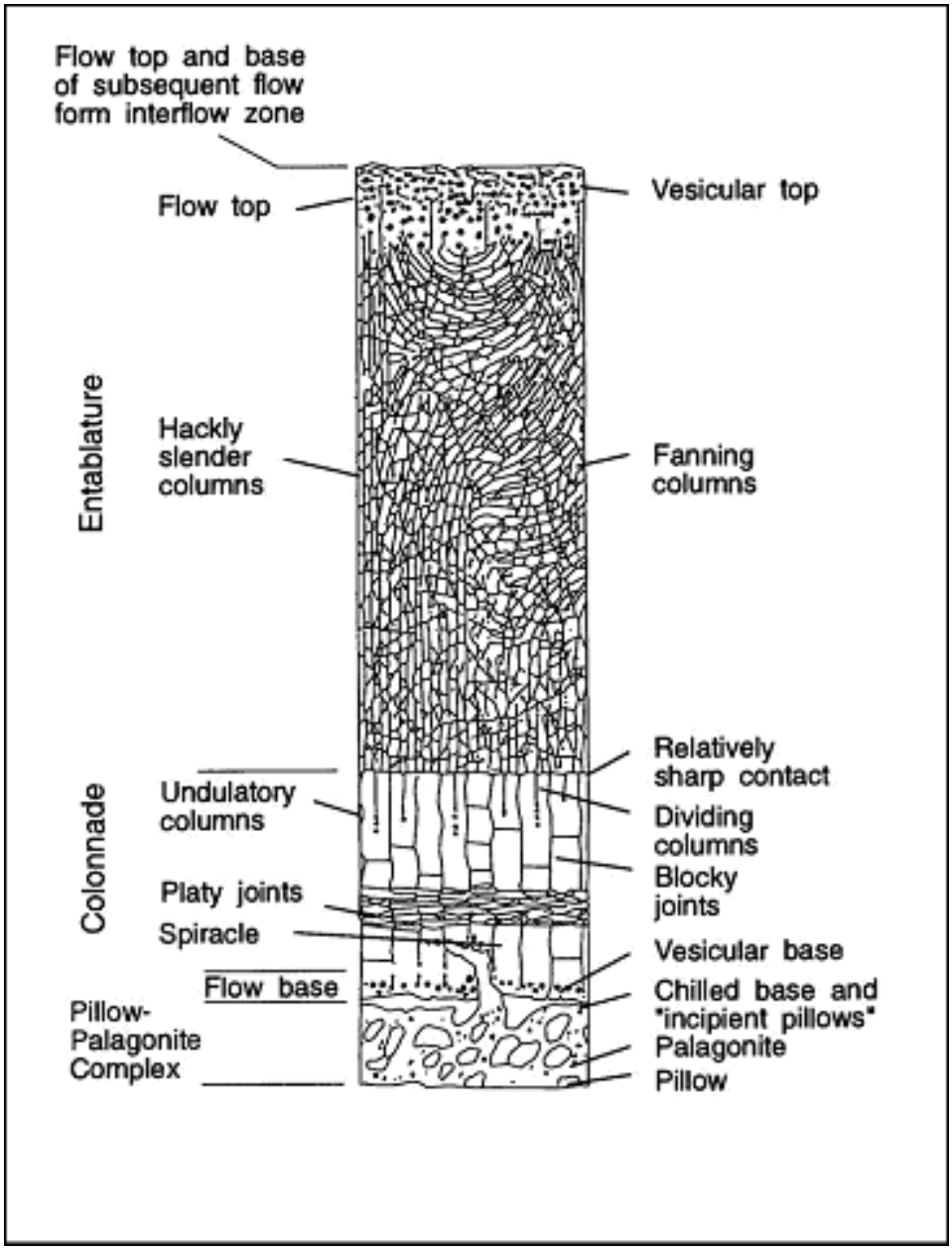


**Figure 3. Physical characteristics of Columbia River Basalt Group flows (modified after Swanson and Wright, 1978).**

## PREVIOUS INVESTIGATIONS

The first, extensive hydrogeologic investigation of the Palouse Basin was conducted in the 1890's by Russell (1897). He noted the paucity of significant springs discharging from the Wanapum and Grande Ronde Formations along tens of kilometers of outcrop in river canyons during the early stages of ground water development in the basin. This lack of natural ground water discharge clearly reflected the small amount of recharge to the aquifer systems. Russell (1897) also noted the fact that the first wells drilled in the Pullman and Moscow areas flowed at the land surface. However, most of these wells were left uncapped, and water levels soon fell below land surface.

Ongoing geologic and hydrologic studies in the local area are primarily focused on evaluation of ground water resource sustainability within the basin. Conceptual models of recharge in the basin have ranged from the mechanisms of infiltration of areally distributed precipitation, to the possibility of percolation from losing streams in the eastern part of the basin (Bauer and Vaccaro, 1990; Barker, 1979; Heinemann, 1994; Kopp, 1994; Lum et al., 1990, Johnson, 1991; Muniz, 1991; O'Brien et al, 1996; Provant, 1995; Smoot and Ralston, 1987). Additionally, it has long been hypothesized that infiltration of runoff from the Palouse Range recharges sediments interbedded with the basalts on the eastern side of the basin (Lin, 1967; Jones and Ross, 1972; Pierce, 1998). Each of these proposed scenarios suggested relatively short travel times to the basalt aquifers (e.g., on the order of years to hundreds of years). Crosby and Chatters (1965) conducted the first investigation of ground water ages within the Palouse Basin. They found that radiocarbon age dates in the Moscow-Pullman area range between 8,500 and 32,000 years B.P. Crosby and Chatters (1965) suggested that isotopic exchange does not occur in the basalts, and that no correction of the

raw $^{14}CO_2$ ages are necessary based on the fact that the associated $^{13}C$ values are very similar between samples of recent perched water and deep old ground water. Overall, Crosby and Chatters (1965) found a general relationship of increasing age with increasing depth. However, samples were collected primarily from the upper, shallow aquifer system in the Wanapum Formation; only four out of 50 samples were taken from the Grande Ronde Formation.

An analysis of $\delta^{18}O$ concentrations in ground water and meteoric water was completed in the Palouse Basin by Larson et al. (2000), focusing primarily on the evaluation of various conceptual models for recharge in the basin. They found that the deeper basalt ground water had $\delta^{18}O$ values statistically distinct from the shallower basalt ground water and from ground water in other lithologic units. Grande Ronde ground water samples consistently yielded $\delta^{18}O$ values between –15.4 and –17.5 ‰, which generally are depleted relative to Wanapum ground water samples ($\delta^{18}O$ values between –14.9 and –15.7 ‰) and ground water from the loess and fluvial sediments ($\delta^{18}O$ values between –12.6 and –14.7 ‰). This was interpreted to indicate that the deep ground water in the basin was not recharged under the present climatic conditions, and that shallower aquifer systems were recharged more recently.

Hopster (2003) investigated physical, ground water recharge and discharge mechanisms in the basin. This investigation provided insight into the controls exerted by spatially variable, overburden thicknesses on recharge to the basalt aquifers within the basin. The overburden consists primarily of rolling hills comprised of low hydraulic conductivity loess, and in part includes fluvial sediments. Lateral hydraulic conductivity values of the

overburden aquifer defined by Vaccaro (1999) from specific-capacity data range from $8.8x10^{-6}$ to 5.2 cm/s ($2.9x10^{-7}$ to $1.7x10^{-1}$ ft/s) and regional values derived from a ground water flow model range from $1.5x10^{-5}$ to $4.0x10^{-1}$cm/s ($5.0x10^{-7}$ to $1.3x10^{-2}$ ft/s). McDaniel et al. (2001), Brooks et al. (2000) and O'Geen (2002) concluded that fragipans present in the soils and paleosols of the loess deposits allow very little recharge to infiltrate on an annual basis. They indicated that the impeding effect of fragipans is greater on the east side of the basin (i.e., in the direction of increasing rainfall and soil development).

Nonpumping water level measurements suggest that under the present conditions, ground water potential decreases with depth throughout most of the basin. Historical water level data show that ground water levels in the Grande Ronde aquifers have been declining steadily while water levels in the Wanapum aquifer system have been relatively stable except for seasonal fluctuations due to increased summer-time pumping, and spring-time recharge. Large-scale aquifer tests have shown that lateral hydraulic connections between various Grande Ronde pumping centers exist over distances of several kilometers; however, no vertical hydraulic connections between the Grande Ronde aquifers and the overlying Wanapum aquifer system were measured over pumping periods ranging from six hours to 48 hours (Owsley, 2003).

The objectives of this study were to use radiocarbon dating techniques, along with $^{18}O$ analysis, and water chemistry in the basin to evaluate the spatial characteristics of ground water recharge to the deep Grande Ronde basalt aquifers in the Palouse Basin. Samples and water level data were collected for the Grande Ronde aquifers through existing, domestic and municipal wells throughout the basin.

**METHODS**

Ground water samples were collected from 31 wells within the study area over a three-year period (2000-2003). Most samples were collected from the Grande Ronde basalts; however, additional ground water samples were also collected from the Wanapum basalts, the surficial loess deposits, and granitic bedrock in the basin. Sample collection points were located as close to the wellheads as possible, and before passage through water treatment systems. Water samples were collected after flushing of the casing and well plumbing. Temperature, pH, and alkalinity were measured in the field. Alkalinities were measured with a digital titrator. The water samples for both $^{14}C$ and $^{13}C$ were collected in 50 liter (13 gallon) Nalgene™ carboy bottles, and capped immediately. The same day in the lab, $BaCl_2 \bullet 2H_2O$ and $NH_4$ were added to quantitatively precipitate $BaCO_3$. The water was then decanted, and the precipitate transferred to a 1.0 liter HDPE Nalgene™ bottle. The carbonate precipitate was analyzed for $^{14}C$ and $^{13}C$ by Beta Analytics Inc. in Miami, Florida. $^{14}C$ results are reported as percentage of the modern standard (pmc) and as the Apparent Radiocarbon Age (BP). $^{13}C$ results are expressed as $\delta^{13}C$, which is the deviation in per mil (parts per thousand) of the $^{13}C/^{12}C$ ratio of the sample, relative to the Peedee belemnite international standard (Craig, 1957). Water chemistry results were analyzed in the Department of Geological Sciences at the University of Idaho. Major anion concentrations were determined on an ionchromatograph (IC) and major cation analysis was performed using a Perkin Elmer, Optima 3000XL ® Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP_AES) equipped with an axial torch. Oxygen-18 analyses were performed by automated $CO_2$ equilibration (Epstein and Mayeda, 1953) and gas-source mass

spectrometry at the Geoanalytical Lab at Washington State University and reported as $\delta^{18}O$ relative to VSMOW (Gat and Gonfiantini, 1981).

**GEOCHEMICAL MODELING**

The ground water chemistry in the basin is predominantly of the calcium bicarbonate type (Cotton, 1982; Nelson, 2003). The $^{14}C$ ages are primarily related to the original $^{14}C$ content of the water as it percolated through the soil zone (Crosby and Chatters, 1965). The radioactive age of ground water is given by the general law of radioactive decay

$$t = \frac{\lambda}{\ln 2} \ln \frac{A_0}{A} \qquad (1)$$

where: $t$ is the travel time in years, between the recharge location and sampling location, $\lambda$ is the half-life of $^{14}C$ ($5730 \pm 30$ years), A is the measured $^{14}C$ activity (in pmc) of dissolved inorganic carbon (DIC) in the sample (downgradient well), and $A_0$ is the $^{14}C$ activity of DIC in the recharge water (upgradient well).

Correction factors based on water chemistry, and tested by analysis of $\delta^{13}C$ concentrations, can be applied to the age dates. Crosby and Chatters (1965) determined that the radiocarbon concentrations in the ground water of the Palouse Basin were affected only by radioactive decay. Additionally, Bacon (1997) found that $^{14}CO_2$ concentrations in the gas phase of the vadose zone are modern, containing bomb radiocarbon. While this study was limited to one location between Moscow and Pullman, it supports the assumption that the initial $^{14}C$ concentration at the recharge point, $A_0$, can be taken as 100 pmc. Uncorrected ages are calculated on this basis, and neglecting any subsequent hydrochemical reactions. However, $\delta^{13}C$ values vary by approximately 5 per mil, and these variations may reflect gains or losses of $CO_2$ by reactions subsequent to recharge. Therefore, conventional

adjustment models based on water chemistry and $\delta^{13}C$ were also applied using NETPATH (Plummer et al., 1994). Because the Palouse Basin is not a carbonate terrain and is primarily a silicate environment, only adjustment models that are applicable to silicate terrains were utilized.

NETPATH considers several well-known methods for age date adjustment. The adjustment model of Mook (1980) was determined to be the most applicable to the study area, and was considered the only appropriate model for silicate terrains. Mook (1980) is based on the $^{13}C$ values and does not assume that cations or alkalinity necessarily come from dead carbonates.

Application and results of Mook (1980) and the other adjustment models to the age dates are provided in (Douglas, 2004). Results indicate that whichever correction method is used, the relative age relationships are the same among wells, and so the spatial age patterns are preserved. Mook (1980) provides a very small, minimal correction to the uncorrected age dates, with corrected ages having a 1.0-1.7 % difference from the uncorrected ages. Therefore, for purposes of this specific investigation, measured $^{14}C$ concentrations in pmc are used for spatial analysis.

**RESULTS AND DISCUSSION**

Concentrations of $^{14}C$ in the ground water samples from the lower portion of the Grande Ronde aquifer system ranged from 4.1 to 20.77 pmc. Concentrations of $^{14}C$ ranged from 15.38 to 58.59 pmc in ground water samples from the upper portion of the Grande Ronde aquifer system. Ground water from the Wanapum aquifer system and from the loess deposits yielded concentrations of $^{14}C$ between modern and 33.34 pmc. The corresponding ages ranged from 12,993 to 26,406 years (B.P.) for the lower portion of the Grande Ronde

aquifer, and from 4,420 to 11,832 years (B.P.) for the upper portion of the Grande Ronde aquifer. Ages ranged from modern to 14,605 years (B.P.) for the Wanapum aquifer system and loess deposits (Table 1). $^{18}O$ results are consistent with results reported by Larson et al. (2000) for the Grande Ronde Formation, Wanapum Formation, and loess deposits.

| # | Well Name | Geologic Layer | Uncorrected Age (B.P.) | $^{14}C$, pmc | Detection Limits (±) | $\delta^{13}C$, ‰ PDB | $\delta^{18}O$, ‰ VSMOW |
|---|---|---|---|---|---|---|---|
| 1 | Butters | Granite | 6,066 | 48.01 | 50 | -15.2 | -17.38 |
| 2 | Gentry | Granite | Modern | 104.5 | 0.5 pmc | -18.1 | -15.38 |
| 3 | UIGRS | Alluvium | Modern | 115.75 | 0.79 pmc | -16.4 | -14.72 |
| 4 | Loess6A | Loess | 1,578 | 82.62 | 40 | -13.2 | n/a |
| 5 | Stalnaker | Wanapum | 14,605 | 17.09 | 50 | -16.3 | -15.62 |
| 6 | COM2 | Wanapum | 8,679 | 35 | 40 | -16.2 | -16.58 |
| 7 | COM3 | Wanapum | 9,081 | 33.34 | 120 | -15.8 | -16.38 |
| 8 | UI5 | Wanapum | 3,311 | 67 | 60 | -15.7 | -15.15 |
| 9 | COP3 | Grande R. | 12,993 | 20.77 | 150 | -14.6 | -16.70 |
| 10 | COP5 | Grande R. | 16,254 | 14 | 230 | -13.1 | -17.07 |
| 11 | COP6 | Grande R. | 17,125 | 12.6 | 200 | -13.5 | -17.06 |
| 12 | COP7 | Grande R. | 16,463 | 13.65 | 150 | -15.1 | -17.06 |
| 13 | WSU5 | Grande R. | 14,306 | 17.72 | 120 | -14 | n/s |
| 14 | WSU6 | Grande R. | 21,058 | 7.83 | 190 | -12.8 | -17.57 |
| 15 | WSU7 | Grande R. | 17,959 | 11.39 | 180 | -15.1 | -18.23 |
| 16 | WSU8 | Grande R. | 18,438 | 10.75 | 160 | -14.8 | -17.97 |
| 17 | Glenwood | Grande R. | 15,525 | 15.29 | 120 | -15.3 | -17.29 |
| 18 | Fairview | Grande R. | 15,129 | 16.04 | 130 | -14.9 | -17.27 |
| 19 | Claystreet | Grande R. | 14,003 | 18.38 | 120 | -16 | -17.65 |
| 20 | COM6A | Grande R. | 23,741 | 5.66 | 310 | -11 | -17.34 |
| 21 | COM6 | Grande R. | 22,559 | 6.53 | 220 | -12.3 | -18.41 |
| 22 | COM8 | Grande R. | 21,111 | 7.78 | 290 | -11.6 | -17.25 |
| 23 | COM9 | Grande R. | 19,127 | 9.89 | 180 | -14.6 | -18.45 |
| 24 | UI4 | Grande R. | 19,716 | 9.21 | 160 | -15.9 | -18.49 |
| 25 | UI3 | Grande R. | 20,467 | 8.41 | 300* | -15.9 | -18.66 |
| 26 | Palouse1 | Grande R. | 21,925 | 7.05 | 120 | -13.1 | n/s |
| 27 | Palouse2 | Grande R. | 26,406 | 4.1 | 350 | -13.7 | -18.37 |
| 28 | Paulson | Grande R. | 15,477 | 15.38 | 170* | -14.9 | -18.07 |
| 29 | Brawdy | Grande R. | 4,420 | 58.59 | 70* | -15.7 | -16.75 |
| 30 | McGreevy | Grande R. | 6,636 | 44.81 | 80* | -16.1 | -17.23 |
| 31 | Ch. Electric | Grande R. | 11,832 | 23.9 | 100* | -14.8 | -18.03 |

**Table 1. Isotopic characteristics, uncorrected ages and stratigraphic data for sampled wells (n/s = not sampled, * = samples analyzed through extended counting procedure). Wells 28-30 are shallow Grande Ronde Wells.**

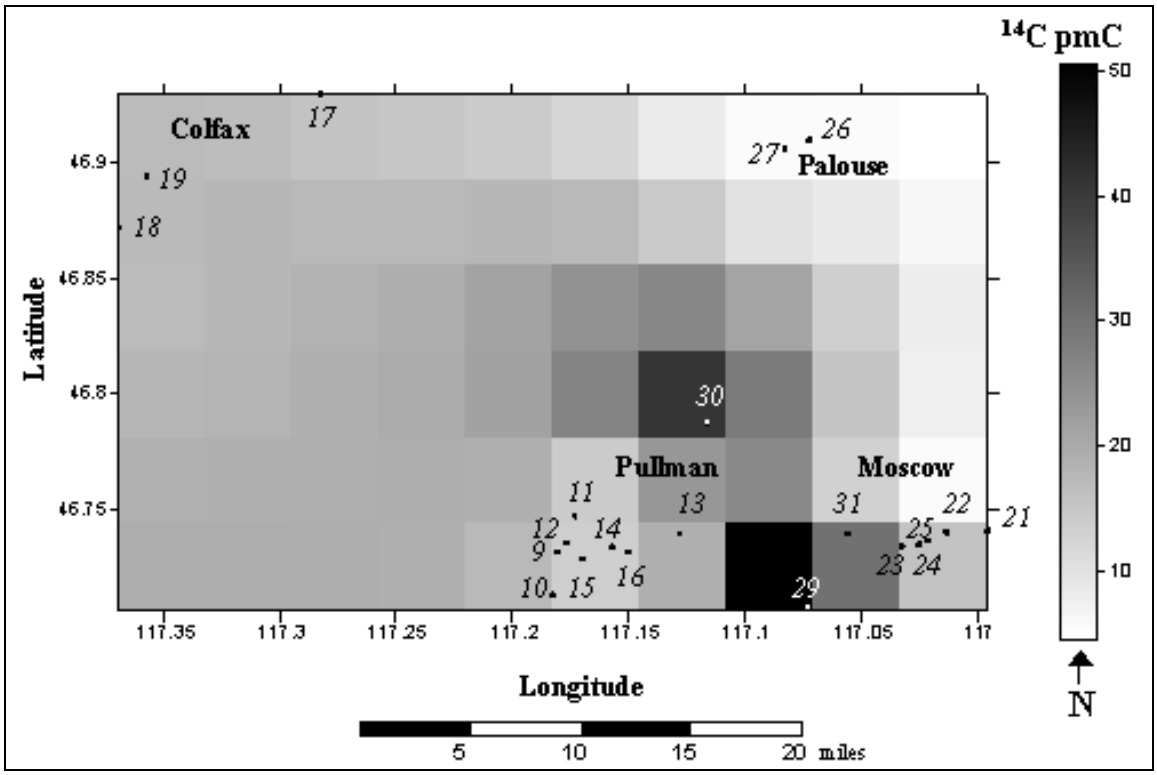


**Figure 4. Shaded cell map of ground water $^{14}C$ (pmc) concentrations in the Grande Ronde aquifer system. Wells samples are identified through a sample number given in Table 1. Darker cells represent areas of younger waters. Two of the cells located around wells #30 and #29 are relatively the youngest ground water found to date in the Grande Ronde aquifer system. These two areas could suggest potential recharge areas for the Grande Ronde system.**

Figure 4 presents a kriged, shaded cell map of measured $^{14}C$ content as pmc for the both the lower and upper parts of the Grande Ronde aquifer system. In general, lower concentrations represent longer residence times or greater ages of the water. The age dates suggest that the oldest ground water exists in the northeast and eastern portions of the basin. Significantly younger water exists between Moscow and Pullman. Scatter in the timing of recharge events is prominent in the $\delta^{18}O$ isotope data throughout the Grande Ronde aquifer system (Larson et al., 2000). Wells 30 and 29 are completed into the very top of the Grande

Ronde aquifer system. While mixing at that location cannot be ruled out, with the data available, the existence of relatively young water at those locations is consistent with findings of previous investigations. Foxworthy and Washburn (1963) suggested that a potential ground water barrier exists between the cities of Moscow and Pullman based on differences in water level fluctuations and ground water chemistry. Several, large scale aquifer tests conducted between Moscow, Pullman, and Palouse, and between Pullman, Moscow and Palouse, suggest the existence of a hydraulic boundary between Moscow and Pullman. These aquifer tests also show that portions of both the Moscow and Pullman pumping centers are hydraulically connected to Palouse (Owsley, 2003). In addition, the crest of a subsurface anticlinal fold in the Grande Ronde basalt flows has been mapped in the same area (Bush, 2004). Newcomb (1969) suggested that faults associated with anticlinal folds commonly produce ground water barriers in basalts of the CRBG.

Ground water ages derived for three common wells between this investigation and that of Crosby and Chatters (1965) yielded comparable ages. Because the ages fall into the same time period for each stratigraphic unit, it is apparent that the residence times for each unit have not been changed by 40 years of pumping in each of the major pumping centers. Ground water flow in horizontally layered Columbia River basalts occurs primarily within interflow zones between individual basalt flows, and wells completed in these interflow zones draw water radially from large horizontal distances. Water within specific interflow zones is expected to be similar in age because recharge water must traverse similar vertical, travel distances. Large-scale aquifer tests in the Grande Ronde aquifer system consistently yield high horizontal hydraulic conductivity values, and low storativity values for the relatively thin (e.g., one to three meters), interflow, producing zones. Vaccaro (1999)

reported lateral hydraulic conductivity values up to 1.9 cm/s ($6.1x10^{-2}$ ft/s) and vertical hydraulic conductivity values up to $3.0x10^{-4}$ cm/s ($1.0x10^{-5}$ ft/s) for basalts of the CRBG.

Figure 5 compares $^{14}C$ (pmc) concentrations for individual wells relative to the elevation of their producing zones. In the Wanapum aquifer system, a very wide range of $^{14}C$ values exists (67 to 17.09 pmc), over a relatively narrow range of elevations. The variable age dates likely reflect the fact that the Wanapum aquifer system is known to receive recharge seasonally in response to high flows in local streams. In addition, water levels in the Wanapum aquifer system are in a state of quasi-equilibrium on an annual time frame as

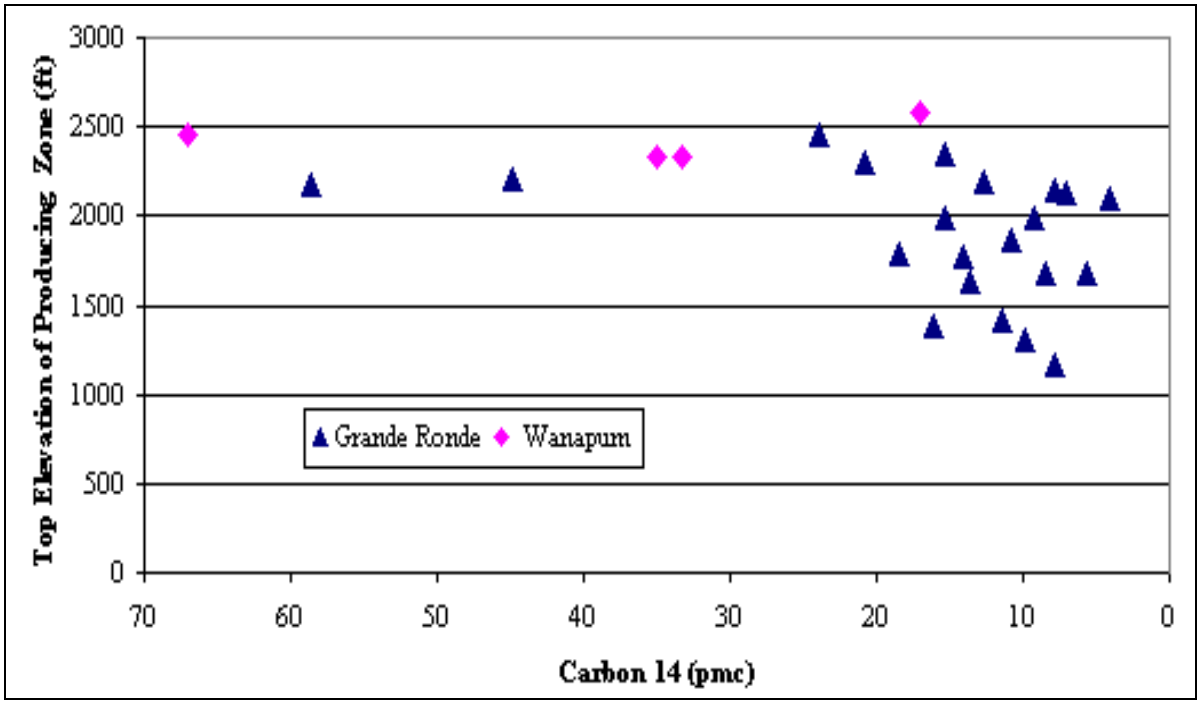


**Figure 5. Arithmetic plot of $^{14}C$ concentration versus elevation of the producing zone for ground water samples collected from the Grande Ronde and Wanapum aquifer systems. Wanapum $^{14}C$ concentrations are highly variable at relatively similar elevations. Grande Ronde $^{14}C$ concentrations exhibit a general relationship of increasing age (lower $^{14}C$ pmc) with depth (lower producing zone elevations). Ages for the two Grande Ronde wells that fall outside of the general trend potentially represent mixing with younger recharge water.**

pumping withdrawals are balanced by recharge. Therefore, mixing of young water with old water must occur locally within the Wanapum aquifer system.

In the Grande Ronde aquifer system, a rough relationship appears to exist between decreasing elevation of the producing zones and lower $^{14}C$ concentrations. This general trend also was noted by Crosby and Chatters (1965); however, their analysis was limited to only four Grande Ronde water samples. The only two Grande Ronde wells that lie outside of the general trend are the shallow domestic wells #29 and #30.

Several factors are believed to contribute to the observed vertical trend associated with the Grande Ronde $^{14}C$ concentrations. First, the spatial distribution of overburden thickness in the basin potentially influences vertical infiltration (Hopster, 2003). Figure 6 shows the well locations relative to overburden thickness. This overburden consists primarily of low hydraulic conductivity loess, which forms irregular dune-like hills with relief up to 60 m (Busacca, 1989). These hills have asymmetric slopes, which may influence runoff and recharge. North and northeast facing slopes are steep (0-45%); south and southwest facing slopes are longer and less steep (0-30%) due to deposition by wind (Johnson, 1991). Loess-derived soils contain fragipans and horizons with fragic character that restrict vertical percolation of water (McDaniel et. al, 2001). Fragipans are brittle subsurface soil horizons that exhibit high bulk density and restrict the movement of water and roots (Soil Survey Staff, 1993). O'Geen (2002) identified buried paleofragipan horizons in the Palouse Basin through detection of abrupt changes in $Cl^-$ concentrations. He found that recharge is lower in the eastern part of the basin than in the western part because soils and deep regolith display a greater degree of soil and associated fragipan development.

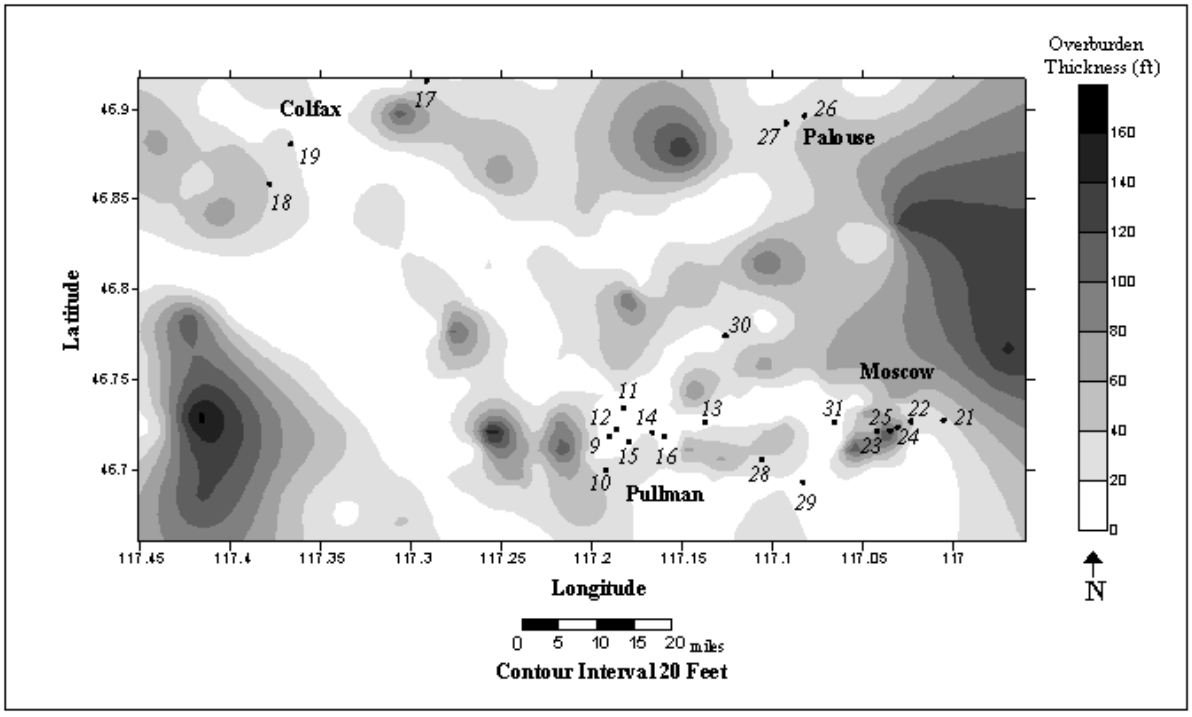


**Figure 6. Isopach map of overburden thickness in the Palouse Basin. Darker areas represent greater overburden thicknesses while lighter areas have little to no overburden. Wells shown are Grande Ronde sampling points (Figures 4 and 5) (modified after Hopster, 2003).**

Another potential controlling factor that restricts vertical flow within the basin is the thicknesses of the overlying Wanapum Formation and Vantage Member. Teasdale (2002) noted the Wanapum Formation thins in a westerly direction throughout the Palouse Basin. The Wanapum ranges in thickness from 42.7 to 61 meters (140 to 200 feet) in the east compared to 0 to 30.5 meters (0 to 100 feet) in the west. The sedimentary Vantage Member separating the Wanapum Formation from the Grande Ronde Formation also has a similar trend in thickness as the Wanapum Formation (Teasdale, 2002). The Vantage Member ranges in thickness from 18.3 to 67.1 meters (60 to 220 feet) in eastern areas of the Palouse Basin around the cities of Palouse and Moscow (Figure 2). In comparison, the thickness

throughout the rest of the basin is relatively uniform, ranging from 6.1 to 12.2 meters (20 to 40 feet).

The trends in thickness of the loess, Wanapum Formation, and Vantage Member are general and are not always consistent throughout the Basin. As a result, the $^{14}C$ concentrations and thus "ages" of the water don't uniformly decrease to the west because of the potential variability in the trends, variations in soil development and variations in topography.

**SUMMARY AND CONCLUSIONS**

Ground water in the lower Grande Ronde system is the oldest water in the basin, with a possible zone of recharge in the upper part of the Grande Ronde, occurring between the cities of Pullman and Moscow. Apparent stratification of ground water with similar $^{14}C$ age dates suggests that different ages reflect primarily vertical travel times from the land surface to the sampled locations. Overall a general trend exists with age dates increasing in age as well depth is increased. This shift in ground water ages with depth is consistent with $^{14}C$ ages reported by Crosby and Chatters (1965). Uncorrected ages could be deemed actual ages based on modern components of water found in the soil zone and any corrections based on $^{13}C/^{12}C$ ratios will be relative throughout the Basin, thus preserving the spatial trend in age dates. $^{18}O$ samples are consistent with results given by Larson et al. (2000), which identify deep Grande Ronde samples as the most depleted in $^{18}O$, and statistically different from Holocene recharge. Several potential factors, such as overburden thickness, fragipan development, thickness of the Wanapum Formation, and thickness of the Vantage Member, all collectively contribute to the restriction of vertical migration of infiltrating recharge

water. These restricting factors are more prevalent in the eastern section of the Palouse Basin compared to the western section.

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# CHAPTER III:

# GEOCHEMICAL MASS-TRANSFER MODELING OF CARBON AND ESTIMATES OF GROUND WATER RESIDENCE TIME

## INTRODUCTION

Radiocarbon dating is based on measurement of the loss of the parent radionuclide, $^{14}C$, in a given sample. The geochemistry of carbon in ground water systems is influenced by various reactions in the atmosphere, biosphere, and geosphere, consequently creating multiple sources and sinks for carbon that vary in time and space.

For this study, analyses of the major ions in the ground water samples were used to develop a conceptual model of water quality variations along potential ground water flow paths. Ion concentrations were speciated with WATEQ, an aqueous speciation program, and input into NETPATH, a geochemical computer model which is used to calculate net geochemical mass-balance reactions between initial and final waters along a hydrologic flow path (Plummer et al., 1994). NETPATH is capable of using water chemistry, and $^{13}C/^{12}C$ ratios to refine $^{14}C$ estimates of ground water age by accounting for mass transfers of carbon that occur within the ground water flow system, and that affect the $^{14}C$ concentrations of the sampled ground water. It is important to note that, NETPATH has no means of confirming evolutionary relationships along flow paths and will therefore always report all mathematically plausible reactions (Plummer et al. 1994).

## BACKGROUND ON $^{14}C$ AND $^{13}C$

Radiocarbon, $^{14}C$, is produced naturally in the atmosphere through the nuclear reaction:

$$^{14}N + n \rightarrow {}^{14}C + p \qquad (2)$$

The $^{14}C$ atoms oxidize to form $^{14}CO_2$ molecules, which mix with all living matter through photosynthesis, and with meteoric waters through $CO_2$ exchange reactions. There are four dominant pathways in which radiocarbon will enter the hydrologic cycle (Kalin, 2000).

1) Formation and dissociation of carbonic acid during gas exchange between $CO_2$ in surface water and ground water with atmospheric $CO_2$.

2) Biologic activity of plants creates respired $CO_2$ in the soil zone that dissolves in water.

3) Microbial utilization of organic material in the soil produces $CO_2$ that dissolves in water.

4) Dissolution of mineral phases that contain geologically young carbon.

Once isolated from the atmosphere, $^{14}C$ radioactively decays at a rate of one-half of the remaining carbon every $5730 \pm 30$ years (Godwin, 1962). $^{14}C$ ages are expressed in terms of years before present (B.P.) with the $^{14}C$ concentrations expressed as percent modern carbon (pmc). The modern activity of $^{14}C$ is by convention set as 13.56 decays-per-minute per gram (dpm/g c) of carbon, with the 'zero year' for this activity as 1950 A.D. (Kalin, 2000). The 1950 value is considered to have an activity of 100 pmc. After 1950, $^{14}C$ in the atmosphere increased due to atmospheric testing of nuclear weapons, and $^{14}C$ concentrations greater then 100 pmc often result, indicating the presence of bomb carbon. By international convention, the modern reference standard for radiocarbon dating is 95 percent of the $^{14}C$ content of the National Bureau of Standards (NBS) oxalic acid (= 0.95 * 13.56 dpm/g C in the year 1950 A.D.). The measured activity of a sample A is then given as a percentage of this standard activity, or pmc (Mook, 1980).

$^{14}C$ ground water ages are computed by the general law of radioactive decay:

$$t = (\frac{\lambda}{\ln 2}) \ln(\frac{A_o}{A_t}) \qquad (3)$$

where: t is the time since the sample was isolated from the atmosphere, $\lambda$ is the radioactive half life, $A_t$ is the measured $^{14}C$ activity in sample at time t, and $A_0$ is initial $^{14}C$ activity at time zero.

For a half life of 5730 years, this equation simplifies to:

$$t = -8267 * \ln \frac{A_t}{A_o} \qquad (4)$$

The standard assumptions of the decay law are that the $^{14}C$ initial concentration is known, and that the system is closed to gains or losses in $^{14}C$, except through radioactive decay. These two assumptions cannot be deemed completely accurate in real systems; therefore physical, chemical and biological processes that may have affected the initial $^{14}C$ concentration and $^{14}C$ concentration along the flow path must be evaluated and corrected for.

Carbon-13 typically is a good tracer of open and closed system evolution of dissolved inorganic carbon (DIC) in ground water (Clark and Fritz, 1997). Carbon mass transfers between reservoirs can change the isotopic composition of the DIC. The magnitude of this effect can be traced by the stable carbon isotopic ratio $^{13}C/^{12}C$. For example, the measured $^{13}C$ can be used to correct the initial $^{14}C$ content of biological material for fractionation effects, which occurred during carbon fixation (Mook, 1980). Additionally, the differences in $^{13}C$ between the soil derived DIC and carbonate minerals in an aquifer can provide a reliable measure of $^{14}C$ dilution by carbonate dissolution (Clark and Fritz, 1997). By convention, $^{13}C$ values are calculated relative to the Peedee belemnite international standard, which has a $\delta^{13}C = 0$ ‰ (per mil) (Craig, 1957).

In this study, $^{13}C$ and ancillary chemical data for ground water samples were used to evaluate the extent to which physical, chemical and biological processes have affected the initial $^{14}C$ concentration, through the use of NETPATH.

**NETPATH BACKGROUND**

Reliable radiocarbon dating of ground water requires defining the $^{14}C$ activity at an initial point in the system ($A_0$), and adjustment of $A_0$ for chemical reactions occurring along the flow path to the point where the $^{14}C$ activity is measured ($A_t$). Traditionally, these two factors are combined to form an adjustment model that can be applied to a single water analysis at some point in the flow system (Clark and Fritz, 1997). To accomplish this, water chemistry, and $^{13}C$ and $^{14}C$ activities are measured for a single water sample. Adjustment models, which account for inorganic reactions affecting the inorganic carbon reservoir, are applied to the single water analysis. The measured $^{14}C$ activity ($A_t$) is compared to the adjusted initial $^{14}C$ activity ($A_0$) through the radioactive decay equation to determine the radiocarbon age of the water (Plummer et al., 1994).

For NETPATH modeling, two water analyses along a presumed evolutionary flow path must be selected (i.e., an initial water and final water). When the initial and final waters are defined identically, no mass transfer is calculated, despite chosen phases and constraints in the reaction model, and thus NETPATH reverts to the traditional format where the adjustment model is applied to a single water. If the initial water is defined separately from the final water, the traditional adjustment model is applied only to the initial water. The mass transfer models identified by NETPATH are used by the program to adjust the initial $^{14}C$ compositions ($A_0$) for all sources and sinks of carbon that affect the carbon mass transfer between initial and final well locations along the flow path. Based on this, NETPATH

calculates the term $A_{ND}$, which is the $^{14}C$ concentration at the final well, adjusted for chemical reaction, but not radioactive decay.

NETPATH calculates values for $A_{ND}$ for each reaction model using the defined value of $A_0$, defined $^{14}C$ isotopic content for carbon sources, defined $^{14}C$ fractionation factors, and the computed carbon-mass transfer (Plummer et al., 1994). The age increment between initial and final wells, *dt*, is then applied to the final well using $A_{ND}$ and the observed value $A_t$, with the adjusted $^{14}C$ age calculated according to the equation:

$$\Delta t_{years} = \frac{5730}{\ln 2} \ln\left(\frac{A_{ND}}{A_t}\right) \qquad (5)$$

Hence, the age dating procedure in NETPATH depends on 1) the $^{14}C$ value at the initial point in the system, $A_0$, 2) the adjusted $^{14}C$ value computed at the final well by accounting for reaction effects to the initial $^{14}C$, $A_{ND}$, and 3) the measured $^{14}C$ content in the final water, $A_t$.

NETPATH considers several well-known methods of defining $A_0$ which are briefly described below:

1. The Vogel (1967) model assumes a fixed value of 85 pmc for $A_0$. This value is most applicable for soil waters and shallow ground waters in temperate climates, but does not account for isotopic exchange reactions below the water table

2. The Tamers (1967) model assumes carbonate dissolution in the system is closed and calculates a chemical mass balance, but does not consider isotopic exchange.

3. Ingerson and Pearson (1964) use two of Tamers' equations for $^{14}C$ and $^{13}C$. This model indirectly accounts for mixing components in carbon chemistry, but does not include isotopic fractionation effects during exchange reactions.

4. Mook (1980) assumes isotopic equilibrium under open system conditions in the vadose zone, and closed system re-equilibration below the water table. This model is similar to Tamers (1967) with a correction factor for isotopic exchange.

5. Fontes and Garnier (1979) accounts for dissolution and isotopic exchange of carbonate minerals with $CO_2$ in the unsaturated zone and isotopic exchange with the

carbonate rocks in the saturated zone by employing a two-stage evolution for recharge waters.

6. Eichinger (1983) considers isotopic exchange and mass balance through assessment of equilibrium isotopic exchange, and is similar to Ingerson and Pearson (1964) with modification for equilibrium isotopic exchange.

**METHODS**

Ground water samples were collected from 31 wells within the study area over a three-year period (2000-2003). Wells were sampled during two time periods. In 2000-2001, Alex Kirk, a former WSU graduate student collected water samples from wells: City of Moscow wells COM2, COM3, COM6, COM8; University of Idaho well, UIGRS; City of Pullman wells, COP3, COP5, COP6; Washington State University wells WSU5, WSU6; City of Colfax wells GLENWOOD, FAIRVIEW; City of Palouse well PALOUSE1; and private wells BUTTERS, GENTRY, STALNAKER, LOESS6A. In 2003-2004 additional water samples were collected from wells: University of Idaho wells UI5, UI4, UI3; City of Moscow wells COM6, COM9; Washington State University wells WSU7, WSU8; City of Pullman well COP7; City of Palouse well PALOUSE2; City of Colfax well CLAYSTREET, and private wells BRAWDY, MCGREEVY, CHAMPION ELECTRIC, and PAULSON.

Most samples were collected from the Grande Ronde basalts; however, additional ground water samples were also collected from the Wanapum basalts, loess, and granitic bedrock in the basin. Sample collection points were located as close to the wellheads as possible, and before passage through water treatment systems. Water samples were collected after flushing of the casing and well plumbing. Temperature, pH, and alkalinity were measured in the field. Alkalinities were measured with a digital titrator. The water samples for both $^{14}C$ and $^{13}C$ were collected in a 13 gallon Nalgene™ carboy bottle and immediately

capped. The same day in the lab, $BaCl_2 \bullet 2H_2O$ and $NH_4$ were added to quantitatively precipitate $BaCO_3$. The water was then decanted, and the precipitate transferred to a 1-Liter HDPE Nalgene™ bottle. The precipitated carbonate was analyzed for $^{14}C$ and $^{13}C$ by Beta Analytics Inc. in Miami, Florida. $^{14}C$ results are reported as percentage of the modern standard (pmc), and as the Apparent Radiocarbon Age (BP). $^{13}C$ results are expressed as $\delta^{13}C$, which is the deviation in per mil (parts per thousand) of the $^{13}C/^{12}C$ ratio of the sample, relative to the Peedee belemnite international standard (Craig, 1957). Water chemistries were determined in the Department of Geological Sciences at the University of Idaho. Major anion concentrations were determined on an ion chromatograph (IC), and major cation analysis was performed using a Perkin Elmer, Optima 3000XL ® Inductively Coupled Plasma – Atomic Emission Spectrometer (ICP_AES) equipped with an axial torch. Oxygen-18 analysis was performed by automated $CO_2$ equilibration (Epstein and Mayeda, 1953) and gas-source mass spectrometry at the Geoanalytical Lab at Washington State University, reported as $\delta^{18}O$ relative to VSMOW (Gat and Gonfiantini, 1981).

Samples for City of Moscow wells COM2, COM3, COM6A, COM8; University of Idaho well UIGRS; City of Pullman wells, COP3, COP5, COP6; Washington State University wells WSU5, WSU6; City of Colfax wells GLENWOOD, FAIRVIEW; City of Palouse well PALOUSE1; and private wells BUTTERS, GENTRY, STALNAKER, LOESS6A were all processed, and sent to the lab for $^{14}C$ and $^{13}C$ analysis immediately after collection. However, samples for cation and anions were placed in storage and were not analyzed until 2003. These cation and anion analyses should be used with caution.

Water chemistry for each well was speciated in WATEQ (Plummer et al., 1994). Speciation output for selected wells was then used in NETPATH modeling (Plummer et. al,

1994) to quantify hydrogeochemically reasonable, mass transfers, and to adjust the radiocarbon age dates for any carbon mass transfers. The selected wells were: University of Idaho wells UI5, UI4, UI3; City of Moscow wells COM6, COM9; Washington State University wells WSU7, WSU8; City of Pullman well COP7; City of Palouse well PALOUSE2; City of Colfax CLAYSTREET; and private wells BRAWDY, MCGREEY, PAULSON, CHAMPION ELECTRIC. These were the most recent wells sampled. Additionally, PALOUSE1, GLENWOOD, CLAYSTREET, COM2, and COM3 were analyzed from the first round of sampling to add more representative wells from specific locations throughout the study area.

Speciation data from Nelson (2003) were used for wells COM2, COM3, and COM9. Cation and anion concentrations measured for wells PALOUSE1, GLENWOOD and FAIRVIEW in 2003 were used for speciation even though the samples were old. It is recognized that some degree of inaccuracy may exist here. Samples for the remaining wells: BUTTERS, GENTRY, UIGRS, LOESS6A, STALNAKER, COM8, COP3, COP5, COP6, WSU5, and WSU6 were speciated but not modeled.

**MODELING APPROACH**

The assumptions that $A_0$ is known, and that the system is closed to potential gains or losses in carbon except through radioactive decay prompted examination of applicability of the assumptions to the study area. With respect to the first assumption, Bacon (1997) found that $^{14}CO_2$ concentrations in the gas phase of the vadose zone are modern, containing bomb radiocarbon. Average delta $\delta^{13}C$ values for vadose $CO_2$ became more abundant with depth, increasing from an average value of -23.6‰ at a depth of 0.7 m to an average value of –21.8‰ at a depth of 4.3 m (Bacon, 1997). While this study was limited to one location

between Pullman and Moscow, it supports the assumption that the initial $^{14}C$ concentration at the recharge point, $A_0$, was close to atmospheric at the time of recharge, and can be taken as 100 pmc. The standard assumption that $A_0$ is 100 pmc is an approximation based on dendrochronological and other proxies showing that atmospheric $^{14}C$ has varied between 97 and 140 pmc over the past 25,000 years (Clark and Fritz, 1997). Calculated ages are termed *radiocarbon years* when the standard of 100 pmc for $A_0$ is used (Clark and Fritz, 1997). Uncorrected ages for this study are calculated on this basis and neglecting any subsequent hydrochemical reactions. In relation to the second assumption, if there are no reactions affecting the carbon concentrations, $\delta^{13}C$ values will follow the path as diagrammed by Figure 7. If groundwater $\delta^{13}C$ values deviate from approximately -15.1‰ per mil, gains or losses in carbon by reactions subsequent to recharge may have occurred. If this is the case, adjustment models based on water chemistry and $\delta^{13}C$ values can be applied to model mass balance reactions occurring in the study area. For this study, $\delta^{13}C$ values did vary by approximately 5 per mil, therefore adjustment models based on water chemistry and $\delta^{13}C$ values were applied using NETPATH (Plummer et al., 1994). During modeling, $^{13}C$ values

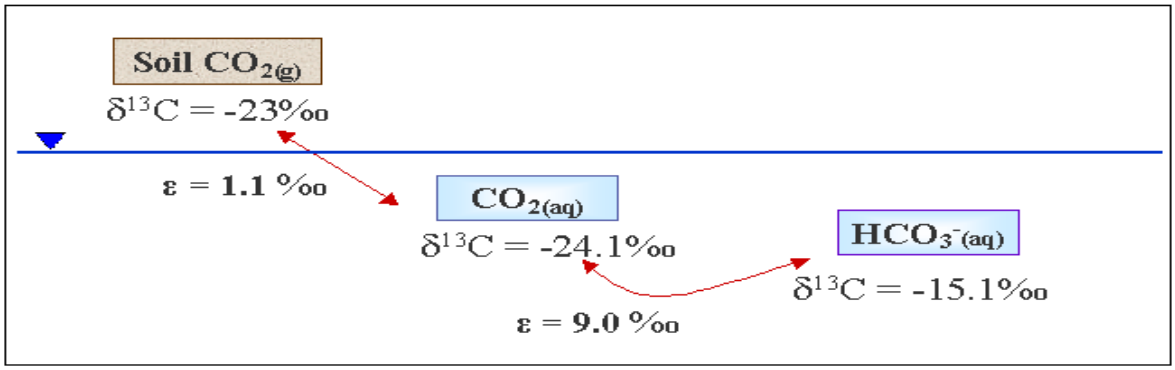


**Figure 7. Equilibrium fractionation factors for $\delta^{13}C$ of $CO_2$.**

for TDIC in the initial solution, in carbonate minerals, and in soil $CO_2$ (g) must be defined. Soil $CO_2$ $\delta^{13}C_{(g)}$ = -23‰ per mil was assumed based on the aforementioned observations by Bacon (1997). $^{13}C$ values for TDIC in the initial solution were defined as the measured $^{13}C$ values for the selected initial water and using default $^{13}C$ values (0 per mil) for carbonate minerals.

Determining applicable geochemical mass balance reactions began with identifying reactive mineral phases in the Columbia River Basalt Group that might be expected to dissolve. WATEQ was used to compute saturation indices, defined as

$$SI = \log (IAP/K_{eq}) \qquad (6)$$

where: SI = saturation index, IAP = ion activity product, and $K_{eq}$ = solubility product or equilibrium constant for the dissolution reaction. These values were judged to verify reasonableness of secondary mineral precipitation. Langmuir (1971) notes that for carbonate minerals in natural water, SI values within $\pm$ 0.1 unit of zero are considered saturated. Choices of dissolving and precipitating phases were guided substantially by previous hydrogeochemical investigations in the Columbia River Basalt Group (Hearn, 1985; Cox, 2003; Hinkle, 1996). The overall conceptual hydrochemical model used in this study draws substantially from the conceptual model developed by Cox (2003). Choices of weathering reactions followed Wood (1986) (Table 2).

In defining two distinctly separate waters for analyses, NETPATH modeling was attempted between wells along various flow paths. It is important to note that natural flow paths within the Palouse Basin have not been delineated reliably by independent means. This is partly because the measured water levels in the basin reflect the spatial distribution of

- Dissolution of augite: $\boldsymbol{x}(Ca_{34}Mg_{39}Fe_{27})Si_2O_6 + \boldsymbol{y}CO_2 + \boldsymbol{z}H_2O \rightarrow \boldsymbol{q}Ca^{2+} + \boldsymbol{r}Mg^{2+} + \boldsymbol{s}Fe^{2+} + \boldsymbol{t}HCO_3^- + \boldsymbol{u}H_4SiO_4$
- Weathering of plagioclase to smectite: $\boldsymbol{x}(Ca_5Na_5Al_5Si_{2.5}O_8) + \boldsymbol{y}CO_2 + \boldsymbol{z}H_2O \rightarrow \boldsymbol{q}[Ca_{33}Al_{4.67}Si_{7.34}O_{20}(OH)_4] + \boldsymbol{r}Na^+ + \boldsymbol{s}Ca^{2+} + \boldsymbol{t}HCO_3^- + \boldsymbol{u}H_4SiO_4$
- Dissolution of chlorite: $\boldsymbol{x}Mg_6Si_4O_{10}(OH_8) + \boldsymbol{y}CO_2 + \boldsymbol{z}H_2O \rightarrow \boldsymbol{q}Mg^{2+} + \boldsymbol{r}Fe^{2+} + \boldsymbol{s}HCO_3^- + \boldsymbol{t}H_4SiO_4$
- Precipitation of silica: $\boldsymbol{x}SiO_2 + \boldsymbol{y}H_20 \rightarrow \boldsymbol{q}H_4SiO_4$
- Precipitation of calcite: $\boldsymbol{x}Ca^{2+} + \boldsymbol{y}HCO_3^- \rightarrow \boldsymbol{q}CaCO_3 + \boldsymbol{r}H_2CO_3$
- Precipitation of goethite: $\boldsymbol{x}Fe^{3+}\ \boldsymbol{y}H_20 \rightarrow \boldsymbol{q}FeOOH + \boldsymbol{r}H^+$
- Precipitation of pyrite: $\boldsymbol{x}Fe^{2+} + \boldsymbol{y}HS^- \rightarrow \boldsymbol{q}FeS_2 + \boldsymbol{r}H^+$
- Dissolve $CO_2$: $\boldsymbol{x}CO_2 + \boldsymbol{y}H_2O \rightarrow \boldsymbol{q}H_2CO_3$

**Table 2. Possible weathering reactions controlling solute chemistry in the Columbia River Basalts, after Wood (1986) who wrote similar reactions for the Eastern Snake River Plain. Coefficients *x, y, z, q, r, s, t, u* are the molar coefficients for each given Netpath simulation of the evolution of water along hypothesized flow paths.**

pumping centers. In the horizontal direction, water chemistry was too similar to calculate any mass transfers, thus modeling was not completed in this direction. In the vertical direction, modeling was successfully completed which considered Wanapum water chemistry as the initial condition, and Grande Ronde water chemistry as the final condition. Comparison and evaluation of the spatially variable, Wanapum water chemistry led to the selection of well UI5 as representative of Wanapum ground water in general. Therefore, the ground water chemistry of the water in well UI5 was used to represent initial conditions for the vertical models throughout the basin. Several wells that were determined to be spatially representative in the study area (see above) were then modeled as final endpoints, to evaluate potential adjustment models.

## RESULTS AND DISCUSSION

Table 3 provides a summary of the $^{14}C$, $^{13}C$, and $^{18}O$ concentrations and pH and alkalinity values for the Palouse Basin. The pH of the water samples are distributed slightly

| # | Well Name | Geologic Layer | Uncorrected Age (B.P.) | $^{14}C$, pmc | $\delta^{13}C$, ‰ PDB | $\delta^{18}O$, ‰ VSMOW | pH | Alkalinity (mg/l) |
|---|---|---|---|---|---|---|---|---|
| 1 | Butters | Granite | 6066 | 48.01 | -15.2 | -17.38 | 8.95 | 100.04 |
| 2 | Gentry | Granite | Modern | 104.5 | -18.1 | -15.38 | 7.3 | 46.36 |
| 3 | UIGRS | Alluvium | Modern | 115.75 | -16.4 | -14.72 | 7.72 | 458.72 |
| 4 | Loess6A | Loess | 1,578 | 82.62 | -13.2 | n/s | 8.21 | 75.64 |
| 5 | Stalnaker | Wanapum | 14,605 | 17.09 | -16.3 | -15.62 | 6.85 | 192.76 |
| 6 | COM2 | Wanapum | 8,679 | 35 | -16.2 | -16.58 | 7.95 | 104.92 |
| 7 | COM3 | Wanapum | 9,081 | 33.34 | -15.8 | -16.38 | 7.6 | 122 |
| 8 | UI5 | Wanapum | 3,311 | 67 | -15.7 | -15.15 | 7.239 | 224.48 |
| 9 | COP3 | Gr. Ronde | 12,993 | 20.77 | -14.6 | -16.7 | 7.48 | 183 |
| 10 | COP5 | Gr. Ronde | 16,254 | 14 | -13.1 | -17.07 | 7.34 | 134.2 |
| 11 | COP6 | Gr. Ronde | 17,125 | 12.6 | -13.5 | -17.06 | 7.85 | 163.48 |
| 12 | COP7 | Gr. Ronde | 16,463 | 13.65 | -15.1 | -17.06 | 7.74 | 168.36 |
| 13 | WSU5 | Gr. Ronde | 14,306 | 17.72 | -14 | n/s | n/s | n/s |
| 14 | WSU6 | Gr. Ronde | 21,058 | 7.83 | -12.8 | -17.57 | 7.72 | 122 |
| 15 | WSU7 | Gr. Ronde | 17,959 | 11.39 | -15.1 | -18.23 | 7.43 | 204.96 |
| 16 | WSU8 | Gr. Ronde | 18,438 | 10.75 | -14.8 | -17.97 | 7.938 | 165.92 |
| 17 | Glenwood | Gr. Ronde | 15,525 | 15.29 | -15.3 | -17.29 | 8.75 | 61 |
| 18 | Fairview | Gr. Ronde | 15,129 | 16.04 | -14.9 | -17.27 | 7.97 | 92.72 |
| 19 | Claystreet | Gr. Ronde | 14,003 | 18.38 | -16 | -17.65 | 7.72 | 153.72 |
| 20 | COM6A | Gr. Ronde | 23,741 | 5.66 | -11 | -17.34 | 7.84 | 185.44 |
| 21 | COM6 | Gr. Ronde | 22,559 | 6.53 | -12.3 | -18.41 | 7.85 | 270.84 |
| 22 | COM8 | Gr. Ronde | 21,111 | 7.78 | -11.6 | -17.25 | 7.18 | 139.08 |
| 23 | COM9 | Gr. Ronde | 19,127 | 9.89 | -14.6 | -18.45 | 7.42 | 183 |
| 24 | UI4 | Gr. Ronde | 19,716 | 9.21 | -15.9 | -18.49 | 7.64 | 197.64 |
| 25 | UI3 | Gr. Ronde | 20,467 | 8.41 | -15.9 | -18.66 | 7.548 | 158.6 |
| 26 | Palouse1 | Gr. Ronde | 21,925 | 7.05 | -13.1 | n/s | 5.59 | 180.56 |
| 27 | Palouse2 | Gr. Ronde | 26,406 | 4.1 | -13.7 | -18.37 | 7.11 | 180.56 |
| 28 | Paulson | Gr. Ronde | 15,477 | 15.38 | -14.9 | -18.07 | 7.21 | 156.16 |
| 29 | Brawdy | Gr. Ronde | 4,420 | 58.59 | -15.7 | -16.75 | 7.28 | 87.84 |
| 30 | McGreevy | Gr. Ronde | 6,636 | 44.81 | -16.1 | -17.23 | 7.35 | 209.84 |
| 31 | Ch. Electric | Gr. Ronde | 11,832 | 23.9 | -14.8 | -18.03 | 7.14 | 153.72 |

**Table 3. Isotopic characteristics, uncorrected ages, pH and alkalinity for sampled wells. (n/s = not sampled). Uncorrected ages are calculated using $A_0$ = 100pmc. (well locations and depths are given in Appendix II)**

above neutral (Figure 8). Nelson (2003) found the pH's of Grande Ronde water samples to be somewhat higher than water samples from the Wanapum and Loess. Cotton (1982) reported the same trend. Additionally Nelson (2003) found that alkalinity may be somewhat higher for Grande Ronde water samples; however, this is not an obvious trend in this study (Figure 9).

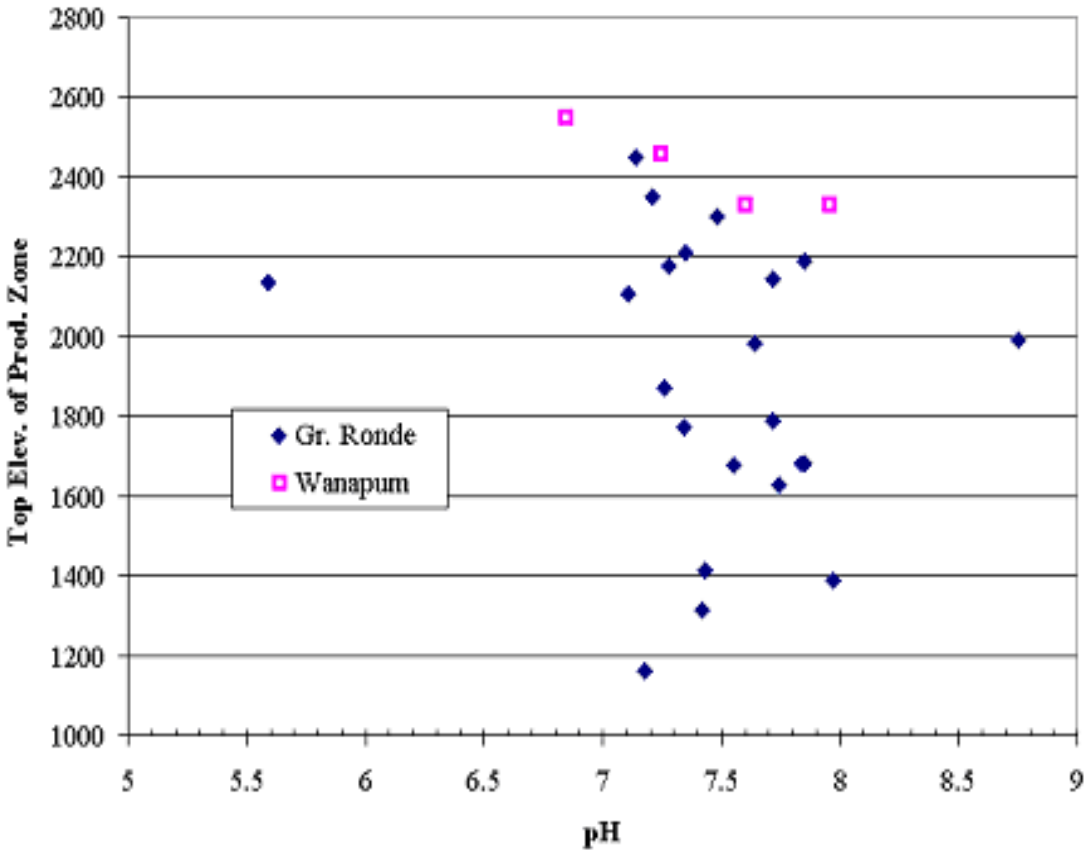


**Figure 8. Distribution of pH for the Grande Ronde and Wanapum samples for this study (Table 3). There is no obvious trend in pH values vs. depth.**

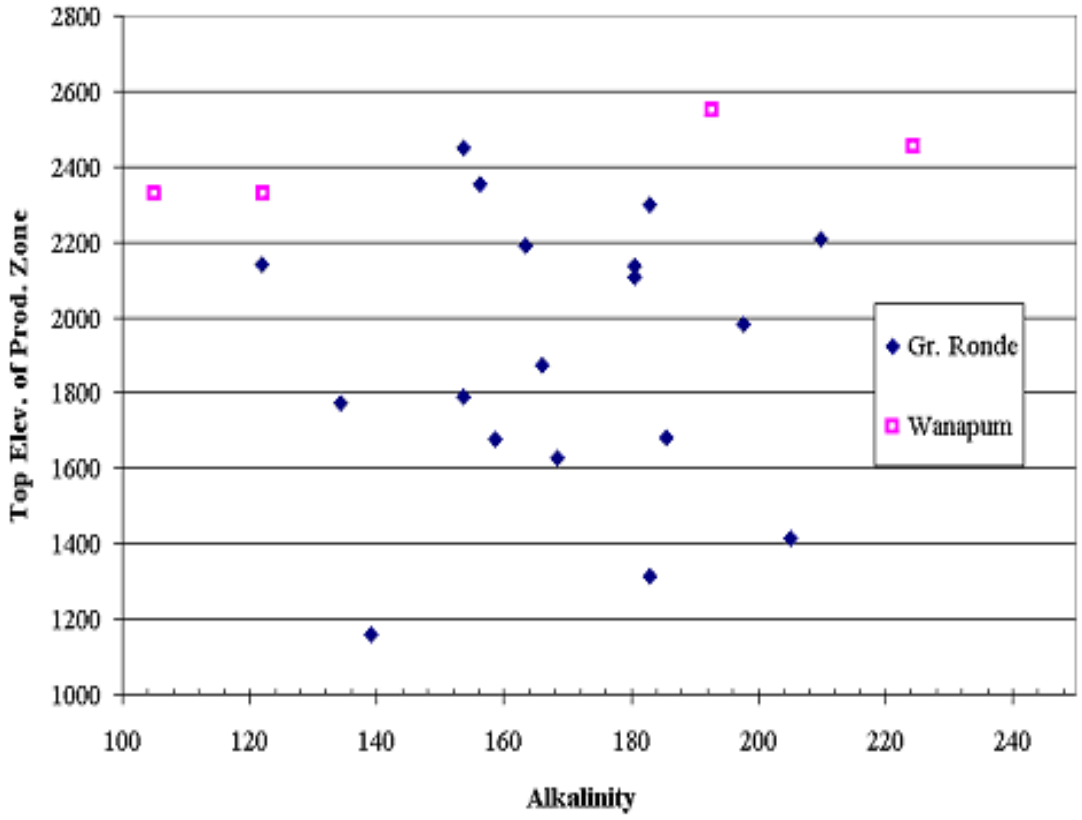


**Figure 9. Distribution of alkalinity values for the Grande Ronde and Wanapum samples for this study (Table 3). There is no obvious trend in alkalinity values vs. depth.**

The ground water chemistry in the area is predominantly of the calcium bicarbonate type (Appendix I), as reported by Cotton (1982), and Nelson (2003). Speciation modeling indicated that water samples were at or near saturation with respect to quartz and calcite. Some samples were also near saturation with respect to hematite and goethite. These results (Appendix III) are consistent with speciation results found by Nelson (2003).

Mass transfer modeling by NETPATH explored the hypothesis that age dates derived from ground water in the basalt aquifers of the Palouse Basin represent predominantly vertical travel times from the land surface, through the Wanapum basalts, down into the Grande Ronde aquifer system. Accordingly, averaged ground water chemistry data for the

Wanapum aquifer system in the Moscow area were used to represent the initial conditions, using well UI5 data; and ten different spatially representative wells were selected for the Grande Ronde aquifer system to represent ten different final conditions. UI5 was chosen to represent initial Wanapum conditions because this well provided the youngest age date for the Wanapum wells, or highest pmc. In general, reasonable mass transfer models included dissolution of augite, chlorite, and plagioclase, and the precipitation of ca-montmorillinite, goethite, pyrite, calcite and mafic montmorillinite (Table 4). Constraints considered in these models were concentrations of carbon, calcium, magnesium, aluminum, sodium, iron, and silica. Precipitation of calcite and cationic clay is consistent with dissolution of primary aluminosilicates in a mafic silicate terrain (Drever 1997). In certain cases, $CO_2$ was added as a phase to provide another source/sink of carbon, to yield calculated $^{13}C$ values closer to the measured $^{13}C$ values. Deviations of calculated $^{13}C$ values from measured $^{13}C$ values were generally very small (Table 4). However, at times the calculated $^{13}C$ values varied by a maximum of 5 per mil from the measured $^{13}C$ values. This deviation suggests the existence of another source or sink for DIC along some flowpaths which was not accurately modeled in the selection of mass transfer reactions.

Tamers (1967), Ingerson and Pearson (1964), Fontes and Garnier (1979), and Eichinger (1983) are each specifically applicable to carbonate terrains, and take into account carbonate minerals and "dead" DIC inputs from carbonate rocks. Vogel (1967) is not directly specific to a carbonate terrain; however, he assumes a fixed value for $A_0$ of 85 pmc, and this was deemed unrepresentative for the study area. Therefore, we determined Mook (1980) is the most applicable correction model for the study area. Mook (1980) does not use

| Well No. | UI3 | COM9 | WSU7 | COP7 |
|---|---|---|---|---|
| **Phase** | | | | |
| **Augite** | 1.72 | 0.165 | 0.273 | 0.119 |
| **Chlorite** | 0.078 | -0.081 | - | - |
| **Ca-Mont** | 4.08 | -0.381 | - | - |
| **Goethite** | -0.66 | -0.115 | - | - |
| **Mont-Maf** | -5.21 | - | -0.578 | -0.584 |
| **Calcite** | -1.41 | -0.915 | -0.939 | -0.951 |
| **Plagan-30** | 0.27 | 0.783 | 0.844 | 0.876 |
| **Pyrite** | - | - | -0.133 | -0.0246 |
| **SiO2** | - | -0.543 | -0.552 | -0.343 |
| **CO2** | - | - | 0.421 | -0.359 |
| **$^{13}$C, measured, (per mil)** | -16.18 | -16.04 | -16.94 | -15.15 |
| **$^{13}$C, model calculated, (per mil)** | -15.9 | -14.6 | -15.1 | -15.1 |

**Table 4. Representative mass transfers of modeled phases and measured and model-calculated values of carbon-13 from selected geochemical mass-transfer models from well UI 5 to selected Grande Ronde samples. All units that are not specified are millimoles. A "+" value indicates dissolution while a "-" value indicates precipitation. All NETPATH modeling results are shown in Appendix IV.**

cation concentrations in calculations, and does not assume isotopic exchange of DIC with solid phases. Additionally, a model termed "user-defined" was used (See Appendix IV for all modeling results).

Figure 10 illustrates an example of the comparisons of results for each of the adjustment models for well UI3. The user-defined age, in which $A_0$ for the model was defined to be 100 pmc, is the same as the uncorrected ages given in Table 3. The adjusted ages derived the methods of Tamers (1967), Ingerson and Pearson (1964), Fontes and Garnier (1979) and Eichinger (1983) are all younger than the uncorrected ages by 3000 to 5000 years. This is a result of the fact that each of these adjustment models assumes dilution of the $^{14}$C activity by "dead carbon" entering the waters via closed-system dissolution of marine carbonates. However, if the study area is a silicate terrain, dead carbonates would not be dissolving, and such models would be ascribing radiocarbon loss to geochemical dilution

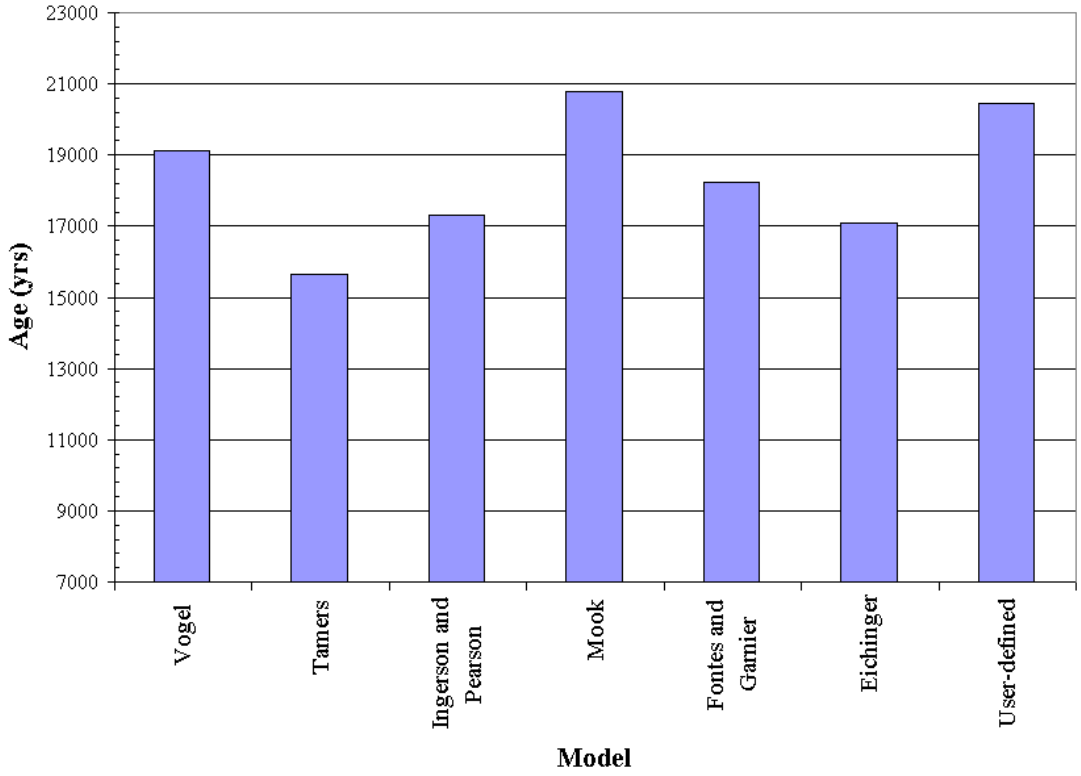


**Figure 10. Comparison of calculated ages from the various adjustment models for well UI3, assuming UI5 as the initial well.**

when it is actually due to decay. This would yield ages younger than actual. Mook does not assume cations or alkalinity to necessarily come from dead carbonates, and thus is more applicable to the study area. The age calculated by Mook is very close to the uncorrected age.

Figure 11 illustrates the adjusted ages calculated by Mook (1980) for the ten selected representative wells by modeling UI5 as the initial water. Again Mook (1980) gives ages very close to the uncorrected ages. Results generated by the adjustment model of Tamers (1967) are included in Figure 11. Tamers (1967) assumes the initial water reacts with calcite, dolomite, and gypsum; this yields a maximum correction assuming dilution of DIC by dead carbon. Therefore, Tamers (1967) yields conservatively large corrections to the age dates,

which accommodate any sources of dead carbon suggested by the higher-than-predicted DIC values observed in some wells (Table 3; Figure 8), and therefore yields a lower bound on the age estimates.

Results of the NETPATH modeling indicate that any mass transfers of carbon are small, such that it is not crucial, at this scale of observation, to adjust the age dates. This agrees with the tentative conclusion of Crosby and Chatters (1965) who also stated without documentation that radiocarbon activities of caliches from areas adjacent to the Palouse Basin were near the half-life of $^{14}C$. Therefore, any closed-system dissolution in soils would dilute $^{14}C$ only half as much as assumed in the Tamers correction. Adjusted ages calculated by Mook (1980) only deviate from the uncorrected ages by a factor of 500 years or less which is insignificant considering the analytical uncertainties for the ages range from 60 to 300 years.

Estimated ages were not sensitive to the choice of well UI5 and its particular water chemistry as the initial well. This is demonstrated by the similarity of the age estimates using the traditional methods (neglecting initial-well chemistry and using a single water analysis, as described in MODELING APPROACH; results not shown) to the estimates obtained here, i.e. considering the initial-to-final well mass transfers. This is due to the fact that the mass transfers along flowpaths in the basalt are small.

As an independent check on the calculated age dates, oxygen-18 results were compared to radiocarbon concentrations. Assuming negligible model corrections (above), $^{14}C$ concentrations scale directly with age. Figure 12 displays the general relationship between $^{14}C$ and $\delta^{18}O$. As the $^{14}C$ concentration decreases, the $\delta^{18}O$ concentration also decreases or becomes more depleted. Larson et al. (2000) previously noted that Grande

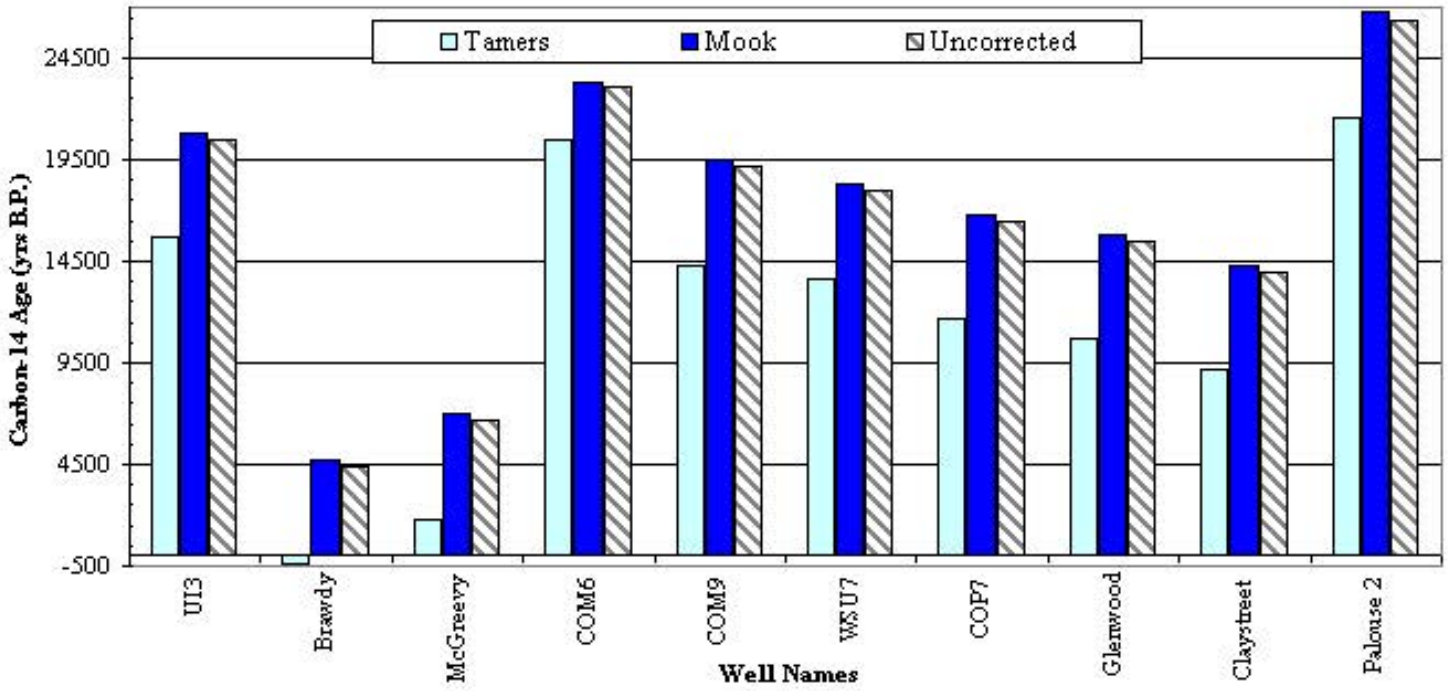


**Figure 11. Results of adjustment models for age date corrections along potential vertical flow paths. Average well UI5 water chemistry was used as the intial condition, with the water chemistry in each well used as the final condition. Generally corrected ages by Mook (1980) are very similar to the uncorrected ages**

Ronde water consistently yields $\delta^{18}O$ values that are statistically distinct from ground water from the shallower Wanapum, and from other stratigraphic units, which suggests that the deep ground water in the basin was recharged during the Pleistocene, i.e. 1.8 M to 10,000 years ago. Based on this reasoning, observed Grande Ronde $^{14}C$ concentrations should reflect a minimum age of 10,000 years. All deep Grande Ronde values pass this test. The younger ages and heavier stable isotopes above the deep Grande Ronde (Figure 12; Larson et al., 2000) are consistent with the present climatic conditions, and flow paths, which generally have a downward vertical component. However, some shallower Grande Ronde wells, specifically Brawdy and McGreevy, exhibit ages that are much younger than 10,000 years, potentially indicating ground water mixing and/or the existence of younger recharge water at those locations. Larson et al. (2000) noted existence of younger ground water at the top of

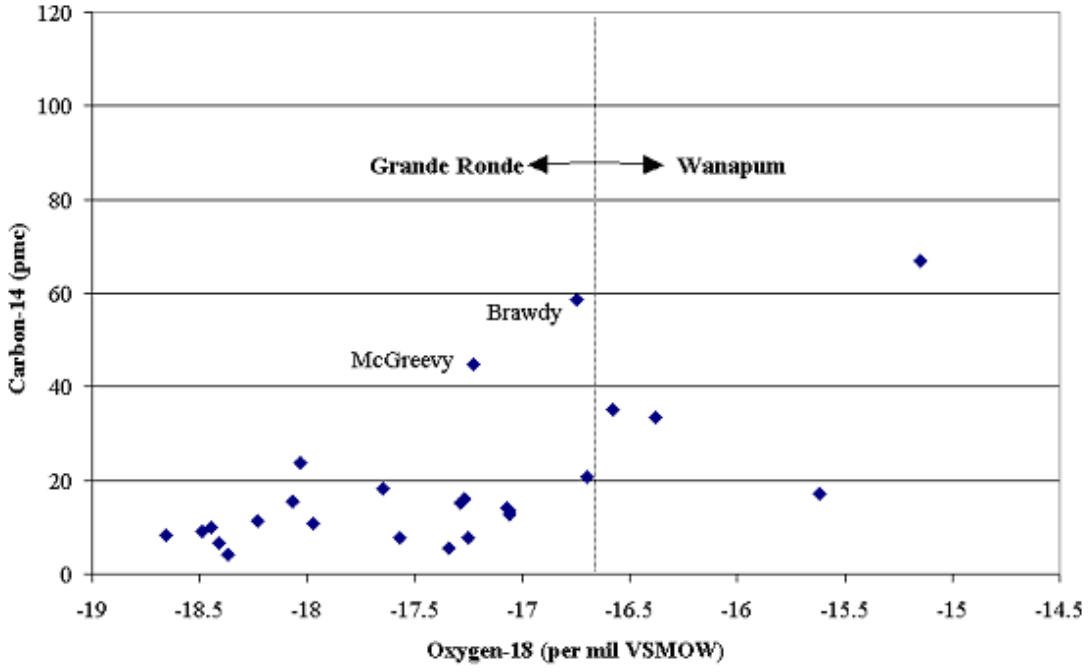


**Figure 12. Carbon-14 vs. Oxygen-18 concentrations for wells sampled in the Palouse Basin (Table 3).**

the Grande Ronde aquifer based on heavier $\delta^{18}O$ values. However $\delta^{18}O$ values for the Grande Ronde, including the shallow Grande Ronde samples, in this investigation all exhibited light $\delta^{18}O$ values as described by Larson et al. (2000).

**CONCLUSIONS**

In radiocarbon dating, the initial $^{14}C$ concentration ($A_0$) should not always be assumed to be 100 pmc. Adjustment models can be applied to more accurately predict the initial $^{14}C$ concentrations. However results of this study support the assumption that $A_0$ = 100 pmc is acceptable for the study area. The initial radiocarbon-activity model of Mook (1980) was deemed the most applicable and acceptable for the given study area, and calculated adjusted ages by this model did not deviate significantly from the uncorrected ages. Some failure of mass transfer models to accurately predict $^{13}C$ were encountered; however, in general the predicted $^{13}C$ only deviated from the measured $^{13}C$ by less than 1 per mil, and did not appear to affect the overall corrections in the age dates based on the fact that all ages were corrected by a similar time interval.

# CHAPTER IV:

# CONCLUSIONS AND RECOMMENDATIONS

## CONCLUSIONS

Radiocarbon dating of the ground water in the Palouse Basin has provided another piece of the puzzle relative to the questions of recharge rates in the basin. Water samples from the deep Grande Ronde aquifer system clearly represent the oldest water known to exist in the basin. Apparent stratification of ground water by age, with generally increasing ages with depth, implies that very long travel times are required for recharge water to reach producing zones in the Grande Ronde aquifer system.

The general conclusions of this study are:

1.) Ground water ages for the Grande Ronde aquifer system derived by analysis of $^{14}C$ concentrations generally increase with depth of well penetration throughout the Palouse Basin. This condition reflects very long travel times for water moving vertically to producing zones in the Grande Ronde aquifer system.

2.) Differences in ground water ages throughout the Palouse Basin do not appear to reflect identifiable, horizontal flow paths consistent with present day water level elevations throughout the basin. Horizontal ground water flow from locations where water is younger to where water is older would require reversal of present day hydraulic gradients at several locations in the basin.

3.) Younger ground water ages in the area between Moscow and Pullman potentially represent a ground water recharge area for the Grande Ronde system. This area also potentially identifies the approximate location of a ground water divide between Moscow and Pullman.

4.) Results of NETPATH modeling, and application of adjustment factors to the measured $^{14}C$ age dates indicate that relative ages are maintained throughout the basin despite applied correction factors.

5.) Oxygen-18 isotope data collected for the basin are consistent with those presented by Larson et al. (2000). These data indicate that ground water in the Grande Ronde is statistically distinct from ground water in the Wanapum, and from other lithologic units.

6.) The general low hydraulic conductivity of the Palouse Formation, together with the existence of fragipans impedes vertical ground water migration and increases travel times to the basalt aquifer systems.

7.) Spatially variable age dates in the Grande Ronde aquifer system appear to be related to spatial variations in total overburden thickness (i.e., combined thickness of the Palouse Formation, Sediments of Bovill, Wanapum Formation and Vantage Member).

**RECOMMENDATIONS**

Several recommendations are offered for additional studies that should be completed to develop a further understanding of radiocarbon age dates in the Palouse Basin.

1.) Further sampling of $^{14}C$ age dates should be conducted to expand the current database extending into the areas around the cities of Palouse and Colfax, and additionally in a southwestern direction towards the Snake River to increase the spatial distribution of ground water age dates in the Palouse Basin. Furthermore auxiliary sampling in the upper portion of the Grande Ronde should be completed to determine the presence and/or absence of additional younger ground water.

2.) Monitoring wells should be installed for sample collection, to avoid complications presented by sampling in pumping wells, and to allow the collection of samples from specific hydrostratigraphic horizons. Ideally, multilevel monitoring wells or piezometers would yield the most accurate $^{14}C$ samples for different depths. These data should be used to refine the age/depth relationships in the Wanapum and Grande Ronde aquifer systems.

3.) Collect ground water samples for tritium concentrations to analyze the degree to which mixing with modern water might influence age dates. This is of particular importance where apparently young water exists in upper portion of the Grande Ronde aquifer system in the region between Moscow and Pullman.

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# APPENDIX I:

# GROUND WATER CHEMISTRY AND ISOTOPIC DATA

**Table A1.1: Ground water sample date and anion concentration data for sampled wells**

| # | Name | Date Sampled* | F- | Cl- | Br- | NO3- | PO4-2 | SO4-2 |
|---|---|---|---|---|---|---|---|---|
| 1 | Butters | n/a | 0.34 | 0.94 | 0.00 | 0.04 | 0.00 | 7.90 |
| 2 | Gentry | n/a | 0.07 | 7.53 | 45.12 | 0.00 | 0.11 | 3.49 |
| 3 | UIGRS | n/a | 0.41 | 11.38 | 0.05 | 23.97 | 0.00 | 67.82 |
| 4 | Loess6A | n/a | 0.14 | 2.04 | 50.21 | 0.00 | 0.19 | 20.73 |
| 5 | Stalnaker | n/a | 0.06 | 2.10 | 0.02 | 0.26 | 0.01 | 18.47 |
| 6 | COM2 | n/a | 0.30 | 5.16 | 0.02 | 0.62 | 0.03 | 31.89 |
| 7 | COM3 | n/a | 0.16 | 4.24 | 0.03 | 0.06 | 0.01 | 79.73 |
| 8 | UI5 | 11/25/03 | 0.12 | 16.83 | 0.01 | 20.07 | 0.03 | 41.37 |
| 9 | COP3 | n/a | 0.21 | 4.74 | 0.02 | 1.73 | 0.10 | 8.25 |
| 10 | COP5 | n/a | 0.27 | 2.25 | 0.02 | 0.98 | 0.08 | 3.35 |
| 11 | COP6 | n/a | 0.22 | 2.31 | 0.02 | 1.47 | 0.05 | 2.18 |
| 12 | COP7 | 07/31/03 | 0.26 | 2.72 | 0.05 | 0.06 | 0.15 | 1.57 |
| 13 | WSU5 | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 14 | WSU6 | n/a | 0.43 | 2.29 | 0.01 | 2.85 | 0.01 | 4.02 |
| 15 | WSU7 | 09/11/03 | 0.34 | 2.54 | 0.02 | 0.03 | 0.06 | 18.84 |
| 16 | WSU8 | 08/12/03 | 0.30 | 3.69 | 0.01 | 1.00 | 0.03 | 2.45 |
| 17 | Glenwood | n/a | 0.26 | 2.17 | 0.01 | 2.05 | 0.08 | 2.88 |
| 18 | Fairview | n/a | 0.33 | 1.85 | 0.02 | 0.53 | 0.07 | 5.00 |
| 19 | Claystreet | 08/05/03 | 0.27 | 1.90 | 0.03 | 0.02 | 0.03 | 2.89 |
| 20 | COM6A** | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 21 | COM6 | 09/10/03 | 0.94 | 2.57 | 0.01 | 1.36 | 0.02 | 5.01 |
| 22 | COM8 | n/a | 0.98 | 2.40 | 0.01 | 1.71 | 0.02 | 3.42 |
| 23 | COM9 | 09/10/03 | 0.38 | 2.20 | 0.05 | 0.05 | 0.19 | 2.00 |
| 24 | UI4 | 09/18/03 | 0.30 | 2.28 | 0.05 | 0.01 | 0.09 | 1.80 |
| 25 | UI3 | 11/25/03 | 0.35 | 2.34 | 0.05 | 0.03 | 0.10 | 1.31 |
| 26 | Palouse1 | n/a | 0.25 | 3.07 | 0.02 | 0.11 | 0.16 | 0.15 |
| 27 | Palouse2 | 08/05/03 | 0.24 | 2.58 | 0.03 | 0.02 | 0.16 | 0.10 |
| 28 | Paulson | 09/29/03 | 0.31 | 2.08 | 0.01 | 0.84 | 0.09 | 11.74 |
| 29 | Brawdy | 10/23/03 | 0.11 | 1.01 | 0.02 | 0.02 | 0.07 | 10.97 |
| 30 | McGreevy | 10/23/03 | 0.22 | 1.69 | 0.02 | 4.57 | 0.12 | 4.22 |
| 31 | Ch. Electric | 11/03/03 | 0.32 | 1.97 | 0.02 | 0.75 | 0.08 | 3.91 |

* n/a dates were collected between 2000 and 2001, exact dates were not available.
**COM6A was collected by Alex Kirk.

**Table A1.2: Ground water cation concentrations for sampled wells**

| # | Name | Al | B | Ba | Ca | Fe | K | Mg | Mn | Na | Pb | Si | Sr | Zn |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | Butters | nd | nd | 0.01 | 20.98 | nd | 2.52 | 4.54 | nd | 16.67 | nd | 2.94 | 0.14 | 1.02 |
| 2 | Gentry | nd | nd | 0.03 | 10.85 | nd | 1.54 | 2.62 | nd | 17.33 | nd | 27.47 | 0.11 | 1.47 |
| 3 | UIGRS | nd | 0.08 | 0.30 | 162.65 | nd | 7.85 | 59.11 | 0.17 | 79.12 | nd | 26.69 | 0.82 | 0.00 |
| 4 | Loess6A | nd | nd | 0.05 | 26.21 | nd | 1.01 | 8.68 | nd | 36.22 | nd | 19.46 | 0.14 | 0.07 |
| 5 | Stalnaker | nd | 0.07 | 0.20 | 48.54 | 17.36 | 3.61 | 21.80 | 0.18 | 21.89 | 1.73 | 32.69 | 0.29 | 0.04 |
| 6 | COM2 | nd | 0.00 | 0.19 | 34.88 | 0.50 | 3.91 | 14.15 | 0.15 | 19.43 | 0.06 | 32.07 | 0.35 | nd |
| 7 | COM3 | nd | 0.02 | 0.04 | 51.92 | 5.59 | 3.64 | 23.57 | 0.44 | 20.76 | 0.55 | 31.51 | 0.24 | nd |
| 8 | UI5 | nd | 0.17 | 0.13 | 49.8 | 0.036 | 3.56 | 19.95 | 0.049 | 16.60 | 0.039 | 23.37 | 0 | 0.061 |
| 9 | COP3 | 0.02 | 0.00 | 0.09 | 26.04 | 0.12 | 4.87 | 19.92 | 0.03 | 30.10 | 0.02 | 33.72 | 0.18 | Nd |
| 10 | COP5 | nd | 0.00 | 0.09 | 23.80 | 0.03 | 3.92 | 17.24 | 0.02 | 21.78 | 0.01 | 33.08 | 0.20 | Nd |
| 11 | COP6 | 0.01 | 0.00 | 0.08 | 21.95 | 0.13 | 4.87 | 17.97 | 0.05 | 32.34 | 0.02 | 36.03 | 0.15 | Nd |
| 12 | COP7 | nd | nd | 0.07 | 21.07 | 0.08 | 4.43 | 16.60 | 0.02 | 26.13 | 0.01 | 33.05 | 0.14 | Nd |
| 13 | WSU5 | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a | n/a |
| 14 | WSU6 | nd | nd | 0.09 | 22.08 | nd | 5.07 | 18.57 | 0.04 | 28.17 | 0.00 | 34.48 | 0.18 | Nd |
| 15 | WSU7 | nd | nd | 0.08 | 23.66 | 0.02 | 4.41 | 19.63 | 0.04 | 25.61 | 0.01 | 33.85 | 0.20 | Nd |
| 16 | WSU8 | nd | nd | 0.07 | 20.94 | nd | 4.24 | 17.41 | 0.04 | 29.73 | 0.00 | 31.42 | 0.17 | Nd |
| 17 | Glenwood | nd | 0.00 | 0.06 | 21.41 | nd | 3.33 | 14.46 | 0.01 | 24.32 | 0.01 | 31.19 | 0.11 | Nd |
| 18 | Fairview | nd | 0.00 | 0.03 | 21.00 | nd | 4.13 | 13.03 | 0.00 | 26.61 | nd | 36.44 | 0.09 | Nd |
| 19 | Claystreet | 0.03 | 0.01 | 0.06 | 41.28 | nd | 6.70 | 29.66 | 0.04 | 19.96 | 0.00 | 2.39 | 0.19 | Nd |
| 21 | COM6 | nd | 0.08 | 0.04 | 23.95 | nd | 5.56 | 4.55 | 0.01 | 79.27 | nd | 28.07 | 0.53 | Nd |
| 22 | COM8 | nd | 0.02 | 0.01 | 22.01 | 0.27 | 5.27 | 7.76 | 0.05 | 62.74 | 0.03 | 40.81 | 0.47 | Nd |
| 23 | COM9 | nd | nd | 0.20 | 22.61 | 0.07 | 6.56 | 13.30 | 0.07 | 24.63 | 0.02 | 40.27 | 0.27 | Nd |
| 24 | UI4 | nd | 0.00 | 0.18 | 22.98 | 0.34 | 6.38 | 13.53 | 0.07 | 27.55 | 0.04 | 40.41 | 0.27 | Nd |
| 25 | UI3 | 0.007 | 0.121 | 0.313 | 24.41 | 0.909 | 6.47 | 12.169 | 0.082 | 25.04 | 1.002 | 36.248 | 0 | 0.008 |
| 26 | Palouse1 | nd | 0.02 | 0.14 | 20.50 | 0.24 | 6.02 | 13.90 | 0.02 | 31.55 | 0.03 | 29.95 | 0.13 | Nd |
| 27 | Palouse2 | 0.00 | 0.02 | 0.35 | 47.35 | 0.12 | 13.04 | 33.09 | 0.04 | 34.97 | 0.02 | 3.26 | 0.27 | Nd |
| 28 | Paulson | nd | nd | 0.12 | 25.94 | nd | 5.22 | 17.21 | 0.02 | 28.39 | nd | 36.90 | 0.25 | 0.08 |
| 29 | Brawdy | nd | nd | 0.07 | 27.79 | nd | 3.37 | 13.51 | nd | 14.19 | nd | 26.90 | 0.14 | 0.01 |
| 30 | McGreevy | nd | nd | 0.10 | 25.61 | nd | 3.34 | 19.54 | nd | 12.90 | nd | 27.72 | 0.12 | 0.30 |
| 31 | Ch. Electric | nd | nd | 0.14 | 22.94 | nd | 5.27 | 15.41 | 0.01 | 21.71 | nd | 31.55 | 0.25 | 0.22 |

# APPENDIX II:

# DEPTH ANALYSIS AND WELL LOCATIONS

**Table 2.1: Well location and elevation for sampled wells**

| # | Name | Aquifer | Easting | Northing | Latitude | Longitude | Surface Elev. (ft) | Bottom Elev. Of Prod. Zone (ft) | Top Elev. Of Prod. Zone (ft) |
|---|---|---|---|---|---|---|---|---|---|
| 5 | Stalnaker | W | 500306 | 5177050 | 46.747 | 116.996 | 2600 | 2371 | 2532 |
| 6 | COM2 | W | 499813 | 5175694 | 46.735 | 117.002 | 2569.1 | 2328 | 2328 |
| 7 | COM3 | W | 499827 | 5175729 | 46.735 | 117.002 | 2569.1 | 2000 | 2329 |
| 8 | UI5 | W | 498639 | 5174633 | 46.725 | 117.018 | 2617 | 2370 | 2457 |
| 9 | COP3 | GR | 486207 | 5175407 | 46.732 | 117.181 | 2339.64 | 2172.6 | 2298.6 |
| 10 | COP5 | GR | 486056 | 5173370 | 46.713 | 117.182 | 2446.14 | 1734.1 | 1772.1 |
| 11 | COP6 | GR | 486787 | 5177123 | 46.748 | 117.173 | 2423.24 | 1863.2 | 2188.2 |
| 12 | COP7 | GR | 486516 | 5175822 | 46.736 | 117.176 | 2345.28 | 1627.3 | 1627.3 |
| 13 | WSU5 | GR | 490240 | 5176270 | 46.740 | 117.128 | 2505.04 | 2109 | 2165 |
| 14 | WSU6 | GR | 488020 | 5175640 | 46.734 | 117.157 | 2534.71 | 1832.7 | 2142.7 |
| 15 | WSU7 | GR | 487027 | 5175072 | 46.729 | 117.170 | 2414.12 | 600.1 | 1414.1 |
| 16 | WSU8 | GR | 488555 | 5175386 | 46.732 | 117.150 | 2414 | 1602 | 1872 |
| 17 | Glenwood | GR | 478522 | 5197370 | 46.930 | 117.282 | 2071.36 | 1966.4 | 1991.4 |
| 18 | Fairview | GR | 471887 | 5191022 | 46.872 | 117.369 | 2110.62 | 1387.6 | 1387.6 |
| 19 | Claystreet | GR | 472794 | 5193476 | 46.894 | 117.357 | 1961.85 | 1361.9 | 1787.9 |
| 20 | COM6A | GR | 500349 | 5176385 | 46.741 | 116.995 | 2585.62 | 1280.6 | 1680.6 |
| 21 | COM6 | GR | 500349 | 5176385 | 46.741 | 116.995 | 2618.6 | 1160.6 | 1160.6 |
| 22 | COM8 | GR | 498990 | 5176315 | 46.740 | 117.013 | 2555.1 | 1313.1 | 1313.1 |
| 23 | COM9 | GR | 497529 | 5175673 | 46.735 | 117.032 | 2553.1 | 1806.1 | 1982.1 |
| 24 | UI4 | GR | 498095 | 5175730 | 46.735 | 117.025 | 2566.9 | 1229.9 | 1676.9 |
| 25 | UI3 | GR | 498399 | 5175935 | 46.737 | 117.021 | 2431.51 | 2134.5 | 2134.5 |
| 26 | Palouse1 | GR | 494493 | 5195152 | 46.910 | 117.072 | 2505.41 | 2045.4 | 2105.4 |
| 27 | Palouse2 | GR | 493694 | 5194707 | 46.906 | 117.083 | 2596.8 | 2191.8 | 2351.8 |
| 28 | Paulson | GR | 492647 | 5173983 | 46.719 | 117.096 | 2576.54 | 2176.5 | 2176.5 |
| 29 | Brawdy | GR | 494409 | 5172585 | 46.707 | 117.073 | 2531.64 | 2207.6 | 2207.6 |
| 30 | McGreevy | GR | 491124 | 5181599 | 46.788 | 117.116 | 2480 | 2101 | 2449 |
| 31 | Ch. Electric | GR | 495727 | 5176241 | 46.740 | 117.056 | 2510 | 2131 | 2479 |

# APPENDIX III:

# WATEQ SPECIATION RESULTS

PALOUSE BASIN: DEEP GRANDE RONDE SAMPLES
**1. COM6**

INITIAL SOLUTION

TEMPERATURE = 21.40 DEGREES C PH = 7.850
ANALYTICAL EPMCAT = 5.177 ANALYTICAL EPMAN = 4.768

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.97808E-04 | -3.2234 | 2.39500E+01 |
| Mg+2 | 2.0 | 1.87230E-04 | -3.7276 | 4.55000E+00 |
| Na+ | 1.0 | 3.44951E-03 | -2.4622 | 7.92700E+01 |
| K+ | 1.0 | 1.42252E-04 | -3.8469 | 5.56000E+00 |
| Mn+2 | 2.0 | 1.82100E-07 | -6.7397 | 1.00000E-02 |
| Ba+2 | 2.0 | 2.91371E-07 | -6.5356 | 4.00000E-02 |
| Sr+2 | 2.0 | 6.05141E-06 | -5.2181 | 5.30000E-01 |
| H4SiO4 | 0.0 | 4.67371E-04 | -3.3303 | 2.80700E+01 |
| Cl- | -1.0 | 7.25210E-05 | -4.1395 | 2.57000E+00 |
| HCO3- | -1.0 | 4.44062E-03 | -2.3526 | 2.70840E+02 |
| SO4-2 | -2.0 | 5.21761E-05 | -4.2825 | 5.01000E+00 |
| NO3- | -1.0 | 9.71375E-05 | -4.0126 | 1.36000E+00 |
| H3BO3 | 0.0 | 7.40369E-06 | -5.1306 | 8.00000E-02 |
| HPO4-2 | -2.0 | 6.45980E-07 | -6.1898 | 2.00000E-02 |
| F- | -1.0 | 4.94988E-05 | -4.3054 | 9.40000E-01 |
| Br- | -1.0 | 1.25203E-07 | -6.9024 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 5.18 | 5.11 | 7.850 | ACTIVITY H2O = 0.9998 |
| EPMAN | 4.77 | 4.70 | | PCO2= 3.559712E-03 |
| | | | TEMPERATURE | LOG PCO2 = -2.4486 |
| EH = 0.0000 | PE = 0.000 | | 21.40 DEG C | PO2 = 1.102255E-53 |
| PE CALC S = | 0.000 | | | PCH4 = 1.621281E-42 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | CO2 TOT = 4.541193E-03 |
| PE SATO DOX= | 0.000 | | 5.719627E-03 | DENSITY = 1.0000 |
| TOT ALK = | 4.441E+00 MEQ | | | TDS = 422.8MG/L |
| ELECT = | 4.100E-01 MEQ | | | CARB ALK = 4.435E+00 MEQ |
| | | | | CHARGE IMBALANCE = 4.2% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.5184E-08 | 1.4125E-08 | -7.850 | 9.3026E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.6517E-04 | 4.1348E-04 | -3.384 | 7.3160E-01 |
| 5 | Mg+2 | 2. | 1.7779E-04 | 1.3058E-04 | -3.884 | 7.3446E-01 |
| 6 | Na+ | 1. | 3.4410E-03 | 3.1782E-03 | -2.498 | 9.2361E-01 |
| 7 | K+ | 1. | 1.4222E-04 | 1.3113E-04 | -3.882 | 9.2204E-01 |
| 9 | Mn+2 | 2. | 9.0537E-08 | 6.6544E-08 | -7.177 | 7.3499E-01 |
| 11 | Ba+2 | 2. | 2.7902E-07 | 2.0369E-07 | -6.691 | 7.3001E-01 |
| 12 | Sr+2 | 2. | 5.7469E-06 | 4.2095E-06 | -5.376 | 7.3249E-01 |
| 13 | H4SiO4 | 0. | 4.6276E-04 | 4.6337E-04 | -3.334 | 1.0013E+00 |
| 14 | Cl- | -1. | 7.2521E-05 | 6.6867E-05 | -4.175 | 9.2204E-01 |
| 15 | CO3-2 | -2. | 1.6892E-05 | 1.2365E-05 | -4.908 | 7.3203E-01 |
| 16 | SO4-2 | -2. | 4.7778E-05 | 3.4860E-05 | -4.458 | 7.2963E-01 |
| 17 | NO3- | -1. | 5.3122E-18 | 4.8925E-18 | -17.310 | 9.2099E-01 |
| 18 | H3BO3 | 0. | 7.1095E-06 | 7.1189E-06 | -5.148 | 1.0013E+00 |
| 19 | PO4-3 | -3. | 1.9824E-11 | 9.6106E-12 | -11.017 | 4.8479E-01 |
| 20 | F- | -1. | 4.8860E-05 | 4.5042E-05 | -4.346 | 9.2185E-01 |
| 22 | Br- | -1. | 1.2520E-07 | 1.1531E-07 | -6.938 | 9.2099E-01 |
| 31 | OH- | -1. | 5.8238E-07 | 5.3687E-07 | -6.270 | 9.2185E-01 |
| 33 | H2 AQ | 0. | 1.4628E-19 | 1.4647E-19 | -18.834 | 1.0013E+00 |
| 34 | HCO3- | -1. | 4.3447E-03 | 4.0188E-03 | -2.396 | 9.2498E-01 |
| 35 | H2CO3 | 0. | 1.3378E-04 | 1.3396E-04 | -3.873 | 1.0013E+00 |
| 40 | HSO4- | -1. | 4.8010E-11 | 4.4309E-11 | -10.354 | 9.2292E-01 |
| 48 | NO2- | -1. | 9.7137E-05 | 8.9463E-05 | -4.048 | 9.2099E-01 |
| 57 | H2BO3- | -1. | 2.9401E-07 | 2.7135E-07 | -6.566 | 9.2292E-01 |
| 58 | BFOH3- | -1. | 1.3313E-10 | 1.2287E-10 | -9.911 | 9.2292E-01 |
| 59 | BF2OH2- | -1. | 9.1212E-15 | 8.4182E-15 | -14.075 | 9.2292E-01 |
| 60 | BF3OH- | -1. | 6.8029E-21 | 6.2786E-21 | -20.202 | 9.2292E-01 |
| 61 | BF4- | -1. | 1.7720E-26 | 1.6354E-26 | -25.786 | 9.2292E-01 |
| 65 | HPO4-2 | -2. | 4.4682E-07 | 3.2387E-07 | -6.490 | 7.2484E-01 |
| 66 | H2PO4- | -1. | 8.1431E-08 | 7.5204E-08 | -7.124 | 9.2353E-01 |
| 69 | HF AQ | 0. | 8.9355E-10 | 8.9473E-10 | -9.048 | 1.0013E+00 |
| 70 | HF2- | -1. | 1.6267E-13 | 1.5013E-13 | -12.824 | 9.2292E-01 |
| 75 | CaOH+ | 1. | 5.2628E-09 | 4.8571E-09 | -8.314 | 9.2292E-01 |
| 76 | CaCO3 | 0. | 8.0177E-06 | 8.0282E-06 | -5.095 | 1.0013E+00 |
| 77 | CaHCO3+ | 1. | 2.1600E-05 | 1.9979E-05 | -4.699 | 9.2498E-01 |
| 78 | CaSO4 | 0. | 2.7760E-06 | 2.7797E-06 | -5.556 | 1.0013E+00 |
| 79 | CaHSO4 | 1. | 2.5800E-13 | 2.3811E-13 | -12.623 | 9.2292E-01 |
| 80 | CaPO4- | -1. | 1.1621E-08 | 1.0726E-08 | -7.970 | 9.2292E-01 |
| 81 | CaHPO4 | 0. | 6.8500E-08 | 6.8590E-08 | -7.164 | 1.0013E+00 |
| 82 | CaH2PO4+ | 1. | 8.0365E-10 | 7.4171E-10 | -9.130 | 9.2292E-01 |
| 83 | CaF+ | 1. | 1.6143E-07 | 1.4899E-07 | -6.827 | 9.2292E-01 |
| 85 | MgOH+ | 1. | 2.6361E-08 | 2.4329E-08 | -7.614 | 9.2292E-01 |
| 86 | MgCO3 | 0. | 1.4560E-06 | 1.4579E-06 | -5.836 | 1.0013E+00 |
| 87 | MgHCO3+ | 1. | 6.5562E-06 | 6.0509E-06 | -5.218 | 9.2292E-01 |
| 88 | MgSO4 | 0. | 9.7022E-07 | 9.7150E-07 | -6.013 | 1.0013E+00 |
| 89 | MgPO4- | -1. | 4.9510E-09 | 4.5694E-09 | -8.340 | 9.2292E-01 |
| 90 | MgHPO4 | 0. | 2.9249E-08 | 2.9288E-08 | -7.533 | 1.0013E+00 |
| 91 | MgH2PO4+ | 1. | 3.2322E-10 | 2.9831E-10 | -9.525 | 9.2292E-01 |
| 92 | MgF+ | 1. | 3.9415E-07 | 3.6377E-07 | -6.439 | 9.2292E-01 |
| 93 | NaOH | 0. | 1.4843E-09 | 1.4863E-09 | -8.828 | 1.0013E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 94 | NaCO3- | -1. | 6.5977E-07 | 6.0892E-07 | -6.215 | 9.2292E-01 |
| 95 | NaHCO3 | 0. | 7.1567E-06 | 7.1661E-06 | -5.145 | 1.0013E+00 |
| 96 | NaSO4- | -1. | 5.8790E-07 | 5.4259E-07 | -6.266 | 9.2292E-01 |
| 97 | NaHPO4- | -1. | 2.1746E-09 | 2.0070E-09 | -8.697 | 9.2292E-01 |
| 98 | NaF aq | 0. | 8.2266E-08 | 8.2374E-08 | -7.084 | 1.0013E+00 |
| 99 | KOH | 0. | 3.2141E-11 | 3.2184E-11 | -10.492 | 1.0013E+00 |
| 100 | KSO4- | -1. | 3.2658E-08 | 3.0141E-08 | -7.521 | 9.2292E-01 |
| 101 | KHPO4- | -1. | 8.9726E-11 | 8.2810E-11 | -10.082 | 9.2292E-01 |
| 134 | MnOH+ | 1. | 9.7468E-11 | 8.9955E-11 | -10.046 | 9.2292E-01 |
| 136 | MnCl+ | 1. | 1.9641E-11 | 1.8127E-11 | -10.742 | 9.2292E-01 |
| 137 | MnCl2 | 0. | 5.2839E-16 | 5.2909E-16 | -15.276 | 1.0013E+00 |
| 138 | MnCl3- | -1. | 1.0558E-20 | 9.7441E-21 | -20.011 | 9.2292E-01 |
| 139 | MnCO3 | 0. | 6.5274E-08 | 6.5360E-08 | -7.185 | 1.0013E+00 |
| 140 | MnHCO3+ | 1. | 2.5766E-08 | 2.3780E-08 | -7.624 | 9.2292E-01 |
| 141 | MnSO4 | 0. | 3.8430E-10 | 3.8481E-10 | -9.415 | 1.0013E+00 |
| 143 | MnF+ | 1. | 2.2468E-11 | 2.0736E-11 | -10.683 | 9.2292E-01 |
| 144 | Mn+3 | 3. | 2.4859E-33 | 1.2077E-33 | -32.918 | 4.8583E-01 |
| 164 | H3SiO4- | -1. | 4.6104E-06 | 4.2550E-06 | -5.371 | 9.2292E-01 |
| 165 | H2SiO4-2 | -2. | 2.2227E-11 | 1.6127E-11 | -10.792 | 7.2554E-01 |
| 166 | SiF6-2 | -2. | 4.4969E-31 | 3.2627E-31 | -30.486 | 7.2554E-01 |
| 170 | BaOH+ | 1. | 5.2933E-13 | 4.8853E-13 | -12.311 | 9.2292E-01 |
| 171 | BaCO3 | 0. | 1.2088E-09 | 1.2104E-09 | -8.917 | 1.0013E+00 |
| 172 | BaHCO3+ | 1. | 7.5908E-09 | 7.0058E-09 | -8.155 | 9.2292E-01 |
| 173 | BaSO4 | 0. | 3.5540E-09 | 3.5587E-09 | -8.449 | 1.0013E+00 |
| 176 | SrOH+ | 1. | 1.6532E-11 | 1.5281E-11 | -10.816 | 9.2434E-01 |
| 177 | SrHCO3+ | 1. | 2.4732E-07 | 2.2877E-07 | -6.641 | 9.2498E-01 |
| 178 | SrCO3 | 0. | 2.9838E-08 | 2.9877E-08 | -7.525 | 1.0013E+00 |
| 179 | SrSO4 | 0. | 2.7375E-08 | 2.7411E-08 | -7.562 | 1.0013E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 5.113E-09 | 3.464E-09 | -8.291 | -8.460 | 1.476E+00 | 0.169 |
| 2 | Aragonit | 5.113E-09 | 4.853E-09 | -8.291 | -8.314 | 1.054E+00 | 0.023 |
| 3 | Dolomite | 8.255E-18 | 9.875E-18 | -17.083 | -17.005 | 8.360E-01 | -0.078 |
| 5 | Rhodochr | 8.228E-13 | 7.635E-12 | -12.085 | -11.117 | 1.078E-01 | -0.968 |
| 6 | Strontit | 5.205E-11 | 5.386E-10 | -10.284 | -9.269 | 9.665E-02 | -1.015 |
| 7 | Witherit | 2.519E-12 | 2.690E-09 | -11.599 | -8.570 | 9.363E-04 | -3.029 |
| 8 | Gypsum | 1.441E-08 | 2.626E-05 | -7.841 | -4.581 | 5.488E-04 | -3.261 |
| 9 | Anhydrit | 1.441E-08 | 4.490E-05 | -7.841 | -4.348 | 3.210E-04 | -3.493 |
| 10 | Celestit | 1.467E-10 | 2.374E-07 | -9.833 | -6.624 | 6.181E-04 | -3.209 |
| 11 | Barite | 7.100E-12 | 9.357E-11 | -11.149 | -10.029 | 7.588E-02 | -1.120 |
| 12 | Hydroxap | 1.031E-05 | 7.997E-04 | -4.987 | -3.097 | 1.289E-02 | -1.890 |
| 13 | Fluorite | 8.388E-13 | 2.277E-11 | -12.076 | -10.643 | 3.683E-02 | -1.434 |
| 14 | SiO2 (a) | 4.635E-04 | 1.812E-03 | -3.334 | -2.742 | 2.558E-01 | -0.592 |
| 15 | Chalcedy | 4.635E-04 | 2.549E-04 | -3.334 | -3.594 | 1.819E+00 | 0.260 |
| 16 | Quartz | 4.635E-04 | 9.246E-05 | -3.334 | -4.034 | 5.013E+00 | 0.700 |
| 26 | Talc | 1.293E+22 | 6.520E+21 | 22.112 | 21.814 | 1.983E+00 | 0.297 |
| 28 | Chrysotl | 6.018E+28 | 4.493E+32 | 28.779 | 32.653 | 1.339E-04 | -3.873 |
| 29 | Sepiol c | 4.262E+13 | 7.176E+15 | 13.630 | 15.856 | 5.939E-03 | -2.226 |
| 30 | Sepiol d | 4.262E+13 | 4.571E+18 | 13.630 | 18.660 | 9.323E-06 | -5.030 |
| 38 | Pyrolusi | 1.671E+24 | 9.190E+41 | 24.223 | 41.963 | 1.818E-18 | -17.740 |
| 39 | Hausmani | 1.858E+41 | 8.543E+61 | 41.269 | 61.932 | 2.175E-21 | -20.663 |
| 40 | Manganit | 2.360E+16 | 2.188E+25 | 16.373 | 25.340 | 1.079E-09 | -8.967 |
| 41 | Pyrochro | 3.334E+08 | 1.585E+15 | 8.523 | 15.200 | 2.104E-07 | -6.677 |
| 42 | PCO2 | 1.340E-04 | 3.763E-02 | -3.873 | -1.424 | 3.560E-03 | -2.449 |
| 44 | H2 gas | 1.465E-19 | 7.341E-04 | -18.834 | -3.134 | 1.995E-16 | -15.700 |

**2. COM8**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.180
ANALYTICAL EPMCAT = 4.626 ANALYTICAL EPMAN = 2.595

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.49309E-04 | -3.2602 | 2.20100E+01 |
| Mg+2 | 2.0 | 3.19276E-04 | -3.4958 | 7.76000E+00 |
| Na+ | 1.0 | 2.72982E-03 | -2.5639 | 6.27400E+01 |
| K+ | 1.0 | 1.34814E-04 | -3.8703 | 5.27000E+00 |
| Fe+2 | 2.0 | 4.83603E-06 | -5.3155 | 2.70000E-01 |
| Mn+2 | 2.0 | 9.10378E-07 | -6.0408 | 5.00000E-02 |
| Ba+2 | 2.0 | 7.28329E-08 | -7.1377 | 1.00000E-02 |
| Sr+2 | 2.0 | 5.36561E-06 | -5.2704 | 4.70000E-01 |
| H4SiO4 | 0.0 | 6.79402E-04 | -3.1679 | 4.08100E+01 |
| Cl- | -1.0 | 6.77147E-05 | -4.1693 | 2.40000E+00 |
| HCO3- | -1.0 | 2.28001E-03 | -2.6421 | 1.39080E+02 |
| SO4-2 | -2.0 | 3.56124E-05 | -4.4484 | 3.42000E+00 |
| NO3- | -1.0 | 1.22119E-04 | -3.9132 | 1.71000E+00 |
| H3BO3 | 0.0 | 1.85067E-06 | -5.7327 | 2.00000E-02 |
| HPO4-2 | -2.0 | 6.45892E-07 | -6.1898 | 2.00000E-02 |
| F- | -1.0 | 5.15981E-05 | -4.2874 | 9.80000E-01 |
| Br- | -1.0 | 1.25186E-07 | -6.9024 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 4.63 | 4.59 | PH 7.180 | ACTIVITY H2O = 0.9999 |
| EPMAN | 2.59 | 2.56 | | PCO2= 8.304473E-03 |
| | | | | LOG PCO2 = -2.0807 |
| | | | TEMPERATURE | PO2 = 1.468075E-57 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 2.856168E-36 |
| PE CALC S = 0.000 | | | | CO2 TOT = 2.620381E-03 |
| PE CALC DOX= 0.000 | | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= 0.000 | | | 4.470400E-03 | TDS = 287.0MG/L |
| TOT ALK = 2.280E+00 MEQ | | | | CARB ALK = 2.278E+00 MEQ |
| ELECT = 2.031E+00 MEQ | | | | CHARGE IMBALANCE = 28.4% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 7.0503E-08 | 6.6069E-08 | -7.180 | 9.3711E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.3620E-04 | 4.0581E-04 | -3.392 | 7.5682E-01 |
| 5 | Mg+2 | 2. | 3.1108E-04 | 2.3617E-04 | -3.627 | 7.5917E-01 |
| 6 | Na+ | 1. | 2.7264E-03 | 2.5403E-03 | -2.595 | 9.3172E-01 |
| 7 | K+ | 1. | 1.3479E-04 | 1.2542E-04 | -3.902 | 9.3047E-01 |
| 8 | Fe+2 | 2. | 4.0319E-06 | 3.0628E-06 | -5.514 | 7.5965E-01 |
| 9 | Mn+2 | 2. | 7.3904E-07 | 5.6141E-07 | -6.251 | 7.5965E-01 |
| 11 | Ba+2 | 2. | 7.1212E-08 | 5.3803E-08 | -7.269 | 7.5554E-01 |
| 12 | Sr+2 | 2. | 5.2381E-06 | 3.9682E-06 | -5.401 | 7.5757E-01 |
| 13 | H4SiO4 | 0. | 6.7814E-04 | 6.7884E-04 | -3.168 | 1.0010E+00 |
| 14 | Cl- | -1. | 6.7714E-05 | 6.3006E-05 | -4.201 | 9.3047E-01 |
| 15 | CO3-2 | -2. | 1.6875E-06 | 1.2778E-06 | -5.894 | 7.5720E-01 |
| 16 | SO4-2 | -2. | 3.2277E-05 | 2.4376E-05 | -4.613 | 7.5523E-01 |
| 17 | NO3- | -1. | 1.2751E-19 | 1.1853E-19 | -18.926 | 9.2964E-01 |
| 18 | H3BO3 | 0. | 1.8356E-06 | 1.8374E-06 | -5.736 | 1.0010E+00 |
| 19 | PO4-3 | -3. | 2.4910E-12 | 1.3090E-12 | -11.883 | 5.2549E-01 |
| 20 | F- | -1. | 5.0678E-05 | 4.7147E-05 | -4.327 | 9.3033E-01 |
| 22 | Br- | -1. | 1.2519E-07 | 1.1638E-07 | -6.934 | 9.2964E-01 |
| 31 | OH- | -1. | 9.3998E-08 | 8.7449E-08 | -7.058 | 9.3033E-01 |
| 33 | H2 AQ | 0. | 3.3155E-18 | 3.3189E-18 | -17.479 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.2522E-03 | 2.1010E-03 | -2.678 | 9.3283E-01 |
| 35 | H2CO3 | 0. | 3.4498E-04 | 3.4534E-04 | -3.462 | 1.0010E+00 |
| 40 | HSO4- | -1. | 1.4499E-10 | 1.3501E-10 | -9.870 | 9.3116E-01 |
| 48 | NO2- | -1. | 1.2212E-04 | 1.1353E-04 | -3.945 | 9.2964E-01 |
| 57 | H2BO3- | -1. | 1.5079E-08 | 1.4041E-08 | -7.853 | 9.3116E-01 |
| 58 | BFOH3- | -1. | 3.4359E-11 | 3.1994E-11 | -10.495 | 9.3116E-01 |
| 59 | BF2OH2- | -1. | 1.1578E-14 | 1.0781E-14 | -13.967 | 9.3116E-01 |
| 60 | BF3OH- | -1. | 4.5093E-20 | 4.1989E-20 | -19.377 | 9.3116E-01 |
| 61 | BF4- | -1. | 5.7771E-25 | 5.3794E-25 | -24.269 | 9.3116E-01 |
| 65 | HPO4-2 | -2. | 2.9468E-07 | 2.2139E-07 | -6.655 | 7.5129E-01 |
| 66 | H2PO4- | -1. | 2.6323E-07 | 2.4525E-07 | -6.610 | 9.3167E-01 |
| 69 | HF AQ | 0. | 4.1219E-09 | 4.1262E-09 | -8.384 | 1.0010E+00 |
| 70 | HF2- | -1. | 7.5457E-13 | 7.0263E-13 | -12.153 | 9.3116E-01 |
| 75 | CaOH+ | 1. | 1.0946E-09 | 1.0192E-09 | -8.992 | 9.3116E-01 |
| 76 | CaCO3 | 0. | 7.7045E-07 | 7.7124E-07 | -6.113 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.0299E-05 | 9.6074E-06 | -5.017 | 9.3283E-01 |
| 78 | CaSO4 | 0. | 1.8440E-06 | 1.8459E-06 | -5.734 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 8.2085E-13 | 7.6434E-13 | -12.117 | 9.3116E-01 |
| 80 | CaPO4- | -1. | 1.4475E-09 | 1.3478E-09 | -8.870 | 9.3116E-01 |
| 81 | CaHPO4 | 0. | 4.3040E-08 | 4.3084E-08 | -7.366 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 2.3822E-09 | 2.2182E-09 | -8.654 | 9.3116E-01 |
| 83 | CaF+ | 1. | 1.5141E-07 | 1.4098E-07 | -6.851 | 9.3116E-01 |
| 85 | MgOH+ | 1. | 7.4021E-09 | 6.8925E-09 | -8.162 | 9.3116E-01 |
| 86 | MgCO3 | 0. | 2.5835E-07 | 2.5862E-07 | -6.587 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 6.0752E-06 | 5.6570E-06 | -5.247 | 9.3116E-01 |
| 88 | MgSO4 | 0. | 1.1209E-06 | 1.1220E-06 | -5.950 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 1.1363E-09 | 1.0581E-09 | -8.975 | 9.3116E-01 |
| 90 | MgHPO4 | 0. | 3.3867E-08 | 3.3901E-08 | -7.470 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 1.7655E-09 | 1.6440E-09 | -8.784 | 9.3116E-01 |
| 92 | MgF+ | 1. | 6.9383E-07 | 6.4607E-07 | -6.190 | 9.3116E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 93 | NaOH | 0. | 2.5373E-10 | 2.5399E-10 | -9.595 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 4.5216E-08 | 4.2104E-08 | -7.376 | 9.3116E-01 |
| 95 | NaHCO3 | 0. | 2.9693E-06 | 2.9724E-06 | -5.527 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 3.1848E-07 | 2.9656E-07 | -6.528 | 9.3116E-01 |
| 97 | NaHPO4- | -1. | 1.1776E-09 | 1.0966E-09 | -8.960 | 9.3116E-01 |
| 98 | NaF aq | 0. | 6.8848E-08 | 6.8918E-08 | -7.162 | 1.0010E+00 |
| 99 | KOH | 0. | 6.5746E-12 | 6.5814E-12 | -11.182 | 1.0010E+00 |
| 100 | KSO4- | -1. | 2.0358E-08 | 1.8957E-08 | -7.722 | 9.3116E-01 |
| 101 | KHPO4- | -1. | 5.8144E-11 | 5.4142E-11 | -10.266 | 9.3116E-01 |
| 102 | FeOH+ | 1. | 9.2133E-09 | 8.5791E-09 | -8.067 | 9.3116E-01 |
| 105 | FeCl+ | 1. | 2.8608E-10 | 2.6638E-10 | -9.574 | 9.3116E-01 |
| 106 | FeCO3 | 0. | 9.3788E-08 | 9.3884E-08 | -7.027 | 1.0010E+00 |
| 107 | FeHCO3+ | 1. | 6.8442E-07 | 6.3731E-07 | -6.196 | 9.3116E-01 |
| 108 | FeSO4 | 0. | 1.1634E-08 | 1.1646E-08 | -7.934 | 1.0010E+00 |
| 109 | FeHSO4+ | 1. | 6.1954E-15 | 5.7689E-15 | -14.239 | 9.3116E-01 |
| 112 | FeHPO4 | 0. | 2.6967E-09 | 2.6995E-09 | -8.569 | 1.0010E+00 |
| 113 | FeH2PO4+ | 1. | 4.0430E-10 | 3.7647E-10 | -9.424 | 9.3116E-01 |
| 114 | FeF+ | 1. | 1.5508E-09 | 1.4440E-09 | -8.840 | 9.3116E-01 |
| 115 | Fe+3 | 3. | 3.5433E-19 | 1.9748E-19 | -18.704 | 5.5735E-01 |
| 117 | FeOH+2 | 2. | 1.6830E-14 | 1.2653E-14 | -13.898 | 7.5180E-01 |
| 118 | FeOH2+ | 1. | 5.1884E-11 | 4.8313E-11 | -10.316 | 9.3116E-01 |
| 119 | FeOH3 | 0. | 6.8843E-11 | 6.8914E-11 | -10.162 | 1.0010E+00 |
| 120 | FeOH4- | -1. | 7.6577E-13 | 7.1306E-13 | -12.147 | 9.3116E-01 |
| 121 | Fe2OH2+4 | 4. | 1.8140E-26 | 5.7948E-27 | -26.237 | 3.1945E-01 |
| 122 | Fe3OH4+5 | 5. | 6.7411E-34 | 1.1333E-34 | -33.946 | 1.6812E-01 |
| 123 | FeCl+2 | 2. | 3.9822E-22 | 2.9938E-22 | -21.524 | 7.5180E-01 |
| 124 | FeCl2+ | 1. | 1.1357E-25 | 1.0575E-25 | -24.976 | 9.3116E-01 |
| 125 | FeCl3 | 0. | 6.6563E-31 | 6.6631E-31 | -30.176 | 1.0010E+00 |
| 126 | FeSO4+ | 1. | 4.8369E-20 | 4.5039E-20 | -19.346 | 9.3116E-01 |
| 127 | FeHSO4+2 | 2. | 1.8407E-26 | 1.3839E-26 | -25.859 | 7.5180E-01 |
| 128 | FeSO42- | -1. | 2.5083E-23 | 2.3356E-23 | -22.632 | 9.3116E-01 |
| 129 | FeHPO4+ | 1. | 1.0003E-20 | 9.3149E-21 | -20.031 | 9.3116E-01 |
| 130 | FeH2P+2 | 2. | 1.7116E-20 | 1.2868E-20 | -19.891 | 7.5180E-01 |
| 131 | FeF+2 | 2. | 1.7591E-17 | 1.3225E-17 | -16.879 | 7.5180E-01 |
| 132 | FeF2+ | 1. | 2.4481E-17 | 2.2796E-17 | -16.642 | 9.3116E-01 |
| 133 | FeF3 | 0. | 1.6607E-18 | 1.6624E-18 | -17.779 | 1.0010E+00 |
| 134 | MnOH+ | 1. | 1.3075E-10 | 1.2174E-10 | -9.915 | 9.3116E-01 |
| 136 | MnCl+ | 1. | 1.5475E-10 | 1.4410E-10 | -9.841 | 9.3116E-01 |
| 137 | MnCl2 | 0. | 3.9591E-15 | 3.9632E-15 | -14.402 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 7.3859E-20 | 6.8775E-20 | -19.163 | 9.3116E-01 |
| 139 | MnCO3 | 0. | 5.6925E-08 | 5.6984E-08 | -7.244 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 1.1181E-07 | 1.0411E-07 | -6.982 | 9.3116E-01 |
| 141 | MnSO4 | 0. | 2.1204E-09 | 2.1226E-09 | -8.673 | 1.0010E+00 |
| 143 | MnF+ | 1. | 1.9666E-10 | 1.8312E-10 | -9.737 | 9.3116E-01 |
| 144 | Mn+3 | 3. | 1.1571E-32 | 6.0897E-33 | -32.215 | 5.2629E-01 |
| 164 | H3SiO4- | -1. | 1.2609E-06 | 1.1741E-06 | -5.930 | 9.3116E-01 |
| 165 | H2SiO4-2 | -2. | 9.9964E-13 | 7.5153E-13 | -12.124 | 7.5180E-01 |
| 166 | SiF6-2 | -2. | 5.5358E-28 | 4.1618E-28 | -27.381 | 7.5180E-01 |
| 170 | BaOH+ | 1. | 2.9630E-14 | 2.7590E-14 | -13.559 | 9.3116E-01 |
| 171 | BaCO3 | 0. | 3.0828E-11 | 3.0860E-11 | -10.511 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 9.3354E-10 | 8.6927E-10 | -9.061 | 9.3116E-01 |
| 173 | BaSO4 | 0. | 6.5665E-10 | 6.5732E-10 | -9.182 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 3.3035E-12 | 3.0799E-12 | -11.511 | 9.3232E-01 |
| 177 | SrHCO3+ | 1. | 1.0758E-07 | 1.0035E-07 | -6.998 | 9.3283E-01 |
| 178 | SrCO3 | 0. | 2.6297E-09 | 2.6324E-09 | -8.580 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 1.7316E-08 | 1.7334E-08 | -7.761 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 5.185E-10 | 3.601E-09 | -9.285 | -8.444 | 1.440E-01 | -0.842 |
| 2 | Aragonit | 5.185E-10 | 5.073E-09 | -9.285 | -8.295 | 1.022E-01 | -0.991 |
| 3 | Dolomite | 1.565E-19 | 1.192E-17 | -18.806 | -16.924 | 1.313E-02 | -1.882 |
| 4 | Siderite | 3.914E-12 | 1.425E-11 | -11.407 | -10.846 | 2.747E-01 | -0.561 |
| 5 | Rhodochr | 7.174E-13 | 7.856E-12 | -12.144 | -11.105 | 9.132E-02 | -1.039 |
| 6 | Strontit | 5.071E-12 | 5.365E-10 | -11.295 | -9.270 | 9.452E-03 | -2.024 |
| 7 | Witherit | 6.875E-14 | 2.613E-09 | -13.163 | -8.583 | 2.631E-05 | -4.580 |
| 8 | Gypsum | 9.890E-09 | 2.618E-05 | -8.005 | -4.582 | 3.778E-04 | -3.423 |
| 9 | Anhydrit | 9.892E-09 | 4.577E-05 | -8.005 | -4.339 | 2.161E-04 | -3.665 |
| 10 | Celestit | 9.673E-11 | 2.394E-07 | -10.014 | -6.621 | 4.041E-04 | -3.394 |
| 11 | Barite | 1.312E-12 | 8.160E-11 | -11.882 | -10.088 | 1.607E-02 | -1.794 |
| 12 | Hydroxap | 6.266E-09 | 1.645E-03 | -8.203 | -2.784 | 3.809E-06 | -5.419 |
| 13 | Fluorite | 9.021E-13 | 2.063E-11 | -12.045 | -10.686 | 4.373E-02 | -1.359 |
| 14 | SiO2 (a) | 6.790E-04 | 1.695E-03 | -3.168 | -2.771 | 4.005E-01 | -0.397 |
| 15 | Chalcedy | 6.790E-04 | 2.320E-04 | -3.168 | -3.635 | 2.927E+00 | 0.466 |
| 16 | Quartz | 6.790E-04 | 8.204E-05 | -3.168 | -4.086 | 8.276E+00 | 0.918 |
| 26 | Talc | 3.365E+19 | 1.644E+22 | 19.527 | 22.216 | 2.047E-03 | -2.689 |
| 28 | Chrysotl | 7.297E+25 | 1.227E+33 | 25.863 | 33.089 | 5.947E-08 | -7.226 |
| 29 | Sepiol c | 9.157E+11 | 8.883E+15 | 11.962 | 15.949 | 1.031E-04 | -3.987 |
| 30 | Sepiol d | 9.157E+11 | 4.571E+18 | 11.962 | 18.660 | 2.003E-07 | -6.698 |
| 31 | Hematite | 4.687E+05 | 3.432E-04 | 5.671 | -3.464 | 1.366E+09 | 9.135 |
| 32 | Goethite | 6.846E+02 | 5.557E-02 | 2.835 | -1.255 | 1.232E+04 | 4.091 |
| 33 | Fe(OH)3a | 6.845E+02 | 7.780E+04 | 2.835 | 4.891 | 8.798E-03 | -2.056 |
| 37 | Vivianit | 4.919E-41 | 1.000E-36 | -40.308 | -36.000 | 4.919E-05 | -4.308 |
| 38 | Pyrolusi | 2.946E+22 | 3.369E+42 | 22.469 | 42.527 | 8.744E-21 | -20.058 |
| 39 | Hausmani | 4.871E+38 | 6.362E+62 | 38.688 | 62.804 | 7.656E-25 | -24.116 |
| 40 | Manganit | 1.946E+15 | 2.188E+25 | 15.289 | 25.340 | 8.896E-11 | -10.051 |
| 41 | Pyrochro | 1.286E+08 | 1.585E+15 | 8.109 | 15.200 | 8.113E-08 | -7.091 |
| 42 | PCO2 | 3.453E-04 | 4.158E-02 | -3.462 | -1.381 | 8.304E-03 | -2.081 |
| 44 | H2 gas | 3.319E-18 | 7.603E-04 | -17.479 | -3.119 | 4.365E-15 | -14.360 |
| 49 | Melanter | 7.460E-11 | 5.037E-03 | -10.127 | -2.298 | 1.481E-08 | -7.829 |
| 51 | K-Jarosi | 6.896E-27 | 2.194E-09 | -26.161 | -8.659 | 3.143E-18 | -17.503 |

**3. COM9**

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INITIAL SOLUTION

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TEMPERATURE = 19.90 DEGREES C PH = 7.420
ANALYTICAL EPMCAT = 3.478 ANALYTICAL EPMAN = 3.130

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.64289E-04 | -3.2485 | 2.26100E+01 |
| Mg+2 | 2.0 | 5.47217E-04 | -3.2618 | 1.33000E+01 |
| Na+ | 1.0 | 1.07166E-03 | -2.9699 | 2.46300E+01 |
| K+ | 1.0 | 1.67816E-04 | -3.7752 | 6.56000E+00 |
| Fe+2 | 2.0 | 1.25380E-06 | -5.9018 | 7.00000E-02 |
| Mn+2 | 2.0 | 1.27454E-06 | -5.8946 | 7.00000E-02 |
| Ba+2 | 2.0 | 1.45667E-06 | -5.8366 | 2.00000E-01 |
| Sr+2 | 2.0 | 3.08240E-06 | -5.5111 | 2.70000E-01 |
| H4SiO4 | 0.0 | 6.70418E-04 | -3.1737 | 4.02700E+01 |
| Cl- | -1.0 | 6.20723E-05 | -4.2071 | 2.20000E+00 |
| HCO3- | -1.0 | 3.00004E-03 | -2.5229 | 1.83000E+02 |
| SO4-2 | -2.0 | 2.08261E-05 | -4.6814 | 2.00000E+00 |
| NO3- | -1.0 | 3.57078E-06 | -5.4472 | 5.00000E-02 |
| HPO4-2 | -2.0 | 6.45898E-07 | -6.1898 | 2.00000E-02 |
| F- | -1.0 | 2.00076E-05 | -4.6988 | 3.80000E-01 |
| Br- | -1.0 | 6.25936E-07 | -6.2035 | 5.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | |
|---|---|---|---|---|
| EPMCAT | 3.48 | 3.43 | 7.420 | ACTIVITY H2O = 0.9999 |
| EPMAN | 3.13 | 3.09 | | PCO2= 6.432565E-03 |
| | | | | LOG PCO2 = -2.1916 |
| | | | TEMPERATURE | PO2 = 6.282532E-56 |
| EH = 0.0000 | PE = 0.000 | | 19.90 DEG C | PCH4 = 1.361515E-38 |
| PE CALC S = | 0.000 | | | CO2 TOT = 3.242307E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.367219E-03 | TDS = 295.7MG/L |
| TOT ALK = | 3.000E+00 MEQ | | | CARB ALK = 2.997E+00 MEQ |
| ELECT = | 3.480E-01 MEQ | | | CHARGE IMBALANCE = 5.3% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 4.0552E-08 | 3.8019E-08 | -7.420 | 9.3753E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.4681E-04 | 4.1470E-04 | -3.382 | 7.5840E-01 |
| 5 | Mg+2 | 2. | 5.3071E-04 | 4.0371E-04 | -3.394 | 7.6071E-01 |
| 6 | Na+ | 1. | 1.0700E-03 | 9.9747E-04 | -3.001 | 9.3222E-01 |
| 7 | K+ | 1. | 1.6780E-04 | 1.5622E-04 | -3.806 | 9.3099E-01 |
| 8 | Fe+2 | 2. | 9.7409E-07 | 7.4147E-07 | -6.130 | 7.6119E-01 |
| 9 | Mn+2 | 2. | 9.1960E-07 | 6.9999E-07 | -6.155 | 7.6119E-01 |
| 11 | Ba+2 | 2. | 1.4216E-06 | 1.0764E-06 | -5.968 | 7.5714E-01 |
| 12 | Sr+2 | 2. | 2.9868E-06 | 2.2674E-06 | -5.644 | 7.5913E-01 |
| 13 | H4SiO4 | 0. | 6.6810E-04 | 6.6877E-04 | -3.175 | 1.0010E+00 |
| 14 | Cl- | -1. | 6.2072E-05 | 5.7789E-05 | -4.238 | 9.3099E-01 |
| 15 | CO3-2 | -2. | 4.0135E-06 | 3.0454E-06 | -5.516 | 7.5877E-01 |
| 16 | SO4-2 | -2. | 1.8465E-05 | 1.3975E-05 | -4.855 | 7.5683E-01 |
| 17 | NO3- | -1. | 1.8386E-20 | 1.7102E-20 | -19.767 | 9.3018E-01 |
| 19 | PO4-3 | -3. | 5.1655E-12 | 2.7280E-12 | -11.564 | 5.2811E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | F- | -1. | 1.9462E-05 | 1.8116E-05 | -4.742 | 9.3085E-01 |
| 22 | Br- | -1. | 6.2594E-07 | 5.8223E-07 | -6.235 | 9.3018E-01 |
| 31 | OH- | -1. | 1.9029E-07 | 1.7714E-07 | -6.752 | 9.3085E-01 |
| 33 | H2 AQ | 0. | 1.0765E-18 | 1.0776E-18 | -17.968 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.9524E-03 | 2.7555E-03 | -2.560 | 9.3331E-01 |
| 35 | H2CO3 | 0. | 2.5255E-04 | 2.5281E-04 | -3.597 | 1.0010E+00 |
| 40 | HSO4- | -1. | 4.9724E-11 | 4.6326E-11 | -10.334 | 9.3167E-01 |
| 48 | NO2- | -1. | 3.5708E-06 | 3.3214E-06 | -5.479 | 9.3018E-01 |
| 65 | HPO4-2 | -2. | 3.3892E-07 | 2.5519E-07 | -6.593 | 7.5295E-01 |
| 66 | H2PO4- | -1. | 1.7258E-07 | 1.6088E-07 | -6.794 | 9.3217E-01 |
| 69 | HF AQ | 0. | 9.4230E-10 | 9.4325E-10 | -9.025 | 1.0010E+00 |
| 70 | HF2- | -1. | 6.7425E-14 | 6.2817E-14 | -13.202 | 9.3167E-01 |
| 75 | CaOH+ | 1. | 1.9428E-09 | 1.8100E-09 | -8.742 | 9.3167E-01 |
| 76 | CaCO3 | 0. | 1.9319E-06 | 1.9338E-06 | -5.714 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.4322E-05 | 1.3367E-05 | -4.874 | 9.3331E-01 |
| 78 | CaSO4 | 0. | 1.1005E-06 | 1.1017E-06 | -5.958 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 2.7659E-13 | 2.5769E-13 | -12.589 | 9.3167E-01 |
| 80 | CaPO4- | -1. | 3.1898E-09 | 2.9718E-09 | -8.527 | 9.3167E-01 |
| 81 | CaHPO4 | 0. | 5.2610E-08 | 5.2663E-08 | -7.278 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 1.6581E-09 | 1.5448E-09 | -8.811 | 9.3167E-01 |
| 83 | CaF+ | 1. | 6.2227E-08 | 5.7975E-08 | -7.237 | 9.3167E-01 |
| 85 | MgOH+ | 1. | 2.6174E-08 | 2.4385E-08 | -7.613 | 9.3167E-01 |
| 86 | MgCO3 | 0. | 1.0837E-06 | 1.0848E-06 | -5.965 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.3695E-05 | 1.2759E-05 | -4.894 | 9.3167E-01 |
| 88 | MgSO4 | 0. | 1.1560E-06 | 1.1572E-06 | -5.937 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 4.1890E-09 | 3.9027E-09 | -8.409 | 9.3167E-01 |
| 90 | MgHPO4 | 0. | 6.9248E-08 | 6.9318E-08 | -7.159 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 2.0556E-09 | 1.9151E-09 | -8.718 | 9.3167E-01 |
| 92 | MgF+ | 1. | 4.7212E-07 | 4.3986E-07 | -6.357 | 9.3167E-01 |
| 93 | NaOH | 0. | 1.7315E-10 | 1.7332E-10 | -9.761 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 4.6732E-08 | 4.3539E-08 | -7.361 | 9.3167E-01 |
| 95 | NaHCO3 | 0. | 1.5365E-06 | 1.5380E-06 | -5.813 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 7.2562E-08 | 6.7604E-08 | -7.170 | 9.3167E-01 |
| 97 | NaHPO4- | -1. | 5.3273E-10 | 4.9633E-10 | -9.304 | 9.3167E-01 |
| 98 | NaF aq | 0. | 1.0388E-08 | 1.0398E-08 | -7.983 | 1.0010E+00 |
| 99 | KOH | 0. | 1.4232E-11 | 1.4246E-11 | -10.846 | 1.0010E+00 |
| 100 | KSO4- | -1. | 1.5040E-08 | 1.4013E-08 | -7.853 | 9.3167E-01 |
| 101 | KHPO4- | -1. | 8.3435E-11 | 7.7734E-11 | -10.109 | 9.3167E-01 |
| 102 | FeOH+ | 1. | 4.4915E-09 | 4.1846E-09 | -8.378 | 9.3167E-01 |
| 105 | FeCl+ | 1. | 6.3485E-11 | 5.9147E-11 | -10.228 | 9.3167E-01 |
| 106 | FeCO3 | 0. | 5.4112E-08 | 5.4166E-08 | -7.266 | 1.0010E+00 |
| 107 | FeHCO3+ | 1. | 2.1822E-07 | 2.0331E-07 | -6.692 | 9.3167E-01 |
| 108 | FeSO4 | 0. | 1.6742E-09 | 1.6759E-09 | -8.776 | 1.0010E+00 |
| 109 | FeHSO4+ | 1. | 4.9453E-16 | 4.6073E-16 | -15.337 | 9.3167E-01 |
| 112 | FeHPO4 | 0. | 7.5253E-10 | 7.5329E-10 | -9.123 | 1.0010E+00 |
| 113 | FeH2PO4+ | 1. | 6.4170E-11 | 5.9785E-11 | -10.223 | 9.3167E-01 |
| 114 | FeF+ | 1. | 1.4418E-10 | 1.3432E-10 | -9.872 | 9.3167E-01 |
| 115 | Fe+3 | 3. | 9.5224E-20 | 5.3285E-20 | -19.273 | 5.5958E-01 |
| 117 | FeOH+2 | 2. | 8.8481E-15 | 6.6664E-15 | -14.176 | 7.5343E-01 |
| 118 | FeOH2+ | 1. | 5.1181E-11 | 4.7684E-11 | -10.322 | 9.3167E-01 |
| 119 | FeOH3 | 0. | 1.2873E-10 | 1.2885E-10 | -9.890 | 1.0010E+00 |
| 120 | FeOH4- | -1. | 2.6929E-12 | 2.5089E-12 | -11.601 | 9.3167E-01 |
| 121 | Fe2OH2+4 | 4. | 4.5998E-27 | 1.4822E-27 | -26.829 | 3.2223E-01 |
| 122 | Fe3OH4+5 | 5. | 1.3986E-34 | 2.3835E-35 | -34.623 | 1.7042E-01 |
| 123 | FeCl+2 | 2. | 1.0471E-22 | 7.8888E-23 | -22.103 | 7.5343E-01 |
| 124 | FeCl2+ | 1. | 2.5765E-26 | 2.4005E-26 | -25.620 | 9.3167E-01 |
| 125 | FeCl3 | 0. | 1.3858E-31 | 1.3872E-31 | -30.858 | 1.0010E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 126 | FeSO4+ | 1. | 7.8131E-21 | 7.2792E-21 | -20.138 | 9.3167E-01 |
| 127 | FeHSO4+2 | 2. | 1.4669E-27 | 1.1052E-27 | -26.957 | 7.5343E-01 |
| 128 | FeSO42- | -1. | 2.3409E-24 | 2.1809E-24 | -23.661 | 9.3167E-01 |
| 129 | FeHPO4+ | 1. | 3.3169E-21 | 3.0903E-21 | -20.510 | 9.3167E-01 |
| 130 | FeH2P+2 | 2. | 3.0338E-21 | 2.2857E-21 | -20.641 | 7.5343E-01 |
| 131 | FeF+2 | 2. | 1.8758E-18 | 1.4133E-18 | -17.850 | 7.5343E-01 |
| 132 | FeF2+ | 1. | 1.0286E-18 | 9.5829E-19 | -18.019 | 9.3167E-01 |
| 133 | FeF3 | 0. | 2.7007E-20 | 2.7034E-20 | -19.568 | 1.0010E+00 |
| 134 | MnOH+ | 1. | 3.3273E-10 | 3.0999E-10 | -9.509 | 9.3167E-01 |
| 136 | MnCl+ | 1. | 1.7688E-10 | 1.6479E-10 | -9.783 | 9.3167E-01 |
| 137 | MnCl2 | 0. | 4.1528E-15 | 4.1570E-15 | -14.381 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 7.1016E-20 | 6.6164E-20 | -19.179 | 9.3167E-01 |
| 139 | MnCO3 | 0. | 1.6916E-07 | 1.6933E-07 | -6.771 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 1.8361E-07 | 1.7106E-07 | -6.767 | 9.3167E-01 |
| 141 | MnSO4 | 0. | 1.5741E-09 | 1.5756E-09 | -8.803 | 1.0010E+00 |
| 143 | MnF+ | 1. | 9.4165E-11 | 8.7731E-11 | -10.057 | 9.3167E-01 |
| 144 | Mn+3 | 3. | 1.9170E-32 | 1.0138E-32 | -31.994 | 5.2887E-01 |
| 164 | H3SiO4- | -1. | 2.3174E-06 | 2.1591E-06 | -5.666 | 9.3167E-01 |
| 165 | H2SiO4-2 | -2. | 3.6409E-12 | 2.7431E-12 | -11.562 | 7.5343E-01 |
| 166 | SiF6-2 | -2. | 1.6004E-31 | 1.2058E-31 | -30.919 | 7.5343E-01 |
| 170 | BaOH+ | 1. | 1.0296E-12 | 9.5921E-13 | -12.018 | 9.3167E-01 |
| 171 | BaCO3 | 0. | 1.5270E-09 | 1.5286E-09 | -8.816 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 2.5990E-08 | 2.4214E-08 | -7.616 | 9.3167E-01 |
| 173 | BaSO4 | 0. | 7.5315E-09 | 7.5391E-09 | -8.123 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 3.2785E-12 | 3.0583E-12 | -11.515 | 9.3281E-01 |
| 177 | SrHCO3+ | 1. | 8.5994E-08 | 8.0260E-08 | -7.096 | 9.3331E-01 |
| 178 | SrCO3 | 0. | 3.7878E-09 | 3.7916E-09 | -8.421 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 5.8064E-09 | 5.8123E-09 | -8.236 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.263E-09 | 3.525E-09 | -8.899 | -8.453 | 3.582E-01 | -0.446 |
| 2 | Aragonit | 1.263E-09 | 4.951E-09 | -8.899 | -8.305 | 2.551E-01 | -0.593 |
| 3 | Dolomite | 1.553E-18 | 1.072E-17 | -17.809 | -16.970 | 1.448E-01 | -0.839 |
| 4 | Siderite | 2.258E-12 | 1.386E-11 | -11.646 | -10.858 | 1.630E-01 | -0.788 |
| 5 | Rhodochr | 2.132E-12 | 7.731E-12 | -11.671 | -11.112 | 2.757E-01 | -0.560 |
| 6 | Strontit | 6.905E-12 | 5.381E-10 | -11.161 | -9.269 | 1.283E-02 | -1.892 |
| 7 | Witherit | 3.278E-12 | 2.659E-09 | -11.484 | -8.575 | 1.233E-03 | -2.909 |
| 8 | Gypsum | 5.794E-09 | 2.623E-05 | -8.237 | -4.581 | 2.209E-04 | -3.656 |
| 9 | Anhydrit | 5.796E-09 | 4.533E-05 | -8.237 | -4.344 | 1.278E-04 | -3.893 |
| 10 | Celestit | 3.169E-11 | 2.385E-07 | -10.499 | -6.622 | 1.328E-04 | -3.877 |
| 11 | Barite | 1.504E-11 | 8.819E-11 | -10.823 | -10.055 | 1.706E-01 | -0.768 |
| 12 | Hydroxap | 9.755E-08 | 1.097E-03 | -7.011 | -2.960 | 8.892E-05 | -4.051 |
| 13 | Fluorite | 1.361E-13 | 2.182E-11 | -12.866 | -10.661 | 6.238E-03 | -2.205 |
| 14 | SiO2 (a) | 6.689E-04 | 1.760E-03 | -3.175 | -2.754 | 3.800E-01 | -0.420 |
| 15 | Chalcedy | 6.689E-04 | 2.446E-04 | -3.175 | -3.612 | 2.735E+00 | 0.437 |
| 16 | Quartz | 6.689E-04 | 8.774E-05 | -3.175 | -4.057 | 7.624E+00 | 0.882 |
| 26 | Talc | 4.360E+21 | 9.779E+21 | 21.640 | 21.990 | 4.459E-01 | -0.351 |
| 28 | Chrysotl | 9.744E+27 | 6.979E+32 | 27.989 | 32.844 | 1.396E-05 | -4.855 |
| 29 | Sepiol c | 2.333E+13 | 7.879E+15 | 13.368 | 15.896 | 2.961E-03 | -2.528 |
| 30 | Sepiol d | 2.333E+13 | 4.571E+18 | 13.368 | 18.660 | 5.105E-06 | -5.292 |
| 31 | Hematite | 9.399E+05 | 2.429E-04 | 5.973 | -3.615 | 3.869E+09 | 9.588 |
| 32 | Goethite | 9.694E+02 | 6.536E-02 | 2.987 | -1.185 | 1.483E+04 | 4.171 |
| 33 | Fe(OH)3a | 9.693E+02 | 7.780E+04 | 2.986 | 4.891 | 1.246E-02 | -1.905 |
| 37 | Vivianit | 3.031E-42 | 1.000E-36 | -41.518 | -36.000 | 3.031E-06 | -5.518 |
| 38 | Pyrolusi | 3.350E+23 | 1.624E+42 | 23.525 | 42.211 | 2.063E-19 | -18.686 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 39 Hausmani | 7.854E+40 | 2.060E+62 | 40.895 | 62.314 | 3.813E-22 | -21.419 |
| 40 Manganit | 1.273E+16 | 2.188E+25 | 16.105 | 25.340 | 5.821E-10 | -9.235 |
| 41 Pyrochro | 4.842E+08 | 1.585E+15 | 8.685 | 15.200 | 3.055E-07 | -6.515 |
| 42 PCO2 | 2.528E-04 | 3.930E-02 | -3.597 | -1.406 | 6.433E-03 | -2.192 |
| 44 H2 gas | 1.078E-18 | 7.455E-04 | -17.968 | -3.128 | 1.445E-15 | -14.840 |
| 49 Melanter | 1.035E-11 | 5.334E-03 | -10.985 | -2.273 | 1.941E-09 | -8.712 |
| 51 K-Jarosi | 1.528E-27 | 1.545E-09 | -26.816 | -8.811 | 9.885E-19 | -18.005 |

**4. UI4**

INITIAL SOLUTION

TEMPERATURE = 20.00 DEGREES C PH = 7.640
ANALYTICAL EPMCAT = 3.647 ANALYTICAL EPMAN = 3.371

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.73533E-04 | -3.2414 | 2.29800E+01 |
| Mg+2 | 2.0 | 5.56690E-04 | -3.2544 | 1.35300E+01 |
| Na+ | 1.0 | 1.19873E-03 | -2.9213 | 2.75500E+01 |
| K+ | 1.0 | 1.63214E-04 | -3.7872 | 6.38000E+00 |
| Fe+2 | 2.0 | 6.08997E-06 | -5.2154 | 3.40000E-01 |
| Mn+2 | 2.0 | 1.27456E-06 | -5.8946 | 7.00000E-02 |
| Ba+2 | 2.0 | 1.31103E-06 | -5.8824 | 1.80000E-01 |
| Sr+2 | 2.0 | 3.08246E-06 | -5.5111 | 2.70000E-01 |
| H4SiO4 | 0.0 | 6.72761E-04 | -3.1721 | 4.04100E+01 |
| Cl- | -1.0 | 6.43307E-05 | -4.1916 | 2.28000E+00 |
| HCO3- | -1.0 | 3.24010E-03 | -2.4894 | 1.97640E+02 |
| SO4-2 | -2.0 | 2.08265E-05 | -4.6814 | 2.00000E+00 |
| NO3- | -1.0 | 7.14168E-07 | -6.1462 | 1.00000E-02 |
| HPO4-2 | -2.0 | 2.90659E-06 | -5.5366 | 9.00000E-02 |
| F- | -1.0 | 1.57958E-05 | -4.8015 | 3.00000E-01 |
| Br- | -1.0 | 6.25948E-07 | -6.2035 | 5.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 3.65 | 3.59 | PH 7.640 | ACTIVITY H2O = 0.9999 |
| EPMAN | 3.37 | 3.31 | | PCO2= 4.165110E-03 |
| | | | TEMPERATURE | LOG PCO2 = -2.3804 |
| EH = 0.0000 | PE = 0.000 | | 20.00 DEG C | PO2 = 5.166962E-55 |
| PE CALC S = | 0.000 | | | PCH4 = 1.479301E-40 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | CO2 TOT = 3.383001E-03 |
| | | | | DENSITY = 1.0000 |

PE SATO DOX= 0.000 4.581503E-03 TDS = 314.1MG/L
TOT ALK = 3.240E+00 MEQ CARB ALK = 3.233E+00 MEQ
ELECT = 2.798E-01 MEQ CHARGE IMBALANCE = 4.1%

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.4467E-08 | 2.2909E-08 | -7.640 | 9.3630E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.5311E-04 | 4.1695E-04 | -3.380 | 7.5383E-01 |
| 5 | Mg+2 | 2. | 5.3793E-04 | 4.0680E-04 | -3.391 | 7.5624E-01 |
| 6 | Na+ | 1. | 1.1967E-03 | 1.1139E-03 | -2.953 | 9.3077E-01 |
| 7 | K+ | 1. | 1.6320E-04 | 1.5169E-04 | -3.819 | 9.2949E-01 |
| 8 | Fe+2 | 2. | 4.5033E-06 | 3.4078E-06 | -5.468 | 7.5673E-01 |
| 9 | Mn+2 | 2. | 8.2637E-07 | 6.2534E-07 | -6.204 | 7.5673E-01 |
| 11 | Ba+2 | 2. | 1.2769E-06 | 9.6089E-07 | -6.017 | 7.5252E-01 |
| 12 | Sr+2 | 2. | 2.9781E-06 | 2.2472E-06 | -5.648 | 7.5459E-01 |
| 13 | H4SiO4 | 0. | 6.6889E-04 | 6.6960E-04 | -3.174 | 1.0011E+00 |
| 14 | Cl- | -1. | 6.4330E-05 | 5.9794E-05 | -4.223 | 9.2949E-01 |
| 15 | CO3-2 | -2. | 7.2073E-06 | 5.4359E-06 | -5.265 | 7.5422E-01 |
| 16 | SO4-2 | -2. | 1.8450E-05 | 1.3878E-05 | -4.858 | 7.5221E-01 |
| 17 | NO3- | -1. | 1.0391E-20 | 9.6493E-21 | -20.016 | 9.2864E-01 |
| 19 | PO4-3 | -3. | 4.3145E-11 | 2.2461E-11 | -10.649 | 5.2060E-01 |
| 20 | F- | -1. | 1.5360E-05 | 1.4275E-05 | -4.845 | 9.2934E-01 |
| 22 | Br- | -1. | 6.2595E-07 | 5.8128E-07 | -6.236 | 9.2864E-01 |
| 31 | OH- | -1. | 3.1885E-07 | 2.9632E-07 | -6.528 | 9.2934E-01 |
| 33 | H2 AQ | 0. | 3.9042E-19 | 3.9083E-19 | -18.408 | 1.0011E+00 |
| 34 | HCO3- | -1. | 3.1730E-03 | 2.9569E-03 | -2.529 | 9.3191E-01 |
| 35 | H2CO3 | 0. | 1.6304E-04 | 1.6321E-04 | -3.787 | 1.0011E+00 |
| 40 | HSO4- | -1. | 2.9863E-11 | 2.7779E-11 | -10.556 | 9.3020E-01 |
| 48 | NO2- | -1. | 7.1417E-07 | 6.6320E-07 | -6.178 | 9.2864E-01 |
| 65 | HPO4-2 | -2. | 1.6887E-06 | 1.2635E-06 | -5.898 | 7.4817E-01 |
| 66 | H2PO4- | -1. | 5.1538E-07 | 4.7967E-07 | -6.319 | 9.3072E-01 |
| 69 | HF AQ | 0. | 4.4817E-10 | 4.4864E-10 | -9.348 | 1.0011E+00 |
| 70 | HF2- | -1. | 2.5332E-14 | 2.3564E-14 | -13.628 | 9.3020E-01 |
| 75 | CaOH+ | 1. | 3.2469E-09 | 3.0202E-09 | -8.520 | 9.3020E-01 |
| 76 | CaCO3 | 0. | 3.4726E-06 | 3.4762E-06 | -5.459 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.5505E-05 | 1.4449E-05 | -4.840 | 9.3191E-01 |
| 78 | CaSO4 | 0. | 1.0999E-06 | 1.1010E-06 | -5.958 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 1.6667E-13 | 1.5503E-13 | -12.810 | 9.3020E-01 |
| 80 | CaPO4- | -1. | 2.6497E-08 | 2.4647E-08 | -7.608 | 9.3020E-01 |
| 81 | CaHPO4 | 0. | 2.6238E-07 | 2.6266E-07 | -6.581 | 1.0011E+00 |
| 82 | CaH2PO4+ | 1. | 4.9883E-09 | 4.6401E-09 | -8.333 | 9.3020E-01 |
| 83 | CaF+ | 1. | 4.9496E-08 | 4.6041E-08 | -7.337 | 9.3020E-01 |
| 85 | MgOH+ | 1. | 4.4241E-08 | 4.1153E-08 | -7.386 | 9.3020E-01 |
| 86 | MgCO3 | 0. | 1.9521E-06 | 1.9542E-06 | -5.709 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 1.4837E-05 | 1.3801E-05 | -4.860 | 9.3020E-01 |
| 88 | MgSO4 | 0. | 1.1598E-06 | 1.1610E-06 | -5.935 | 1.0011E+00 |
| 89 | MgPO4- | -1. | 3.4873E-08 | 3.2439E-08 | -7.489 | 9.3020E-01 |
| 90 | MgHPO4 | 0. | 3.4613E-07 | 3.4649E-07 | -6.460 | 1.0011E+00 |
| 91 | MgH2PO4+ | 1. | 6.1980E-09 | 5.7653E-09 | -8.239 | 9.3020E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 92 | MgF+ | 1. | 3.7616E-07 | 3.4990E-07 | -6.456 | 9.3020E-01 |
| 93 | NaOH | 0. | 3.2087E-10 | 3.2121E-10 | -9.493 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 9.3785E-08 | 8.7238E-08 | -7.059 | 9.3020E-01 |
| 95 | NaHCO3 | 0. | 1.8415E-06 | 1.8434E-06 | -5.734 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 8.0648E-08 | 7.5018E-08 | -7.125 | 9.3020E-01 |
| 97 | NaHPO4- | -1. | 2.9500E-09 | 2.7441E-09 | -8.562 | 9.3020E-01 |
| 98 | NaF aq | 0. | 9.1399E-09 | 9.1495E-09 | -8.039 | 1.0011E+00 |
| 99 | KOH | 0. | 2.2933E-11 | 2.2957E-11 | -10.639 | 1.0011E+00 |
| 100 | KSO4- | -1. | 1.4552E-08 | 1.3536E-08 | -7.868 | 9.3020E-01 |
| 101 | KHPO4- | -1. | 4.0175E-10 | 3.7371E-10 | -9.427 | 9.3020E-01 |
| 102 | FeOH+ | 1. | 3.4579E-08 | 3.2166E-08 | -7.493 | 9.3020E-01 |
| 105 | FeCl+ | 1. | 3.0238E-10 | 2.8128E-10 | -9.551 | 9.3020E-01 |
| 106 | FeCO3 | 0. | 4.4390E-07 | 4.4437E-07 | -6.352 | 1.0011E+00 |
| 107 | FeHCO3+ | 1. | 1.0782E-06 | 1.0029E-06 | -5.999 | 9.3020E-01 |
| 108 | FeSO4 | 0. | 7.6554E-09 | 7.6635E-09 | -8.116 | 1.0011E+00 |
| 109 | FeHSO4+ | 1. | 1.3622E-15 | 1.2671E-15 | -14.897 | 9.3020E-01 |
| 112 | FeHPO4 | 0. | 1.7123E-08 | 1.7141E-08 | -7.766 | 1.0011E+00 |
| 113 | FeH2PO4+ | 1. | 8.8073E-10 | 8.1925E-10 | -9.087 | 9.3020E-01 |
| 114 | FeF+ | 1. | 5.2295E-10 | 4.8645E-10 | -9.313 | 9.3020E-01 |
| 115 | Fe+3 | 3. | 4.4537E-19 | 2.4629E-19 | -18.609 | 5.5300E-01 |
| 117 | FeOH+2 | 2. | 6.8719E-14 | 5.1449E-14 | -13.289 | 7.4869E-01 |
| 118 | FeOH2+ | 1. | 6.5915E-10 | 6.1314E-10 | -9.212 | 9.3020E-01 |
| 119 | FeOH3 | 0. | 2.7592E-09 | 2.7621E-09 | -8.559 | 1.0011E+00 |
| 120 | FeOH4- | -1. | 9.6351E-11 | 8.9625E-11 | -10.048 | 9.3020E-01 |
| 121 | Fe2OH2+4 | 4. | 2.7978E-25 | 8.7906E-26 | -25.056 | 3.1420E-01 |
| 122 | Fe3OH4+5 | 5. | 1.0990E-31 | 1.8004E-32 | -31.745 | 1.6382E-01 |
| 123 | FeCl+2 | 2. | 5.0559E-22 | 3.7853E-22 | -21.422 | 7.4869E-01 |
| 124 | FeCl2+ | 1. | 1.2770E-25 | 1.1879E-25 | -24.925 | 9.3020E-01 |
| 125 | FeCl3 | 0. | 7.0953E-31 | 7.1028E-31 | -30.149 | 1.0011E+00 |
| 126 | FeSO4+ | 1. | 3.6002E-20 | 3.3489E-20 | -19.475 | 9.3020E-01 |
| 127 | FeHSO4+2 | 2. | 4.0598E-27 | 3.0395E-27 | -26.517 | 7.4869E-01 |
| 128 | FeSO42- | -1. | 1.0716E-23 | 9.9681E-24 | -23.001 | 9.3020E-01 |
| 129 | FeHPO4+ | 1. | 7.6283E-20 | 7.0958E-20 | -19.149 | 9.3020E-01 |
| 130 | FeH2P+2 | 2. | 4.2082E-20 | 3.1506E-20 | -19.502 | 7.4869E-01 |
| 131 | FeF+2 | 2. | 6.8859E-18 | 5.1554E-18 | -17.288 | 7.4869E-01 |
| 132 | FeF2+ | 1. | 2.9648E-18 | 2.7578E-18 | -17.559 | 9.3020E-01 |
| 133 | FeF3 | 0. | 6.1260E-20 | 6.1324E-20 | -19.212 | 1.0011E+00 |
| 134 | MnOH+ | 1. | 4.9826E-10 | 4.6348E-10 | -9.334 | 9.3020E-01 |
| 136 | MnCl+ | 1. | 1.6376E-10 | 1.5233E-10 | -9.817 | 9.3020E-01 |
| 137 | MnCl2 | 0. | 3.9717E-15 | 3.9759E-15 | -14.401 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 7.0392E-20 | 6.5478E-20 | -19.184 | 9.3020E-01 |
| 139 | MnCO3 | 0. | 2.6973E-07 | 2.7001E-07 | -6.569 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 1.7633E-07 | 1.6402E-07 | -6.785 | 9.3020E-01 |
| 141 | MnSO4 | 0. | 1.3991E-09 | 1.4006E-09 | -8.854 | 1.0011E+00 |
| 143 | MnF+ | 1. | 6.6390E-11 | 6.1756E-11 | -10.209 | 9.3020E-01 |
| 144 | Mn+3 | 3. | 1.7635E-32 | 9.1951E-33 | -32.036 | 5.2141E-01 |
| 164 | H3SiO4- | -1. | 3.8712E-06 | 3.6010E-06 | -5.444 | 9.3020E-01 |
| 165 | H2SiO4-2 | -2. | 1.0212E-11 | 7.6453E-12 | -11.117 | 7.4869E-01 |
| 166 | SiF6-2 | -2. | 5.0395E-33 | 3.7730E-33 | -32.423 | 7.4869E-01 |
| 170 | BaOH+ | 1. | 1.5277E-12 | 1.4211E-12 | -11.847 | 9.3020E-01 |
| 171 | BaCO3 | 0. | 2.4381E-09 | 2.4407E-09 | -8.612 | 1.0011E+00 |
| 172 | BaHCO3+ | 1. | 2.5015E-08 | 2.3269E-08 | -7.633 | 9.3020E-01 |
| 173 | BaSO4 | 0. | 6.6766E-09 | 6.6836E-09 | -8.175 | 1.0011E+00 |
| 176 | SrOH+ | 1. | 5.4010E-12 | 5.0304E-12 | -11.298 | 9.3139E-01 |
| 177 | SrHCO3+ | 1. | 9.1913E-08 | 8.5655E-08 | -7.067 | 9.3191E-01 |
| 178 | SrCO3 | 0. | 6.7206E-09 | 6.7277E-09 | -8.172 | 1.0011E+00 |
| 179 | SrSO4 | 0. | 5.7217E-09 | 5.7277E-09 | -8.242 | 1.0011E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 2.267E-09 | 3.521E-09 | -8.645 | -8.453 | 6.437E-01 | -0.191 |
| 2 | Aragonit | 2.267E-09 | 4.945E-09 | -8.645 | -8.306 | 4.584E-01 | -0.339 |
| 3 | Dolomite | 5.012E-18 | 1.067E-17 | -17.300 | -16.972 | 4.699E-01 | -0.328 |
| 4 | Siderite | 1.852E-11 | 1.384E-11 | -10.732 | -10.859 | 1.339E+00 | 0.127 |
| 5 | Rhodochr | 3.399E-12 | 7.725E-12 | -11.469 | -11.112 | 4.401E-01 | -0.356 |
| 6 | Strontit | 1.222E-11 | 5.382E-10 | -10.913 | -9.269 | 2.270E-02 | -1.644 |
| 7 | Witherit | 5.223E-12 | 2.661E-09 | -11.282 | -8.575 | 1.963E-03 | -2.707 |
| 8 | Gypsum | 5.785E-09 | 2.623E-05 | -8.238 | -4.581 | 2.205E-04 | -3.657 |
| 9 | Anhydrit | 5.787E-09 | 4.531E-05 | -8.238 | -4.344 | 1.277E-04 | -3.894 |
| 10 | Celestit | 3.119E-11 | 2.385E-07 | -10.506 | -6.623 | 1.308E-04 | -3.883 |
| 11 | Barite | 1.334E-11 | 8.855E-11 | -10.875 | -10.053 | 1.506E-01 | -0.822 |
| 12 | Hydroxap | 9.228E-05 | 1.074E-03 | -4.035 | -2.969 | 8.591E-02 | -1.066 |
| 13 | Fluorite | 8.496E-14 | 2.188E-11 | -13.071 | -10.660 | 3.883E-03 | -2.411 |
| 14 | SiO2 (a) | 6.697E-04 | 1.764E-03 | -3.174 | -2.754 | 3.798E-01 | -0.420 |
| 15 | Chalcedy | 6.697E-04 | 2.453E-04 | -3.174 | -3.610 | 2.731E+00 | 0.436 |
| 16 | Quartz | 6.697E-04 | 8.805E-05 | -3.174 | -4.055 | 7.607E+00 | 0.881 |
| 26 | Talc | 9.367E+22 | 9.517E+21 | 22.972 | 21.979 | 9.842E+00 | 0.993 |
| 28 | Chrysotl | 2.088E+29 | 6.776E+32 | 29.320 | 32.831 | 3.081E-04 | -3.511 |
| 29 | Sepiol c | 1.804E+14 | 7.830E+15 | 14.256 | 15.894 | 2.304E-02 | -1.638 |
| 30 | Sepiol d | 1.804E+14 | 4.571E+18 | 14.256 | 18.660 | 3.947E-05 | -4.404 |
| 31 | Hematite | 4.195E+08 | 2.386E-04 | 8.623 | -3.622 | 1.758E+12 | 12.245 |
| 32 | Goethite | 2.048E+04 | 6.591E-02 | 4.311 | -1.181 | 3.107E+05 | 5.492 |
| 33 | Fe(OH)3a | 2.048E+04 | 7.780E+04 | 4.311 | 4.891 | 2.632E-01 | -0.580 |
| 37 | Vivianit | 1.995E-38 | 1.000E-36 | -37.700 | -36.000 | 1.995E-02 | -1.700 |
| 38 | Pyrolusi | 2.270E+24 | 1.563E+42 | 24.356 | 42.194 | 1.452E-18 | -17.838 |
| 39 | Hausmani | 3.222E+42 | 1.942E+62 | 42.508 | 62.288 | 1.659E-20 | -19.780 |
| 40 | Manganit | 5.200E+16 | 2.188E+25 | 16.716 | 25.340 | 2.377E-09 | -8.624 |
| 41 | Pyrochro | 1.191E+09 | 1.585E+15 | 9.076 | 15.200 | 7.517E-07 | -6.124 |
| 42 | PCO2 | 1.632E-04 | 3.919E-02 | -3.787 | -1.407 | 4.165E-03 | -2.380 |
| 44 | H2 gas | 3.908E-19 | 7.447E-04 | -18.408 | -3.128 | 5.248E-16 | -15.280 |
| 49 | Melanter | 4.726E-11 | 5.349E-03 | -10.326 | -2.272 | 8.834E-09 | -8.054 |
| 51 | K-Jarosi | 3.018E-24 | 1.517E-09 | -23.520 | -8.819 | 1.989E-15 | -14.701 |

**5. UI3**

INITIAL SOLUTION

TEMPERATURE = 18.40 DEGREES C PH = 7.550
ANALYTICAL EPMCAT = 3.142 ANALYTICAL EPMAN = 2.722

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.09265E-04 | -3.2152 | 2.44130E+01 |
| Mg+2 | 2.0 | 5.00665E-04 | -3.3005 | 1.21690E+01 |
| Na+ | 1.0 | 7.15851E-04 | -3.1452 | 1.64530E+01 |
| K+ | 1.0 | 1.65508E-04 | -3.7812 | 6.47000E+00 |
| Fe+2 | 2.0 | 1.62808E-05 | -4.7883 | 9.09000E-01 |
| Mn+2 | 2.0 | 1.49298E-06 | -5.8259 | 8.20000E-02 |
| Ba+2 | 2.0 | 2.27961E-06 | -5.6421 | 3.13000E-01 |
| H4SiO4 | 0.0 | 6.03438E-04 | -3.2194 | 3.62480E+01 |
| Cl- | -1.0 | 6.60200E-05 | -4.1803 | 2.34000E+00 |
| HCO3- | -1.0 | 2.59994E-03 | -2.5850 | 1.58600E+02 |
| SO4-2 | -2.0 | 1.36406E-05 | -4.8652 | 1.31000E+00 |
| NO3- | -1.0 | 2.14239E-06 | -5.6691 | 3.00000E-02 |
| H3BO3 | 0.0 | 1.11962E-05 | -4.9509 | 1.21000E-01 |
| HPO4-2 | -2.0 | 3.22937E-06 | -5.4909 | 1.00000E-01 |
| F- | -1.0 | 1.84274E-05 | -4.7345 | 3.50000E-01 |
| Br- | -1.0 | 6.25914E-07 | -6.2035 | 5.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.14 | 3.10 | 7.550 | PCO2= 4.043649E-03 |
| EPMAN | 2.72 | 2.68 | | LOG PCO2 = -2.3932 |
| | | | TEMPERATURE | PO2 = 6.149104E-56 |
| EH = 0.0000 | PE = 0.000 | | 18.40 DEG C | PCH4 = 1.323462E-39 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.751200E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.002010E-03 | TDS = 260.0MG/L |
| TOT ALK = | 2.600E+00 MEQ | | | CARB ALK = 2.594E+00 MEQ |
| ELECT = | 4.237E-01 MEQ | | | CHARGE IMBALANCE = 7.3% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.9988E-08 | 2.8184E-08 | -7.550 | 9.3984E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.9259E-04 | 4.5451E-04 | -3.342 | 7.6698E-01 |
| 5 | Mg+2 | 2. | 4.8717E-04 | 3.7470E-04 | -3.426 | 7.6914E-01 |
| 6 | Na+ | 1. | 7.1489E-04 | 6.6837E-04 | -3.175 | 9.3493E-01 |
| 7 | K+ | 1. | 1.6550E-04 | 1.5454E-04 | -3.811 | 9.3379E-01 |
| 8 | Fe+2 | 2. | 1.2822E-05 | 9.8675E-06 | -5.006 | 7.6959E-01 |
| 9 | Mn+2 | 2. | 1.0778E-06 | 8.2950E-07 | -6.081 | 7.6959E-01 |
| 11 | Ba+2 | 2. | 2.2350E-06 | 1.7116E-06 | -5.767 | 7.6582E-01 |
| 13 | H4SiO4 | 0. | 6.0079E-04 | 6.0134E-04 | -3.221 | 1.0009E+00 |
| 14 | Cl- | -1. | 6.6019E-05 | 6.1648E-05 | -4.210 | 9.3379E-01 |
| 15 | CO3-2 | -2. | 4.4746E-06 | 3.4336E-06 | -5.464 | 7.6734E-01 |
| 16 | SO4-2 | -2. | 1.2104E-05 | 9.2661E-06 | -5.033 | 7.6553E-01 |
| 17 | NO3- | -1. | 1.3637E-20 | 1.2724E-20 | -19.895 | 9.3304E-01 |
| 18 | H3BO3 | 0. | 1.0984E-05 | 1.0994E-05 | -4.959 | 1.0009E+00 |
| 19 | PO4-3 | -3. | 3.5092E-11 | 1.9033E-11 | -10.721 | 5.4236E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 20 | F- | -1. | 1.7964E-05 | 1.6773E-05 | -4.775 | 9.3367E-01 |
| 22 | Br- | -1. | 6.2591E-07 | 5.8400E-07 | -6.234 | 9.3304E-01 |
| 31 | OH- | -1. | 2.2683E-07 | 2.1178E-07 | -6.674 | 9.3367E-01 |
| 33 | H2 AQ | 0. | 6.0088E-19 | 6.0143E-19 | -18.221 | 1.0009E+00 |
| 34 | HCO3- | -1. | 2.5485E-03 | 2.3853E-03 | -2.622 | 9.3594E-01 |
| 35 | H2CO3 | 0. | 1.6599E-04 | 1.6614E-04 | -3.780 | 1.0009E+00 |
| 40 | HSO4- | -1. | 2.3622E-11 | 2.2073E-11 | -10.656 | 9.3441E-01 |
| 48 | NO2- | -1. | 2.1424E-06 | 1.9989E-06 | -5.699 | 9.3304E-01 |
| 57 | H2BO3- | -1. | 2.1238E-07 | 1.9845E-07 | -6.702 | 9.3441E-01 |
| 58 | BFOH3- | -1. | 7.3202E-11 | 6.8401E-11 | -10.165 | 9.3441E-01 |
| 59 | BF2OH2- | -1. | 3.7412E-15 | 3.4959E-15 | -14.456 | 9.3441E-01 |
| 60 | BF3OH- | -1. | 2.1943E-21 | 2.0504E-21 | -20.688 | 9.3441E-01 |
| 61 | BF4- | -1. | 4.2637E-27 | 3.9840E-27 | -26.400 | 9.3441E-01 |
| 65 | HPO4-2 | -2. | 1.7872E-06 | 1.3617E-06 | -5.866 | 7.6192E-01 |
| 66 | H2PO4- | -1. | 6.8666E-07 | 6.4195E-07 | -6.192 | 9.3488E-01 |
| 69 | HF AQ | 0. | 6.2999E-10 | 6.3057E-10 | -9.200 | 1.0009E+00 |
| 70 | HF2- | -1. | 4.1037E-14 | 3.8345E-14 | -13.416 | 9.3441E-01 |
| 75 | CaOH+ | 1. | 2.8639E-09 | 2.6761E-09 | -8.572 | 9.3441E-01 |
| 76 | CaCO3 | 0. | 2.3326E-06 | 2.3347E-06 | -5.632 | 1.0009E+00 |
| 77 | CaHCO3+ | 1. | 1.3159E-05 | 1.2316E-05 | -4.910 | 9.3594E-01 |
| 78 | CaSO4 | 0. | 7.8824E-07 | 7.8896E-07 | -6.103 | 1.0009E+00 |
| 79 | CaHSO4 | 1. | 1.4856E-13 | 1.3882E-13 | -12.858 | 9.3441E-01 |
| 80 | CaPO4- | -1. | 2.3663E-08 | 2.2111E-08 | -7.655 | 9.3441E-01 |
| 81 | CaHPO4 | 0. | 2.9885E-07 | 2.9913E-07 | -6.524 | 1.0009E+00 |
| 82 | CaH2PO4+ | 1. | 7.0159E-09 | 6.5558E-09 | -8.183 | 9.3441E-01 |
| 83 | CaF+ | 1. | 6.0707E-08 | 5.6726E-08 | -7.246 | 9.3441E-01 |
| 85 | MgOH+ | 1. | 2.8469E-08 | 2.6602E-08 | -7.575 | 9.3441E-01 |
| 86 | MgCO3 | 0. | 1.1083E-06 | 1.1093E-06 | -5.955 | 1.0009E+00 |
| 87 | MgHCO3+ | 1. | 1.0918E-05 | 1.0202E-05 | -4.991 | 9.3441E-01 |
| 88 | MgSO4 | 0. | 6.8340E-07 | 6.8403E-07 | -6.165 | 1.0009E+00 |
| 89 | MgPO4- | -1. | 2.6315E-08 | 2.4589E-08 | -7.609 | 9.3441E-01 |
| 90 | MgHPO4 | 0. | 3.3312E-07 | 3.3342E-07 | -6.477 | 1.0009E+00 |
| 91 | MgH2PO4+ | 1. | 7.3659E-09 | 6.8828E-09 | -8.162 | 9.3441E-01 |
| 92 | MgF+ | 1. | 3.9323E-07 | 3.6744E-07 | -6.435 | 9.3441E-01 |
| 93 | NaOH | 0. | 1.5652E-10 | 1.5667E-10 | -9.805 | 1.0009E+00 |
| 94 | NaCO3- | -1. | 3.2537E-08 | 3.0403E-08 | -7.517 | 9.3441E-01 |
| 95 | NaHCO3 | 0. | 8.8808E-07 | 8.8890E-07 | -6.051 | 1.0009E+00 |
| 96 | NaSO4- | -1. | 3.1827E-08 | 2.9739E-08 | -7.527 | 9.3441E-01 |
| 97 | NaHPO4- | -1. | 1.8991E-09 | 1.7746E-09 | -8.751 | 9.3441E-01 |
| 98 | NaF aq | 0. | 6.4450E-09 | 6.4509E-09 | -8.190 | 1.0009E+00 |
| 99 | KOH | 0. | 1.8993E-11 | 1.9011E-11 | -10.721 | 1.0009E+00 |
| 100 | KSO4- | -1. | 9.5718E-09 | 8.9440E-09 | -8.048 | 9.3441E-01 |
| 101 | KHPO4- | -1. | 4.3912E-10 | 4.1031E-10 | -9.387 | 9.3441E-01 |
| 102 | FeOH+ | 1. | 7.1548E-08 | 6.6855E-08 | -7.175 | 9.3441E-01 |
| 105 | FeCl+ | 1. | 8.9865E-10 | 8.3971E-10 | -9.076 | 9.3441E-01 |
| 106 | FeCO3 | 0. | 8.1200E-07 | 8.1274E-07 | -6.090 | 1.0009E+00 |
| 107 | FeHCO3+ | 1. | 2.4975E-06 | 2.3337E-06 | -5.632 | 9.3441E-01 |
| 108 | FeSO4 | 0. | 1.4358E-08 | 1.4372E-08 | -7.842 | 1.0009E+00 |
| 109 | FeHSO4+ | 1. | 3.2253E-15 | 3.0137E-15 | -14.521 | 9.3441E-01 |
| 112 | FeHPO4 | 0. | 5.3442E-08 | 5.3491E-08 | -7.272 | 1.0009E+00 |
| 113 | FeH2PO4+ | 1. | 3.3976E-09 | 3.1748E-09 | -8.498 | 9.3441E-01 |
| 114 | FeF+ | 1. | 1.7712E-09 | 1.6551E-09 | -8.781 | 9.3441E-01 |
| 115 | Fe+3 | 3. | 1.1379E-18 | 6.5100E-19 | -18.186 | 5.7213E-01 |
| 117 | FeOH+2 | 2. | 1.3147E-13 | 1.0022E-13 | -12.999 | 7.6235E-01 |
| 118 | FeOH2+ | 1. | 9.7547E-10 | 9.1149E-10 | -9.040 | 9.3441E-01 |
| 119 | FeOH3 | 0. | 3.1013E-09 | 3.1041E-09 | -8.508 | 1.0009E+00 |
| 120 | FeOH4- | -1. | 8.1950E-11 | 7.6575E-11 | -10.116 | 9.3441E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 121 | Fe2OH2+4 | 4. | 1.0579E-24 | 3.5733E-25 | -24.447 | 3.3776E-01 |
| 122 | Fe3OH4+5 | 5. | 6.9159E-31 | 1.2685E-31 | -30.897 | 1.8342E-01 |
| 123 | FeCl+2 | 2. | 1.2836E-21 | 9.7854E-22 | -21.009 | 7.6235E-01 |
| 124 | FeCl2+ | 1. | 3.5718E-25 | 3.3375E-25 | -24.477 | 9.3441E-01 |
| 125 | FeCl3 | 0. | 2.0556E-30 | 2.0575E-30 | -29.687 | 1.0009E+00 |
| 126 | FeSO4+ | 1. | 6.0962E-20 | 5.6964E-20 | -19.244 | 9.3441E-01 |
| 127 | FeHSO4+2 | 2. | 9.4831E-27 | 7.2294E-27 | -26.141 | 7.6235E-01 |
| 128 | FeSO42- | -1. | 1.2037E-23 | 1.1247E-23 | -22.949 | 9.3441E-01 |
| 129 | FeHPO4+ | 1. | 2.0490E-19 | 1.9146E-19 | -18.718 | 9.3441E-01 |
| 130 | FeH2P+2 | 2. | 1.4575E-19 | 1.1112E-19 | -18.954 | 7.6235E-01 |
| 131 | FeF+2 | 2. | 2.0475E-17 | 1.5609E-17 | -16.807 | 7.6235E-01 |
| 132 | FeF2+ | 1. | 1.0294E-17 | 9.6193E-18 | -17.017 | 9.3441E-01 |
| 133 | FeF3 | 0. | 2.4968E-19 | 2.4991E-19 | -18.602 | 1.0009E+00 |
| 134 | MnOH+ | 1. | 4.6697E-10 | 4.3634E-10 | -9.360 | 9.3441E-01 |
| 136 | MnCl+ | 1. | 2.2294E-10 | 2.0832E-10 | -9.681 | 9.3441E-01 |
| 137 | MnCl2 | 0. | 5.6009E-15 | 5.6060E-15 | -14.251 | 1.0009E+00 |
| 138 | MnCl3- | -1. | 1.0187E-19 | 9.5187E-20 | -19.021 | 9.3441E-01 |
| 139 | MnCO3 | 0. | 2.2603E-07 | 2.2624E-07 | -6.645 | 1.0009E+00 |
| 140 | MnHCO3+ | 1. | 1.8712E-07 | 1.7484E-07 | -6.757 | 9.3441E-01 |
| 141 | MnSO4 | 0. | 1.2006E-09 | 1.2017E-09 | -8.920 | 1.0009E+00 |
| 143 | MnF+ | 1. | 1.0301E-10 | 9.6254E-11 | -10.017 | 9.3441E-01 |
| 144 | Mn+3 | 3. | 1.7614E-32 | 9.5653E-33 | -32.019 | 5.4305E-01 |
| 164 | H3SiO4- | -1. | 2.6492E-06 | 2.4754E-06 | -5.606 | 9.3441E-01 |
| 165 | H2SiO4-2 | -2. | 5.0120E-12 | 3.8209E-12 | -11.418 | 7.6235E-01 |
| 166 | SiF6-2 | -2. | 3.1230E-32 | 2.3808E-32 | -31.623 | 7.6235E-01 |
| 170 | BaOH+ | 1. | 2.2020E-12 | 2.0576E-12 | -11.687 | 9.3441E-01 |
| 171 | BaCO3 | 0. | 2.6568E-09 | 2.6592E-09 | -8.575 | 1.0009E+00 |
| 172 | BaHCO3+ | 1. | 3.4025E-08 | 3.1793E-08 | -7.498 | 9.3441E-01 |
| 173 | BaSO4 | 0. | 7.9414E-09 | 7.9487E-09 | -8.100 | 1.0009E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.561E-09 | 3.585E-09 | -8.807 | -8.446 | 4.353E-01 | -0.361 |
| 2 | Aragonit | 1.561E-09 | 5.048E-09 | -8.807 | -8.297 | 3.092E-01 | -0.510 |
| 3 | Dolomite | 2.008E-18 | 1.166E-17 | -17.697 | -16.933 | 1.722E-01 | -0.764 |
| 4 | Siderite | 3.388E-11 | 1.416E-11 | -10.470 | -10.849 | 2.392E+00 | 0.379 |
| 5 | Rhodochr | 2.848E-12 | 7.829E-12 | -11.545 | -11.106 | 3.638E-01 | -0.439 |
| 7 | Witherit | 5.877E-12 | 2.623E-09 | -11.231 | -8.581 | 2.240E-03 | -2.650 |
| 8 | Gypsum | 4.211E-09 | 2.619E-05 | -8.376 | -4.582 | 1.608E-04 | -3.794 |
| 9 | Anhydrit | 4.212E-09 | 4.569E-05 | -8.376 | -4.340 | 9.217E-05 | -4.035 |
| 11 | Barite | 1.586E-11 | 8.297E-11 | -10.800 | -10.081 | 1.912E-01 | -0.719 |
| 12 | Hydroxap | 7.760E-05 | 1.510E-03 | -4.110 | -2.821 | 5.140E-02 | -1.289 |
| 13 | Fluorite | 1.279E-13 | 2.088E-11 | -12.893 | -10.680 | 6.125E-03 | -2.213 |
| 14 | SiO2 (a) | 6.015E-04 | 1.709E-03 | -3.221 | -2.767 | 3.520E-01 | -0.454 |
| 15 | Chalcedy | 6.015E-04 | 2.346E-04 | -3.221 | -3.630 | 2.564E+00 | 0.409 |
| 16 | Quartz | 6.015E-04 | 8.322E-05 | -3.221 | -4.080 | 7.228E+00 | 0.859 |
| 26 | Talc | 1.373E+22 | 1.473E+22 | 22.138 | 22.168 | 9.323E-01 | -0.030 |
| 28 | Chrysotl | 3.795E+28 | 1.089E+33 | 28.579 | 33.037 | 3.486E-05 | -4.458 |
| 29 | Sepiol c | 4.839E+13 | 8.661E+15 | 13.685 | 15.938 | 5.587E-03 | -2.253 |
| 30 | Sepiol d | 4.839E+13 | 4.571E+18 | 13.685 | 18.660 | 1.059E-05 | -4.975 |
| 31 | Hematite | 8.454E+08 | 3.190E-04 | 8.927 | -3.496 | 2.650E+12 | 12.423 |
| 32 | Goethite | 2.907E+04 | 5.751E-02 | 4.464 | -1.240 | 5.056E+05 | 5.704 |
| 33 | Fe(OH)3a | 2.907E+04 | 7.780E+04 | 4.463 | 4.891 | 3.736E-01 | -0.428 |
| 37 | Vivianit | 3.478E-37 | 1.000E-36 | -36.459 | -36.000 | 3.478E-01 | -0.459 |
| 38 | Pyrolusi | 1.314E+24 | 2.887E+42 | 24.119 | 42.460 | 4.553E-19 | -18.342 |
| 39 | Hausmani | 1.433E+42 | 5.012E+62 | 42.156 | 62.700 | 2.860E-21 | -20.544 |
| 40 | Manganit | 3.705E+16 | 2.188E+25 | 16.569 | 25.340 | 1.693E-09 | -8.771 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 41 Pyrochro | 1.044E+09 | 1.585E+15 | 9.019 | 15.200 | 6.588E-07 | -6.181 |
| 42 PCO2 | 1.661E-04 | 4.109E-02 | -3.780 | -1.386 | 4.044E-03 | -2.393 |
| 44 H2 gas | 6.014E-19 | 7.572E-04 | -18.221 | -3.121 | 7.943E-16 | -15.100 |
| 49 Melanter | 9.137E-11 | 5.098E-03 | -10.039 | -2.293 | 1.792E-08 | -7.747 |
| 51 K-Jarosi | 7.300E-24 | 2.037E-09 | -23.137 | -8.691 | 3.583E-15 | -14.446 |

**6. Palouse2**

INITIAL SOLUTION

TEMPERATURE = 21.70 DEGREES C PH = 7.110
ANALYTICAL EPMCAT = 6.961 ANALYTICAL EPMAN = 3.052

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 1.18176E-03 | -2.9275 | 4.73500E+01 |
| Mg+2 | 2.0 | 1.36149E-03 | -2.8660 | 3.30900E+01 |
| Na+ | 1.0 | 1.52159E-03 | -2.8177 | 3.49700E+01 |
| K+ | 1.0 | 3.33592E-04 | -3.4768 | 1.30400E+01 |
| Fe+2 | 2.0 | 2.14941E-06 | -5.6677 | 1.20000E-01 |
| Mn+2 | 2.0 | 7.28323E-07 | -6.1377 | 4.00000E-02 |
| Ba+2 | 2.0 | 2.54922E-06 | -5.5936 | 3.50000E-01 |
| Sr+2 | 2.0 | 3.08246E-06 | -5.5111 | 2.70000E-01 |
| H4SiO4 | 0.0 | 5.42738E-05 | -4.2654 | 3.26000E+00 |
| Cl- | -1.0 | 7.27954E-05 | -4.1379 | 2.58000E+00 |
| HCO3- | -1.0 | 2.95091E-03 | -2.5300 | 1.80000E+02 |
| SO4-2 | -2.0 | 1.04133E-06 | -5.9824 | 1.00000E-01 |
| NO3- | -1.0 | 1.42834E-06 | -5.8452 | 2.00000E-02 |
| H3BO3 | 0.0 | 1.85072E-06 | -5.7327 | 2.00000E-02 |
| HPO4-2 | -2.0 | 5.16729E-06 | -5.2867 | 1.60000E-01 |
| F- | -1.0 | 1.26366E-05 | -4.8984 | 2.40000E-01 |
| Br- | -1.0 | 3.75569E-07 | -6.4253 | 3.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 6.96 | 6.88 | PH 7.110 | ACTIVITY H2O = 0.9999 |
| EPMAN | 3.05 | 2.97 | | PCO2= 1.287518E-02 |
| | | | TEMPERATURE | LOG PCO2 = -1.8902 |
| EH = 0.0000 | PE = 0.000 | | 21.70 DEG C | PO2 = 1.536520E-56 |
| PE CALC S = | 0.000 | | | PCH4 = 4.395075E-36 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | CO2 TOT = 3.421567E-03 |
| | | | | DENSITY = 1.0000 |

PE SATO DOX= 0.000 7.420054E-03 TDS = 315.6MG/L
TOT ALK = 2.951E+00 MEQ CARB ALK = 2.947E+00 MEQ
ELECT = 3.913E+00 MEQ CHARGE IMBALANCE = 39.7%

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 8.4118E-08 | 7.7625E-08 | -7.110 | 9.2280E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 1.1509E-03 | 8.1075E-04 | -3.091 | 7.0443E-01 |
| 5 | Mg+2 | 2. | 1.3272E-03 | 9.3953E-04 | -3.027 | 7.0790E-01 |
| 6 | Na+ | 1. | 1.5195E-03 | 1.3897E-03 | -2.857 | 9.1461E-01 |
| 7 | K+ | 1. | 3.3359E-04 | 3.0444E-04 | -3.517 | 9.1261E-01 |
| 8 | Fe+2 | 2. | 1.7390E-06 | 1.2320E-06 | -5.909 | 7.0847E-01 |
| 9 | Mn+2 | 2. | 5.7548E-07 | 4.0771E-07 | -6.390 | 7.0847E-01 |
| 11 | Ba+2 | 2. | 2.5037E-06 | 1.7587E-06 | -5.755 | 7.0245E-01 |
| 12 | Sr+2 | 2. | 2.9974E-06 | 2.1146E-06 | -5.675 | 7.0549E-01 |
| 13 | H4SiO4 | 0. | 5.4173E-05 | 5.4266E-05 | -4.265 | 1.0017E+00 |
| 14 | Cl- | -1. | 7.2795E-05 | 6.6434E-05 | -4.178 | 9.1261E-01 |
| 15 | CO3-2 | -2. | 2.1060E-06 | 1.4845E-06 | -5.828 | 7.0488E-01 |
| 16 | SO4-2 | -2. | 8.2685E-07 | 5.8042E-07 | -6.236 | 7.0197E-01 |
| 17 | NO3- | -1. | 2.7911E-21 | 2.5435E-21 | -20.595 | 9.1129E-01 |
| 18 | H3BO3 | 0. | 1.8367E-06 | 1.8398E-06 | -5.735 | 1.0017E+00 |
| 19 | PO4-3 | -3. | 1.5815E-11 | 7.0015E-12 | -11.155 | 4.4271E-01 |
| 20 | F- | -1. | 1.1857E-05 | 1.0818E-05 | -4.966 | 9.1238E-01 |
| 22 | Br- | -1. | 3.7557E-07 | 3.4225E-07 | -6.466 | 9.1129E-01 |
| 31 | OH- | -1. | 1.0963E-07 | 1.0002E-07 | -7.000 | 9.1238E-01 |
| 33 | H2 AQ | 0. | 4.4024E-18 | 4.4099E-18 | -17.356 | 1.0017E+00 |
| 34 | HCO3- | -1. | 2.8745E-03 | 2.6339E-03 | -2.579 | 9.1628E-01 |
| 35 | H2CO3 | 0. | 4.7956E-04 | 4.8038E-04 | -3.318 | 1.0017E+00 |
| 40 | HSO4- | -1. | 4.4651E-12 | 4.0801E-12 | -11.389 | 9.1377E-01 |
| 48 | NO2- | -1. | 1.4283E-06 | 1.3016E-06 | -5.886 | 9.1129E-01 |
| 57 | H2BO3- | -1. | 1.4044E-08 | 1.2833E-08 | -7.892 | 9.1377E-01 |
| 58 | BFOH3- | -1. | 8.3739E-12 | 7.6518E-12 | -11.116 | 9.1377E-01 |
| 59 | BF2OH2- | -1. | 7.5693E-16 | 6.9165E-16 | -15.160 | 9.1377E-01 |
| 60 | BF3OH- | -1. | 7.4096E-22 | 6.7706E-22 | -21.169 | 9.1377E-01 |
| 61 | BF4- | -1. | 2.5464E-27 | 2.3268E-27 | -26.633 | 9.1377E-01 |
| 65 | HPO4-2 | -2. | 1.8511E-06 | 1.2887E-06 | -5.890 | 6.9617E-01 |
| 66 | H2PO4- | -1. | 1.7952E-06 | 1.6416E-06 | -5.785 | 9.1448E-01 |
| 69 | HF AQ | 0. | 1.1853E-09 | 1.1873E-09 | -8.925 | 1.0017E+00 |
| 70 | HF2- | -1. | 5.2501E-14 | 4.7974E-14 | -13.319 | 9.1377E-01 |
| 75 | CaOH+ | 1. | 1.8967E-09 | 1.7331E-09 | -8.761 | 9.1377E-01 |
| 76 | CaCO3 | 0. | 1.8966E-06 | 1.8998E-06 | -5.721 | 1.0017E+00 |
| 77 | CaHCO3+ | 1. | 2.8171E-05 | 2.5812E-05 | -4.588 | 9.1628E-01 |
| 78 | CaSO4 | 0. | 9.0856E-08 | 9.1011E-08 | -7.041 | 1.0017E+00 |
| 79 | CaHSO4 | 1. | 4.6751E-14 | 4.2720E-14 | -13.369 | 9.1377E-01 |
| 80 | CaPO4- | -1. | 1.6858E-08 | 1.5405E-08 | -7.812 | 9.1377E-01 |
| 81 | CaHPO4 | 0. | 5.3731E-07 | 5.3823E-07 | -6.269 | 1.0017E+00 |
| 82 | CaH2PO4+ | 1. | 3.4949E-08 | 3.1935E-08 | -7.496 | 9.1377E-01 |
| 83 | CaF+ | 1. | 7.7342E-08 | 7.0673E-08 | -7.151 | 9.1377E-01 |
| 85 | MgOH+ | 1. | 3.5818E-08 | 3.2729E-08 | -7.485 | 9.1377E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 86 | MgCO3 | 0. | 1.2630E-06 | 1.2651E-06 | -5.898 | 1.0017E+00 |
| 87 | MgHCO3+ | 1. | 3.1261E-05 | 2.8565E-05 | -4.544 | 9.1377E-01 |
| 88 | MgSO4 | 0. | 1.1711E-07 | 1.1731E-07 | -6.931 | 1.0017E+00 |
| 89 | MgPO4- | -1. | 2.6353E-08 | 2.4081E-08 | -7.618 | 9.1377E-01 |
| 90 | MgHPO4 | 0. | 8.4187E-07 | 8.4331E-07 | -6.074 | 1.0017E+00 |
| 91 | MgH2PO4+ | 1. | 5.1577E-08 | 4.7129E-08 | -7.327 | 9.1377E-01 |
| 92 | MgF+ | 1. | 6.9181E-07 | 6.3215E-07 | -6.199 | 9.1377E-01 |
| 93 | NaOH | 0. | 1.1807E-10 | 1.1827E-10 | -9.927 | 1.0017E+00 |
| 94 | NaCO3- | -1. | 3.5529E-08 | 3.2465E-08 | -7.489 | 9.1377E-01 |
| 95 | NaHCO3 | 0. | 2.0511E-06 | 2.0546E-06 | -5.687 | 1.0017E+00 |
| 96 | NaSO4- | -1. | 4.3316E-09 | 3.9581E-09 | -8.403 | 9.1377E-01 |
| 97 | NaHPO4- | -1. | 3.8216E-09 | 3.4921E-09 | -8.457 | 9.1377E-01 |
| 98 | NaF aq | 0. | 8.6369E-09 | 8.6516E-09 | -8.063 | 1.0017E+00 |
| 99 | KOH | 0. | 1.3574E-11 | 1.3597E-11 | -10.867 | 1.0017E+00 |
| 100 | KSO4- | -1. | 1.2819E-09 | 1.1714E-09 | -8.931 | 9.1377E-01 |
| 101 | KHPO4- | -1. | 8.3717E-10 | 7.6498E-10 | -9.116 | 9.1377E-01 |
| 102 | FeOH+ | 1. | 4.2799E-09 | 3.9108E-09 | -8.408 | 9.1377E-01 |
| 105 | FeCl+ | 1. | 1.2364E-10 | 1.1298E-10 | -9.947 | 9.1377E-01 |
| 106 | FeCO3 | 0. | 4.3798E-08 | 4.3873E-08 | -7.358 | 1.0017E+00 |
| 107 | FeHCO3+ | 1. | 3.5447E-07 | 3.2390E-07 | -6.490 | 9.1377E-01 |
| 108 | FeSO4 | 0. | 1.1943E-10 | 1.1964E-10 | -9.922 | 1.0017E+00 |
| 109 | FeHSO4+ | 1. | 7.1043E-17 | 6.4917E-17 | -16.188 | 9.1377E-01 |
| 112 | FeHPO4 | 0. | 6.3100E-09 | 6.3208E-09 | -8.199 | 1.0017E+00 |
| 113 | FeH2PO4+ | 1. | 1.1093E-09 | 1.0137E-09 | -8.994 | 9.1377E-01 |
| 114 | FeF+ | 1. | 1.4586E-10 | 1.3329E-10 | -9.875 | 9.1377E-01 |
| 115 | Fe+3 | 3. | 2.0194E-19 | 9.7995E-20 | -19.009 | 4.8527E-01 |
| 117 | FeOH+2 | 2. | 9.6046E-15 | 6.6961E-15 | -14.174 | 6.9718E-01 |
| 118 | FeOH2+ | 1. | 2.7540E-11 | 2.5165E-11 | -10.599 | 9.1377E-01 |
| 119 | FeOH3 | 0. | 3.6044E-11 | 3.6105E-11 | -10.442 | 1.0017E+00 |
| 120 | FeOH4- | -1. | 4.0591E-13 | 3.7091E-13 | -12.431 | 9.1377E-01 |
| 121 | Fe2OH2+4 | 4. | 5.8636E-27 | 1.3853E-27 | -26.858 | 2.3625E-01 |
| 122 | Fe3OH4+5 | 5. | 9.4441E-35 | 9.9097E-36 | -35.004 | 1.0493E-01 |
| 123 | FeCl+2 | 2. | 2.5369E-22 | 1.7687E-22 | -21.752 | 6.9718E-01 |
| 124 | FeCl2+ | 1. | 6.3847E-26 | 5.8342E-26 | -25.234 | 9.1377E-01 |
| 125 | FeCl3 | 0. | 3.8692E-31 | 3.8758E-31 | -30.412 | 1.0017E+00 |
| 126 | FeSO4+ | 1. | 6.3392E-22 | 5.7925E-22 | -21.237 | 9.1377E-01 |
| 127 | FeHSO4+2 | 2. | 2.2337E-28 | 1.5573E-28 | -27.808 | 6.9718E-01 |
| 128 | FeSO42- | -1. | 7.9454E-27 | 7.2602E-27 | -26.139 | 9.1377E-01 |
| 129 | FeHPO4+ | 1. | 3.3363E-20 | 3.0486E-20 | -19.516 | 9.1377E-01 |
| 130 | FeH2P+2 | 2. | 6.1732E-20 | 4.3038E-20 | -19.366 | 6.9718E-01 |
| 131 | FeF+2 | 2. | 2.2902E-18 | 1.5967E-18 | -17.797 | 6.9718E-01 |
| 132 | FeF2+ | 1. | 7.2330E-19 | 6.6093E-19 | -18.180 | 9.1377E-01 |
| 133 | FeF3 | 0. | 1.1186E-20 | 1.1205E-20 | -19.951 | 1.0017E+00 |
| 134 | MnOH+ | 1. | 1.1254E-10 | 1.0284E-10 | -9.988 | 9.1377E-01 |
| 136 | MnCl+ | 1. | 1.2075E-10 | 1.1034E-10 | -9.957 | 9.1377E-01 |
| 137 | MnCl2 | 0. | 3.1943E-15 | 3.1998E-15 | -14.495 | 1.0017E+00 |
| 138 | MnCl3- | -1. | 6.4073E-20 | 5.8548E-20 | -19.232 | 9.1377E-01 |
| 139 | MnCO3 | 0. | 4.7994E-08 | 4.8076E-08 | -7.318 | 1.0017E+00 |
| 140 | MnHCO3+ | 1. | 1.0455E-07 | 9.5531E-08 | -7.020 | 9.1377E-01 |
| 141 | MnSO4 | 0. | 3.9419E-11 | 3.9486E-11 | -10.404 | 1.0017E+00 |
| 143 | MnF+ | 1. | 3.3395E-11 | 3.0515E-11 | -10.515 | 9.1377E-01 |
| 144 | Mn+3 | 3. | 1.7425E-32 | 7.7390E-33 | -32.111 | 4.4414E-01 |
| 164 | H3SiO4- | -1. | 1.0032E-07 | 9.1673E-08 | -7.038 | 9.1377E-01 |
| 165 | H2SiO4-2 | -2. | 9.2551E-14 | 6.4524E-14 | -13.190 | 6.9718E-01 |
| 166 | SiF6-2 | -2. | 9.3285E-33 | 6.5036E-33 | -32.187 | 6.9718E-01 |
| 170 | BaOH+ | 1. | 8.4003E-13 | 7.6759E-13 | -12.115 | 9.1377E-01 |
| 171 | BaCO3 | 0. | 1.2601E-09 | 1.2623E-09 | -8.899 | 1.0017E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 172 | BaHCO3+ | 1. | 4.3798E-08 | 4.0021E-08 | -7.398 | 9.1377E-01 |
| 173 | BaSO4 | 0. | 5.1073E-10 | 5.1160E-10 | -9.291 | 1.0017E+00 |
| 176 | SrOH+ | 1. | 1.5259E-12 | 1.3969E-12 | -11.855 | 9.1549E-01 |
| 177 | SrHCO3+ | 1. | 8.3049E-08 | 7.6097E-08 | -7.119 | 9.1628E-01 |
| 178 | SrCO3 | 0. | 1.8148E-09 | 1.8179E-09 | -8.740 | 1.0017E+00 |
| 179 | SrSO4 | 0. | 2.2970E-10 | 2.3010E-10 | -9.638 | 1.0017E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.204E-09 | 3.452E-09 | -8.920 | -8.462 | 3.487E-01 | -0.458 |
| 2 | Aragonit | 1.204E-09 | 4.833E-09 | -8.920 | -8.316 | 2.490E-01 | -0.604 |
| 3 | Dolomite | 1.679E-18 | 9.714E-18 | -17.775 | -17.013 | 1.728E-01 | -0.762 |
| 4 | Siderite | 1.829E-12 | 1.350E-11 | -11.738 | -10.870 | 1.355E-01 | -0.868 |
| 5 | Rhodochr | 6.052E-13 | 7.616E-12 | -12.218 | -11.118 | 7.947E-02 | -1.100 |
| 6 | Strontit | 3.139E-12 | 5.386E-10 | -11.503 | -9.269 | 5.829E-03 | -2.234 |
| 7 | Witherit | 2.611E-12 | 2.696E-09 | -11.583 | -8.569 | 9.685E-04 | -3.014 |
| 8 | Gypsum | 4.705E-10 | 2.626E-05 | -9.327 | -4.581 | 1.791E-05 | -4.747 |
| 9 | Anhydrit | 4.706E-10 | 4.480E-05 | -9.327 | -4.349 | 1.050E-05 | -4.979 |
| 10 | Celestit | 1.227E-12 | 2.371E-07 | -11.911 | -6.625 | 5.176E-06 | -5.286 |
| 11 | Barite | 1.021E-12 | 9.467E-11 | -11.991 | -10.024 | 1.078E-02 | -1.967 |
| 12 | Hydroxap | 2.065E-05 | 7.510E-04 | -4.685 | -3.124 | 2.749E-02 | -1.561 |
| 13 | Fluorite | 9.489E-14 | 2.297E-11 | -13.023 | -10.639 | 4.131E-03 | -2.384 |
| 14 | SiO2 (a) | 5.428E-05 | 1.823E-03 | -4.265 | -2.739 | 2.978E-02 | -1.526 |
| 15 | Chalcedy | 5.428E-05 | 2.570E-04 | -4.265 | -3.590 | 2.112E-01 | -0.675 |
| 16 | Quartz | 5.428E-05 | 9.342E-05 | -4.265 | -4.030 | 5.810E-01 | -0.236 |
| 26 | Talc | 3.289E+16 | 6.015E+21 | 16.517 | 21.779 | 5.468E-06 | -5.262 |
| 28 | Chrysotl | 1.116E+25 | 4.116E+32 | 25.048 | 32.615 | 2.712E-08 | -7.567 |
| 29 | Sepiol c | 3.885E+09 | 7.043E+15 | 9.589 | 15.848 | 5.516E-07 | -6.258 |
| 30 | Sepiol d | 3.885E+09 | 4.571E+18 | 9.589 | 18.660 | 8.500E-10 | -9.071 |
| 31 | Hematite | 4.388E+04 | 1.758E-04 | 4.642 | -3.755 | 2.496E+08 | 8.397 |
| 32 | Goethite | 2.095E+02 | 7.607E-02 | 2.321 | -1.119 | 2.753E+03 | 3.440 |
| 33 | Fe(OH)3a | 2.094E+02 | 7.780E+04 | 2.321 | 4.891 | 2.692E-03 | -2.570 |
| 37 | Vivianit | 9.157E-41 | 1.000E-36 | -40.038 | -36.000 | 9.157E-05 | -4.038 |
| 38 | Pyrolusi | 1.123E+22 | 8.207E+41 | 22.050 | 41.914 | 1.368E-20 | -19.864 |
| 39 | Hausmani | 5.138E+37 | 7.172E+61 | 37.711 | 61.856 | 7.164E-25 | -24.145 |
| 40 | Manganit | 8.714E+14 | 2.188E+25 | 14.940 | 25.340 | 3.983E-11 | -10.400 |
| 41 | Pyrochro | 6.764E+07 | 1.585E+15 | 7.830 | 15.200 | 4.268E-08 | -7.370 |
| 42 | PCO2 | 4.804E-04 | 3.731E-02 | -3.318 | -1.428 | 1.288E-02 | -1.890 |
| 44 | H2 gas | 4.410E-18 | 7.319E-04 | -17.356 | -3.136 | 6.026E-15 | -14.220 |
| 49 | Melanter | 7.144E-13 | 5.623E-03 | -12.146 | -2.250 | 1.270E-10 | -9.896 |
| 51 | K-Jarosi | 4.408E-31 | 1.113E-09 | -30.356 | -8.953 | 3.959E-22 | -21.402 |

**7. Palouse1**

INITIAL SOLUTION

TEMPERATURE = 21.70 DEGREES C PH = 7.110
ANALYTICAL EPMCAT = 3.709 ANALYTICAL EPMAN = 3.073

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS

PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.11623E-04 | -3.2910 | 2.05000E+01 |
| Mg+2 | 2.0 | 5.71898E-04 | -3.2427 | 1.39000E+01 |
| Na+ | 1.0 | 1.37274E-03 | -2.8624 | 3.15500E+01 |
| K+ | 1.0 | 1.54000E-04 | -3.8125 | 6.02000E+00 |
| Fe+2 | 2.0 | 4.29869E-06 | -5.3667 | 2.40000E-01 |
| Mn+2 | 2.0 | 3.64151E-07 | -6.4387 | 2.00000E-02 |
| Ba+2 | 2.0 | 1.01966E-06 | -5.9915 | 1.40000E-01 |
| Sr+2 | 2.0 | 1.48410E-06 | -5.8285 | 1.30000E-01 |
| H4SiO4 | 0.0 | 4.98605E-04 | -3.3022 | 2.99500E+01 |
| Cl- | -1.0 | 8.66183E-05 | -4.0624 | 3.07000E+00 |
| HCO3- | -1.0 | 2.95083E-03 | -2.5301 | 1.80000E+02 |
| SO4-2 | -2.0 | 1.56195E-06 | -5.8063 | 1.50000E-01 |
| NO3- | -1.0 | 7.85563E-06 | -5.1048 | 1.10000E-01 |
| H3BO3 | 0.0 | 1.85067E-06 | -5.7327 | 2.00000E-02 |
| HPO4-2 | -2.0 | 5.16714E-06 | -5.2868 | 1.60000E-01 |
| F- | -1.0 | 1.31628E-05 | -4.8807 | 2.50000E-01 |
| Br- | -1.0 | 2.50372E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | |
|---|---|---|---|---|
| EPMCAT | 3.71 | 3.67 | 7.110 | ACTIVITY H2O = 0.9999 |
| EPMAN | 3.07 | 3.03 | | PCO2= 1.326561E-02 |
| | | | | LOG PCO2 = -1.8773 |
| | | | TEMPERATURE | PO2 = 1.536586E-56 |
| EH = 0.0000 | PE = | 0.000 | 21.70 DEG C | PCH4 = 4.528158E-36 |
| PE CALC S = | | 0.000 | | CO2 TOT = 3.437670E-03 |
| PE CALC DOX= | | 0.000 | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | | 0.000 | 4.416538E-03 | TDS = 286.2MG/L |
| TOT ALK = | 2.951E+00 MEQ | | | CARB ALK = 2.947E+00 MEQ |
| ELECT = | 6.411E-01 MEQ | | | CHARGE IMBALANCE = 9.6% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 8.2837E-08 | 7.7625E-08 | -7.110 | 9.3707E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 4.9704E-04 | 3.7613E-04 | -3.425 | 7.5674E-01 |
| 5 | Mg+2 | 2. | 5.5615E-04 | 4.2216E-04 | -3.375 | 7.5908E-01 |
| 6 | Na+ | 1. | 1.3707E-03 | 1.2771E-03 | -2.894 | 9.3170E-01 |
| 7 | K+ | 1. | 1.5400E-04 | 1.4329E-04 | -3.844 | 9.3045E-01 |
| 8 | Fe+2 | 2. | 3.4187E-06 | 2.5967E-06 | -5.586 | 7.5956E-01 |
| 9 | Mn+2 | 2. | 2.8233E-07 | 2.1445E-07 | -6.669 | 7.5956E-01 |
| 11 | Ba+2 | 2. | 9.9969E-07 | 7.5523E-07 | -6.122 | 7.5547E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 12 | Sr+2 | 2. | 1.4396E-06 | 1.0905E-06 | -5.962 | 7.5748E-01 |
| 13 | H4SiO4 | 0. | 4.9770E-04 | 4.9821E-04 | -3.303 | 1.0010E+00 |
| 14 | Cl- | -1. | 8.6618E-05 | 8.0594E-05 | -4.094 | 9.3045E-01 |
| 15 | CO3-2 | -2. | 2.0202E-06 | 1.5296E-06 | -5.815 | 7.5712E-01 |
| 16 | SO4-2 | -2. | 1.3822E-06 | 1.0438E-06 | -5.981 | 7.5516E-01 |
| 17 | NO3- | -1. | 1.5351E-20 | 1.4270E-20 | -19.846 | 9.2962E-01 |
| 18 | H3BO3 | 0. | 1.8369E-06 | 1.8388E-06 | -5.735 | 1.0010E+00 |
| 19 | PO4-3 | -3. | 1.6462E-11 | 8.6490E-12 | -11.063 | 5.2540E-01 |
| 20 | F- | -1. | 1.2778E-05 | 1.1888E-05 | -4.925 | 9.3031E-01 |
| 22 | Br- | -1. | 2.5037E-07 | 2.3275E-07 | -6.633 | 9.2962E-01 |
| 31 | OH- | -1. | 1.0752E-07 | 1.0003E-07 | -7.000 | 9.3031E-01 |
| 33 | H2 AQ | 0. | 4.4054E-18 | 4.4099E-18 | -17.356 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.9093E-03 | 2.7138E-03 | -2.566 | 9.3281E-01 |
| 35 | H2CO3 | 0. | 4.9444E-04 | 4.9494E-04 | -3.305 | 1.0010E+00 |
| 40 | HSO4- | -1. | 7.8800E-12 | 7.3374E-12 | -11.134 | 9.3113E-01 |
| 48 | NO2- | -1. | 7.8556E-06 | 7.3028E-06 | -5.137 | 9.2962E-01 |
| 57 | H2BO3- | -1. | 1.3774E-08 | 1.2826E-08 | -7.892 | 9.3113E-01 |
| 58 | BFOH3- | -1. | 9.0249E-12 | 8.4034E-12 | -11.076 | 9.3113E-01 |
| 59 | BF2OH2- | -1. | 8.9640E-16 | 8.3467E-16 | -15.078 | 9.3113E-01 |
| 60 | BF3OH- | -1. | 9.6422E-22 | 8.9781E-22 | -21.047 | 9.3113E-01 |
| 61 | BF4- | -1. | 3.6411E-27 | 3.3904E-27 | -26.470 | 9.3113E-01 |
| 65 | HPO4-2 | -2. | 2.1191E-06 | 1.5919E-06 | -5.798 | 7.5123E-01 |
| 66 | H2PO4- | -1. | 2.1767E-06 | 2.0279E-06 | -5.693 | 9.3165E-01 |
| 69 | HF AQ | 0. | 1.3033E-09 | 1.3047E-09 | -8.885 | 1.0010E+00 |
| 70 | HF2- | -1. | 6.2212E-14 | 5.7928E-14 | -13.237 | 9.3113E-01 |
| 75 | CaOH+ | 1. | 8.6352E-10 | 8.0405E-10 | -9.095 | 9.3113E-01 |
| 76 | CaCO3 | 0. | 9.0720E-07 | 9.0812E-07 | -6.042 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.3227E-05 | 1.2338E-05 | -4.909 | 9.3281E-01 |
| 78 | CaSO4 | 0. | 7.5852E-08 | 7.5929E-08 | -7.120 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 3.8277E-14 | 3.5641E-14 | -13.448 | 9.3113E-01 |
| 80 | CaPO4- | -1. | 9.4810E-09 | 8.8281E-09 | -8.054 | 9.3113E-01 |
| 81 | CaHPO4 | 0. | 3.0814E-07 | 3.0845E-07 | -6.511 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 1.9655E-08 | 1.8301E-08 | -7.738 | 9.3113E-01 |
| 83 | CaF+ | 1. | 3.8693E-08 | 3.6028E-08 | -7.443 | 9.3113E-01 |
| 85 | MgOH+ | 1. | 1.5794E-08 | 1.4707E-08 | -7.832 | 9.3113E-01 |
| 86 | MgCO3 | 0. | 5.8513E-07 | 5.8573E-07 | -6.232 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.4203E-05 | 1.3225E-05 | -4.879 | 9.3113E-01 |
| 88 | MgSO4 | 0. | 9.4694E-08 | 9.4790E-08 | -7.023 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 1.4355E-08 | 1.3366E-08 | -7.874 | 9.3113E-01 |
| 90 | MgHPO4 | 0. | 4.6762E-07 | 4.6809E-07 | -6.330 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 2.8094E-08 | 2.6160E-08 | -7.582 | 9.3113E-01 |
| 92 | MgF+ | 1. | 3.3521E-07 | 3.1213E-07 | -6.506 | 9.3113E-01 |
| 93 | NaOH | 0. | 1.0858E-10 | 1.0869E-10 | -9.964 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 3.3013E-08 | 3.0740E-08 | -7.512 | 9.3113E-01 |
| 95 | NaHCO3 | 0. | 1.9434E-06 | 1.9454E-06 | -5.711 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 7.0249E-09 | 6.5411E-09 | -8.184 | 9.3113E-01 |
| 97 | NaHPO4- | -1. | 4.2574E-09 | 3.9642E-09 | -8.402 | 9.3113E-01 |
| 98 | NaF aq | 0. | 8.7276E-09 | 8.7365E-09 | -8.059 | 1.0010E+00 |
| 99 | KOH | 0. | 6.3933E-12 | 6.3998E-12 | -11.194 | 1.0010E+00 |
| 100 | KSO4- | -1. | 1.0648E-09 | 9.9145E-10 | -9.004 | 9.3113E-01 |
| 101 | KHPO4- | -1. | 4.7767E-10 | 4.4477E-10 | -9.352 | 9.3113E-01 |
| 102 | FeOH+ | 1. | 8.8527E-09 | 8.2430E-09 | -8.084 | 9.3113E-01 |
| 105 | FeCl+ | 1. | 3.1025E-10 | 2.8889E-10 | -9.539 | 9.3113E-01 |
| 106 | FeCO3 | 0. | 9.5181E-08 | 9.5278E-08 | -7.021 | 1.0010E+00 |
| 107 | FeHCO3+ | 1. | 7.5543E-07 | 7.0341E-07 | -6.153 | 9.3113E-01 |
| 108 | FeSO4 | 0. | 4.5300E-10 | 4.5346E-10 | -9.343 | 1.0010E+00 |
| 109 | FeHSO4+ | 1. | 2.6426E-16 | 2.4606E-16 | -15.609 | 9.3113E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 112 | FeHPO4 | 0. | 1.6440E-08 | 1.6457E-08 | -7.784 | 1.0010E+00 |
| 113 | FeH2PO4+ | 1. | 2.8344E-09 | 2.6392E-09 | -8.579 | 9.3113E-01 |
| 114 | FeF+ | 1. | 3.3153E-10 | 3.0870E-10 | -9.510 | 9.3113E-01 |
| 115 | Fe+3 | 3. | 3.7072E-19 | 2.0654E-19 | -18.685 | 5.5714E-01 |
| 117 | FeOH+2 | 2. | 1.8776E-14 | 1.4114E-14 | -13.850 | 7.5170E-01 |
| 118 | FeOH2+ | 1. | 5.6966E-11 | 5.3043E-11 | -10.275 | 9.3113E-01 |
| 119 | FeOH3 | 0. | 7.6027E-11 | 7.6104E-11 | -10.119 | 1.0010E+00 |
| 120 | FeOH4- | -1. | 8.3965E-13 | 7.8183E-13 | -12.107 | 9.3113E-01 |
| 121 | Fe2OH2+4 | 4. | 1.9275E-26 | 6.1543E-27 | -26.211 | 3.1929E-01 |
| 122 | Fe3OH4+5 | 5. | 5.5238E-34 | 9.2796E-35 | -34.032 | 1.6799E-01 |
| 123 | FeCl+2 | 2. | 6.0163E-22 | 4.5225E-22 | -21.345 | 7.5170E-01 |
| 124 | FeCl2+ | 1. | 1.9436E-25 | 1.8098E-25 | -24.742 | 9.3113E-01 |
| 125 | FeCl3 | 0. | 1.4571E-30 | 1.4586E-30 | -29.836 | 1.0010E+00 |
| 126 | FeSO4+ | 1. | 2.3580E-21 | 2.1956E-21 | -20.658 | 9.3113E-01 |
| 127 | FeHSO4+2 | 2. | 7.8522E-28 | 5.9025E-28 | -27.229 | 7.5170E-01 |
| 128 | FeSO42- | -1. | 5.3148E-26 | 4.9488E-26 | -25.306 | 9.3113E-01 |
| 129 | FeHPO4+ | 1. | 8.5245E-20 | 7.9375E-20 | -19.100 | 9.3113E-01 |
| 130 | FeH2P+2 | 2. | 1.4907E-19 | 1.1206E-19 | -18.951 | 7.5170E-01 |
| 131 | FeF+2 | 2. | 4.9195E-18 | 3.6980E-18 | -17.432 | 7.5170E-01 |
| 132 | FeF2+ | 1. | 1.8065E-18 | 1.6821E-18 | -17.774 | 9.3113E-01 |
| 133 | FeF3 | 0. | 3.1304E-20 | 3.1335E-20 | -19.504 | 1.0010E+00 |
| 134 | MnOH+ | 1. | 5.8093E-11 | 5.4092E-11 | -10.267 | 9.3113E-01 |
| 136 | MnCl+ | 1. | 7.5616E-11 | 7.0409E-11 | -10.152 | 9.3113E-01 |
| 137 | MnCl2 | 0. | 2.4745E-15 | 2.4770E-15 | -14.606 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 5.9050E-20 | 5.4983E-20 | -19.260 | 9.3113E-01 |
| 139 | MnCO3 | 0. | 2.6028E-08 | 2.6055E-08 | -7.584 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 5.5602E-08 | 5.1773E-08 | -7.286 | 9.3113E-01 |
| 141 | MnSO4 | 0. | 3.7312E-11 | 3.7350E-11 | -10.428 | 1.0010E+00 |
| 143 | MnF+ | 1. | 1.8942E-11 | 1.7637E-11 | -10.754 | 9.3113E-01 |
| 144 | Mn+3 | 3. | 7.7367E-33 | 4.0706E-33 | -32.390 | 5.2614E-01 |
| 164 | H3SiO4- | -1. | 9.0388E-07 | 8.4164E-07 | -6.075 | 9.3113E-01 |
| 165 | H2SiO4-2 | -2. | 7.8806E-13 | 5.9239E-13 | -12.227 | 7.5170E-01 |
| 166 | SiF6-2 | -2. | 1.3983E-31 | 1.0511E-31 | -30.978 | 7.5170E-01 |
| 170 | BaOH+ | 1. | 3.5401E-13 | 3.2963E-13 | -12.482 | 9.3113E-01 |
| 171 | BaCO3 | 0. | 5.5795E-10 | 5.5851E-10 | -9.253 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 1.9018E-08 | 1.7708E-08 | -7.752 | 9.3113E-01 |
| 173 | BaSO4 | 0. | 3.9469E-10 | 3.9509E-10 | -9.403 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 7.7269E-13 | 7.2037E-13 | -12.142 | 9.3230E-01 |
| 177 | SrHCO3+ | 1. | 4.3344E-08 | 4.0432E-08 | -7.393 | 9.3281E-01 |
| 178 | SrCO3 | 0. | 9.6489E-10 | 9.6587E-10 | -9.015 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 2.1316E-10 | 2.1338E-10 | -9.671 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 5.753E-10 | 3.452E-09 | -9.240 | -8.462 | 1.667E-01 | -0.778 |
| 2 | Aragonit | 5.753E-10 | 4.833E-09 | -9.240 | -8.316 | 1.190E-01 | -0.924 |
| 3 | Dolomite | 3.715E-19 | 9.714E-18 | -18.430 | -17.013 | 3.824E-02 | -1.417 |
| 4 | Siderite | 3.972E-12 | 1.350E-11 | -11.401 | -10.870 | 2.942E-01 | -0.531 |
| 5 | Rhodochr | 3.280E-13 | 7.616E-12 | -12.484 | -11.118 | 4.307E-02 | -1.366 |
| 6 | Strontit | 1.668E-12 | 5.386E-10 | -11.778 | -9.269 | 3.097E-03 | -2.509 |
| 7 | Witherit | 1.155E-12 | 2.696E-09 | -11.937 | -8.569 | 4.285E-04 | -3.368 |
| 8 | Gypsum | 3.925E-10 | 2.626E-05 | -9.406 | -4.581 | 1.495E-05 | -4.825 |
| 9 | Anhydrit | 3.926E-10 | 4.480E-05 | -9.406 | -4.349 | 8.763E-06 | -5.057 |
| 10 | Celestit | 1.138E-12 | 2.371E-07 | -11.944 | -6.625 | 4.800E-06 | -5.319 |
| 11 | Barite | 7.883E-13 | 9.467E-11 | -12.103 | -10.024 | 8.327E-03 | -2.080 |
| 12 | Hydroxap | 8.364E-07 | 7.510E-04 | -6.078 | -3.124 | 1.114E-03 | -2.953 |
| 13 | Fluorite | 5.316E-14 | 2.297E-11 | -13.274 | -10.639 | 2.314E-03 | -2.636 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14 SiO2 (a) | 4.983E-04 | 1.823E-03 | -3.302 | -2.739 | 2.734E-01 | -0.563 |
| 15 Chalcedy | 4.983E-04 | 2.570E-04 | -3.302 | -3.590 | 1.939E+00 | 0.288 |
| 16 Quartz | 4.983E-04 | 9.342E-05 | -3.302 | -4.030 | 5.334E+00 | 0.727 |
| 26 Talc | 2.120E+19 | 6.015E+21 | 19.326 | 21.779 | 3.524E-03 | -2.453 |
| 28 Chrysotl | 8.535E+25 | 4.116E+32 | 25.931 | 32.615 | 2.074E-07 | -6.683 |
| 29 Sepiol c | 6.070E+11 | 7.043E+15 | 11.783 | 15.848 | 8.619E-05 | -4.065 |
| 30 Sepiol d | 6.070E+11 | 4.571E+18 | 11.783 | 18.660 | 1.328E-07 | -6.877 |
| 31 Hematite | 1.949E+05 | 1.758E-04 | 5.290 | -3.755 | 1.109E+09 | 9.045 |
| 32 Goethite | 4.415E+02 | 7.607E-02 | 2.645 | -1.119 | 5.804E+03 | 3.764 |
| 33 Fe(OH)3a | 4.414E+02 | 7.780E+04 | 2.645 | 4.891 | 5.674E-03 | -2.246 |
| 37 Vivianit | 1.309E-39 | 1.000E-36 | -38.883 | -36.000 | 1.309E-03 | -2.883 |
| 38 Pyrolusi | 5.905E+21 | 8.207E+41 | 21.771 | 41.914 | 7.196E-21 | -20.143 |
| 39 Hausmani | 7.478E+36 | 7.172E+61 | 36.874 | 61.856 | 1.043E-25 | -24.982 |
| 40 Manganit | 4.584E+14 | 2.188E+25 | 14.661 | 25.340 | 2.095E-11 | -10.679 |
| 41 Pyrochro | 3.558E+07 | 1.585E+15 | 7.551 | 15.200 | 2.245E-08 | -7.649 |
| 42 PCO2 | 4.949E-04 | 3.731E-02 | -3.305 | -1.428 | 1.327E-02 | -1.877 |
| 44 H2 gas | 4.410E-18 | 7.319E-04 | -17.356 | -3.136 | 6.026E-15 | -14.220 |
| 49 Melanter | 2.708E-12 | 5.623E-03 | -11.567 | -2.250 | 4.816E-10 | -9.317 |
| 51 K-Jarosi | 6.283E-30 | 1.113E-09 | -29.202 | -8.953 | 5.644E-21 | -20.248 |

**8. WSU6**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.720
ANALYTICAL EPMCAT = 4.668 ANALYTICAL EPMAN = 2.376

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.51041E-04 | -3.2588 | 2.20800E+01 |
| Mg+2 | 2.0 | 7.64018E-04 | -3.1169 | 1.85700E+01 |
| Na+ | 1.0 | 1.22564E-03 | -2.9116 | 2.81700E+01 |
| K+ | 1.0 | 1.29694E-04 | -3.8871 | 5.07000E+00 |
| Mn+2 | 2.0 | 3.38105E-04 | -3.4709 | 1.85700E+01 |
| Ba+2 | 2.0 | 6.55478E-07 | -6.1834 | 9.00000E-02 |
| Sr+2 | 2.0 | 2.05486E-06 | -5.6872 | 1.80000E-01 |
| H4SiO4 | 0.0 | 5.74004E-04 | -3.2411 | 3.44800E+01 |
| Cl- | -1.0 | 6.46093E-05 | -4.1897 | 2.29000E+00 |
| HCO3- | -1.0 | 1.99995E-03 | -2.6990 | 1.22000E+02 |
| SO4-2 | -2.0 | 4.18590E-05 | -4.3782 | 4.02000E+00 |
| NO3- | -1.0 | 2.03527E-04 | -3.6914 | 2.85000E+00 |
| HPO4-2 | -2.0 | 3.22937E-07 | -6.4909 | 1.00000E-02 |
| F- | -1.0 | 2.26393E-05 | -4.6451 | 4.30000E-01 |

Br- -1.0 1.25183E-07 -6.9025 1.00000E-02

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 4.67 | 4.49 | 7.720 | PCO2= 1.928507E-03 |
| EPMAN | 2.38 | 2.19 | | LOG PCO2 = -2.7148 |
| | | | TEMPERATURE | PO2 = 2.122121E-55 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 3.174470E-41 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.013162E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.923197E-03 | TDS = 258.8MG/L |
| TOT ALK = | 2.000E+00 MEQ | | | CARB ALK = 1.995E+00 MEQ |
| ELECT = | 2.292E+00 MEQ | | | CHARGE IMBALANCE = 34.3% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.0387E-08 | 1.9055E-08 | -7.720 | 9.3462E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.3854E-04 | 4.0262E-04 | -3.395 | 7.4761E-01 |
| 5 | Mg+2 | 2. | 7.4691E-04 | 5.6029E-04 | -3.252 | 7.5014E-01 |
| 6 | Na+ | 1. | 1.2243E-03 | 1.1372E-03 | -2.944 | 9.2879E-01 |
| 7 | K+ | 1. | 1.2967E-04 | 1.2026E-04 | -3.920 | 9.2742E-01 |
| 9 | Mn+2 | 2. | 2.5283E-04 | 1.8978E-04 | -3.722 | 7.5064E-01 |
| 11 | Ba+2 | 2. | 6.4158E-07 | 4.7875E-07 | -6.320 | 7.4621E-01 |
| 12 | Sr+2 | 2. | 2.0119E-06 | 1.5057E-06 | -5.822 | 7.4840E-01 |
| 13 | H4SiO4 | 0. | 5.7032E-04 | 5.7096E-04 | -3.243 | 1.0011E+00 |
| 14 | Cl- | -1. | 6.4559E-05 | 5.9873E-05 | -4.223 | 9.2742E-01 |
| 15 | CO3-2 | -2. | 4.7696E-06 | 3.5677E-06 | -5.448 | 7.4800E-01 |
| 16 | SO4-2 | -2. | 3.5942E-05 | 2.6808E-05 | -4.572 | 7.4587E-01 |
| 17 | NO3- | -1. | 2.5549E-18 | 2.3671E-18 | -17.626 | 9.2651E-01 |
| 19 | PO4-3 | -3. | 5.5808E-12 | 2.8485E-12 | -11.545 | 5.1041E-01 |
| 20 | F- | -1. | 2.1824E-05 | 2.0236E-05 | -4.694 | 9.2726E-01 |
| 22 | Br- | -1. | 1.2518E-07 | 1.1598E-07 | -6.936 | 9.2651E-01 |
| 31 | OH- | -1. | 3.2701E-07 | 3.0323E-07 | -6.518 | 9.2726E-01 |
| 33 | H2 AQ | 0. | 2.7575E-19 | 2.7606E-19 | -18.559 | 1.0011E+00 |
| 34 | HCO3- | -1. | 1.8191E-03 | 1.6918E-03 | -2.772 | 9.2998E-01 |
| 35 | H2CO3 | 0. | 8.0105E-05 | 8.0196E-05 | -4.096 | 1.0011E+00 |
| 40 | HSO4- | -1. | 4.6135E-11 | 4.2821E-11 | -10.368 | 9.2818E-01 |
| 48 | NO2- | -1. | 2.0353E-04 | 1.8857E-04 | -3.725 | 9.2651E-01 |
| 65 | HPO4-2 | -2. | 1.8734E-07 | 1.3894E-07 | -6.857 | 7.4163E-01 |
| 66 | H2PO4- | -1. | 4.7796E-08 | 4.4389E-08 | -7.353 | 9.2872E-01 |
| 69 | HF AQ | 0. | 5.1018E-10 | 5.1076E-10 | -9.292 | 1.0011E+00 |
| 70 | HF2- | -1. | 4.0219E-14 | 3.7331E-14 | -13.428 | 9.2818E-01 |
| 75 | CaOH+ | 1. | 3.7776E-09 | 3.5063E-09 | -8.455 | 9.2818E-01 |
| 76 | CaCO3 | 0. | 2.1340E-06 | 2.1364E-06 | -5.670 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 8.2532E-06 | 7.6754E-06 | -5.115 | 9.2998E-01 |
| 78 | CaSO4 | 0. | 2.0118E-06 | 2.0141E-06 | -5.696 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 2.5914E-13 | 2.4053E-13 | -12.619 | 9.2818E-01 |
| 80 | CaPO4- | -1. | 3.1350E-09 | 2.9099E-09 | -8.536 | 9.2818E-01 |
| 81 | CaHPO4 | 0. | 2.6796E-08 | 2.6826E-08 | -7.571 | 1.0011E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 82 | CaH2PO4+ | 1. | 4.2916E-10 | 3.9833E-10 | -9.400 | 9.2818E-01 |
| 83 | CaF+ | 1. | 6.4681E-08 | 6.0036E-08 | -7.222 | 9.2818E-01 |
| 85 | MgOH+ | 1. | 6.1088E-08 | 5.6700E-08 | -7.246 | 9.2818E-01 |
| 86 | MgCO3 | 0. | 1.7111E-06 | 1.7131E-06 | -5.766 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 1.1643E-05 | 1.0807E-05 | -4.966 | 9.2818E-01 |
| 88 | MgSO4 | 0. | 2.9242E-06 | 2.9275E-06 | -5.534 | 1.0011E+00 |
| 89 | MgPO4- | -1. | 5.8852E-09 | 5.4625E-09 | -8.263 | 9.2818E-01 |
| 90 | MgHPO4 | 0. | 5.0418E-08 | 5.0476E-08 | -7.297 | 1.0011E+00 |
| 91 | MgH2PO4+ | 1. | 7.6056E-10 | 7.0594E-10 | -9.151 | 9.2818E-01 |
| 92 | MgF+ | 1. | 7.0878E-07 | 6.5788E-07 | -6.182 | 9.2818E-01 |
| 93 | NaOH | 0. | 3.9381E-10 | 3.9425E-10 | -9.404 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 5.6696E-08 | 5.2624E-08 | -7.279 | 9.2818E-01 |
| 95 | NaHCO3 | 0. | 1.0702E-06 | 1.0714E-06 | -5.970 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 1.5730E-07 | 1.4600E-07 | -6.836 | 9.2818E-01 |
| 97 | NaHPO4- | -1. | 3.3190E-10 | 3.0807E-10 | -9.511 | 9.2818E-01 |
| 98 | NaF aq | 0. | 1.3227E-08 | 1.3242E-08 | -7.878 | 1.0011E+00 |
| 99 | KOH | 0. | 2.1857E-11 | 2.1882E-11 | -10.660 | 1.0011E+00 |
| 100 | KSO4- | -1. | 2.1537E-08 | 1.9990E-08 | -7.699 | 9.2818E-01 |
| 101 | KHPO4- | -1. | 3.5101E-11 | 3.2580E-11 | -10.487 | 9.2818E-01 |
| 134 | MnOH+ | 1. | 1.5375E-07 | 1.4270E-07 | -6.846 | 9.2818E-01 |
| 136 | MnCl+ | 1. | 4.9872E-08 | 4.6290E-08 | -7.335 | 9.2818E-01 |
| 137 | MnCl2 | 0. | 1.2085E-12 | 1.2098E-12 | -11.917 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 2.1495E-17 | 1.9951E-17 | -16.700 | 9.2818E-01 |
| 139 | MnCO3 | 0. | 5.3722E-05 | 5.3783E-05 | -4.269 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 3.0533E-05 | 2.8340E-05 | -4.548 | 9.2818E-01 |
| 141 | MnSO4 | 0. | 7.8821E-07 | 7.8911E-07 | -6.103 | 1.0011E+00 |
| 143 | MnF+ | 1. | 2.8625E-08 | 2.6569E-08 | -7.576 | 9.2818E-01 |
| 144 | Mn+3 | 3. | 4.0261E-30 | 2.0586E-30 | -29.686 | 5.1131E-01 |
| 164 | H3SiO4- | -1. | 3.6889E-06 | 3.4240E-06 | -5.465 | 9.2818E-01 |
| 165 | H2SiO4-2 | -2. | 1.0239E-11 | 7.5995E-12 | -11.119 | 7.4221E-01 |
| 166 | SiF6-2 | -2. | 2.0397E-32 | 1.5139E-32 | -31.820 | 7.4221E-01 |
| 170 | BaOH+ | 1. | 9.1714E-13 | 8.5127E-13 | -12.070 | 9.2818E-01 |
| 171 | BaCO3 | 0. | 7.6581E-10 | 7.6668E-10 | -9.115 | 1.0011E+00 |
| 172 | BaHCO3+ | 1. | 6.7103E-09 | 6.2284E-09 | -8.206 | 9.2818E-01 |
| 173 | BaSO4 | 0. | 6.4252E-09 | 6.4325E-09 | -8.192 | 1.0011E+00 |
| 176 | SrOH+ | 1. | 4.3599E-12 | 4.0522E-12 | -11.392 | 9.2943E-01 |
| 177 | SrHCO3+ | 1. | 3.2970E-08 | 3.0662E-08 | -7.513 | 9.2998E-01 |
| 178 | SrCO3 | 0. | 2.7856E-09 | 2.7888E-09 | -8.555 | 1.0011E+00 |
| 179 | SrSO4 | 0. | 7.2253E-09 | 7.2335E-09 | -8.141 | 1.0011E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.436E-09 | 3.601E-09 | -8.843 | -8.444 | 3.989E-01 | -0.399 |
| 2 | Aragonit | 1.436E-09 | 5.073E-09 | -8.843 | -8.295 | 2.831E-01 | -0.548 |
| 3 | Dolomite | 2.871E-18 | 1.192E-17 | -17.542 | -16.924 | 2.409E-01 | -0.618 |
| 5 | Rhodochr | 6.771E-10 | 7.856E-12 | -9.169 | -11.105 | 8.619E+01 | 1.935 |
| 6 | Strontit | 5.372E-12 | 5.365E-10 | -11.270 | -9.270 | 1.001E-02 | -1.999 |
| 7 | Witherit | 1.708E-12 | 2.613E-09 | -11.768 | -8.583 | 6.537E-04 | -3.185 |
| 8 | Gypsum | 1.079E-08 | 2.618E-05 | -7.967 | -4.582 | 4.123E-04 | -3.385 |
| 9 | Anhydrit | 1.079E-08 | 4.577E-05 | -7.967 | -4.339 | 2.358E-04 | -3.627 |
| 10 | Celestit | 4.036E-11 | 2.394E-07 | -10.394 | -6.621 | 1.686E-04 | -3.773 |
| 11 | Barite | 1.283E-11 | 8.160E-11 | -10.892 | -10.088 | 1.573E-01 | -0.803 |
| 12 | Hydroxap | 2.152E-07 | 1.645E-03 | -6.667 | -2.784 | 1.308E-04 | -3.883 |
| 13 | Fluorite | 1.649E-13 | 2.063E-11 | -12.783 | -10.686 | 7.992E-03 | -2.097 |
| 14 | SiO2 (a) | 5.711E-04 | 1.695E-03 | -3.243 | -2.771 | 3.368E-01 | -0.473 |
| 15 | Chalcedy | 5.711E-04 | 2.320E-04 | -3.243 | -3.635 | 2.462E+00 | 0.391 |
| 16 | Quartz | 5.711E-04 | 8.204E-05 | -3.243 | -4.086 | 6.961E+00 | 0.843 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 26 Talc | 3.907E+23 | 1.644E+22 | 23.592 | 22.216 | 2.377E+01 | 1.376 |
| 28 Chrysotl | 1.198E+30 | 1.227E+33 | 30.078 | 33.089 | 9.763E-04 | -3.010 |
| 29 Sepiol c | 4.433E+14 | 8.883E+15 | 14.647 | 15.949 | 4.990E-02 | -1.302 |
| 30 Sepiol d | 4.433E+14 | 4.571E+18 | 14.647 | 18.660 | 9.698E-05 | -4.013 |
| 38 Pyrolusi | 1.439E+27 | 3.369E+42 | 27.158 | 42.527 | 4.273E-16 | -15.369 |
| 39 Hausmani | 3.932E+50 | 6.362E+62 | 50.595 | 62.804 | 6.180E-13 | -12.209 |
| 40 Manganit | 2.743E+19 | 2.188E+25 | 19.438 | 25.340 | 1.254E-06 | -5.902 |
| 41 Pyrochro | 5.226E+11 | 1.585E+15 | 11.718 | 15.200 | 3.297E-04 | -3.482 |
| 42 PCO2 | 8.020E-05 | 4.158E-02 | -4.096 | -1.381 | 1.929E-03 | -2.715 |
| 44 H2 gas | 2.761E-19 | 7.603E-04 | -18.559 | -3.119 | 3.631E-16 | -15.440 |

**9. WSU7**

INITIAL SOLUTION

TEMPERATURE = 16.30 DEGREES C PH = 7.430
ANALYTICAL EPMCAT = 4.033 ANALYTICAL EPMAN = 3.850

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.90517E-04 | -3.2288 | 2.36600E+01 |
| Mg+2 | 2.0 | 8.07690E-04 | -3.0928 | 1.96300E+01 |
| Na+ | 1.0 | 1.11434E-03 | -2.9530 | 2.56100E+01 |
| K+ | 1.0 | 1.12820E-04 | -3.9476 | 4.41000E+00 |
| Fe+2 | 2.0 | 3.58241E-07 | -6.4458 | 2.00000E-02 |
| Mn+2 | 2.0 | 7.28337E-07 | -6.1377 | 4.00000E-02 |
| Ba+2 | 2.0 | 5.82691E-07 | -6.2346 | 8.00000E-02 |
| Sr+2 | 2.0 | 2.28335E-06 | -5.6414 | 2.00000E-01 |
| H4SiO4 | 0.0 | 5.63559E-04 | -3.2491 | 3.38500E+01 |
| Cl- | -1.0 | 7.16681E-05 | -4.1447 | 2.54000E+00 |
| HCO3- | -1.0 | 3.36017E-03 | -2.4736 | 2.04960E+02 |
| SO4-2 | -2.0 | 1.96190E-04 | -3.7073 | 1.88400E+01 |
| NO3- | -1.0 | 2.14255E-06 | -5.6691 | 3.00000E-02 |
| HPO4-2 | -2.0 | 1.93777E-06 | -5.7127 | 6.00000E-02 |
| F- | -1.0 | 1.79022E-05 | -4.7471 | 3.40000E-01 |
| Br- | -1.0 | 2.50384E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 4.03 | 3.94 | 7.430 | PCO2= 6.656475E-03 |
| EPMAN | 3.85 | 3.75 | | LOG PCO2 = -2.1768 |
| | | | TEMPERATURE | PO2 = 3.621797E-57 |

EH = 0.0000  PE =  0.000  16.30 DEG C  PCH4 = 4.195445E-38
PE CALC S = 0.000  CO2 TOT = 3.640160E-03
PE CALC DOX= 0.000  IONIC STRENGTH  DENSITY = 1.0000
PE SATO DOX= 0.000  5.359521E-03  TDS = 334.3MG/L
TOT ALK = 3.360E+00 MEQ  CARB ALK = 3.357E+00 MEQ
ELECT = 1.850E-01 MEQ  CHARGE IMBALANCE = 2.4%

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000  EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 3.9841E-08 | 3.7154E-08 | -7.430 | 9.3254E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.6370E-04 | 4.1708E-04 | -3.380 | 7.3989E-01 |
| 5 | Mg+2 | 2. | 7.7032E-04 | 5.7203E-04 | -3.243 | 7.4259E-01 |
| 6 | Na+ | 1. | 1.1119E-03 | 1.0299E-03 | -2.987 | 9.2630E-01 |
| 7 | K+ | 1. | 1.1273E-04 | 1.0426E-04 | -3.982 | 9.2482E-01 |
| 8 | Fe+2 | 2. | 2.7157E-07 | 2.0180E-07 | -6.695 | 7.4309E-01 |
| 9 | Mn+2 | 2. | 5.1367E-07 | 3.8170E-07 | -6.418 | 7.4309E-01 |
| 11 | Ba+2 | 2. | 5.4672E-07 | 4.0369E-07 | -6.394 | 7.3838E-01 |
| 12 | Sr+2 | 2. | 2.1841E-06 | 1.6178E-06 | -5.791 | 7.4073E-01 |
| 13 | H4SiO4 | 0. | 5.6181E-04 | 5.6250E-04 | -3.250 | 1.0012E+00 |
| 14 | Cl- | -1. | 7.1668E-05 | 6.6280E-05 | -4.179 | 9.2482E-01 |
| 15 | CO3-2 | -2. | 4.2928E-06 | 3.1779E-06 | -5.498 | 7.4028E-01 |
| 16 | SO4-2 | -2. | 1.7214E-04 | 1.2704E-04 | -3.896 | 7.3802E-01 |
| 17 | NO3- | -1. | 4.5368E-21 | 4.1913E-21 | -20.378 | 9.2384E-01 |
| 19 | PO4-3 | -3. | 1.4920E-11 | 7.4286E-12 | -11.129 | 4.9791E-01 |
| 20 | F- | -1. | 1.7286E-05 | 1.5984E-05 | -4.796 | 9.2465E-01 |
| 22 | Br- | -1. | 2.5038E-07 | 2.3132E-07 | -6.636 | 9.2384E-01 |
| 31 | OH- | -1. | 1.4625E-07 | 1.3523E-07 | -6.869 | 9.2465E-01 |
| 33 | H2 AQ | 0. | 1.0671E-18 | 1.0685E-18 | -17.971 | 1.0012E+00 |
| 34 | HCO3- | -1. | 3.3026E-03 | 3.0634E-03 | -2.514 | 9.2758E-01 |
| 35 | H2CO3 | 0. | 2.9122E-04 | 2.9158E-04 | -3.535 | 1.0012E+00 |
| 40 | HSO4- | -1. | 4.1292E-10 | 3.8223E-10 | -9.418 | 9.2566E-01 |
| 48 | NO2- | -1. | 2.1425E-06 | 1.9794E-06 | -5.703 | 9.2384E-01 |
| 65 | HPO4-2 | -2. | 9.9835E-07 | 7.3229E-07 | -6.135 | 7.3350E-01 |
| 66 | H2PO4- | -1. | 4.9748E-07 | 4.6078E-07 | -6.337 | 9.2622E-01 |
| 69 | HF AQ | 0. | 7.6277E-10 | 7.6371E-10 | -9.117 | 1.0012E+00 |
| 70 | HF2- | -1. | 4.6845E-14 | 4.3362E-14 | -13.363 | 9.2566E-01 |
| 75 | CaOH+ | 1. | 2.0124E-09 | 1.8628E-09 | -8.730 | 9.2566E-01 |
| 76 | CaCO3 | 0. | 1.9235E-06 | 1.9259E-06 | -5.715 | 1.0012E+00 |
| 77 | CaHCO3+ | 1. | 1.4973E-05 | 1.3888E-05 | -4.857 | 9.2758E-01 |
| 78 | CaSO4 | 0. | 9.7113E-06 | 9.7233E-06 | -5.012 | 1.0012E+00 |
| 79 | CaHSO4 | 1. | 2.4872E-12 | 2.3023E-12 | -11.638 | 9.2566E-01 |
| 80 | CaPO4- | -1. | 8.2295E-09 | 7.6177E-09 | -8.118 | 9.2566E-01 |
| 81 | CaHPO4 | 0. | 1.4147E-07 | 1.4164E-07 | -6.849 | 1.0012E+00 |
| 82 | CaH2PO4+ | 1. | 4.4704E-09 | 4.1381E-09 | -8.383 | 9.2566E-01 |
| 83 | CaF+ | 1. | 5.0894E-08 | 4.7111E-08 | -7.327 | 9.2566E-01 |
| 85 | MgOH+ | 1. | 2.7377E-08 | 2.5342E-08 | -7.596 | 9.2566E-01 |
| 86 | MgCO3 | 0. | 1.5158E-06 | 1.5177E-06 | -5.819 | 1.0012E+00 |
| 87 | MgHCO3+ | 1. | 2.1483E-05 | 1.9886E-05 | -4.701 | 9.2566E-01 |
| 88 | MgSO4 | 0. | 1.3508E-05 | 1.3525E-05 | -4.869 | 1.0012E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 89 | MgPO4- | -1. | 1.5226E-08 | 1.4094E-08 | -7.851 | 9.2566E-01 |
| 90 | MgHPO4 | 0. | 2.6233E-07 | 2.6266E-07 | -6.581 | 1.0012E+00 |
| 91 | MgH2PO4+ | 1. | 7.8082E-09 | 7.2277E-09 | -8.141 | 9.2566E-01 |
| 92 | MgF+ | 1. | 5.5481E-07 | 5.1356E-07 | -6.289 | 9.2566E-01 |
| 93 | NaOH | 0. | 1.8290E-10 | 1.8313E-10 | -9.737 | 1.0012E+00 |
| 94 | NaCO3- | -1. | 4.1898E-08 | 3.8783E-08 | -7.411 | 9.2566E-01 |
| 95 | NaHCO3 | 0. | 1.7453E-06 | 1.7474E-06 | -5.758 | 1.0012E+00 |
| 96 | NaSO4- | -1. | 6.6932E-07 | 6.1956E-07 | -6.208 | 9.2566E-01 |
| 97 | NaHPO4- | -1. | 1.5887E-09 | 1.4706E-09 | -8.833 | 9.2566E-01 |
| 98 | NaF aq | 0. | 9.4613E-09 | 9.4730E-09 | -8.024 | 1.0012E+00 |
| 99 | KOH | 0. | 9.7168E-12 | 9.7288E-12 | -11.012 | 1.0012E+00 |
| 100 | KSO4- | -1. | 8.5989E-08 | 7.9596E-08 | -7.099 | 9.2566E-01 |
| 101 | KHPO4- | -1. | 1.6082E-10 | 1.4887E-10 | -9.827 | 9.2566E-01 |
| 102 | FeOH+ | 1. | 9.4971E-10 | 8.7911E-10 | -9.056 | 9.2566E-01 |
| 105 | FeCl+ | 1. | 1.9946E-11 | 1.8463E-11 | -10.734 | 9.2566E-01 |
| 106 | FeCO3 | 0. | 1.5365E-08 | 1.5384E-08 | -7.813 | 1.0012E+00 |
| 107 | FeHCO3+ | 1. | 6.5775E-08 | 6.0885E-08 | -7.215 | 9.2566E-01 |
| 108 | FeSO4 | 0. | 3.8652E-09 | 3.8700E-09 | -8.412 | 1.0012E+00 |
| 109 | FeHSO4+ | 1. | 1.2034E-15 | 1.1140E-15 | -14.953 | 9.2566E-01 |
| 112 | FeHPO4 | 0. | 5.8758E-10 | 5.8830E-10 | -9.230 | 1.0012E+00 |
| 113 | FeH2PO4+ | 1. | 5.0346E-11 | 4.6603E-11 | -10.332 | 9.2566E-01 |
| 114 | FeF+ | 1. | 3.4845E-11 | 3.2255E-11 | -10.491 | 9.2566E-01 |
| 115 | Fe+3 | 3. | 2.2113E-20 | 1.1794E-20 | -19.928 | 5.3333E-01 |
| 117 | FeOH+2 | 2. | 1.6469E-15 | 1.2091E-15 | -14.918 | 7.3418E-01 |
| 118 | FeOH2+ | 1. | 8.2860E-12 | 7.6700E-12 | -11.115 | 9.2566E-01 |
| 119 | FeOH3 | 0. | 1.7970E-11 | 1.7993E-11 | -10.745 | 1.0012E+00 |
| 120 | FeOH4- | -1. | 3.3278E-13 | 3.0804E-13 | -12.511 | 9.2566E-01 |
| 121 | Fe2OH2+4 | 4. | 1.9613E-28 | 5.6984E-29 | -28.244 | 2.9054E-01 |
| 122 | Fe3OH4+5 | 5. | 1.4402E-36 | 2.0877E-37 | -36.680 | 1.4496E-01 |
| 123 | FeCl+2 | 2. | 2.4202E-23 | 1.7769E-23 | -22.750 | 7.3418E-01 |
| 124 | FeCl2+ | 1. | 7.5503E-27 | 6.9890E-27 | -26.156 | 9.2566E-01 |
| 125 | FeCl3 | 0. | 4.6266E-32 | 4.6323E-32 | -31.334 | 1.0012E+00 |
| 126 | FeSO4+ | 1. | 1.4555E-20 | 1.3473E-20 | -19.871 | 9.2566E-01 |
| 127 | FeHSO4+2 | 2. | 3.6397E-27 | 2.6722E-27 | -26.573 | 7.3418E-01 |
| 128 | FeSO42- | -1. | 3.9062E-23 | 3.6158E-23 | -22.442 | 9.2566E-01 |
| 129 | FeHPO4+ | 1. | 1.8749E-21 | 1.7355E-21 | -20.761 | 9.2566E-01 |
| 130 | FeH2P+2 | 2. | 1.9601E-21 | 1.4391E-21 | -20.842 | 7.3418E-01 |
| 131 | FeF+2 | 2. | 3.5484E-19 | 2.6052E-19 | -18.584 | 7.3418E-01 |
| 132 | FeF2+ | 1. | 1.6099E-19 | 1.4902E-19 | -18.827 | 9.2566E-01 |
| 133 | FeF3 | 0. | 3.6574E-21 | 3.6619E-21 | -20.436 | 1.0012E+00 |
| 134 | MnOH+ | 1. | 1.3739E-10 | 1.2718E-10 | -9.896 | 9.2566E-01 |
| 136 | MnCl+ | 1. | 1.1134E-10 | 1.0306E-10 | -9.987 | 9.2566E-01 |
| 137 | MnCl2 | 0. | 2.9782E-15 | 2.9819E-15 | -14.526 | 1.0012E+00 |
| 138 | MnCl3- | -1. | 5.8806E-20 | 5.4434E-20 | -19.264 | 9.2566E-01 |
| 139 | MnCO3 | 0. | 9.6233E-08 | 9.6352E-08 | -7.016 | 1.0012E+00 |
| 140 | MnHCO3+ | 1. | 1.1088E-07 | 1.0264E-07 | -6.989 | 9.2566E-01 |
| 141 | MnSO4 | 0. | 7.2592E-09 | 7.2682E-09 | -8.139 | 1.0012E+00 |
| 143 | MnF+ | 1. | 4.5598E-11 | 4.2209E-11 | -10.375 | 9.2566E-01 |
| 144 | Mn+3 | 3. | 6.3862E-33 | 3.1864E-33 | -32.497 | 4.9895E-01 |
| 164 | H3SiO4- | -1. | 1.7504E-06 | 1.6203E-06 | -5.790 | 9.2566E-01 |
| 165 | H2SiO4-2 | -2. | 2.2247E-12 | 1.6334E-12 | -11.787 | 7.3418E-01 |
| 166 | SiF6-2 | -2. | 8.4109E-32 | 6.1751E-32 | -31.209 | 7.3418E-01 |
| 170 | BaOH+ | 1. | 3.9769E-13 | 3.6813E-13 | -12.434 | 9.2566E-01 |
| 171 | BaCO3 | 0. | 5.5583E-10 | 5.5652E-10 | -9.255 | 1.0012E+00 |
| 172 | BaHCO3+ | 1. | 9.7386E-09 | 9.0146E-09 | -8.045 | 9.2566E-01 |
| 173 | BaSO4 | 0. | 2.5672E-08 | 2.5704E-08 | -7.590 | 1.0012E+00 |
| 176 | SrOH+ | 1. | 2.4089E-12 | 2.2330E-12 | -11.651 | 9.2698E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 177 | SrHCO3+ | 1. | 6.0680E-08 | 5.6285E-08 | -7.250 | 9.2758E-01 |
| 178 | SrCO3 | 0. | 2.5353E-09 | 2.5384E-09 | -8.595 | 1.0012E+00 |
| 179 | SrSO4 | 0. | 3.6018E-08 | 3.6063E-08 | -7.443 | 1.0012E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.325E-09 | 3.666E-09 | -8.878 | -8.436 | 3.616E-01 | -0.442 |
| 2 | Aragonit | 1.325E-09 | 5.180E-09 | -8.878 | -8.286 | 2.559E-01 | -0.592 |
| 3 | Dolomite | 2.409E-18 | 1.312E-17 | -17.618 | -16.882 | 1.837E-01 | -0.736 |
| 4 | Siderite | 6.413E-13 | 1.461E-11 | -12.193 | -10.835 | 4.390E-02 | -1.358 |
| 5 | Rhodochr | 1.213E-12 | 7.971E-12 | -11.916 | -11.098 | 1.522E-01 | -0.818 |
| 6 | Strontit | 5.141E-12 | 5.338E-10 | -11.289 | -9.273 | 9.631E-03 | -2.016 |
| 7 | Witherit | 1.283E-12 | 2.565E-09 | -11.892 | -8.591 | 5.002E-04 | -3.301 |
| 8 | Gypsum | 5.297E-08 | 2.610E-05 | -7.276 | -4.583 | 2.030E-03 | -2.693 |
| 9 | Anhydrit | 5.299E-08 | 4.606E-05 | -7.276 | -4.337 | 1.150E-03 | -2.939 |
| 10 | Celestit | 2.055E-10 | 2.395E-07 | -9.687 | -6.621 | 8.581E-04 | -3.066 |
| 11 | Barite | 5.129E-11 | 7.592E-11 | -10.290 | -10.120 | 6.756E-01 | -0.170 |
| 12 | Hydroxap | 2.601E-06 | 2.374E-03 | -5.585 | -2.624 | 1.095E-03 | -2.961 |
| 13 | Fluorite | 1.066E-13 | 1.959E-11 | -12.972 | -10.708 | 5.439E-03 | -2.264 |
| 14 | SiO2 (a) | 5.626E-04 | 1.639E-03 | -3.250 | -2.785 | 3.433E-01 | -0.464 |
| 15 | Chalcedy | 5.626E-04 | 2.211E-04 | -3.250 | -3.655 | 2.545E+00 | 0.406 |
| 16 | Quartz | 5.626E-04 | 7.720E-05 | -3.250 | -4.112 | 7.288E+00 | 0.863 |
| 26 | Talc | 7.128E+21 | 2.632E+22 | 21.853 | 22.420 | 2.708E-01 | -0.567 |
| 28 | Chrysotl | 2.251E+28 | 2.045E+33 | 28.352 | 33.311 | 1.101E-05 | -4.958 |
| 29 | Sepiol c | 3.057E+13 | 9.902E+15 | 13.485 | 15.996 | 3.087E-03 | -2.511 |
| 30 | Sepiol d | 3.057E+13 | 4.571E+18 | 13.485 | 18.660 | 6.687E-06 | -5.175 |
| 31 | Hematite | 5.286E+04 | 4.694E-04 | 4.723 | -3.328 | 1.126E+08 | 8.052 |
| 32 | Goethite | 2.299E+02 | 4.797E-02 | 2.362 | -1.319 | 4.793E+03 | 3.681 |
| 33 | Fe(OH)3a | 2.299E+02 | 7.780E+04 | 2.361 | 4.891 | 2.955E-03 | -2.530 |
| 37 | Vivianit | 4.531E-43 | 1.000E-36 | -42.344 | -36.000 | 4.531E-07 | -6.344 |
| 38 | Pyrolusi | 2.003E+23 | 6.524E+42 | 23.302 | 42.815 | 3.070E-20 | -19.513 |
| 39 | Hausmani | 1.531E+40 | 1.767E+63 | 40.185 | 63.247 | 8.663E-24 | -23.062 |
| 40 | Manganit | 7.441E+15 | 2.188E+25 | 15.872 | 25.340 | 3.401E-10 | -9.468 |
| 41 | Pyrochro | 2.765E+08 | 1.585E+15 | 8.442 | 15.200 | 1.744E-07 | -6.758 |
| 42 | PCO2 | 2.916E-04 | 4.380E-02 | -3.535 | -1.358 | 6.656E-03 | -2.177 |
| 44 | H2 gas | 1.068E-18 | 7.740E-04 | -17.971 | -3.111 | 1.380E-15 | -14.860 |
| 49 | Melanter | 2.562E-11 | 4.779E-03 | -10.591 | -2.321 | 5.360E-09 | -8.271 |
| 51 | K-Jarosi | 1.049E-27 | 3.014E-09 | -26.979 | -8.521 | 3.479E-19 | -18.459 |

**10. WSU8**

INITIAL SOLUTION

TEMPERATURE = 20.60 DEGREES C PH = 7.940
ANALYTICAL EPMCAT = 3.887 ANALYTICAL EPMAN = 2.966

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.22600E-04 | -3.2818 | 2.09400E+01 |
| Mg+2 | 2.0 | 7.16306E-04 | -3.1449 | 1.74100E+01 |
| Na+ | 1.0 | 1.29354E-03 | -2.8882 | 2.97300E+01 |
| K+ | 1.0 | 1.08464E-04 | -3.9647 | 4.24000E+00 |
| Mn+2 | 2.0 | 7.28296E-07 | -6.1377 | 4.00000E-02 |
| Ba+2 | 2.0 | 5.09825E-07 | -6.2926 | 7.00000E-02 |
| Sr+2 | 2.0 | 1.94073E-06 | -5.7120 | 1.70000E-01 |
| H4SiO4 | 0.0 | 5.23073E-04 | -3.2814 | 3.14200E+01 |
| Cl- | -1.0 | 1.04110E-04 | -3.9825 | 3.69000E+00 |
| HCO3- | -1.0 | 2.71998E-03 | -2.5654 | 1.65920E+02 |
| SO4-2 | -2.0 | 2.55115E-05 | -4.5933 | 2.45000E+00 |
| NO3- | -1.0 | 7.14142E-05 | -4.1462 | 1.00000E+00 |
| HPO4-2 | -2.0 | 9.68829E-07 | -6.0138 | 3.00000E-02 |
| F- | -1.0 | 1.57952E-05 | -4.8015 | 3.00000E-01 |
| Br- | -1.0 | 1.25185E-07 | -6.9024 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| | | | PH | ACTIVITY H2O = 0.9999 |
| EPMCAT | 3.89 | 3.83 | 7.940 | PCO2= 1.749881E-03 |
| EPMAN | 2.97 | 2.91 | | LOG PCO2 = -2.7570 |
| | | | TEMPERATURE | PO2 = 1.328612E-53 |
| EH = 0.0000 | PE = 0.000 | | 20.60 DEG C | PCH4 = 2.006041E-43 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.757303E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.603133E-03 | TDS = 277.4MG/L |
| TOT ALK = | 2.720E+00 MEQ | | | CARB ALK = 2.712E+00 MEQ |
| ELECT = | 9.228E-01 MEQ | | | CHARGE IMBALANCE = 13.7% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.2265E-08 | 1.1482E-08 | -7.940 | 9.3612E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.0399E-04 | 3.7960E-04 | -3.421 | 7.5318E-01 |
| 5 | Mg+2 | 2. | 6.9348E-04 | 5.2399E-04 | -3.281 | 7.5560E-01 |
| 6 | Na+ | 1. | 1.2916E-03 | 1.2019E-03 | -2.920 | 9.3057E-01 |
| 7 | K+ | 1. | 1.0845E-04 | 1.0078E-04 | -3.997 | 9.2928E-01 |
| 9 | Mn+2 | 2. | 4.2109E-07 | 3.1838E-07 | -6.497 | 7.5609E-01 |
| 11 | Ba+2 | 2. | 4.9683E-07 | 3.7355E-07 | -6.428 | 7.5187E-01 |
| 12 | Sr+2 | 2. | 1.8799E-06 | 1.4173E-06 | -5.849 | 7.5394E-01 |
| 13 | H4SiO4 | 0. | 5.1697E-04 | 5.1752E-04 | -3.286 | 1.0011E+00 |
| 14 | Cl- | -1. | 1.0411E-04 | 9.6747E-05 | -4.014 | 9.2928E-01 |
| 15 | CO3-2 | -2. | 1.2129E-05 | 9.1400E-06 | -5.039 | 7.5357E-01 |
| 16 | SO4-2 | -2. | 2.2332E-05 | 1.6784E-05 | -4.775 | 7.5155E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 17 | NO3- | -1. | 4.8225E-18 | 4.4773E-18 | -17.349 | 9.2842E-01 |
| 19 | PO4-3 | -3. | 3.0313E-11 | 1.5749E-11 | -10.803 | 5.1954E-01 |
| 20 | F- | -1. | 1.5253E-05 | 1.4172E-05 | -4.849 | 9.2913E-01 |
| 22 | Br- | -1. | 1.2518E-07 | 1.1622E-07 | -6.935 | 9.2842E-01 |
| 31 | OH- | -1. | 6.6743E-07 | 6.2013E-07 | -6.208 | 9.2913E-01 |
| 33 | H2 AQ | 0. | 9.7466E-20 | 9.7569E-20 | -19.011 | 1.0011E+00 |
| 34 | HCO3- | -1. | 2.6382E-03 | 2.4581E-03 | -2.609 | 9.3171E-01 |
| 35 | H2CO3 | 0. | 6.7313E-05 | 6.7384E-05 | -4.171 | 1.0011E+00 |
| 40 | HSO4- | -1. | 1.8334E-11 | 1.7050E-11 | -10.768 | 9.2999E-01 |
| 48 | NO2- | -1. | 7.1414E-05 | 6.6302E-05 | -4.178 | 9.2842E-01 |
| 65 | HPO4-2 | -2. | 5.8667E-07 | 4.3854E-07 | -6.358 | 7.4750E-01 |
| 66 | H2PO4- | -1. | 8.9362E-08 | 8.3153E-08 | -7.080 | 9.3051E-01 |
| 69 | HF AQ | 0. | 2.2537E-10 | 2.2561E-10 | -9.647 | 1.0011E+00 |
| 70 | HF2- | -1. | 1.2719E-14 | 1.1828E-14 | -13.927 | 9.2999E-01 |
| 75 | CaOH+ | 1. | 5.8993E-09 | 5.4863E-09 | -8.261 | 9.2999E-01 |
| 76 | CaCO3 | 0. | 5.3685E-06 | 5.3742E-06 | -5.270 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.1869E-05 | 1.1058E-05 | -4.956 | 9.3171E-01 |
| 78 | CaSO4 | 0. | 1.2180E-06 | 1.2192E-06 | -5.914 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 9.1988E-14 | 8.5548E-14 | -13.068 | 9.2999E-01 |
| 80 | CaPO4- | -1. | 1.7102E-08 | 1.5905E-08 | -7.798 | 9.2999E-01 |
| 81 | CaHPO4 | 0. | 8.3876E-08 | 8.3965E-08 | -7.076 | 1.0011E+00 |
| 82 | CaH2PO4+ | 1. | 7.9688E-10 | 7.4109E-10 | -9.130 | 9.2999E-01 |
| 83 | CaF+ | 1. | 4.5399E-08 | 4.2221E-08 | -7.374 | 9.2999E-01 |
| 85 | MgOH+ | 1. | 1.2012E-07 | 1.1171E-07 | -6.952 | 9.2999E-01 |
| 86 | MgCO3 | 0. | 4.2670E-06 | 4.2716E-06 | -5.369 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 1.5924E-05 | 1.4809E-05 | -4.829 | 9.2999E-01 |
| 88 | MgSO4 | 0. | 1.8357E-06 | 1.8376E-06 | -5.736 | 1.0011E+00 |
| 89 | MgPO4- | -1. | 3.1846E-08 | 2.9617E-08 | -7.528 | 9.2999E-01 |
| 90 | MgHPO4 | 0. | 1.5654E-07 | 1.5671E-07 | -6.805 | 1.0011E+00 |
| 91 | MgH2PO4+ | 1. | 1.4009E-09 | 1.3028E-09 | -8.885 | 9.2999E-01 |
| 92 | MgF+ | 1. | 4.8658E-07 | 4.5251E-07 | -6.344 | 9.2999E-01 |
| 93 | NaOH | 0. | 6.9083E-10 | 6.9156E-10 | -9.160 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 1.7560E-07 | 1.6330E-07 | -6.787 | 9.2999E-01 |
| 95 | NaHCO3 | 0. | 1.6537E-06 | 1.6555E-06 | -5.781 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 1.0568E-07 | 9.8279E-08 | -7.008 | 9.2999E-01 |
| 97 | NaHPO4- | -1. | 1.1051E-09 | 1.0277E-09 | -8.988 | 9.2999E-01 |
| 98 | NaF aq | 0. | 9.7915E-09 | 9.8019E-09 | -8.009 | 1.0011E+00 |
| 99 | KOH | 0. | 3.0400E-11 | 3.0433E-11 | -10.517 | 1.0011E+00 |
| 100 | KSO4- | -1. | 1.1822E-08 | 1.0994E-08 | -7.959 | 9.2999E-01 |
| 101 | KHPO4- | -1. | 9.2665E-11 | 8.6177E-11 | -10.065 | 9.2999E-01 |
| 134 | MnOH+ | 1. | 5.3250E-10 | 4.9521E-10 | -9.305 | 9.2999E-01 |
| 136 | MnCl+ | 1. | 1.3493E-10 | 1.2548E-10 | -9.901 | 9.2999E-01 |
| 137 | MnCl2 | 0. | 5.2937E-15 | 5.2993E-15 | -14.276 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 1.5184E-19 | 1.4121E-19 | -18.850 | 9.2999E-01 |
| 139 | MnCO3 | 0. | 2.3090E-07 | 2.3115E-07 | -6.636 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 7.4733E-08 | 6.9501E-08 | -7.158 | 9.2999E-01 |
| 141 | MnSO4 | 0. | 8.7170E-10 | 8.7262E-10 | -9.059 | 1.0011E+00 |
| 143 | MnF+ | 1. | 3.3566E-11 | 3.1216E-11 | -10.506 | 9.2999E-01 |
| 144 | Mn+3 | 3. | 9.8487E-33 | 5.1247E-33 | -32.290 | 5.2035E-01 |
| 164 | H3SiO4- | -1. | 6.1051E-06 | 5.6776E-06 | -5.246 | 9.2999E-01 |
| 165 | H2SiO4-2 | -2. | 3.3510E-11 | 2.5066E-11 | -10.601 | 7.4801E-01 |
| 166 | SiF6-2 | -2. | 2.2251E-34 | 1.6644E-34 | -33.779 | 7.4801E-01 |
| 170 | BaOH+ | 1. | 1.1853E-12 | 1.1023E-12 | -11.958 | 9.2999E-01 |
| 171 | BaCO3 | 0. | 1.6130E-09 | 1.6147E-09 | -8.792 | 1.0011E+00 |
| 172 | BaHCO3+ | 1. | 8.2402E-09 | 7.6633E-09 | -8.116 | 9.2999E-01 |
| 173 | BaSO4 | 0. | 3.1389E-09 | 3.1422E-09 | -8.503 | 1.0011E+00 |
| 176 | SrOH+ | 1. | 6.7981E-12 | 6.3303E-12 | -11.199 | 9.3118E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 177 | SrHCO3+ | 1. | 4.9200E-08 | 4.5840E-08 | -7.339 | 9.3171E-01 |
| 178 | SrCO3 | 0. | 7.2543E-09 | 7.2620E-09 | -8.139 | 1.0011E+00 |
| 179 | SrSO4 | 0. | 4.3960E-09 | 4.4006E-09 | -8.356 | 1.0011E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 3.470E-09 | 3.497E-09 | -8.460 | -8.456 | 9.921E-01 | -0.003 |
| 2 | Aragonit | 3.470E-09 | 4.905E-09 | -8.460 | -8.309 | 7.073E-01 | -0.150 |
| 3 | Dolomite | 1.662E-17 | 1.032E-17 | -16.779 | -16.986 | 1.610E+00 | 0.207 |
| 5 | Rhodochr | 2.910E-12 | 7.686E-12 | -11.536 | -11.114 | 3.786E-01 | -0.422 |
| 6 | Strontit | 1.295E-11 | 5.384E-10 | -10.888 | -9.269 | 2.406E-02 | -1.619 |
| 7 | Witherit | 3.414E-12 | 2.674E-09 | -11.467 | -8.573 | 1.277E-03 | -2.894 |
| 8 | Gypsum | 6.370E-09 | 2.625E-05 | -8.196 | -4.581 | 2.427E-04 | -3.615 |
| 9 | Anhydrit | 6.371E-09 | 4.514E-05 | -8.196 | -4.345 | 1.411E-04 | -3.850 |
| 10 | Celestit | 2.379E-11 | 2.381E-07 | -10.624 | -6.623 | 9.992E-05 | -4.000 |
| 11 | Barite | 6.270E-12 | 9.069E-11 | -11.203 | -10.042 | 6.913E-02 | -1.160 |
| 12 | Hydroxap | 3.825E-05 | 9.462E-04 | -4.417 | -3.024 | 4.042E-02 | -1.393 |
| 13 | Fluorite | 7.624E-14 | 2.226E-11 | -13.118 | -10.652 | 3.425E-03 | -2.465 |
| 14 | SiO2 (a) | 5.176E-04 | 1.784E-03 | -3.286 | -2.749 | 2.901E-01 | -0.537 |
| 15 | Chalcedy | 5.176E-04 | 2.493E-04 | -3.286 | -3.603 | 2.076E+00 | 0.317 |
| 16 | Quartz | 5.176E-04 | 8.991E-05 | -3.286 | -4.046 | 5.757E+00 | 0.760 |
| 26 | Talc | 4.507E+24 | 8.090E+21 | 24.654 | 21.908 | 5.571E+02 | 2.746 |
| 28 | Chrysotl | 1.682E+31 | 5.680E+32 | 31.226 | 32.754 | 2.961E-02 | -1.529 |
| 29 | Sepiol c | 2.190E+15 | 7.542E+15 | 15.340 | 15.877 | 2.904E-01 | -0.537 |
| 30 | Sepiol d | 2.190E+15 | 4.571E+18 | 15.340 | 18.660 | 4.791E-04 | -3.320 |
| 38 | Pyrolusi | 1.832E+25 | 1.244E+42 | 25.263 | 42.095 | 1.472E-17 | -16.832 |
| 39 | Hausmani | 1.068E+44 | 1.365E+62 | 44.029 | 62.135 | 7.828E-19 | -18.106 |
| 40 | Manganit | 2.103E+17 | 2.188E+25 | 17.323 | 25.340 | 9.613E-09 | -8.017 |
| 41 | Pyrochro | 2.415E+09 | 1.585E+15 | 9.383 | 15.200 | 1.524E-06 | -5.817 |
| 42 | PCO2 | 6.738E-05 | 3.851E-02 | -4.171 | -1.414 | 1.750E-03 | -2.757 |
| 44 | H2 gas | 9.757E-20 | 7.401E-04 | -19.011 | -3.131 | 1.318E-16 | -15.880 |

**11. COP3**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.480
ANALYTICAL EPMCAT = 4.388 ANALYTICAL EPMAN = 3.448

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.49904E-04 | -3.1872 | 2.60400E+01 |
| Mg+2 | 2.0 | 8.19605E-04 | -3.0864 | 1.99200E+01 |
| Na+ | 1.0 | 1.30969E-03 | -2.8828 | 3.01000E+01 |
| K+ | 1.0 | 1.24585E-04 | -3.9045 | 4.87000E+00 |
| Fe+2 | 2.0 | 2.14940E-06 | -5.6677 | 1.20000E-01 |
| Mn+2 | 2.0 | 5.46241E-07 | -6.2626 | 3.00000E-02 |
| Al+3 | 3.0 | 7.41481E-07 | -6.1299 | 2.00000E-02 |
| Ba+2 | 2.0 | 6.55513E-07 | -6.1834 | 9.00000E-02 |
| Sr+2 | 2.0 | 2.05497E-06 | -5.6872 | 1.80000E-01 |
| H4SiO4 | 0.0 | 5.61383E-04 | -3.2507 | 3.37200E+01 |
| Cl- | -1.0 | 1.33740E-04 | -3.8737 | 4.74000E+00 |
| HCO3- | -1.0 | 3.00009E-03 | -2.5229 | 1.83000E+02 |
| SO4-2 | -2.0 | 8.59093E-05 | -4.0660 | 8.25000E+00 |
| NO3- | -1.0 | 1.23551E-04 | -3.9082 | 1.73000E+00 |
| HPO4-2 | -2.0 | 3.22955E-06 | -5.4909 | 1.00000E-01 |
| F- | -1.0 | 1.10570E-05 | -4.9564 | 2.10000E-01 |
| Br- | -1.0 | 2.50379E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 4.39 | 4.31 | 7.480 | PCO2= 5.397529E-03 |
| EPMAN | 3.45 | 3.37 | | LOG PCO2 = -2.2678 |
| | | | TEMPERATURE | PO2 = 2.326771E-56 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 7.390273E-39 |
| PE CALC S = | 0.000 | | | CO2 TOT = 3.207872E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 5.346083E-03 | TDS = 313.1MG/L |
| TOT ALK = | 3.000E+00 MEQ | | | CARB ALK = 2.992E+00 MEQ |
| ELECT = | 9.426E-01 MEQ | | | CHARGE IMBALANCE = 12.3% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 3.5512E-08 | 3.3113E-08 | -7.480 | 9.3244E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 6.2719E-04 | 4.6383E-04 | -3.334 | 7.3955E-01 |
| 5 | Mg+2 | 2. | 7.9105E-04 | 5.8716E-04 | -3.231 | 7.4225E-01 |
| 6 | Na+ | 1. | 1.3074E-03 | 1.2109E-03 | -2.917 | 9.2619E-01 |
| 7 | K+ | 1. | 1.2454E-04 | 1.1517E-04 | -3.939 | 9.2472E-01 |
| 8 | Fe+2 | 2. | 1.6655E-06 | 1.2371E-06 | -5.908 | 7.4276E-01 |
| 9 | Mn+2 | 2. | 3.9158E-07 | 2.9085E-07 | -6.536 | 7.4276E-01 |
| 10 | Al+3 | 3. | 3.9059E-13 | 2.0812E-13 | -12.682 | 5.3282E-01 |
| 11 | Ba+2 | 2. | 6.3146E-07 | 4.6605E-07 | -6.332 | 7.3805E-01 |
| 12 | Sr+2 | 2. | 1.9860E-06 | 1.4704E-06 | -5.833 | 7.4039E-01 |
| 13 | H4SiO4 | 0. | 5.5929E-04 | 5.5998E-04 | -3.252 | 1.0012E+00 |
| 14 | Cl- | -1. | 1.3374E-04 | 1.2367E-04 | -3.908 | 9.2472E-01 |
| 15 | CO3-2 | -2. | 4.4684E-06 | 3.3064E-06 | -5.481 | 7.3995E-01 |
| 16 | SO4-2 | -2. | 7.4456E-05 | 5.4925E-05 | -4.260 | 7.3769E-01 |
| 17 | NO3- | -1. | 5.1356E-19 | 4.7439E-19 | -18.324 | 9.2374E-01 |
| 19 | PO4-3 | -3. | 2.9117E-11 | 1.4483E-11 | -10.839 | 4.9740E-01 |
| 20 | F- | -1. | 1.0651E-05 | 9.8469E-06 | -5.007 | 9.2455E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 22 | Br- | -1. | 2.5038E-07 | 2.3128E-07 | -6.636 | 9.2374E-01 |
| 31 | OH- | -1. | 1.8873E-07 | 1.7449E-07 | -6.758 | 9.2455E-01 |
| 33 | H2 AQ | 0. | 8.3265E-19 | 8.3368E-19 | -18.079 | 1.0012E+00 |
| 34 | HCO3- | -1. | 2.9377E-03 | 2.7246E-03 | -2.565 | 9.2747E-01 |
| 35 | H2CO3 | 0. | 2.2418E-04 | 2.2445E-04 | -3.649 | 1.0012E+00 |
| 40 | HSO4- | -1. | 1.6473E-10 | 1.5246E-10 | -9.817 | 9.2555E-01 |
| 48 | NO2- | -1. | 1.2355E-04 | 1.1413E-04 | -3.943 | 9.2374E-01 |
| 65 | HPO4-2 | -2. | 1.6744E-06 | 1.2276E-06 | -5.911 | 7.3317E-01 |
| 66 | H2PO4- | -1. | 7.3594E-07 | 6.8156E-07 | -6.166 | 9.2611E-01 |
| 69 | HF AQ | 0. | 4.3138E-10 | 4.3191E-10 | -9.365 | 1.0012E+00 |
| 70 | HF2- | -1. | 1.6596E-14 | 1.5361E-14 | -13.814 | 9.2555E-01 |
| 75 | CaOH+ | 1. | 2.5114E-09 | 2.3244E-09 | -8.634 | 9.2555E-01 |
| 76 | CaCO3 | 0. | 2.2782E-06 | 2.2810E-06 | -5.642 | 1.0012E+00 |
| 77 | CaHCO3+ | 1. | 1.5354E-05 | 1.4241E-05 | -4.846 | 9.2747E-01 |
| 78 | CaSO4 | 0. | 4.7481E-06 | 4.7540E-06 | -5.323 | 1.0012E+00 |
| 79 | CaHSO4 | 1. | 1.0660E-12 | 9.8659E-13 | -12.006 | 9.2555E-01 |
| 80 | CaPO4- | -1. | 1.8415E-08 | 1.7044E-08 | -7.768 | 9.2555E-01 |
| 81 | CaHPO4 | 0. | 2.7273E-07 | 2.7306E-07 | -6.564 | 1.0012E+00 |
| 82 | CaH2PO4+ | 1. | 7.6129E-09 | 7.0461E-09 | -8.152 | 9.2555E-01 |
| 83 | CaF+ | 1. | 3.6363E-08 | 3.3655E-08 | -7.473 | 9.2555E-01 |
| 85 | MgOH+ | 1. | 3.6942E-08 | 3.4191E-08 | -7.466 | 9.2555E-01 |
| 86 | MgCO3 | 0. | 1.6617E-06 | 1.6637E-06 | -5.779 | 1.0012E+00 |
| 87 | MgHCO3+ | 1. | 1.9706E-05 | 1.8239E-05 | -4.739 | 9.2555E-01 |
| 88 | MgSO4 | 0. | 6.2778E-06 | 6.2855E-06 | -5.202 | 1.0012E+00 |
| 89 | MgPO4- | -1. | 3.1446E-08 | 2.9105E-08 | -7.536 | 9.2555E-01 |
| 90 | MgHPO4 | 0. | 4.6679E-07 | 4.6736E-07 | -6.330 | 1.0012E+00 |
| 91 | MgH2PO4+ | 1. | 1.2273E-08 | 1.1359E-08 | -7.945 | 9.2555E-01 |
| 92 | MgF+ | 1. | 3.6246E-07 | 3.3547E-07 | -6.474 | 9.2555E-01 |
| 93 | NaOH | 0. | 2.4129E-10 | 2.4159E-10 | -9.617 | 1.0012E+00 |
| 94 | NaCO3- | -1. | 5.6112E-08 | 5.1934E-08 | -7.285 | 9.2555E-01 |
| 95 | NaHCO3 | 0. | 1.8353E-06 | 1.8375E-06 | -5.736 | 1.0012E+00 |
| 96 | NaSO4- | -1. | 3.4416E-07 | 3.1854E-07 | -6.497 | 9.2555E-01 |
| 97 | NaHPO4- | -1. | 3.1317E-09 | 2.8986E-09 | -8.538 | 9.2555E-01 |
| 98 | NaF aq | 0. | 6.8531E-09 | 6.8615E-09 | -8.164 | 1.0012E+00 |
| 99 | KOH | 0. | 1.2043E-11 | 1.2058E-11 | -10.919 | 1.0012E+00 |
| 100 | KSO4- | -1. | 4.2376E-08 | 3.9221E-08 | -7.406 | 9.2555E-01 |
| 101 | KHPO4- | -1. | 2.9784E-10 | 2.7567E-10 | -9.560 | 9.2555E-01 |
| 102 | FeOH+ | 1. | 7.4699E-09 | 6.9138E-09 | -8.160 | 9.2555E-01 |
| 105 | FeCl+ | 1. | 2.2817E-10 | 2.1119E-10 | -9.675 | 9.2555E-01 |
| 106 | FeCO3 | 0. | 9.7997E-08 | 9.8118E-08 | -7.008 | 1.0012E+00 |
| 107 | FeHCO3+ | 1. | 3.6067E-07 | 3.3382E-07 | -6.476 | 9.2555E-01 |
| 108 | FeSO4 | 0. | 1.0585E-08 | 1.0599E-08 | -7.975 | 1.0012E+00 |
| 109 | FeHSO4+ | 1. | 2.8430E-15 | 2.6313E-15 | -14.580 | 9.2555E-01 |
| 112 | FeHPO4 | 0. | 6.0384E-09 | 6.0458E-09 | -8.219 | 1.0012E+00 |
| 113 | FeH2PO4+ | 1. | 4.5657E-10 | 4.2257E-10 | -9.374 | 9.2555E-01 |
| 114 | FeF+ | 1. | 1.3161E-10 | 1.2181E-10 | -9.914 | 9.2555E-01 |
| 115 | Fe+3 | 3. | 1.4970E-19 | 7.9763E-20 | -19.098 | 5.3282E-01 |
| 117 | FeOH+2 | 2. | 1.3895E-14 | 1.0197E-14 | -13.992 | 7.3382E-01 |
| 118 | FeOH2+ | 1. | 8.3934E-11 | 7.7685E-11 | -10.110 | 9.2555E-01 |
| 119 | FeOH3 | 0. | 2.2083E-10 | 2.2110E-10 | -9.655 | 1.0012E+00 |
| 120 | FeOH4- | -1. | 4.9318E-12 | 4.5646E-12 | -11.341 | 9.2555E-01 |
| 121 | Fe2OH2+4 | 4. | 1.2978E-26 | 3.7634E-27 | -26.424 | 2.8998E-01 |
| 122 | Fe3OH4+5 | 5. | 8.1890E-34 | 1.1835E-34 | -33.927 | 1.4453E-01 |
| 123 | FeCl+2 | 2. | 3.2343E-22 | 2.3734E-22 | -21.625 | 7.3382E-01 |
| 124 | FeCl2+ | 1. | 1.7780E-25 | 1.6457E-25 | -24.784 | 9.2555E-01 |
| 125 | FeCl3 | 0. | 2.0327E-30 | 2.0352E-30 | -29.691 | 1.0012E+00 |
| 126 | FeSO4+ | 1. | 4.4286E-20 | 4.0989E-20 | -19.387 | 9.2555E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 127 | FeHSO4+2 | 2. | 8.6016E-27 | 6.3120E-27 | -26.200 | 7.3382E-01 |
| 128 | FeSO42- | -1. | 5.1747E-23 | 4.7894E-23 | -22.320 | 9.2555E-01 |
| 129 | FeHPO4+ | 1. | 2.2540E-20 | 2.0862E-20 | -19.681 | 9.2555E-01 |
| 130 | FeH2P+2 | 2. | 1.9682E-20 | 1.4443E-20 | -19.840 | 7.3382E-01 |
| 131 | FeF+2 | 2. | 1.5203E-18 | 1.1156E-18 | -17.952 | 7.3382E-01 |
| 132 | FeF2+ | 1. | 4.3392E-19 | 4.0161E-19 | -18.396 | 9.2555E-01 |
| 133 | FeF3 | 0. | 6.1093E-21 | 6.1169E-21 | -20.213 | 1.0012E+00 |
| 134 | MnOH+ | 1. | 1.3597E-10 | 1.2585E-10 | -9.900 | 9.2555E-01 |
| 136 | MnCl+ | 1. | 1.5832E-10 | 1.4653E-10 | -9.834 | 9.2555E-01 |
| 137 | MnCl2 | 0. | 7.9008E-15 | 7.9105E-15 | -14.102 | 1.0012E+00 |
| 138 | MnCl3- | -1. | 2.9112E-19 | 2.6945E-19 | -18.570 | 9.2555E-01 |
| 139 | MnCO3 | 0. | 7.6294E-08 | 7.6388E-08 | -7.117 | 1.0012E+00 |
| 140 | MnHCO3+ | 1. | 7.5576E-08 | 6.9949E-08 | -7.155 | 9.2555E-01 |
| 141 | MnSO4 | 0. | 2.4747E-09 | 2.4777E-09 | -8.606 | 1.0012E+00 |
| 143 | MnF+ | 1. | 2.1408E-11 | 1.9814E-11 | -10.703 | 9.2555E-01 |
| 144 | Mn+3 | 3. | 6.3300E-33 | 3.1549E-33 | -32.501 | 4.9841E-01 |
| 150 | AlOH+2 | 2. | 5.3580E-11 | 3.9318E-11 | -10.405 | 7.3382E-01 |
| 151 | AlOH2+ | 1. | 5.3159E-09 | 4.9201E-09 | -8.308 | 9.2555E-01 |
| 152 | AlOH3 | 0. | 1.2738E-08 | 1.2754E-08 | -7.894 | 1.0012E+00 |
| 153 | AlOH4- | -1. | 7.2323E-07 | 6.6939E-07 | -6.174 | 9.2555E-01 |
| 154 | AlSO4+ | 1. | 3.5590E-14 | 3.2940E-14 | -13.482 | 9.2555E-01 |
| 155 | AlSO42- | -1. | 5.9792E-17 | 5.5340E-17 | -16.257 | 9.2555E-01 |
| 156 | AlHSO4+2 | 2. | 1.2378E-22 | 9.0830E-23 | -22.042 | 7.3382E-01 |
| 157 | AlF+2 | 2. | 2.6750E-11 | 1.9630E-11 | -10.707 | 7.3382E-01 |
| 158 | AlF2+ | 1. | 1.0083E-10 | 9.3327E-11 | -10.030 | 9.2555E-01 |
| 159 | AlF3 | 0. | 1.1471E-11 | 1.1485E-11 | -10.940 | 1.0012E+00 |
| 160 | AlF4- | -1. | 4.8566E-14 | 4.4950E-14 | -13.347 | 9.2555E-01 |
| 161 | AlF5-2 | -2. | 9.7001E-18 | 7.1182E-18 | -17.148 | 7.3382E-01 |
| 162 | AlF6-3 | -3. | 1.6216E-22 | 8.0821E-23 | -22.092 | 4.9841E-01 |
| 164 | H3SiO4- | -1. | 2.0879E-06 | 1.9324E-06 | -5.714 | 9.2555E-01 |
| 165 | H2SiO4-2 | -2. | 3.3633E-12 | 2.4680E-12 | -11.608 | 7.3382E-01 |
| 166 | SiF6-2 | -2. | 2.4498E-33 | 1.7977E-33 | -32.745 | 7.3382E-01 |
| 170 | BaOH+ | 1. | 5.1520E-13 | 4.7685E-13 | -12.322 | 9.2555E-01 |
| 171 | BaCO3 | 0. | 6.9082E-10 | 6.9167E-10 | -9.160 | 1.0012E+00 |
| 172 | BaHCO3+ | 1. | 1.0550E-08 | 9.7648E-09 | -8.010 | 9.2555E-01 |
| 173 | BaSO4 | 0. | 1.2814E-08 | 1.2829E-08 | -7.892 | 1.0012E+00 |
| 176 | SrOH+ | 1. | 2.4568E-12 | 2.2771E-12 | -11.643 | 9.2688E-01 |
| 177 | SrHCO3+ | 1. | 5.1996E-08 | 4.8225E-08 | -7.317 | 9.2747E-01 |
| 178 | SrCO3 | 0. | 2.5209E-09 | 2.5240E-09 | -8.598 | 1.0012E+00 |
| 179 | SrSO4 | 0. | 1.4455E-08 | 1.4473E-08 | -7.839 | 1.0012E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.534E-09 | 3.601E-09 | -8.814 | -8.444 | 4.259E-01 | -0.371 |
| 2 | Aragonit | 1.534E-09 | 5.073E-09 | -8.814 | -8.295 | 3.023E-01 | -0.520 |
| 3 | Dolomite | 2.977E-18 | 1.192E-17 | -17.526 | -16.924 | 2.498E-01 | -0.602 |
| 4 | Siderite | 4.090E-12 | 1.425E-11 | -11.388 | -10.846 | 2.871E-01 | -0.542 |
| 5 | Rhodochr | 9.617E-13 | 7.856E-12 | -12.017 | -11.105 | 1.224E-01 | -0.912 |
| 6 | Strontit | 4.862E-12 | 5.365E-10 | -11.313 | -9.270 | 9.063E-03 | -2.043 |
| 7 | Witherit | 1.541E-12 | 2.613E-09 | -11.812 | -8.583 | 5.897E-04 | -3.229 |
| 8 | Gypsum | 2.547E-08 | 2.618E-05 | -7.594 | -4.582 | 9.730E-04 | -3.012 |
| 9 | Anhydrit | 2.548E-08 | 4.577E-05 | -7.594 | -4.339 | 5.566E-04 | -3.254 |
| 10 | Celestit | 8.076E-11 | 2.394E-07 | -10.093 | -6.621 | 3.374E-04 | -3.472 |
| 11 | Barite | 2.560E-11 | 8.160E-11 | -10.592 | -10.088 | 3.137E-01 | -0.503 |
| 12 | Hydroxap | 3.303E-05 | 1.645E-03 | -4.481 | -2.784 | 2.008E-02 | -1.697 |
| 13 | Fluorite | 4.497E-14 | 2.063E-11 | -13.347 | -10.686 | 2.180E-03 | -2.662 |
| 14 | SiO2 (a) | 5.601E-04 | 1.695E-03 | -3.252 | -2.771 | 3.304E-01 | -0.481 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 15 | Chalcedy | 5.601E-04 | 2.320E-04 | -3.252 | -3.635 | 2.415E+00 | 0.383 |
| 16 | Quartz | 5.601E-04 | 8.204E-05 | -3.252 | -4.086 | 6.827E+00 | 0.834 |
| 17 | Gibbs(c) | 5.730E+09 | 3.249E+08 | 9.758 | 8.512 | 1.763E+01 | 1.246 |
| 18 | Al(OH)3a | 5.730E+09 | 1.849E+11 | 9.758 | 11.267 | 3.098E-02 | -1.509 |
| 19 | Kaolinit | 1.030E+13 | 1.141E+08 | 13.013 | 8.057 | 9.032E+04 | 4.956 |
| 20 | Albite | 1.425E-19 | 3.480E-19 | -18.846 | -18.458 | 4.094E-01 | -0.388 |
| 21 | Anorth | 6.523E-23 | 1.208E-20 | -22.186 | -19.918 | 5.402E-03 | -2.267 |
| 22 | Kspar | 1.355E-20 | 7.653E-22 | -19.868 | -21.116 | 1.771E+01 | 1.248 |
| 23 | Kmica | 1.150E+23 | 5.616E+13 | 23.061 | 13.749 | 2.048E+09 | 9.311 |
| 24 | Chlorite | 2.542E+68 | 1.122E+71 | 68.405 | 71.050 | 2.267E-03 | -2.645 |
| 25 | Ca-Mont | 1.480E-42 | 8.796E-47 | -41.830 | -46.056 | 1.682E+04 | 4.226 |
| 26 | Talc | 1.511E+22 | 1.644E+22 | 22.179 | 22.216 | 9.189E-01 | -0.037 |
| 27 | Illite | 1.867E-38 | 5.879E-42 | -37.729 | -41.231 | 3.177E+03 | 3.502 |
| 28 | Chrysotl | 4.815E+28 | 1.227E+33 | 28.683 | 33.089 | 3.924E-05 | -4.406 |
| 29 | Sepiol c | 5.036E+13 | 8.883E+15 | 13.702 | 15.949 | 5.669E-03 | -2.247 |
| 30 | Sepiol d | 5.036E+13 | 4.571E+18 | 13.702 | 18.660 | 1.102E-05 | -4.958 |
| 31 | Hematite | 4.824E+06 | 3.432E-04 | 6.683 | -3.464 | 1.406E+10 | 10.148 |
| 32 | Goethite | 2.196E+03 | 5.557E-02 | 3.342 | -1.255 | 3.953E+04 | 4.597 |
| 33 | Fe(OH)3a | 2.196E+03 | 7.780E+04 | 3.342 | 4.891 | 2.823E-02 | -1.549 |
| 37 | Vivianit | 3.967E-40 | 1.000E-36 | -39.402 | -36.000 | 3.967E-04 | -3.402 |
| 38 | Pyrolusi | 2.419E+23 | 3.369E+42 | 23.384 | 42.527 | 7.180E-20 | -19.144 |
| 39 | Hausmani | 1.701E+40 | 6.362E+62 | 40.231 | 62.804 | 2.674E-23 | -22.573 |
| 40 | Manganit | 8.009E+15 | 2.188E+25 | 15.904 | 25.340 | 3.661E-10 | -9.436 |
| 41 | Pyrochro | 2.652E+08 | 1.585E+15 | 8.424 | 15.200 | 1.673E-07 | -6.776 |
| 42 | PCO2 | 2.245E-04 | 4.158E-02 | -3.649 | -1.381 | 5.398E-03 | -2.268 |
| 44 | H2 gas | 8.337E-19 | 7.603E-04 | -18.079 | -3.119 | 1.096E-15 | -14.960 |
| 49 | Melanter | 6.789E-11 | 5.037E-03 | -10.168 | -2.298 | 1.348E-08 | -7.870 |
| 50 | Alunite | 2.374E-06 | 3.059E-01 | -5.625 | -0.514 | 7.761E-06 | -5.110 |
| 51 | K-Jarosi | 1.336E-25 | 2.194E-09 | -24.874 | -8.659 | 6.091E-17 | -16.215 |

**12. COP5**

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INITIAL SOLUTION

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TEMPERATURE = 18.00 DEGREES C PH = 7.340
ANALYTICAL EPMCAT = 3.663 ANALYTICAL EPMAN = 2.419

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.93956E-04 | -3.2262 | 2.38000E+01 |
| Mg+2 | 2.0 | 7.09286E-04 | -3.1492 | 1.72400E+01 |
| Na+ | 1.0 | 9.47605E-04 | -3.0234 | 2.17800E+01 |

| | | | | |
|---|---|---|---|---|
| K+ | 1.0 | 1.00275E-04 | -3.9988 | 3.92000E+00 |
| Fe+2 | 2.0 | 5.37312E-07 | -6.2698 | 3.00000E-02 |
| Mn+2 | 2.0 | 3.64135E-07 | -6.4387 | 2.00000E-02 |
| Ba+2 | 2.0 | 6.55466E-07 | -6.1834 | 9.00000E-02 |
| Sr+2 | 2.0 | 2.28313E-06 | -5.6415 | 2.00000E-01 |
| H4SiO4 | 0.0 | 5.50688E-04 | -3.2591 | 3.30800E+01 |
| Cl- | -1.0 | 6.34796E-05 | -4.1974 | 2.25000E+00 |
| HCO3- | -1.0 | 2.19991E-03 | -2.6576 | 1.34200E+02 |
| SO4-2 | -2.0 | 3.48819E-05 | -4.4574 | 3.35000E+00 |
| NO3- | -1.0 | 6.56987E-05 | -4.1824 | 9.20000E-01 |
| HPO4-2 | -2.0 | 2.58345E-06 | -5.5878 | 8.00000E-02 |
| F- | -1.0 | 1.42152E-05 | -4.8472 | 2.70000E-01 |
| Br- | -1.0 | 2.50361E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.66 | 3.62 | 7.340 | PCO2= 5.523264E-03 |
| EPMAN | 2.42 | 2.38 | | LOG PCO2 = -2.2578 |
| | | | TEMPERATURE | PO2 = 6.408797E-57 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 9.968686E-38 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.421587E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.309531E-03 | TDS = 241.2MG/L |
| TOT ALK = | 2.200E+00 MEQ | | | CARB ALK = 2.197E+00 MEQ |
| ELECT = | 1.246E+00 MEQ | | | CHARGE IMBALANCE = 20.8% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 4.8728E-08 | 4.5709E-08 | -7.340 | 9.3804E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.7989E-04 | 4.4087E-04 | -3.356 | 7.6026E-01 |
| 5 | Mg+2 | 2. | 6.9227E-04 | 5.2789E-04 | -3.277 | 7.6255E-01 |
| 6 | Na+ | 1. | 9.4648E-04 | 8.8289E-04 | -3.054 | 9.3281E-01 |
| 7 | K+ | 1. | 1.0026E-04 | 9.3403E-05 | -4.030 | 9.3160E-01 |
| 8 | Fe+2 | 2. | 4.4566E-07 | 3.4005E-07 | -6.468 | 7.6302E-01 |
| 9 | Mn+2 | 2. | 2.8976E-07 | 2.2109E-07 | -6.655 | 7.6302E-01 |
| 11 | Ba+2 | 2. | 6.4133E-07 | 4.8679E-07 | -6.313 | 7.5902E-01 |
| 12 | Sr+2 | 2. | 2.2304E-06 | 1.6973E-06 | -5.770 | 7.6099E-01 |
| 13 | H4SiO4 | 0. | 5.4921E-04 | 5.4976E-04 | -3.260 | 1.0010E+00 |
| 14 | Cl- | -1. | 6.3480E-05 | 5.9138E-05 | -4.228 | 9.3160E-01 |
| 15 | CO3-2 | -2. | 2.3345E-06 | 1.7757E-06 | -5.751 | 7.6064E-01 |
| 16 | SO4-2 | -2. | 3.0471E-05 | 2.3119E-05 | -4.636 | 7.5872E-01 |
| 17 | NO3- | -1. | 1.4332E-19 | 1.3340E-19 | -18.875 | 9.3079E-01 |
| 19 | PO4-3 | -3. | 1.5114E-11 | 8.0282E-12 | -11.095 | 5.3117E-01 |
| 20 | F- | -1. | 1.3743E-05 | 1.2801E-05 | -4.893 | 9.3146E-01 |
| 22 | Br- | -1. | 2.5036E-07 | 2.3303E-07 | -6.633 | 9.3079E-01 |
| 31 | OH- | -1. | 1.3571E-07 | 1.2641E-07 | -6.898 | 9.3146E-01 |
| 33 | H2 AQ | 0. | 1.5870E-18 | 1.5885E-18 | -17.799 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.1628E-03 | 2.0198E-03 | -2.695 | 9.3389E-01 |
| 35 | H2CO3 | 0. | 2.2945E-04 | 2.2968E-04 | -3.639 | 1.0010E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 40 | HSO4- | -1. | 9.5022E-11 | 8.8586E-11 | -10.053 | 9.3227E-01 |
| 48 | NO2- | -1. | 6.5699E-05 | 6.1152E-05 | -4.214 | 9.3079E-01 |
| 65 | HPO4-2 | -2. | 1.2444E-06 | 9.3935E-07 | -6.027 | 7.5489E-01 |
| 66 | H2PO4- | -1. | 7.7180E-07 | 7.1990E-07 | -6.143 | 9.3276E-01 |
| 69 | HF AQ | 0. | 7.7428E-10 | 7.7505E-10 | -9.111 | 1.0010E+00 |
| 70 | HF2- | -1. | 3.8436E-14 | 3.5833E-14 | -13.446 | 9.3227E-01 |
| 75 | CaOH+ | 1. | 1.7168E-09 | 1.6005E-09 | -8.796 | 9.3227E-01 |
| 76 | CaCO3 | 0. | 1.1632E-06 | 1.1643E-06 | -5.934 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.0745E-05 | 1.0034E-05 | -4.999 | 9.3389E-01 |
| 78 | CaSO4 | 0. | 1.9001E-06 | 1.9020E-06 | -5.721 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 5.8444E-13 | 5.4486E-13 | -12.264 | 9.3227E-01 |
| 80 | CaPO4- | -1. | 9.6328E-09 | 8.9803E-09 | -8.047 | 9.3227E-01 |
| 81 | CaHPO4 | 0. | 1.9840E-07 | 1.9860E-07 | -6.702 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 7.5879E-09 | 7.0740E-09 | -8.150 | 9.3227E-01 |
| 83 | CaF+ | 1. | 4.4606E-08 | 4.1585E-08 | -7.381 | 9.3227E-01 |
| 85 | MgOH+ | 1. | 2.3888E-08 | 2.2270E-08 | -7.652 | 9.3227E-01 |
| 86 | MgCO3 | 0. | 8.0251E-07 | 8.0331E-07 | -6.095 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.3040E-05 | 1.2157E-05 | -4.915 | 9.3227E-01 |
| 88 | MgSO4 | 0. | 2.3763E-06 | 2.3787E-06 | -5.624 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 1.5559E-08 | 1.4505E-08 | -7.838 | 9.3227E-01 |
| 90 | MgHPO4 | 0. | 3.2121E-07 | 3.2153E-07 | -6.493 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 1.1571E-08 | 1.0787E-08 | -7.967 | 9.3227E-01 |
| 92 | MgF+ | 1. | 4.2058E-07 | 3.9209E-07 | -6.407 | 9.3227E-01 |
| 93 | NaOH | 0. | 1.2748E-10 | 1.2760E-10 | -9.894 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 2.1812E-08 | 2.0335E-08 | -7.692 | 9.3227E-01 |
| 95 | NaHCO3 | 0. | 9.9219E-07 | 9.9318E-07 | -6.003 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 1.0486E-07 | 9.7755E-08 | -7.010 | 9.3227E-01 |
| 97 | NaHPO4- | -1. | 1.7346E-09 | 1.6171E-09 | -8.791 | 9.3227E-01 |
| 98 | NaF aq | 0. | 6.4969E-09 | 6.5034E-09 | -8.187 | 1.0010E+00 |
| 99 | KOH | 0. | 7.0776E-12 | 7.0847E-12 | -11.150 | 1.0010E+00 |
| 100 | KSO4- | -1. | 1.4362E-08 | 1.3389E-08 | -7.873 | 9.3227E-01 |
| 101 | KHPO4- | -1. | 1.8350E-10 | 1.7107E-10 | -9.767 | 9.3227E-01 |
| 102 | FeOH+ | 1. | 1.4768E-09 | 1.3768E-09 | -8.861 | 9.3227E-01 |
| 105 | FeCl+ | 1. | 2.9776E-11 | 2.7759E-11 | -10.557 | 9.3227E-01 |
| 106 | FeCO3 | 0. | 1.4470E-08 | 1.4484E-08 | -7.839 | 1.0010E+00 |
| 107 | FeHCO3+ | 1. | 7.2966E-08 | 6.8024E-08 | -7.167 | 9.3227E-01 |
| 108 | FeSO4 | 0. | 1.2251E-09 | 1.2263E-09 | -8.911 | 1.0010E+00 |
| 109 | FeHSO4+ | 1. | 4.5079E-16 | 4.2025E-16 | -15.376 | 9.3227E-01 |
| 112 | FeHPO4 | 0. | 1.2704E-09 | 1.2716E-09 | -8.896 | 1.0010E+00 |
| 113 | FeH2PO4+ | 1. | 1.3160E-10 | 1.2269E-10 | -9.911 | 9.3227E-01 |
| 114 | FeF+ | 1. | 4.6691E-11 | 4.3528E-11 | -10.361 | 9.3227E-01 |
| 115 | Fe+3 | 3. | 3.8990E-20 | 2.1925E-20 | -19.659 | 5.6233E-01 |
| 117 | FeOH+2 | 2. | 2.6882E-15 | 2.0306E-15 | -14.692 | 7.5537E-01 |
| 118 | FeOH2+ | 1. | 1.2022E-11 | 1.1207E-11 | -10.950 | 9.3227E-01 |
| 119 | FeOH3 | 0. | 2.3085E-11 | 2.3108E-11 | -10.636 | 1.0010E+00 |
| 120 | FeOH4- | -1. | 3.7073E-13 | 3.4562E-13 | -12.461 | 9.3227E-01 |
| 121 | Fe2OH2+4 | 4. | 4.5840E-28 | 1.4924E-28 | -27.826 | 3.2557E-01 |
| 122 | Fe3OH4+5 | 5. | 3.9097E-36 | 6.7710E-37 | -36.169 | 1.7318E-01 |
| 123 | FeCl+2 | 2. | 4.1300E-23 | 3.1197E-23 | -22.506 | 7.5537E-01 |
| 124 | FeCl2+ | 1. | 1.1095E-26 | 1.0344E-26 | -25.985 | 9.3227E-01 |
| 125 | FeCl3 | 0. | 6.1109E-32 | 6.1169E-32 | -31.213 | 1.0010E+00 |
| 126 | FeSO4+ | 1. | 5.0871E-21 | 4.7425E-21 | -20.324 | 9.3227E-01 |
| 127 | FeHSO4+2 | 2. | 1.3346E-27 | 1.0081E-27 | -26.996 | 7.5537E-01 |
| 128 | FeSO42- | -1. | 2.5020E-24 | 2.3325E-24 | -23.632 | 9.3227E-01 |
| 129 | FeHPO4+ | 1. | 4.7067E-21 | 4.3879E-21 | -20.358 | 9.3227E-01 |
| 130 | FeH2P+2 | 2. | 5.5516E-21 | 4.1935E-21 | -20.377 | 7.5537E-01 |
| 131 | FeF+2 | 2. | 5.2776E-19 | 3.9865E-19 | -18.399 | 7.5537E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 132 | FeF2+ | 1. | 2.0012E-19 | 1.8656E-19 | -18.729 | 9.3227E-01 |
| 133 | FeF3 | 0. | 3.6902E-21 | 3.6939E-21 | -20.433 | 1.0010E+00 |
| 134 | MnOH+ | 1. | 7.4338E-11 | 6.9302E-11 | -10.159 | 9.3227E-01 |
| 136 | MnCl+ | 1. | 5.7133E-11 | 5.3264E-11 | -10.274 | 9.3227E-01 |
| 137 | MnCl2 | 0. | 1.3736E-15 | 1.3750E-15 | -14.862 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 2.4022E-20 | 2.2395E-20 | -19.650 | 9.3227E-01 |
| 139 | MnCO3 | 0. | 3.1153E-08 | 3.1184E-08 | -7.506 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 4.2281E-08 | 3.9417E-08 | -7.404 | 9.3227E-01 |
| 141 | MnSO4 | 0. | 7.9199E-10 | 7.9278E-10 | -9.101 | 1.0010E+00 |
| 143 | MnF+ | 1. | 2.1002E-11 | 1.9580E-11 | -10.708 | 9.3227E-01 |
| 144 | Mn+3 | 3. | 4.5084E-33 | 2.3982E-33 | -32.620 | 5.3194E-01 |
| 164 | H3SiO4- | -1. | 1.4742E-06 | 1.3744E-06 | -5.862 | 9.3227E-01 |
| 165 | H2SiO4-2 | -2. | 1.6834E-12 | 1.2716E-12 | -11.896 | 7.5537E-01 |
| 166 | SiF6-2 | -2. | 4.0939E-32 | 3.0925E-32 | -31.510 | 7.5537E-01 |
| 170 | BaOH+ | 1. | 3.8704E-13 | 3.6083E-13 | -12.443 | 9.3227E-01 |
| 171 | BaCO3 | 0. | 3.8761E-10 | 3.8799E-10 | -9.411 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 8.1104E-09 | 7.5610E-09 | -8.121 | 9.3227E-01 |
| 173 | BaSO4 | 0. | 5.6348E-09 | 5.6404E-09 | -8.249 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 2.0401E-12 | 1.9042E-12 | -11.720 | 9.3339E-01 |
| 177 | SrHCO3+ | 1. | 4.4187E-08 | 4.1266E-08 | -7.384 | 9.3389E-01 |
| 178 | SrCO3 | 0. | 1.5631E-09 | 1.5646E-09 | -8.806 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 7.0249E-09 | 7.0318E-09 | -8.153 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 7.828E-10 | 3.601E-09 | -9.106 | -8.444 | 2.174E-01 | -0.663 |
| 2 | Aragonit | 7.828E-10 | 5.073E-09 | -9.106 | -8.295 | 1.543E-01 | -0.812 |
| 3 | Dolomite | 7.338E-19 | 1.192E-17 | -18.134 | -16.924 | 6.156E-02 | -1.211 |
| 4 | Siderite | 6.038E-13 | 1.425E-11 | -12.219 | -10.846 | 4.238E-02 | -1.373 |
| 5 | Rhodochr | 3.926E-13 | 7.856E-12 | -12.406 | -11.105 | 4.997E-02 | -1.301 |
| 6 | Strontit | 3.014E-12 | 5.365E-10 | -11.521 | -9.270 | 5.618E-03 | -2.250 |
| 7 | Witherit | 8.644E-13 | 2.613E-09 | -12.063 | -8.583 | 3.308E-04 | -3.480 |
| 8 | Gypsum | 1.019E-08 | 2.618E-05 | -7.992 | -4.582 | 3.893E-04 | -3.410 |
| 9 | Anhydrit | 1.019E-08 | 4.577E-05 | -7.992 | -4.339 | 2.227E-04 | -3.652 |
| 10 | Celestit | 3.924E-11 | 2.394E-07 | -10.406 | -6.621 | 1.639E-04 | -3.785 |
| 11 | Barite | 1.125E-11 | 8.160E-11 | -10.949 | -10.088 | 1.379E-01 | -0.860 |
| 12 | Hydroxap | 3.162E-06 | 1.645E-03 | -5.500 | -2.784 | 1.922E-03 | -2.716 |
| 13 | Fluorite | 7.224E-14 | 2.063E-11 | -13.141 | -10.686 | 3.502E-03 | -2.456 |
| 14 | SiO2 (a) | 5.499E-04 | 1.695E-03 | -3.260 | -2.771 | 3.243E-01 | -0.489 |
| 15 | Chalcedy | 5.499E-04 | 2.320E-04 | -3.260 | -3.635 | 2.370E+00 | 0.375 |
| 16 | Quartz | 5.499E-04 | 8.204E-05 | -3.260 | -4.086 | 6.702E+00 | 0.826 |
| 26 | Talc | 1.474E+21 | 1.644E+22 | 21.168 | 22.216 | 8.966E-02 | -1.047 |
| 28 | Chrysotl | 4.875E+27 | 1.227E+33 | 27.688 | 33.089 | 3.973E-06 | -5.401 |
| 29 | Sepiol c | 1.061E+13 | 8.883E+15 | 13.026 | 15.949 | 1.194E-03 | -2.923 |
| 30 | Sepiol d | 1.061E+13 | 4.571E+18 | 13.026 | 18.660 | 2.321E-06 | -5.634 |
| 31 | Hematite | 5.269E+04 | 3.432E-04 | 4.722 | -3.464 | 1.535E+08 | 8.186 |
| 32 | Goethite | 2.295E+02 | 5.557E-02 | 2.361 | -1.255 | 4.131E+03 | 3.616 |
| 33 | Fe(OH)3a | 2.295E+02 | 7.780E+04 | 2.361 | 4.891 | 2.950E-03 | -2.530 |
| 37 | Vivianit | 2.532E-42 | 1.000E-36 | -41.596 | -36.000 | 2.532E-06 | -5.596 |
| 38 | Pyrolusi | 5.064E+22 | 3.369E+42 | 22.704 | 42.527 | 1.503E-20 | -19.823 |
| 39 | Hausmani | 5.669E+38 | 6.362E+62 | 38.754 | 62.804 | 8.911E-25 | -24.050 |
| 40 | Manganit | 2.315E+15 | 2.188E+25 | 15.364 | 25.340 | 1.058E-10 | -9.976 |
| 41 | Pyrochro | 1.058E+08 | 1.585E+15 | 8.024 | 15.200 | 6.676E-08 | -7.176 |
| 42 | PCO2 | 2.297E-04 | 4.158E-02 | -3.639 | -1.381 | 5.523E-03 | -2.258 |
| 44 | H2 gas | 1.589E-18 | 7.603E-04 | -17.799 | -3.119 | 2.089E-15 | -14.680 |
| 49 | Melanter | 7.857E-12 | 5.037E-03 | -11.105 | -2.298 | 1.560E-09 | -8.807 |
| 51 | K-Jarosi | 5.766E-29 | 2.194E-09 | -28.239 | -8.659 | 2.628E-20 | -19.580 |

**13. COP6**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.850
ANALYTICAL EPMCAT = 4.118 ANALYTICAL EPMAN = 2.912

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.47810E-04 | -3.2614 | 2.19500E+01 |
| Mg+2 | 2.0 | 7.39351E-04 | -3.1311 | 1.79700E+01 |
| Na+ | 1.0 | 1.40711E-03 | -2.8517 | 3.23400E+01 |
| K+ | 1.0 | 1.24581E-04 | -3.9045 | 4.87000E+00 |
| Fe+2 | 2.0 | 2.32845E-06 | -5.6329 | 1.30000E-01 |
| Mn+2 | 2.0 | 9.10375E-07 | -6.0408 | 5.00000E-02 |
| Ba+2 | 2.0 | 5.82661E-07 | -6.2346 | 8.00000E-02 |
| Sr+2 | 2.0 | 1.71242E-06 | -5.7664 | 1.50000E-01 |
| H4SiO4 | 0.0 | 5.99822E-04 | -3.2220 | 3.60300E+01 |
| Cl- | -1.0 | 6.51751E-05 | -4.1859 | 2.31000E+00 |
| HCO3- | -1.0 | 2.68000E-03 | -2.5719 | 1.63480E+02 |
| SO4-2 | -2.0 | 2.27002E-05 | -4.6440 | 2.18000E+00 |
| NO3- | -1.0 | 1.04980E-04 | -3.9789 | 1.47000E+00 |
| HPO4-2 | -2.0 | 1.61473E-06 | -5.7919 | 5.00000E-02 |
| F- | -1.0 | 1.15832E-05 | -4.9362 | 2.20000E-01 |
| Br- | -1.0 | 2.50371E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 4.12 | 4.06 | PH 7.850 | ACTIVITY H2O = 0.9999 |
| EPMAN | 2.91 | 2.86 | | PCO2= 2.052499E-03 |
| | | | | LOG PCO2 = -2.6877 |
| | | | TEMPERATURE | PO2 = 7.026886E-55 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 3.081340E-42 |
| PE CALC S = 0.000 | | | | CO2 TOT = 2.740985E-03 |
| PE CALC DOX= 0.000 | | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= 0.000 | | | 4.743466E-03 | TDS = 283.3MG/L |
| TOT ALK = 2.680E+00 MEQ | | | | CARB ALK = 2.673E+00 MEQ |
| ELECT = 1.208E+00 MEQ | | | | CHARGE IMBALANCE = 17.5% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.5098E-08 | 1.4125E-08 | -7.850 | 9.3559E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.3069E-04 | 3.9865E-04 | -3.399 | 7.5119E-01 |
| 5 | Mg+2 | 2. | 7.1774E-04 | 5.4092E-04 | -3.267 | 7.5365E-01 |
| 6 | Na+ | 1. | 1.4051E-03 | 1.3067E-03 | -2.884 | 9.2993E-01 |
| 7 | K+ | 1. | 1.2457E-04 | 1.1568E-04 | -3.937 | 9.2861E-01 |
| 8 | Fe+2 | 2. | 1.7416E-06 | 1.3134E-06 | -5.882 | 7.5414E-01 |
| 9 | Mn+2 | 2. | 5.7248E-07 | 4.3172E-07 | -6.365 | 7.5414E-01 |
| 11 | Ba+2 | 2. | 5.6956E-07 | 4.2708E-07 | -6.369 | 7.4984E-01 |
| 12 | Sr+2 | 2. | 1.6653E-06 | 1.2522E-06 | -5.902 | 7.5196E-01 |
| 13 | H4SiO4 | 0. | 5.9464E-04 | 5.9529E-04 | -3.225 | 1.0011E+00 |
| 14 | Cl- | -1. | 6.5175E-05 | 6.0522E-05 | -4.218 | 9.2861E-01 |
| 15 | CO3-2 | -2. | 9.1933E-06 | 6.9095E-06 | -5.161 | 7.5157E-01 |
| 16 | SO4-2 | -2. | 1.9899E-05 | 1.4914E-05 | -4.826 | 7.4951E-01 |
| 17 | NO3- | -1. | 2.3980E-18 | 2.2247E-18 | -17.653 | 9.2773E-01 |
| 19 | PO4-3 | -3. | 3.8662E-11 | 1.9959E-11 | -10.700 | 5.1624E-01 |
| 20 | F- | -1. | 1.1191E-05 | 1.0391E-05 | -4.983 | 9.2846E-01 |
| 22 | Br- | -1. | 2.5037E-07 | 2.3228E-07 | -6.634 | 9.2773E-01 |
| 31 | OH- | -1. | 4.4056E-07 | 4.0904E-07 | -6.388 | 9.2846E-01 |
| 33 | H2 AQ | 0. | 1.5154E-19 | 1.5170E-19 | -18.819 | 1.0011E+00 |
| 34 | HCO3- | -1. | 2.6086E-03 | 2.4288E-03 | -2.615 | 9.3109E-01 |
| 35 | H2CO3 | 0. | 8.5259E-05 | 8.5352E-05 | -4.069 | 1.0011E+00 |
| 40 | HSO4- | -1. | 1.9003E-11 | 1.7660E-11 | -10.753 | 9.2934E-01 |
| 48 | NO2- | -1. | 1.0498E-04 | 9.7392E-05 | -4.011 | 9.2773E-01 |
| 65 | HPO4-2 | -2. | 9.6822E-07 | 7.2169E-07 | -6.142 | 7.4538E-01 |
| 66 | H2PO4- | -1. | 1.8381E-07 | 1.7092E-07 | -6.767 | 9.2987E-01 |
| 69 | HF AQ | 0. | 1.9420E-10 | 1.9442E-10 | -9.711 | 1.0011E+00 |
| 70 | HF2- | -1. | 7.8509E-15 | 7.2962E-15 | -14.137 | 9.2934E-01 |
| 75 | CaOH+ | 1. | 5.0393E-09 | 4.6832E-09 | -8.329 | 9.2934E-01 |
| 76 | CaCO3 | 0. | 4.0923E-06 | 4.0968E-06 | -5.388 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.1718E-05 | 1.0911E-05 | -4.962 | 9.3109E-01 |
| 78 | CaSO4 | 0. | 1.1083E-06 | 1.1095E-06 | -5.955 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 1.0569E-13 | 9.8219E-14 | -13.008 | 9.2934E-01 |
| 80 | CaPO4- | -1. | 2.1723E-08 | 2.0188E-08 | -7.695 | 9.2934E-01 |
| 81 | CaHPO4 | 0. | 1.3782E-07 | 1.3797E-07 | -6.860 | 1.0011E+00 |
| 82 | CaH2PO4+ | 1. | 1.6342E-09 | 1.5187E-09 | -8.819 | 9.2934E-01 |
| 83 | CaF+ | 1. | 3.2843E-08 | 3.0523E-08 | -7.515 | 9.2934E-01 |
| 85 | MgOH+ | 1. | 7.9456E-08 | 7.3842E-08 | -7.132 | 9.2934E-01 |
| 86 | MgCO3 | 0. | 3.1995E-06 | 3.2030E-06 | -5.494 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 1.6118E-05 | 1.4979E-05 | -4.825 | 9.2934E-01 |
| 88 | MgSO4 | 0. | 1.5706E-06 | 1.5724E-06 | -5.803 | 1.0011E+00 |
| 89 | MgPO4- | -1. | 3.9762E-08 | 3.6952E-08 | -7.432 | 9.2934E-01 |
| 90 | MgHPO4 | 0. | 2.5285E-07 | 2.5312E-07 | -6.597 | 1.0011E+00 |
| 91 | MgH2PO4+ | 1. | 2.8238E-09 | 2.6243E-09 | -8.581 | 9.2934E-01 |
| 92 | MgF+ | 1. | 3.5092E-07 | 3.2612E-07 | -6.487 | 9.2934E-01 |
| 93 | NaOH | 0. | 6.1043E-10 | 6.1110E-10 | -9.214 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 1.2601E-07 | 1.1711E-07 | -6.931 | 9.2934E-01 |
| 95 | NaHCO3 | 0. | 1.7656E-06 | 1.7675E-06 | -5.753 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 1.0043E-07 | 9.3331E-08 | -7.030 | 9.2934E-01 |
| 97 | NaHPO4- | -1. | 1.9785E-09 | 1.8387E-09 | -8.735 | 9.2934E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 98 | NaF aq | 0. | 7.8042E-09 | 7.8127E-09 | -8.107 | 1.0011E+00 |
| 99 | KOH | 0. | 2.8361E-11 | 2.8392E-11 | -10.547 | 1.0011E+00 |
| 100 | KSO4- | -1. | 1.1510E-08 | 1.0697E-08 | -7.971 | 9.2934E-01 |
| 101 | KHPO4- | -1. | 1.7515E-10 | 1.6278E-10 | -9.788 | 9.2934E-01 |
| 102 | FeOH+ | 1. | 1.8516E-08 | 1.7208E-08 | -7.764 | 9.2934E-01 |
| 105 | FeCl+ | 1. | 1.1807E-10 | 1.0973E-10 | -9.960 | 9.2934E-01 |
| 106 | FeCO3 | 0. | 2.1746E-07 | 2.1770E-07 | -6.662 | 1.0011E+00 |
| 107 | FeHCO3+ | 1. | 3.3996E-07 | 3.1594E-07 | -6.500 | 9.2934E-01 |
| 108 | FeSO4 | 0. | 3.0522E-09 | 3.0555E-09 | -8.515 | 1.0011E+00 |
| 109 | FeHSO4+ | 1. | 3.4820E-16 | 3.2360E-16 | -15.490 | 9.2934E-01 |
| 112 | FeHPO4 | 0. | 3.7695E-09 | 3.7736E-09 | -8.423 | 1.0011E+00 |
| 113 | FeH2PO4+ | 1. | 1.2107E-10 | 1.1251E-10 | -9.949 | 9.2934E-01 |
| 114 | FeF+ | 1. | 1.4685E-10 | 1.3647E-10 | -9.865 | 9.2934E-01 |
| 115 | Fe+3 | 3. | 1.5418E-19 | 8.4686E-20 | -19.072 | 5.4926E-01 |
| 117 | FeOH+2 | 2. | 3.4024E-14 | 2.5379E-14 | -13.596 | 7.4594E-01 |
| 118 | FeOH2+ | 1. | 4.8773E-10 | 4.5327E-10 | -9.344 | 9.2934E-01 |
| 119 | FeOH3 | 0. | 3.0209E-09 | 3.0242E-09 | -8.519 | 1.0011E+00 |
| 120 | FeOH4- | -1. | 1.5749E-10 | 1.4636E-10 | -9.835 | 9.2934E-01 |
| 121 | Fe2OH2+4 | 4. | 7.5302E-26 | 2.3314E-26 | -25.632 | 3.0961E-01 |
| 122 | Fe3OH4+5 | 5. | 2.6721E-32 | 4.2779E-33 | -32.369 | 1.6010E-01 |
| 123 | FeCl+2 | 2. | 1.6532E-22 | 1.2332E-22 | -21.909 | 7.4594E-01 |
| 124 | FeCl2+ | 1. | 4.5026E-26 | 4.1844E-26 | -25.378 | 9.2934E-01 |
| 125 | FeCl3 | 0. | 2.5297E-31 | 2.5325E-31 | -30.596 | 1.0011E+00 |
| 126 | FeSO4+ | 1. | 1.2715E-20 | 1.1817E-20 | -19.927 | 9.2934E-01 |
| 127 | FeHSO4+2 | 2. | 1.0407E-27 | 7.7626E-28 | -27.110 | 7.4594E-01 |
| 128 | FeSO42- | -1. | 4.0343E-24 | 3.7493E-24 | -23.426 | 9.2934E-01 |
| 129 | FeHPO4+ | 1. | 1.4011E-20 | 1.3021E-20 | -19.885 | 9.2934E-01 |
| 130 | FeH2P+2 | 2. | 5.1555E-21 | 3.8457E-21 | -20.415 | 7.4594E-01 |
| 131 | FeF+2 | 2. | 1.6756E-18 | 1.2499E-18 | -17.903 | 7.4594E-01 |
| 132 | FeF2+ | 1. | 5.1089E-19 | 4.7479E-19 | -18.323 | 9.2934E-01 |
| 133 | FeF3 | 0. | 7.6224E-21 | 7.6307E-21 | -20.117 | 1.0011E+00 |
| 134 | MnOH+ | 1. | 4.7120E-10 | 4.3791E-10 | -9.359 | 9.2934E-01 |
| 136 | MnCl+ | 1. | 1.1454E-10 | 1.0644E-10 | -9.973 | 9.2934E-01 |
| 137 | MnCl2 | 0. | 2.8090E-15 | 2.8121E-15 | -14.551 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 5.0439E-20 | 4.6875E-20 | -19.329 | 9.2934E-01 |
| 139 | MnCO3 | 0. | 2.3669E-07 | 2.3695E-07 | -6.625 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 9.9594E-08 | 9.2557E-08 | -7.034 | 9.2934E-01 |
| 141 | MnSO4 | 0. | 9.9757E-10 | 9.9866E-10 | -9.001 | 1.0011E+00 |
| 143 | MnF+ | 1. | 3.3394E-11 | 3.1035E-11 | -10.508 | 9.2934E-01 |
| 144 | Mn+3 | 3. | 9.0561E-33 | 4.6830E-33 | -32.329 | 5.1711E-01 |
| 164 | H3SiO4- | -1. | 5.1818E-06 | 4.8157E-06 | -5.317 | 9.2934E-01 |
| 165 | H2SiO4-2 | -2. | 1.9329E-11 | 1.4418E-11 | -10.841 | 7.4594E-01 |
| 166 | SiF6-2 | -2. | 1.1712E-34 | 8.7361E-35 | -34.059 | 7.4594E-01 |
| 170 | BaOH+ | 1. | 1.1023E-12 | 1.0244E-12 | -11.990 | 9.2934E-01 |
| 171 | BaCO3 | 0. | 1.3231E-09 | 1.3246E-09 | -8.878 | 1.0011E+00 |
| 172 | BaHCO3+ | 1. | 8.5834E-09 | 7.9769E-09 | -8.098 | 9.2934E-01 |
| 173 | BaSO4 | 0. | 3.1889E-09 | 3.1924E-09 | -8.496 | 1.0011E+00 |
| 176 | SrOH+ | 1. | 4.8853E-12 | 4.5460E-12 | -11.342 | 9.3055E-01 |
| 177 | SrHCO3+ | 1. | 3.9320E-08 | 3.6610E-08 | -7.436 | 9.3109E-01 |
| 178 | SrCO3 | 0. | 4.4868E-09 | 4.4917E-09 | -8.348 | 1.0011E+00 |
| 179 | SrSO4 | 0. | 3.3431E-09 | 3.3468E-09 | -8.475 | 1.0011E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 2.754E-09 | 3.601E-09 | -8.560 | -8.444 | 7.650E-01 | -0.116 |
| 2 | Aragonit | 2.754E-09 | 5.073E-09 | -8.560 | -8.295 | 5.429E-01 | -0.265 |
| 3 | Dolomite | 1.029E-17 | 1.192E-17 | -16.987 | -16.924 | 8.636E-01 | -0.064 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Siderite | 9.075E-12 | 1.425E-11 | -11.042 | -10.846 | 6.370E-01 | -0.196 |
| 5 | Rhodochr | 2.983E-12 | 7.856E-12 | -11.525 | -11.105 | 3.797E-01 | -0.421 |
| 6 | Strontit | 8.652E-12 | 5.365E-10 | -11.063 | -9.270 | 1.613E-02 | -1.792 |
| 7 | Witherit | 2.951E-12 | 2.613E-09 | -11.530 | -8.583 | 1.129E-03 | -2.947 |
| 8 | Gypsum | 5.944E-09 | 2.618E-05 | -8.226 | -4.582 | 2.271E-04 | -3.644 |
| 9 | Anhydrit | 5.946E-09 | 4.577E-05 | -8.226 | -4.339 | 1.299E-04 | -3.886 |
| 10 | Celestit | 1.868E-11 | 2.394E-07 | -10.729 | -6.621 | 7.801E-05 | -4.108 |
| 11 | Barite | 6.370E-12 | 8.160E-11 | -11.196 | -10.088 | 7.806E-02 | -1.108 |
| 12 | Hydroxap | 9.505E-05 | 1.645E-03 | -4.022 | -2.784 | 5.778E-02 | -1.238 |
| 13 | Fluorite | 4.304E-14 | 2.063E-11 | -13.366 | -10.686 | 2.086E-03 | -2.681 |
| 14 | SiO2 (a) | 5.954E-04 | 1.695E-03 | -3.225 | -2.771 | 3.512E-01 | -0.454 |
| 15 | Chalcedy | 5.954E-04 | 2.320E-04 | -3.225 | -3.635 | 2.567E+00 | 0.409 |
| 16 | Quartz | 5.954E-04 | 8.204E-05 | -3.225 | -4.086 | 7.257E+00 | 0.861 |
| 26 | Talc | 2.503E+24 | 1.644E+22 | 24.399 | 22.216 | 1.523E+02 | 2.183 |
| 28 | Chrysotl | 7.060E+30 | 1.227E+33 | 30.849 | 33.089 | 5.754E-03 | -2.240 |
| 29 | Sepiol c | 1.551E+15 | 8.883E+15 | 15.190 | 15.949 | 1.745E-01 | -0.758 |
| 30 | Sepiol d | 1.551E+15 | 4.571E+18 | 15.190 | 18.660 | 3.392E-04 | -3.470 |
| 31 | Hematite | 9.026E+08 | 3.432E-04 | 8.955 | -3.464 | 2.630E+12 | 12.420 |
| 32 | Goethite | 3.004E+04 | 5.557E-02 | 4.478 | -1.255 | 5.406E+05 | 5.733 |
| 33 | Fe(OH)3a | 3.004E+04 | 7.780E+04 | 4.478 | 4.891 | 3.861E-01 | -0.413 |
| 37 | Vivianit | 9.018E-40 | 1.000E-36 | -39.045 | -36.000 | 9.018E-04 | -3.045 |
| 38 | Pyrolusi | 1.084E+25 | 3.369E+42 | 25.035 | 42.527 | 3.218E-18 | -17.492 |
| 39 | Hausmani | 5.075E+43 | 6.362E+62 | 43.705 | 62.804 | 7.976E-20 | -19.098 |
| 40 | Manganit | 1.531E+17 | 2.188E+25 | 17.185 | 25.340 | 7.000E-09 | -8.155 |
| 41 | Pyrochro | 2.163E+09 | 1.585E+15 | 9.335 | 15.200 | 1.365E-06 | -5.865 |
| 42 | PCO2 | 8.535E-05 | 4.158E-02 | -4.069 | -1.381 | 2.052E-03 | -2.688 |
| 44 | H2 gas | 1.517E-19 | 7.603E-04 | -18.819 | -3.119 | 1.995E-16 | -15.700 |
| 49 | Melanter | 1.957E-11 | 5.037E-03 | -10.708 | -2.298 | 3.886E-09 | -8.410 |
| 51 | K-Jarosi | 1.966E-24 | 2.194E-09 | -23.706 | -8.659 | 8.961E-16 | -15.048 |

**14. COP7**

INITIAL SOLUTION

TEMPERATURE = 19.90 DEGREES C PH = 7.740
ANALYTICAL EPMCAT = 3.677 ANALYTICAL EPMAN = 2.899

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.25843E-04 | -3.2791 | 2.10700E+01 |
| Mg+2 | 2.0 | 6.82978E-04 | -3.1656 | 1.66000E+01 |
| Na+ | 1.0 | 1.13690E-03 | -2.9443 | 2.61300E+01 |
| K+ | 1.0 | 1.13325E-04 | -3.9457 | 4.43000E+00 |

| | | | | |
|---|---|---|---|---|
| Fe+2 | 2.0 | 1.43288E-06 | -5.8438 | 8.00000E-02 |
| Mn+2 | 2.0 | 3.64147E-07 | -6.4387 | 2.00000E-02 |
| Ba+2 | 2.0 | 5.82656E-07 | -6.2346 | 8.00000E-02 |
| Sr+2 | 2.0 | 1.59825E-06 | -5.7964 | 1.40000E-01 |
| H4SiO4 | 0.0 | 5.50207E-04 | -3.2595 | 3.30500E+01 |
| Cl- | -1.0 | 7.67424E-05 | -4.1150 | 2.72000E+00 |
| HCO3- | -1.0 | 2.75998E-03 | -2.5591 | 1.68360E+02 |
| SO4-2 | -2.0 | 1.63482E-05 | -4.7865 | 1.57000E+00 |
| NO3- | -1.0 | 4.28484E-06 | -5.3681 | 6.00000E-02 |
| HPO4-2 | -2.0 | 4.84413E-06 | -5.3148 | 1.50000E-01 |
| F- | -1.0 | 1.36891E-05 | -4.8636 | 2.60000E-01 |
| Br- | -1.0 | 6.25923E-07 | -6.2035 | 5.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.68 | 3.63 | 7.740 | PCO2= 2.807870E-03 |
| EPMAN | 2.90 | 2.84 | | LOG PCO2 = -2.5516 |
| | | | TEMPERATURE | PO2 = 1.197125E-54 |
| EH = 0.0000 | PE = 0.000 | | 19.90 DEG C | PCH4 = 1.636860E-41 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.847563E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.435058E-03 | TDS = 274.8MG/L |
| TOT ALK = | 2.760E+00 MEQ | | | CARB ALK = 2.751E+00 MEQ |
| ELECT = | 7.830E-01 MEQ | | | CHARGE IMBALANCE = 12.1% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.9418E-08 | 1.8197E-08 | -7.740 | 9.3714E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.0898E-04 | 3.8527E-04 | -3.414 | 7.5695E-01 |
| 5 | Mg+2 | 2. | 6.6243E-04 | 5.0297E-04 | -3.298 | 7.5929E-01 |
| 6 | Na+ | 1. | 1.1353E-03 | 1.0578E-03 | -2.976 | 9.3176E-01 |
| 7 | K+ | 1. | 1.1332E-04 | 1.0544E-04 | -3.977 | 9.3052E-01 |
| 8 | Fe+2 | 2. | 1.0781E-06 | 8.1914E-07 | -6.087 | 7.5977E-01 |
| 9 | Mn+2 | 2. | 2.3737E-07 | 1.8035E-07 | -6.744 | 7.5977E-01 |
| 11 | Ba+2 | 2. | 5.6967E-07 | 4.3048E-07 | -6.366 | 7.5567E-01 |
| 12 | Sr+2 | 2. | 1.5515E-06 | 1.1755E-06 | -5.930 | 7.5769E-01 |
| 13 | H4SiO4 | 0. | 5.4625E-04 | 5.4680E-04 | -3.262 | 1.0010E+00 |
| 14 | Cl- | -1. | 7.6742E-05 | 7.1410E-05 | -4.146 | 9.3052E-01 |
| 15 | CO3-2 | -2. | 7.6621E-06 | 5.8027E-06 | -5.236 | 7.5733E-01 |
| 16 | SO4-2 | -2. | 1.4362E-05 | 1.0849E-05 | -4.965 | 7.5536E-01 |
| 17 | NO3- | -1. | 9.6307E-20 | 8.9535E-20 | -19.048 | 9.2969E-01 |
| 19 | PO4-3 | -3. | 9.0865E-11 | 4.7769E-11 | -10.321 | 5.2572E-01 |
| 20 | F- | -1. | 1.3242E-05 | 1.2320E-05 | -4.909 | 9.3037E-01 |
| 22 | Br- | -1. | 6.2592E-07 | 5.8191E-07 | -6.235 | 9.2969E-01 |
| 31 | OH- | -1. | 3.9779E-07 | 3.7009E-07 | -6.432 | 9.3037E-01 |
| 33 | H2 AQ | 0. | 2.4660E-19 | 2.4685E-19 | -18.608 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.6939E-03 | 2.5130E-03 | -2.600 | 9.3287E-01 |
| 35 | H2CO3 | 0. | 1.1024E-04 | 1.1035E-04 | -3.957 | 1.0010E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 40 | HSO4- | -1. | 1.8485E-11 | 1.7213E-11 | -10.764 | 9.3120E-01 |
| 48 | NO2- | -1. | 4.2848E-06 | 3.9836E-06 | -5.400 | 9.2969E-01 |
| 65 | HPO4-2 | -2. | 2.8464E-06 | 2.1389E-06 | -5.670 | 7.5143E-01 |
| 66 | H2PO4- | -1. | 6.9268E-07 | 6.4537E-07 | -6.190 | 9.3171E-01 |
| 69 | HF AQ | 0. | 3.0671E-10 | 3.0702E-10 | -9.513 | 1.0010E+00 |
| 70 | HF2- | -1. | 1.4932E-14 | 1.3905E-14 | -13.857 | 9.3120E-01 |
| 75 | CaOH+ | 1. | 3.7729E-09 | 3.5133E-09 | -8.454 | 9.3120E-01 |
| 76 | CaCO3 | 0. | 3.4198E-06 | 3.4233E-06 | -5.466 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.2141E-05 | 1.1326E-05 | -4.946 | 9.3287E-01 |
| 78 | CaSO4 | 0. | 7.9369E-07 | 7.9451E-07 | -6.100 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 9.5522E-14 | 8.8950E-14 | -13.051 | 9.3120E-01 |
| 80 | CaPO4- | -1. | 5.1919E-08 | 4.8347E-08 | -7.316 | 9.3120E-01 |
| 81 | CaHPO4 | 0. | 4.0964E-07 | 4.1006E-07 | -6.387 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 6.1824E-09 | 5.7571E-09 | -8.240 | 9.3120E-01 |
| 83 | CaF+ | 1. | 3.9334E-08 | 3.6627E-08 | -7.436 | 9.3120E-01 |
| 85 | MgOH+ | 1. | 6.8164E-08 | 6.3474E-08 | -7.197 | 9.3120E-01 |
| 86 | MgCO3 | 0. | 2.5726E-06 | 2.5753E-06 | -5.589 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.5569E-05 | 1.4497E-05 | -4.839 | 9.3120E-01 |
| 88 | MgSO4 | 0. | 1.1180E-06 | 1.1191E-06 | -5.951 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 9.1433E-08 | 8.5143E-08 | -7.070 | 9.3120E-01 |
| 90 | MgHPO4 | 0. | 7.2308E-07 | 7.2381E-07 | -6.140 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 1.0279E-08 | 9.5715E-09 | -8.019 | 9.3120E-01 |
| 92 | MgF+ | 1. | 4.0020E-07 | 3.7267E-07 | -6.429 | 9.3120E-01 |
| 93 | NaOH | 0. | 3.8363E-10 | 3.8402E-10 | -9.416 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 9.4477E-08 | 8.7977E-08 | -7.056 | 9.3120E-01 |
| 95 | NaHCO3 | 0. | 1.4860E-06 | 1.4875E-06 | -5.828 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 5.9765E-08 | 5.5653E-08 | -7.255 | 9.3120E-01 |
| 97 | NaHPO4- | -1. | 4.7373E-09 | 4.4114E-09 | -8.355 | 9.3120E-01 |
| 98 | NaF aq | 0. | 7.4912E-09 | 7.4989E-09 | -8.125 | 1.0010E+00 |
| 99 | KOH | 0. | 2.0069E-11 | 2.0090E-11 | -10.697 | 1.0010E+00 |
| 100 | KSO4- | -1. | 7.8844E-09 | 7.3420E-09 | -8.134 | 9.3120E-01 |
| 101 | KHPO4- | -1. | 4.7223E-10 | 4.3974E-10 | -9.357 | 9.3120E-01 |
| 102 | FeOH+ | 1. | 1.0372E-08 | 9.6588E-09 | -8.015 | 9.3120E-01 |
| 105 | FeCl+ | 1. | 8.6711E-11 | 8.0745E-11 | -10.093 | 9.3120E-01 |
| 106 | FeCO3 | 0. | 1.1391E-07 | 1.1402E-07 | -6.943 | 1.0010E+00 |
| 107 | FeHCO3+ | 1. | 2.1998E-07 | 2.0484E-07 | -6.689 | 9.3120E-01 |
| 108 | FeSO4 | 0. | 1.4358E-09 | 1.4373E-09 | -8.842 | 1.0010E+00 |
| 109 | FeHSO4+ | 1. | 2.0309E-16 | 1.8912E-16 | -15.723 | 9.3120E-01 |
| 112 | FeHPO4 | 0. | 6.9678E-09 | 6.9749E-09 | -8.156 | 1.0010E+00 |
| 113 | FeH2PO4+ | 1. | 2.8453E-10 | 2.6495E-10 | -9.577 | 9.3120E-01 |
| 114 | FeF+ | 1. | 1.0837E-10 | 1.0092E-10 | -9.996 | 9.3120E-01 |
| 115 | Fe+3 | 3. | 1.0559E-19 | 5.8867E-20 | -19.230 | 5.5748E-01 |
| 117 | FeOH+2 | 2. | 2.0464E-14 | 1.5387E-14 | -13.813 | 7.5192E-01 |
| 118 | FeOH2+ | 1. | 2.4695E-10 | 2.2996E-10 | -9.638 | 9.3120E-01 |
| 119 | FeOH3 | 0. | 1.2970E-09 | 1.2983E-09 | -8.887 | 1.0010E+00 |
| 120 | FeOH4- | -1. | 5.6717E-11 | 5.2815E-11 | -10.277 | 9.3120E-01 |
| 121 | Fe2OH2+4 | 4. | 2.4703E-26 | 7.8966E-27 | -26.103 | 3.1966E-01 |
| 122 | Fe3OH4+5 | 5. | 3.6387E-33 | 6.1238E-34 | -33.213 | 1.6830E-01 |
| 123 | FeCl+2 | 2. | 1.4323E-22 | 1.0769E-22 | -21.968 | 7.5192E-01 |
| 124 | FeCl2+ | 1. | 4.3486E-26 | 4.0494E-26 | -25.393 | 9.3120E-01 |
| 125 | FeCl3 | 0. | 2.8887E-31 | 2.8917E-31 | -30.539 | 1.0010E+00 |
| 126 | FeSO4+ | 1. | 6.7040E-21 | 6.2427E-21 | -20.205 | 9.3120E-01 |
| 127 | FeHSO4+2 | 2. | 6.0335E-28 | 4.5367E-28 | -27.343 | 7.5192E-01 |
| 128 | FeSO42- | -1. | 1.5592E-24 | 1.4520E-24 | -23.838 | 9.3120E-01 |
| 129 | FeHPO4+ | 1. | 3.0728E-20 | 2.8614E-20 | -19.543 | 9.3120E-01 |
| 130 | FeH2P+2 | 2. | 1.3472E-20 | 1.0130E-20 | -19.994 | 7.5192E-01 |
| 131 | FeF+2 | 2. | 1.4121E-18 | 1.0618E-18 | -17.974 | 7.5192E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 132 | FeF2+ | 1. | 5.2577E-19 | 4.8960E-19 | -18.310 | 9.3120E-01 |
| 133 | FeF3 | 0. | 9.3830E-21 | 9.3926E-21 | -20.027 | 1.0010E+00 |
| 134 | MnOH+ | 1. | 1.7920E-10 | 1.6687E-10 | -9.778 | 9.3120E-01 |
| 136 | MnCl+ | 1. | 5.6341E-11 | 5.2465E-11 | -10.280 | 9.3120E-01 |
| 137 | MnCl2 | 0. | 1.6338E-15 | 1.6354E-15 | -14.786 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 3.4542E-20 | 3.2165E-20 | -19.493 | 9.3120E-01 |
| 139 | MnCO3 | 0. | 8.3043E-08 | 8.3128E-08 | -7.080 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 4.3165E-08 | 4.0195E-08 | -7.396 | 9.3120E-01 |
| 141 | MnSO4 | 0. | 3.1482E-10 | 3.1514E-10 | -9.501 | 1.0010E+00 |
| 143 | MnF+ | 1. | 1.6507E-11 | 1.5371E-11 | -10.813 | 9.3120E-01 |
| 144 | Mn+3 | 3. | 4.9614E-33 | 2.6121E-33 | -32.583 | 5.2649E-01 |
| 164 | H3SiO4- | -1. | 3.9608E-06 | 3.6883E-06 | -5.433 | 9.3120E-01 |
| 165 | H2SiO4-2 | -2. | 1.3020E-11 | 9.7904E-12 | -11.009 | 7.5192E-01 |
| 166 | SiF6-2 | -2. | 6.8055E-34 | 5.1172E-34 | -33.291 | 7.5192E-01 |
| 170 | BaOH+ | 1. | 8.6073E-13 | 8.0151E-13 | -12.096 | 9.3120E-01 |
| 171 | BaCO3 | 0. | 1.1637E-09 | 1.1649E-09 | -8.934 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 9.4844E-09 | 8.8319E-09 | -8.054 | 9.3120E-01 |
| 173 | BaSO4 | 0. | 2.3383E-09 | 2.3407E-09 | -8.631 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 3.5531E-12 | 3.3128E-12 | -11.480 | 9.3236E-01 |
| 177 | SrHCO3+ | 1. | 4.0681E-08 | 3.7950E-08 | -7.421 | 9.3287E-01 |
| 178 | SrCO3 | 0. | 3.7418E-09 | 3.7457E-09 | -8.426 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 2.3369E-09 | 2.3393E-09 | -8.631 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 2.236E-09 | 3.525E-09 | -8.651 | -8.453 | 6.342E-01 | -0.198 |
| 2 | Aragonit | 2.236E-09 | 4.951E-09 | -8.651 | -8.305 | 4.515E-01 | -0.345 |
| 3 | Dolomite | 6.525E-18 | 1.072E-17 | -17.185 | -16.970 | 6.084E-01 | -0.216 |
| 4 | Siderite | 4.753E-12 | 1.386E-11 | -11.323 | -10.858 | 3.430E-01 | -0.465 |
| 5 | Rhodochr | 1.047E-12 | 7.731E-12 | -11.980 | -11.112 | 1.354E-01 | -0.868 |
| 6 | Strontit | 6.821E-12 | 5.381E-10 | -11.166 | -9.269 | 1.268E-02 | -1.897 |
| 7 | Witherit | 2.498E-12 | 2.659E-09 | -11.602 | -8.575 | 9.394E-04 | -3.027 |
| 8 | Gypsum | 4.179E-09 | 2.623E-05 | -8.379 | -4.581 | 1.593E-04 | -3.798 |
| 9 | Anhydrit | 4.180E-09 | 4.533E-05 | -8.379 | -4.344 | 9.220E-05 | -4.035 |
| 10 | Celestit | 1.275E-11 | 2.385E-07 | -10.894 | -6.622 | 5.346E-05 | -4.272 |
| 11 | Barite | 4.670E-12 | 8.819E-11 | -11.331 | -10.055 | 5.295E-02 | -1.276 |
| 12 | Hydroxap | 7.574E-04 | 1.097E-03 | -3.121 | -2.960 | 6.904E-01 | -0.161 |
| 13 | Fluorite | 5.847E-14 | 2.182E-11 | -13.233 | -10.661 | 2.680E-03 | -2.572 |
| 14 | SiO2 (a) | 5.469E-04 | 1.760E-03 | -3.262 | -2.754 | 3.107E-01 | -0.508 |
| 15 | Chalcedy | 5.469E-04 | 2.446E-04 | -3.262 | -3.612 | 2.236E+00 | 0.350 |
| 16 | Quartz | 5.469E-04 | 8.774E-05 | -3.262 | -4.057 | 6.234E+00 | 0.795 |
| 26 | Talc | 3.134E+23 | 9.779E+21 | 23.496 | 21.990 | 3.205E+01 | 1.506 |
| 28 | Chrysotl | 1.048E+30 | 6.979E+32 | 30.020 | 32.844 | 1.501E-03 | -2.824 |
| 29 | Sepiol c | 3.772E+14 | 7.879E+15 | 14.577 | 15.896 | 4.787E-02 | -1.320 |
| 30 | Sepiol d | 3.772E+14 | 4.571E+18 | 14.577 | 18.660 | 8.253E-05 | -4.083 |
| 31 | Hematite | 9.541E+07 | 2.429E-04 | 7.980 | -3.615 | 3.928E+11 | 11.594 |
| 32 | Goethite | 9.768E+03 | 6.536E-02 | 3.990 | -1.185 | 1.495E+05 | 5.175 |
| 33 | Fe(OH)3a | 9.767E+03 | 7.780E+04 | 3.990 | 4.891 | 1.255E-01 | -0.901 |
| 37 | Vivianit | 1.253E-39 | 1.000E-36 | -38.902 | -36.000 | 1.253E-03 | -2.902 |
| 38 | Pyrolusi | 1.644E+24 | 1.624E+42 | 24.216 | 42.211 | 1.013E-18 | -17.995 |
| 39 | Hausmani | 4.877E+41 | 2.060E+62 | 41.688 | 62.314 | 2.368E-21 | -20.626 |
| 40 | Manganit | 2.992E+16 | 2.188E+25 | 16.476 | 25.340 | 1.368E-09 | -8.864 |
| 41 | Pyrochro | 5.445E+08 | 1.585E+15 | 8.736 | 15.200 | 3.436E-07 | -6.464 |
| 42 | PCO2 | 1.104E-04 | 3.930E-02 | -3.957 | -1.406 | 2.808E-03 | -2.552 |
| 44 | H2 gas | 2.469E-19 | 7.455E-04 | -18.608 | -3.128 | 3.311E-16 | -15.480 |
| 49 | Melanter | 8.880E-12 | 5.334E-03 | -11.052 | -2.273 | 1.665E-09 | -8.779 |
| 51 | K-Jarosi | 6.968E-26 | 1.545E-09 | -25.157 | -8.811 | 4.509E-17 | -16.346 |

**15. CLAYSTREET**

INITIAL SOLUTION

TEMPERATURE = 20.70 DEGREES C PH = 7.720
ANALYTICAL EPMCAT = 5.549 ANALYTICAL EPMAN = 2.653

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 1.03021E-03 | -2.9871 | 4.12800E+01 |
| Mg+2 | 2.0 | 1.22029E-03 | -2.9135 | 2.96600E+01 |
| Na+ | 1.0 | 8.68436E-04 | -3.0613 | 1.99600E+01 |
| K+ | 1.0 | 1.71391E-04 | -3.7660 | 6.70000E+00 |
| Mn+2 | 2.0 | 7.28282E-07 | -6.1377 | 4.00000E-02 |
| Ba+2 | 2.0 | 4.36985E-07 | -6.3595 | 6.00000E-02 |
| Sr+2 | 2.0 | 2.16902E-06 | -5.6637 | 1.90000E-01 |
| H4SiO4 | 0.0 | 3.97874E-05 | -4.4003 | 2.39000E+00 |
| Cl- | -1.0 | 5.36060E-05 | -4.2708 | 1.90000E+00 |
| HCO3- | -1.0 | 2.51994E-03 | -2.5986 | 1.53720E+02 |
| SO4-2 | -2.0 | 3.00927E-05 | -4.5215 | 2.89000E+00 |
| NO3- | -1.0 | 1.42826E-06 | -5.8452 | 2.00000E-02 |
| H3BO3 | 0.0 | 9.25309E-07 | -6.0337 | 1.00000E-02 |
| HPO4-2 | -2.0 | 9.68812E-07 | -6.0138 | 3.00000E-02 |
| F- | -1.0 | 1.42154E-05 | -4.8472 | 2.70000E-01 |
| Br- | -1.0 | 3.75548E-07 | -6.4253 | 3.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 5.55 | 5.47 | PH 7.720 | ACTIVITY H2O = 0.9999 |
| EPMAN | 2.65 | 2.57 | | PCO2= 2.660507E-03 |
| | | | | LOG PCO2 = -2.5750 |
| | | | TEMPERATURE | PO2 = 1.898215E-54 |
| EH = 0.0000 | PE = 0.000 | | 20.70 DEG C | PCH4 = 1.694909E-41 |
| PE CALC S = 0.000 | | | | CO2 TOT = 2.603484E-03 |
| PE CALC DOX= 0.000 | | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= 0.000 | | | 6.244111E-03 | TDS = 259.1MG/L |
| TOT ALK = 2.520E+00 MEQ | | | | CARB ALK = 2.518E+00 MEQ |
| ELECT = 2.897E+00 MEQ | | | | CHARGE IMBALANCE = 36.0% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

## DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.0535E-08 | 1.9055E-08 | -7.720 | 9.2789E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 1.0009E-03 | 7.2360E-04 | -3.141 | 7.2292E-01 |
| 5 | Mg+2 | 2. | 1.1879E-03 | 8.6241E-04 | -3.064 | 7.2597E-01 |
| 6 | Na+ | 1. | 8.6728E-04 | 7.9857E-04 | -3.098 | 9.2077E-01 |
| 7 | K+ | 1. | 1.7137E-04 | 1.5750E-04 | -3.803 | 9.1906E-01 |
| 9 | Mn+2 | 2. | 5.0164E-07 | 3.6445E-07 | -6.438 | 7.2651E-01 |
| 11 | Ba+2 | 2. | 4.2723E-07 | 3.0812E-07 | -6.511 | 7.2121E-01 |
| 12 | Sr+2 | 2. | 2.1105E-06 | 1.5277E-06 | -5.816 | 7.2387E-01 |
| 13 | H4SiO4 | 0. | 3.9502E-05 | 3.9559E-05 | -4.403 | 1.0014E+00 |
| 14 | Cl- | -1. | 5.3606E-05 | 4.9267E-05 | -4.307 | 9.1906E-01 |
| 15 | CO3-2 | -2. | 6.9811E-06 | 5.0498E-06 | -5.297 | 7.2336E-01 |
| 16 | SO4-2 | -2. | 2.4386E-05 | 1.7577E-05 | -4.755 | 7.2079E-01 |
| 17 | NO3- | -1. | 3.5923E-20 | 3.2975E-20 | -19.482 | 9.1793E-01 |
| 18 | H3BO3 | 0. | 8.9804E-07 | 8.9934E-07 | -6.046 | 1.0014E+00 |
| 19 | PO4-3 | -3. | 1.5769E-11 | 7.4293E-12 | -11.129 | 4.7113E-01 |
| 20 | F- | -1. | 1.3427E-05 | 1.2338E-05 | -4.909 | 9.1886E-01 |
| 22 | Br- | -1. | 3.7555E-07 | 3.4473E-07 | -6.463 | 9.1793E-01 |
| 31 | OH- | -1. | 4.0990E-07 | 3.7664E-07 | -6.424 | 9.1886E-01 |
| 33 | H2 AQ | 0. | 2.6807E-19 | 2.6845E-19 | -18.571 | 1.0014E+00 |
| 34 | HCO3- | -1. | 2.4384E-03 | 2.2488E-03 | -2.648 | 9.2223E-01 |
| 35 | H2CO3 | 0. | 1.0201E-04 | 1.0215E-04 | -3.991 | 1.0014E+00 |
| 40 | HSO4- | -1. | 3.2277E-11 | 2.9696E-11 | -10.527 | 9.2003E-01 |
| 48 | NO2- | -1. | 1.4283E-06 | 1.3110E-06 | -5.882 | 9.1793E-01 |
| 57 | H2BO3- | -1. | 2.7261E-08 | 2.5081E-08 | -7.601 | 9.2003E-01 |
| 58 | BFOH3- | -1. | 4.5868E-12 | 4.2200E-12 | -11.375 | 9.2003E-01 |
| 59 | BF2OH2- | -1. | 1.1622E-16 | 1.0692E-16 | -15.971 | 9.2003E-01 |
| 60 | BF3OH- | -1. | 3.2450E-23 | 2.9855E-23 | -22.525 | 9.2003E-01 |
| 61 | BF4- | -1. | 3.1259E-29 | 2.8759E-29 | -28.541 | 9.2003E-01 |
| 65 | HPO4-2 | -2. | 4.7872E-07 | 3.4262E-07 | -6.465 | 7.1569E-01 |
| 66 | H2PO4- | -1. | 1.1704E-07 | 1.0775E-07 | -6.968 | 9.2067E-01 |
| 69 | HF AQ | 0. | 3.2606E-10 | 3.2653E-10 | -9.486 | 1.0014E+00 |
| 70 | HF2- | -1. | 1.6213E-14 | 1.4916E-14 | -13.826 | 9.2003E-01 |
| 75 | CaOH+ | 1. | 6.8494E-09 | 6.3016E-09 | -8.201 | 9.2003E-01 |
| 76 | CaCO3 | 0. | 5.6614E-06 | 5.6695E-06 | -5.246 | 1.0014E+00 |
| 77 | CaHCO3+ | 1. | 2.0949E-05 | 1.9320E-05 | -4.714 | 9.2223E-01 |
| 78 | CaSO4 | 0. | 2.4329E-06 | 2.4364E-06 | -5.613 | 1.0014E+00 |
| 79 | CaHSO4 | 1. | 3.0807E-13 | 2.8343E-13 | -12.548 | 9.2003E-01 |
| 80 | CaPO4- | -1. | 1.5574E-08 | 1.4328E-08 | -7.844 | 9.2003E-01 |
| 81 | CaHPO4 | 0. | 1.2511E-07 | 1.2529E-07 | -6.902 | 1.0014E+00 |
| 82 | CaH2PO4+ | 1. | 1.9937E-09 | 1.8342E-09 | -8.737 | 9.2003E-01 |
| 83 | CaF+ | 1. | 7.6337E-08 | 7.0232E-08 | -7.153 | 9.2003E-01 |
| 85 | MgOH+ | 1. | 1.2151E-07 | 1.1179E-07 | -6.952 | 9.2003E-01 |
| 86 | MgCO3 | 0. | 3.8846E-06 | 3.8902E-06 | -5.410 | 1.0014E+00 |
| 87 | MgHCO3+ | 1. | 2.4244E-05 | 2.2305E-05 | -4.652 | 9.2003E-01 |
| 88 | MgSO4 | 0. | 3.1712E-06 | 3.1758E-06 | -5.498 | 1.0014E+00 |
| 89 | MgPO4- | -1. | 2.5038E-08 | 2.3036E-08 | -7.638 | 9.2003E-01 |
| 90 | MgHPO4 | 0. | 2.0160E-07 | 2.0189E-07 | -6.695 | 1.0014E+00 |
| 91 | MgH2PO4+ | 1. | 3.0260E-09 | 2.7840E-09 | -8.555 | 9.2003E-01 |
| 92 | MgF+ | 1. | 7.0602E-07 | 6.4956E-07 | -6.187 | 9.2003E-01 |
| 93 | NaOH | 0. | 2.7647E-10 | 2.7686E-10 | -9.558 | 1.0014E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 94 | NaCO3- | -1. | 6.5496E-08 | 6.0258E-08 | -7.220 | 9.2003E-01 |
| 95 | NaHCO3 | 0. | 1.0050E-06 | 1.0064E-06 | -5.997 | 1.0014E+00 |
| 96 | NaSO4- | -1. | 7.4378E-08 | 6.8430E-08 | -7.165 | 9.2003E-01 |
| 97 | NaHPO4- | -1. | 5.7985E-10 | 5.3348E-10 | -9.273 | 9.2003E-01 |
| 98 | NaF aq | 0. | 5.6613E-09 | 5.6695E-09 | -8.246 | 1.0014E+00 |
| 99 | KOH | 0. | 2.8616E-11 | 2.8657E-11 | -10.543 | 1.0014E+00 |
| 100 | KSO4- | -1. | 1.9593E-08 | 1.8026E-08 | -7.744 | 9.2003E-01 |
| 101 | KHPO4- | -1. | 1.1436E-10 | 1.0522E-10 | -9.978 | 9.2003E-01 |
| 134 | MnOH+ | 1. | 3.7440E-10 | 3.4446E-10 | -9.463 | 9.2003E-01 |
| 136 | MnCl+ | 1. | 7.9505E-11 | 7.3147E-11 | -10.136 | 9.2003E-01 |
| 137 | MnCl2 | 0. | 1.5708E-15 | 1.5731E-15 | -14.803 | 1.0014E+00 |
| 138 | MnCl3- | -1. | 2.3201E-20 | 2.1346E-20 | -19.671 | 9.2003E-01 |
| 139 | MnCO3 | 0. | 1.4598E-07 | 1.4619E-07 | -6.835 | 1.0014E+00 |
| 140 | MnHCO3+ | 1. | 7.9124E-08 | 7.2797E-08 | -7.138 | 9.2003E-01 |
| 141 | MnSO4 | 0. | 1.0467E-09 | 1.0482E-09 | -8.980 | 1.0014E+00 |
| 143 | MnF+ | 1. | 3.3812E-11 | 3.1108E-11 | -10.507 | 9.2003E-01 |
| 144 | Mn+3 | 3. | 1.2609E-32 | 5.9552E-33 | -32.225 | 4.7231E-01 |
| 164 | H3SiO4- | -1. | 2.8529E-07 | 2.6247E-07 | -6.581 | 9.2003E-01 |
| 165 | H2SiO4-2 | -2. | 9.8123E-13 | 7.0304E-13 | -12.153 | 7.1649E-01 |
| 166 | SiF6-2 | -2. | 5.8077E-35 | 4.1612E-35 | -34.381 | 7.1649E-01 |
| 170 | BaOH+ | 1. | 5.9550E-13 | 5.4787E-13 | -12.261 | 9.2003E-01 |
| 171 | BaCO3 | 0. | 7.3628E-10 | 7.3734E-10 | -9.132 | 1.0014E+00 |
| 172 | BaHCO3+ | 1. | 6.3052E-09 | 5.8010E-09 | -8.236 | 9.2003E-01 |
| 173 | BaSO4 | 0. | 2.7105E-09 | 2.7144E-09 | -8.566 | 1.0014E+00 |
| 176 | SrOH+ | 1. | 4.4616E-12 | 4.1115E-12 | -11.386 | 9.2154E-01 |
| 177 | SrHCO3+ | 1. | 4.9184E-08 | 4.5359E-08 | -7.343 | 9.2223E-01 |
| 178 | SrCO3 | 0. | 4.3313E-09 | 4.3376E-09 | -8.363 | 1.0014E+00 |
| 179 | SrSO4 | 0. | 4.9666E-09 | 4.9738E-09 | -8.303 | 1.0014E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 3.654E-09 | 3.493E-09 | -8.437 | -8.457 | 1.046E+00 | 0.020 |
| 2 | Aragonit | 3.654E-09 | 4.899E-09 | -8.437 | -8.310 | 7.459E-01 | -0.127 |
| 3 | Dolomite | 1.591E-17 | 1.026E-17 | -16.798 | -16.989 | 1.551E+00 | 0.191 |
| 5 | Rhodochr | 1.840E-12 | 7.680E-12 | -11.735 | -11.115 | 2.396E-01 | -0.620 |
| 6 | Strontit | 7.715E-12 | 5.385E-10 | -11.113 | -9.269 | 1.433E-02 | -1.844 |
| 7 | Witherit | 1.556E-12 | 2.676E-09 | -11.808 | -8.572 | 5.814E-04 | -3.236 |
| 8 | Gypsum | 1.272E-08 | 2.625E-05 | -7.896 | -4.581 | 4.845E-04 | -3.315 |
| 9 | Anhydrit | 1.272E-08 | 4.511E-05 | -7.896 | -4.346 | 2.820E-04 | -3.550 |
| 10 | Celestit | 2.685E-11 | 2.380E-07 | -10.571 | -6.623 | 1.128E-04 | -3.948 |
| 11 | Barite | 5.416E-12 | 9.104E-11 | -11.266 | -10.041 | 5.949E-02 | -1.226 |
| 12 | Hydroxap | 6.052E-05 | 9.264E-04 | -4.218 | -3.033 | 6.532E-02 | -1.185 |
| 13 | Fluorite | 1.101E-13 | 2.233E-11 | -12.958 | -10.651 | 4.933E-03 | -2.307 |
| 14 | SiO2 (a) | 3.957E-05 | 1.788E-03 | -4.403 | -2.748 | 2.213E-02 | -1.655 |
| 15 | Chalcedy | 3.957E-05 | 2.500E-04 | -4.403 | -3.602 | 1.582E-01 | -0.801 |
| 16 | Quartz | 3.957E-05 | 9.023E-05 | -4.403 | -4.045 | 4.385E-01 | -0.358 |
| 26 | Talc | 3.283E+19 | 7.874E+21 | 19.516 | 21.896 | 4.170E-03 | -2.380 |
| 28 | Chrysotl | 2.097E+28 | 5.515E+32 | 28.322 | 32.742 | 3.802E-05 | -4.420 |
| 29 | Sepiol c | 3.493E+11 | 7.495E+15 | 11.543 | 15.875 | 4.660E-05 | -4.332 |
| 30 | Sepiol d | 3.493E+11 | 4.571E+18 | 11.543 | 18.660 | 7.642E-08 | -7.117 |
| 38 | Pyrolusi | 2.764E+24 | 1.198E+42 | 24.442 | 42.078 | 2.308E-18 | -17.637 |
| 39 | Hausmani | 2.784E+42 | 1.287E+62 | 42.445 | 62.110 | 2.164E-20 | -19.665 |
| 40 | Manganit | 5.267E+16 | 2.188E+25 | 16.722 | 25.340 | 2.407E-09 | -8.618 |
| 41 | Pyrochro | 1.004E+09 | 1.585E+15 | 9.002 | 15.200 | 6.332E-07 | -6.198 |
| 42 | PCO2 | 1.022E-04 | 3.840E-02 | -3.991 | -1.416 | 2.661E-03 | -2.575 |
| 44 | H2 gas | 2.685E-19 | 7.394E-04 | -18.571 | -3.131 | 3.631E-16 | -15.440 |

**16. FAIRVIEW**

INITIAL SOLUTION

TEMPERATURE = 20.00 DEGREES C PH = 7.700
ANALYTICAL EPMCAT = 3.387 ANALYTICAL EPMAN = 2.676

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.24088E-04 | -3.2806 | 2.10000E+01 |
| Mg+2 | 2.0 | 5.36088E-04 | -3.2708 | 1.30300E+01 |
| Na+ | 1.0 | 1.15777E-03 | -2.9364 | 2.66100E+01 |
| K+ | 1.0 | 1.05649E-04 | -3.9761 | 4.13000E+00 |
| Ba+2 | 2.0 | 2.18493E-07 | -6.6606 | 3.00000E-02 |
| Sr+2 | 2.0 | 1.02743E-06 | -5.9882 | 9.00000E-02 |
| H4SiO4 | 0.0 | 6.06633E-04 | -3.2171 | 3.64400E+01 |
| Cl- | -1.0 | 5.21953E-05 | -4.2824 | 1.85000E+00 |
| HCO3- | -1.0 | 2.45896E-03 | -2.6092 | 1.50000E+02 |
| SO4-2 | -2.0 | 5.20634E-05 | -4.2835 | 5.00000E+00 |
| NO3- | -1.0 | 3.78488E-05 | -4.4219 | 5.30000E-01 |
| HPO4-2 | -2.0 | 2.26056E-06 | -5.6458 | 7.00000E-02 |
| F- | -1.0 | 1.73744E-05 | -4.7601 | 3.30000E-01 |
| Br- | -1.0 | 2.50365E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| | | | PH | ACTIVITY H2O = 0.9999 |
| EPMCAT | 3.39 | 3.34 | 7.700 | PCO2= 2.762768E-03 |
| EPMAN | 2.68 | 2.63 | | LOG PCO2 = -2.5587 |
| | | | TEMPERATURE | PO2 = 8.979456E-55 |
| EH = 0.0000 | PE = 0.000 | | 20.00 DEG C | PCH4 = 3.249078E-41 |
| PE CALC S = 0.000 | | | | CO2 TOT = 2.549996E-03 |
| PE CALC DOX= 0.000 | | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= 0.000 | | | 4.066591E-03 | TDS = 259.1MG/L |
| TOT ALK = 2.459E+00 MEQ | | | | CARB ALK = 2.453E+00 MEQ |
| ELECT = 7.132E-01 MEQ | | | | CHARGE IMBALANCE = 11.9% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.1242E-08 | 1.9953E-08 | -7.700 | 9.3930E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.0742E-04 | 3.8817E-04 | -3.411 | 7.6500E-01 |
| 5 | Mg+2 | 2. | 5.1972E-04 | 3.9872E-04 | -3.399 | 7.6718E-01 |
| 6 | Na+ | 1. | 1.1561E-03 | 1.0802E-03 | -2.967 | 9.3430E-01 |
| 7 | K+ | 1. | 1.0562E-04 | 9.8564E-05 | -4.006 | 9.3315E-01 |
| 11 | Ba+2 | 2. | 2.1206E-07 | 1.6198E-07 | -6.791 | 7.6382E-01 |
| 12 | Sr+2 | 2. | 9.9679E-07 | 7.6323E-07 | -6.117 | 7.6569E-01 |
| 13 | H4SiO4 | 0. | 6.0264E-04 | 6.0321E-04 | -3.220 | 1.0009E+00 |
| 14 | Cl- | -1. | 5.2195E-05 | 4.8706E-05 | -4.312 | 9.3315E-01 |
| 15 | CO3-2 | -2. | 6.2105E-06 | 4.7533E-06 | -5.323 | 7.6536E-01 |
| 16 | SO4-2 | -2. | 4.6326E-05 | 3.5371E-05 | -4.451 | 7.6353E-01 |
| 17 | NO3- | -1. | 7.2596E-19 | 6.7687E-19 | -18.169 | 9.3239E-01 |
| 19 | PO4-3 | -3. | 3.8995E-11 | 2.1021E-11 | -10.677 | 5.3907E-01 |
| 20 | F- | -1. | 1.6908E-05 | 1.5775E-05 | -4.802 | 9.3302E-01 |
| 22 | Br- | -1. | 2.5037E-07 | 2.3344E-07 | -6.632 | 9.3239E-01 |
| 31 | OH- | -1. | 3.6466E-07 | 3.4023E-07 | -6.468 | 9.3302E-01 |
| 33 | H2 AQ | 0. | 2.9620E-19 | 2.9648E-19 | -18.528 | 1.0009E+00 |
| 34 | HCO3- | -1. | 2.4077E-03 | 2.2520E-03 | -2.647 | 9.3533E-01 |
| 35 | H2CO3 | 0. | 1.0816E-04 | 1.0826E-04 | -3.966 | 1.0009E+00 |
| 40 | HSO4- | -1. | 6.6036E-11 | 6.1663E-11 | -10.210 | 9.3378E-01 |
| 48 | NO2- | -1. | 3.7849E-05 | 3.5290E-05 | -4.452 | 9.3239E-01 |
| 65 | HPO4-2 | -2. | 1.3554E-06 | 1.0299E-06 | -5.987 | 7.5986E-01 |
| 66 | H2PO4- | -1. | 3.6450E-07 | 3.4054E-07 | -6.468 | 9.3426E-01 |
| 69 | HF AQ | 0. | 4.3142E-10 | 4.3182E-10 | -9.365 | 1.0009E+00 |
| 70 | HF2- | -1. | 2.6842E-14 | 2.5065E-14 | -13.601 | 9.3378E-01 |
| 75 | CaOH+ | 1. | 3.4573E-09 | 3.2284E-09 | -8.491 | 9.3378E-01 |
| 76 | CaCO3 | 0. | 2.8273E-06 | 2.8299E-06 | -5.548 | 1.0009E+00 |
| 77 | CaHCO3+ | 1. | 1.0953E-05 | 1.0245E-05 | -4.989 | 9.3533E-01 |
| 78 | CaSO4 | 0. | 2.6100E-06 | 2.6124E-06 | -5.583 | 1.0009E+00 |
| 79 | CaHSO4 | 1. | 3.4311E-13 | 3.2039E-13 | -12.494 | 9.3378E-01 |
| 80 | CaPO4- | -1. | 2.2997E-08 | 2.1474E-08 | -7.668 | 9.3378E-01 |
| 81 | CaHPO4 | 0. | 1.9913E-07 | 1.9932E-07 | -6.700 | 1.0009E+00 |
| 82 | CaH2PO4+ | 1. | 3.2842E-09 | 3.0668E-09 | -8.513 | 9.3378E-01 |
| 83 | CaF+ | 1. | 5.0728E-08 | 4.7369E-08 | -7.325 | 9.3378E-01 |
| 85 | MgOH+ | 1. | 4.9596E-08 | 4.6311E-08 | -7.334 | 9.3378E-01 |
| 86 | MgCO3 | 0. | 1.6733E-06 | 1.6748E-06 | -5.776 | 1.0009E+00 |
| 87 | MgHCO3+ | 1. | 1.1033E-05 | 1.0302E-05 | -4.987 | 9.3378E-01 |
| 88 | MgSO4 | 0. | 2.8975E-06 | 2.9002E-06 | -5.538 | 1.0009E+00 |
| 89 | MgPO4- | -1. | 3.1865E-08 | 2.9755E-08 | -7.526 | 9.3378E-01 |
| 90 | MgHPO4 | 0. | 2.7656E-07 | 2.7682E-07 | -6.558 | 1.0009E+00 |
| 91 | MgH2PO4+ | 1. | 4.2961E-09 | 4.0116E-09 | -8.397 | 9.3378E-01 |
| 92 | MgF+ | 1. | 4.0587E-07 | 3.7899E-07 | -6.421 | 9.3378E-01 |
| 93 | NaOH | 0. | 3.5731E-10 | 3.5764E-10 | -9.447 | 1.0009E+00 |
| 94 | NaCO3- | -1. | 7.9222E-08 | 7.3976E-08 | -7.131 | 9.3378E-01 |
| 95 | NaHCO3 | 0. | 1.3602E-06 | 1.3615E-06 | -5.866 | 1.0009E+00 |
| 96 | NaSO4- | -1. | 1.9856E-07 | 1.8541E-07 | -6.732 | 9.3378E-01 |
| 97 | NaHPO4- | -1. | 2.3229E-09 | 2.1691E-09 | -8.664 | 9.3378E-01 |
| 98 | NaF aq | 0. | 9.7962E-09 | 9.8054E-09 | -8.009 | 1.0009E+00 |
| 99 | KOH | 0. | 1.7111E-11 | 1.7127E-11 | -10.766 | 1.0009E+00 |
| 100 | KSO4- | -1. | 2.4006E-08 | 2.2416E-08 | -7.649 | 9.3378E-01 |
| 101 | KHPO4- | -1. | 2.1196E-10 | 1.9793E-10 | -9.703 | 9.3378E-01 |
| 164 | H3SiO4- | -1. | 3.9887E-06 | 3.7245E-06 | -5.429 | 9.3378E-01 |
| 165 | H2SiO4-2 | -2. | 1.1942E-11 | 9.0793E-12 | -11.042 | 7.6029E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 166 | SiF6-2 | -2. | 4.6858E-33 | 3.5626E-33 | -32.448 | 7.6029E-01 |
| 170 | BaOH+ | 1. | 2.9456E-13 | 2.7505E-13 | -12.561 | 9.3378E-01 |
| 171 | BaCO3 | 0. | 3.5943E-10 | 3.5976E-10 | -9.444 | 1.0009E+00 |
| 172 | BaHCO3+ | 1. | 3.1992E-09 | 2.9874E-09 | -8.525 | 9.3378E-01 |
| 173 | BaSO4 | 0. | 2.8688E-09 | 2.8715E-09 | -8.542 | 1.0009E+00 |
| 176 | SrOH+ | 1. | 2.0983E-12 | 1.9616E-12 | -11.707 | 9.3486E-01 |
| 177 | SrHCO3+ | 1. | 2.3687E-08 | 2.2156E-08 | -7.655 | 9.3533E-01 |
| 178 | SrCO3 | 0. | 1.9961E-09 | 1.9980E-09 | -8.699 | 1.0009E+00 |
| 179 | SrSO4 | 0. | 4.9533E-09 | 4.9579E-09 | -8.305 | 1.0009E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.845E-09 | 3.521E-09 | -8.734 | -8.453 | 5.240E-01 | -0.281 |
| 2 | Aragonit | 1.845E-09 | 4.945E-09 | -8.734 | -8.306 | 3.732E-01 | -0.428 |
| 3 | Dolomite | 3.497E-18 | 1.067E-17 | -17.456 | -16.972 | 3.279E-01 | -0.484 |
| 6 | Strontit | 3.628E-12 | 5.382E-10 | -11.440 | -9.269 | 6.741E-03 | -2.171 |
| 7 | Witherit | 7.699E-13 | 2.661E-09 | -12.114 | -8.575 | 2.893E-04 | -3.539 |
| 8 | Gypsum | 1.373E-08 | 2.623E-05 | -7.862 | -4.581 | 5.233E-04 | -3.281 |
| 9 | Anhydrit | 1.373E-08 | 4.531E-05 | -7.862 | -4.344 | 3.031E-04 | -3.518 |
| 10 | Celestit | 2.700E-11 | 2.385E-07 | -10.569 | -6.623 | 1.132E-04 | -3.946 |
| 11 | Barite | 5.729E-12 | 8.855E-11 | -11.242 | -10.053 | 6.470E-02 | -1.189 |
| 12 | Hydroxap | 6.074E-05 | 1.074E-03 | -4.217 | -2.969 | 5.655E-02 | -1.248 |
| 13 | Fluorite | 9.660E-14 | 2.188E-11 | -13.015 | -10.660 | 4.415E-03 | -2.355 |
| 14 | SiO2 (a) | 6.033E-04 | 1.764E-03 | -3.219 | -2.754 | 3.421E-01 | -0.466 |
| 15 | Chalcedy | 6.033E-04 | 2.453E-04 | -3.219 | -3.610 | 2.460E+00 | 0.391 |
| 16 | Quartz | 6.033E-04 | 8.805E-05 | -3.219 | -4.055 | 6.852E+00 | 0.836 |
| 26 | Talc | 1.331E+23 | 9.517E+21 | 23.124 | 21.979 | 1.398E+01 | 1.146 |
| 28 | Chrysotl | 3.655E+29 | 6.776E+32 | 29.563 | 32.831 | 5.394E-04 | -3.268 |
| 29 | Sepiol c | 2.202E+14 | 7.830E+15 | 14.343 | 15.894 | 2.812E-02 | -1.551 |
| 30 | Sepiol d | 2.202E+14 | 4.571E+18 | 14.343 | 18.660 | 4.817E-05 | -4.317 |
| 42 | PCO2 | 1.083E-04 | 3.919E-02 | -3.966 | -1.407 | 2.763E-03 | -2.559 |
| 44 | H2 gas | 2.965E-19 | 7.447E-04 | -18.528 | -3.128 | 3.981E-16 | -15.400 |

**17. GLENWOOD**

INITIAL SOLUTION

TEMPERATURE = 20.00 DEGREES C PH = 7.700
ANALYTICAL EPMCAT = 3.406 ANALYTICAL EPMAN = 2.747

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.34316E-04 | -3.2722 | 2.14100E+01 |

| | | | | |
|---|---|---|---|---|
| Mg+2 | 2.0 | 5.94918E-04 | -3.2255 | 1.44600E+01 |
| Na+ | 1.0 | 1.05813E-03 | -2.9755 | 2.43200E+01 |
| K+ | 1.0 | 8.51834E-05 | -4.0696 | 3.33000E+00 |
| Mn+2 | 2.0 | 1.82069E-07 | -6.7398 | 1.00000E-02 |
| Ba+2 | 2.0 | 4.36982E-07 | -6.3595 | 6.00000E-02 |
| Sr+2 | 2.0 | 1.25574E-06 | -5.9011 | 1.10000E-01 |
| H4SiO4 | 0.0 | 5.19231E-04 | -3.2846 | 3.11900E+01 |
| Cl- | -1.0 | 6.12232E-05 | -4.2131 | 2.17000E+00 |
| HCO3- | -1.0 | 2.45894E-03 | -2.6093 | 1.50000E+02 |
| SO4-2 | -2.0 | 2.99883E-05 | -4.5230 | 2.88000E+00 |
| NO3- | -1.0 | 1.46395E-04 | -3.8345 | 2.05000E+00 |
| HPO4-2 | -2.0 | 2.58348E-06 | -5.5878 | 8.00000E-02 |
| F- | -1.0 | 1.36888E-05 | -4.8636 | 2.60000E-01 |
| Br- | -1.0 | 1.25182E-07 | -6.9025 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | |
|---|---|---|---|---|
| EPMCAT | 3.41 | 3.36 | 7.700 | ACTIVITY H2O = 0.9999 |
| EPMAN | 2.75 | 2.70 | | PCO2= 2.758975E-03 |
| | | | | LOG PCO2 = -2.5593 |
| | | | TEMPERATURE | PO2 = 8.979470E-55 |
| EH = 0.0000 | PE = 0.000 | | 20.00 DEG C | PCH4 = 3.244612E-41 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.549838E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.164079E-03 | TDS = 252.3MG/L |
| TOT ALK = | 2.459E+00 MEQ | | | CARB ALK = 2.453E+00 MEQ |
| ELECT = | 6.626E-01 MEQ | | | CHARGE IMBALANCE = 10.9% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.1255E-08 | 1.9953E-08 | -7.700 | 9.3872E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.1847E-04 | 3.9549E-04 | -3.403 | 7.6281E-01 |
| 5 | Mg+2 | 2. | 5.7820E-04 | 4.4234E-04 | -3.354 | 7.6504E-01 |
| 6 | Na+ | 1. | 1.0567E-03 | 9.8655E-04 | -3.006 | 9.3361E-01 |
| 7 | K+ | 1. | 8.5172E-05 | 7.9418E-05 | -4.100 | 9.3244E-01 |
| 9 | Mn+2 | 2. | 1.2509E-07 | 9.5759E-08 | -7.019 | 7.6551E-01 |
| 11 | Ba+2 | 2. | 4.2657E-07 | 3.2487E-07 | -6.488 | 7.6160E-01 |
| 12 | Sr+2 | 2. | 1.2209E-06 | 9.3220E-07 | -6.030 | 7.6352E-01 |
| 13 | H4SiO4 | 0. | 5.1581E-04 | 5.1631E-04 | -3.287 | 1.0010E+00 |
| 14 | Cl- | -1. | 6.1223E-05 | 5.7087E-05 | -4.243 | 9.3244E-01 |
| 15 | CO3-2 | -2. | 6.2198E-06 | 4.7468E-06 | -5.324 | 7.6318E-01 |
| 16 | SO4-2 | -2. | 2.6515E-05 | 2.0186E-05 | -4.695 | 7.6131E-01 |
| 17 | NO3- | -1. | 2.8079E-18 | 2.6160E-18 | -17.582 | 9.3166E-01 |
| 19 | PO4-3 | -3. | 4.4038E-11 | 2.3579E-11 | -10.627 | 5.3542E-01 |
| 20 | F- | -1. | 1.3287E-05 | 1.2388E-05 | -4.907 | 9.3231E-01 |
| 22 | Br- | -1. | 1.2518E-07 | 1.1663E-07 | -6.933 | 9.3166E-01 |
| 31 | OH- | -1. | 3.6494E-07 | 3.4023E-07 | -6.468 | 9.3231E-01 |
| 33 | H2 AQ | 0. | 2.9619E-19 | 2.9648E-19 | -18.528 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.4061E-03 | 2.2489E-03 | -2.648 | 9.3467E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 35 | H2CO3 | 0. | 1.0801E-04 | 1.0811E-04 | -3.966 | 1.0010E+00 |
| 40 | HSO4- | -1. | 3.7714E-11 | 3.5190E-11 | -10.454 | 9.3308E-01 |
| 48 | NO2- | -1. | 1.4640E-04 | 1.3639E-04 | -3.865 | 9.3166E-01 |
| 65 | HPO4-2 | -2. | 1.5249E-06 | 1.1552E-06 | -5.937 | 7.5757E-01 |
| 66 | H2PO4- | -1. | 4.0916E-07 | 3.8198E-07 | -6.418 | 9.3357E-01 |
| 69 | HF AQ | 0. | 3.3877E-10 | 3.3909E-10 | -9.470 | 1.0010E+00 |
| 70 | HF2- | -1. | 1.6564E-14 | 1.5456E-14 | -13.811 | 9.3308E-01 |
| 75 | CaOH+ | 1. | 3.5251E-09 | 3.2892E-09 | -8.483 | 9.3308E-01 |
| 76 | CaCO3 | 0. | 2.8766E-06 | 2.8793E-06 | -5.541 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.1152E-05 | 1.0424E-05 | -4.982 | 9.3467E-01 |
| 78 | CaSO4 | 0. | 1.5175E-06 | 1.5190E-06 | -5.818 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 1.9965E-13 | 1.8629E-13 | -12.730 | 9.3308E-01 |
| 80 | CaPO4- | -1. | 2.6302E-08 | 2.4542E-08 | -7.610 | 9.3308E-01 |
| 81 | CaHPO4 | 0. | 2.2757E-07 | 2.2779E-07 | -6.642 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 3.7562E-09 | 3.5048E-09 | -8.455 | 9.3308E-01 |
| 83 | CaF+ | 1. | 4.0616E-08 | 3.7898E-08 | -7.421 | 9.3308E-01 |
| 85 | MgOH+ | 1. | 5.5063E-08 | 5.1379E-08 | -7.289 | 9.3308E-01 |
| 86 | MgCO3 | 0. | 1.8538E-06 | 1.8555E-06 | -5.732 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.2232E-05 | 1.1414E-05 | -4.943 | 9.3308E-01 |
| 88 | MgSO4 | 0. | 1.8344E-06 | 1.8362E-06 | -5.736 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 3.9684E-08 | 3.7028E-08 | -7.431 | 9.3308E-01 |
| 90 | MgHPO4 | 0. | 3.4415E-07 | 3.4448E-07 | -6.463 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 5.3502E-09 | 4.9922E-09 | -8.302 | 9.3308E-01 |
| 92 | MgF+ | 1. | 3.5385E-07 | 3.3017E-07 | -6.481 | 9.3308E-01 |
| 93 | NaOH | 0. | 3.2633E-10 | 3.2665E-10 | -9.486 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 7.2311E-08 | 6.7472E-08 | -7.171 | 9.3308E-01 |
| 95 | NaHCO3 | 0. | 1.2406E-06 | 1.2418E-06 | -5.906 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 1.0357E-07 | 9.6642E-08 | -7.015 | 9.3308E-01 |
| 97 | NaHPO4- | -1. | 2.3816E-09 | 2.2222E-09 | -8.653 | 9.3308E-01 |
| 98 | NaF aq | 0. | 7.0257E-09 | 7.0324E-09 | -8.153 | 1.0010E+00 |
| 99 | KOH | 0. | 1.3787E-11 | 1.3800E-11 | -10.860 | 1.0010E+00 |
| 100 | KSO4- | -1. | 1.1047E-08 | 1.0308E-08 | -7.987 | 9.3308E-01 |
| 101 | KHPO4- | -1. | 1.9172E-10 | 1.7889E-10 | -9.747 | 9.3308E-01 |
| 134 | MnOH+ | 1. | 8.7335E-11 | 8.1491E-11 | -10.089 | 9.3308E-01 |
| 136 | MnCl+ | 1. | 2.3867E-11 | 2.2270E-11 | -10.652 | 9.3308E-01 |
| 137 | MnCl2 | 0. | 5.5442E-16 | 5.5495E-16 | -15.256 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 9.3513E-21 | 8.7256E-21 | -20.059 | 9.3308E-01 |
| 139 | MnCO3 | 0. | 3.6072E-08 | 3.6106E-08 | -7.442 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 2.0473E-08 | 1.9103E-08 | -7.719 | 9.3308E-01 |
| 141 | MnSO4 | 0. | 3.1166E-10 | 3.1196E-10 | -9.506 | 1.0010E+00 |
| 143 | MnF+ | 1. | 8.7952E-12 | 8.2067E-12 | -11.086 | 9.3308E-01 |
| 144 | Mn+3 | 3. | 2.6263E-33 | 1.4081E-33 | -32.851 | 5.3613E-01 |
| 164 | H3SiO4- | -1. | 3.4166E-06 | 3.1880E-06 | -5.496 | 9.3308E-01 |
| 165 | H2SiO4-2 | -2. | 1.0252E-11 | 7.7713E-12 | -11.110 | 7.5801E-01 |
| 166 | SiF6-2 | -2. | 9.4318E-34 | 7.1494E-34 | -33.146 | 7.5801E-01 |
| 170 | BaOH+ | 1. | 5.9123E-13 | 5.5166E-13 | -12.258 | 9.3308E-01 |
| 171 | BaCO3 | 0. | 7.1988E-10 | 7.2057E-10 | -9.142 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 6.4125E-09 | 5.9834E-09 | -8.223 | 9.3308E-01 |
| 173 | BaSO4 | 0. | 3.2836E-09 | 3.2867E-09 | -8.483 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 2.5647E-12 | 2.3959E-12 | -11.621 | 9.3418E-01 |
| 177 | SrHCO3+ | 1. | 2.8912E-08 | 2.7023E-08 | -7.568 | 9.3467E-01 |
| 178 | SrCO3 | 0. | 2.4346E-09 | 2.4370E-09 | -8.613 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 3.4525E-09 | 3.4558E-09 | -8.461 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.877E-09 | 3.521E-09 | -8.726 | -8.453 | 5.331E-01 | -0.273 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 2 | Aragonit | 1.877E-09 | 4.945E-09 | -8.726 | -8.306 | 3.797E-01 | -0.421 |
| 3 | Dolomite | 3.942E-18 | 1.067E-17 | -17.404 | -16.972 | 3.696E-01 | -0.432 |
| 5 | Rhodochr | 4.546E-13 | 7.725E-12 | -12.342 | -11.112 | 5.884E-02 | -1.230 |
| 6 | Strontit | 4.425E-12 | 5.382E-10 | -11.354 | -9.269 | 8.222E-03 | -2.085 |
| 7 | Witherit | 1.542E-12 | 2.661E-09 | -11.812 | -8.575 | 5.794E-04 | -3.237 |
| 8 | Gypsum | 7.982E-09 | 2.623E-05 | -8.098 | -4.581 | 3.042E-04 | -3.517 |
| 9 | Anhydrit | 7.983E-09 | 4.531E-05 | -8.098 | -4.344 | 1.762E-04 | -3.754 |
| 10 | Celestit | 1.882E-11 | 2.385E-07 | -10.725 | -6.623 | 7.891E-05 | -4.103 |
| 11 | Barite | 6.558E-12 | 8.855E-11 | -11.183 | -10.053 | 7.406E-02 | -1.130 |
| 12 | Hydroxap | 9.411E-05 | 1.074E-03 | -4.026 | -2.969 | 8.762E-02 | -1.057 |
| 13 | Fluorite | 6.069E-14 | 2.188E-11 | -13.217 | -10.660 | 2.774E-03 | -2.557 |
| 14 | SiO2 (a) | 5.164E-04 | 1.764E-03 | -3.287 | -2.754 | 2.928E-01 | -0.533 |
| 15 | Chalcedy | 5.164E-04 | 2.453E-04 | -3.287 | -3.610 | 2.106E+00 | 0.323 |
| 16 | Quartz | 5.164E-04 | 8.805E-05 | -3.287 | -4.055 | 5.865E+00 | 0.768 |
| 26 | Talc | 9.752E+22 | 9.517E+21 | 22.989 | 21.979 | 1.025E+01 | 1.011 |
| 28 | Chrysotl | 3.656E+29 | 6.776E+32 | 29.563 | 32.831 | 5.396E-04 | -3.268 |
| 29 | Sepiol c | 1.699E+14 | 7.830E+15 | 14.230 | 15.894 | 2.170E-02 | -1.664 |
| 30 | Sepiol d | 1.699E+14 | 4.571E+18 | 14.230 | 18.660 | 3.718E-05 | -4.430 |
| 38 | Pyrolusi | 6.041E+23 | 1.563E+42 | 23.781 | 42.194 | 3.864E-19 | -18.413 |
| 39 | Hausmani | 3.494E+40 | 1.942E+62 | 40.543 | 62.288 | 1.799E-22 | -21.745 |
| 40 | Manganit | 1.205E+16 | 2.188E+25 | 16.081 | 25.340 | 5.509E-10 | -9.259 |
| 41 | Pyrochro | 2.405E+08 | 1.585E+15 | 8.381 | 15.200 | 1.517E-07 | -6.819 |
| 42 | PCO2 | 1.081E-04 | 3.919E-02 | -3.966 | -1.407 | 2.759E-03 | -2.559 |
| 44 | H2 gas | 2.965E-19 | 7.447E-04 | -18.528 | -3.128 | 3.981E-16 | -15.400 |

PALOUSE BASIN: SHALLOW GRANDE RONDE SAMPLES

**18. BRAWDY**

INITIAL SOLUTION

TEMPERATURE = 12.80 DEGREES C PH = 7.280
ANALYTICAL EPMCAT = 3.207 ANALYTICAL EPMAN = 1.709

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.93492E-04 | -3.1590 | 2.77900E+01 |
| Mg+2 | 2.0 | 5.55796E-04 | -3.2551 | 1.35100E+01 |
| Na+ | 1.0 | 6.17345E-04 | -3.2095 | 1.41900E+01 |
| K+ | 1.0 | 8.62009E-05 | -4.0645 | 3.37000E+00 |
| Ba+2 | 2.0 | 5.09779E-07 | -6.2926 | 7.00000E-02 |
| Sr+2 | 2.0 | 1.59811E-06 | -5.7964 | 1.40000E-01 |
| H4SiO4 | 0.0 | 4.47784E-04 | -3.3489 | 2.69000E+01 |

| | | | | |
|---|---|---|---|---|
| Cl- | -1.0 | 2.84937E-05 | -4.5453 | 1.01000E+00 |
| HCO3- | -1.0 | 1.43986E-03 | -2.8417 | 8.78400E+01 |
| SO4-2 | -2.0 | 1.14219E-04 | -3.9423 | 1.09700E+01 |
| NO3- | -1.0 | 1.42815E-06 | -5.8452 | 2.00000E-02 |
| HPO4-2 | -2.0 | 2.26040E-06 | -5.6458 | 7.00000E-02 |
| F- | -1.0 | 5.79104E-06 | -5.2372 | 1.10000E-01 |
| Br- | -1.0 | 2.50347E-07 | -6.6015 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.21 | 3.16 | 7.280 | PCO2= 3.906090E-03 |
| EPMAN | 1.71 | 1.66 | | LOG PCO2 = -2.4083 |
| | | | TEMPERATURE | PO2 = 4.850943E-59 |
| EH = 0.0000 | PE = 0.000 | | 12.80 DEG C | PCH4 = 1.385229E-36 |
| PE CALC S = | 0.000 | | | CO2 TOT = 1.626516E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 3.739032E-03 | TDS = 186.0MG/L |
| TOT ALK = | 1.440E+00 MEQ | | | CARB ALK = 1.438E+00 MEQ |
| ELECT = | 1.500E+00 MEQ | | | CHARGE IMBALANCE = 31.1% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 5.5714E-08 | 5.2481E-08 | -7.280 | 9.4197E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 6.7789E-04 | 5.2526E-04 | -3.280 | 7.7485E-01 |
| 5 | Mg+2 | 2. | 5.4283E-04 | 4.2171E-04 | -3.375 | 7.7687E-01 |
| 6 | Na+ | 1. | 6.1669E-04 | 5.7808E-04 | -3.238 | 9.3738E-01 |
| 7 | K+ | 1. | 8.6163E-05 | 8.0676E-05 | -4.093 | 9.3632E-01 |
| 11 | Ba+2 | 2. | 4.9123E-07 | 3.8009E-07 | -6.420 | 7.7375E-01 |
| 12 | Sr+2 | 2. | 1.5644E-06 | 1.2132E-06 | -5.916 | 7.7549E-01 |
| 13 | H4SiO4 | 0. | 4.4694E-04 | 4.4732E-04 | -3.349 | 1.0009E+00 |
| 14 | Cl- | -1. | 2.8494E-05 | 2.6679E-05 | -4.574 | 9.3632E-01 |
| 15 | CO3-2 | -2. | 1.1510E-06 | 8.9224E-07 | -6.050 | 7.7518E-01 |
| 16 | SO4-2 | -2. | 1.0109E-04 | 7.8192E-05 | -4.107 | 7.7348E-01 |
| 17 | NO3- | -1. | 5.9732E-22 | 5.5886E-22 | -21.253 | 9.3562E-01 |
| 19 | PO4-3 | -3. | 9.7505E-12 | 5.4167E-12 | -11.266 | 5.5553E-01 |
| 20 | F- | -1. | 5.6449E-06 | 5.2848E-06 | -5.277 | 9.3620E-01 |
| 22 | Br- | -1. | 2.5035E-07 | 2.3423E-07 | -6.630 | 9.3562E-01 |
| 31 | OH- | -1. | 7.6065E-08 | 7.1212E-08 | -7.147 | 9.3620E-01 |
| 33 | H2 AQ | 0. | 2.2112E-18 | 2.2131E-18 | -17.655 | 1.0009E+00 |
| 34 | HCO3- | -1. | 1.4186E-03 | 1.3311E-03 | -2.876 | 9.3832E-01 |
| 35 | H2CO3 | 0. | 1.9111E-04 | 1.9128E-04 | -3.718 | 1.0009E+00 |
| 40 | HSO4- | -1. | 3.3091E-10 | 3.1003E-10 | -9.509 | 9.3690E-01 |
| 48 | NO2- | -1. | 1.4282E-06 | 1.3362E-06 | -5.874 | 9.3562E-01 |
| 65 | HPO4-2 | -2. | 1.0558E-06 | 8.1307E-07 | -6.090 | 7.7008E-01 |
| 66 | H2PO4- | -1. | 7.8740E-07 | 7.3806E-07 | -6.132 | 9.3733E-01 |
| 69 | HF AQ | 0. | 3.3558E-10 | 3.3586E-10 | -9.474 | 1.0009E+00 |
| 70 | HF2- | -1. | 6.4874E-15 | 6.0780E-15 | -14.216 | 9.3690E-01 |
| 75 | CaOH+ | 1. | 1.7728E-09 | 1.6609E-09 | -8.780 | 9.3690E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 76 | CaCO3 | 0. | 6.5422E-07 | 6.5478E-07 | -6.184 | 1.0009E+00 |
| 77 | CaHCO3+ | 1. | 7.4595E-06 | 6.9994E-06 | -5.155 | 9.3832E-01 |
| 78 | CaSO4 | 0. | 7.2704E-06 | 7.2767E-06 | -5.138 | 1.0009E+00 |
| 79 | CaHSO4 | 1. | 2.6905E-12 | 2.5208E-12 | -11.598 | 9.3690E-01 |
| 80 | CaPO4- | -1. | 6.9898E-09 | 6.5488E-09 | -8.184 | 9.3690E-01 |
| 81 | CaHPO4 | 0. | 1.8447E-07 | 1.8463E-07 | -6.734 | 1.0009E+00 |
| 82 | CaH2PO4+ | 1. | 8.2878E-09 | 7.7649E-09 | -8.110 | 9.3690E-01 |
| 83 | CaF+ | 1. | 1.9181E-08 | 1.7970E-08 | -7.745 | 9.3690E-01 |
| 85 | MgOH+ | 1. | 1.0131E-08 | 9.4922E-09 | -8.023 | 9.3690E-01 |
| 86 | MgCO3 | 0. | 2.9745E-07 | 2.9770E-07 | -6.526 | 1.0009E+00 |
| 87 | MgHCO3+ | 1. | 6.7488E-06 | 6.3229E-06 | -5.199 | 9.3690E-01 |
| 88 | MgSO4 | 0. | 5.5655E-06 | 5.5703E-06 | -5.254 | 1.0009E+00 |
| 89 | MgPO4- | -1. | 7.5702E-09 | 7.0925E-09 | -8.149 | 9.3690E-01 |
| 90 | MgHPO4 | 0. | 2.0025E-07 | 2.0042E-07 | -6.698 | 1.0009E+00 |
| 91 | MgH2PO4+ | 1. | 8.4739E-09 | 7.9392E-09 | -8.100 | 9.3690E-01 |
| 92 | MgF+ | 1. | 1.2482E-07 | 1.1694E-07 | -6.932 | 9.3690E-01 |
| 93 | NaOH | 0. | 7.2708E-11 | 7.2770E-11 | -10.138 | 1.0009E+00 |
| 94 | NaCO3- | -1. | 5.3966E-09 | 5.0561E-09 | -8.296 | 9.3690E-01 |
| 95 | NaHCO3 | 0. | 4.1923E-07 | 4.1959E-07 | -6.377 | 1.0009E+00 |
| 96 | NaSO4- | -1. | 2.2306E-07 | 2.0899E-07 | -6.680 | 9.3690E-01 |
| 97 | NaHPO4- | -1. | 9.7818E-10 | 9.1646E-10 | -9.038 | 9.3690E-01 |
| 98 | NaF aq | 0. | 1.7565E-09 | 1.7580E-09 | -8.755 | 1.0009E+00 |
| 99 | KOH | 0. | 5.3253E-12 | 5.3299E-12 | -11.273 | 1.0009E+00 |
| 100 | KSO4- | -1. | 3.7893E-08 | 3.5502E-08 | -7.450 | 9.3690E-01 |
| 101 | KHPO4- | -1. | 1.3652E-10 | 1.2790E-10 | -9.893 | 9.3690E-01 |
| 164 | H3SiO4- | -1. | 8.4666E-07 | 7.9323E-07 | -6.101 | 9.3690E-01 |
| 165 | H2SiO4-2 | -2. | 5.6772E-13 | 4.3743E-13 | -12.359 | 7.7051E-01 |
| 166 | SiF6-2 | -2. | 4.6844E-34 | 3.6094E-34 | -33.443 | 7.7051E-01 |
| 170 | BaOH+ | 1. | 2.6192E-13 | 2.4539E-13 | -12.610 | 9.3690E-01 |
| 171 | BaCO3 | 0. | 1.3701E-10 | 1.3713E-10 | -9.863 | 1.0009E+00 |
| 172 | BaHCO3+ | 1. | 3.5259E-09 | 3.3034E-09 | -8.481 | 9.3690E-01 |
| 173 | BaSO4 | 0. | 1.4882E-08 | 1.4895E-08 | -7.827 | 1.0009E+00 |
| 176 | SrOH+ | 1. | 1.2640E-12 | 1.1855E-12 | -11.926 | 9.3788E-01 |
| 177 | SrHCO3+ | 1. | 1.7338E-08 | 1.6269E-08 | -7.789 | 9.3832E-01 |
| 178 | SrCO3 | 0. | 4.8152E-10 | 4.8194E-10 | -9.317 | 1.0009E+00 |
| 179 | SrSO4 | 0. | 1.5909E-08 | 1.5923E-08 | -7.798 | 1.0009E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 4.687E-10 | 3.792E-09 | -9.329 | -8.421 | 1.236E-01 | -0.908 |
| 2 | Aragonit | 4.687E-10 | 5.393E-09 | -9.329 | -8.268 | 8.690E-02 | -1.061 |
| 3 | Dolomite | 1.763E-19 | 1.604E-17 | -18.754 | -16.795 | 1.100E-02 | -1.959 |
| 6 | Strontit | 1.082E-12 | 5.251E-10 | -11.966 | -9.280 | 2.061E-03 | -2.686 |
| 7 | Witherit | 3.391E-13 | 2.446E-09 | -12.470 | -8.612 | 1.386E-04 | -3.858 |
| 8 | Gypsum | 4.107E-08 | 2.587E-05 | -7.387 | -4.587 | 1.587E-03 | -2.799 |
| 9 | Anhydrit | 4.107E-08 | 4.631E-05 | -7.386 | -4.334 | 8.868E-04 | -3.052 |
| 10 | Celestit | 9.486E-11 | 2.376E-07 | -10.023 | -6.624 | 3.992E-04 | -3.399 |
| 11 | Barite | 2.972E-11 | 6.491E-11 | -10.527 | -10.188 | 4.579E-01 | -0.339 |
| 12 | Hydroxap | 2.833E-06 | 5.125E-03 | -5.548 | -2.290 | 5.527E-04 | -3.257 |
| 13 | Fluorite | 1.467E-14 | 1.753E-11 | -13.834 | -10.756 | 8.368E-04 | -3.077 |
| 14 | SiO2 (a) | 4.474E-04 | 1.526E-03 | -3.349 | -2.816 | 2.931E-01 | -0.533 |
| 15 | Chalcedy | 4.474E-04 | 2.000E-04 | -3.349 | -3.699 | 2.237E+00 | 0.350 |
| 16 | Quartz | 4.474E-04 | 6.796E-05 | -3.349 | -4.168 | 6.583E+00 | 0.818 |
| 26 | Talc | 1.438E+20 | 7.057E+22 | 20.158 | 22.849 | 2.037E-03 | -2.691 |
| 28 | Chrysotl | 7.182E+26 | 5.962E+33 | 26.856 | 33.775 | 1.205E-07 | -6.919 |
| 29 | Sepiol c | 2.098E+12 | 1.243E+16 | 12.322 | 16.095 | 1.688E-04 | -3.773 |
| 30 | Sepiol d | 2.098E+12 | 4.571E+18 | 12.322 | 18.660 | 4.591E-07 | -6.338 |

```
 42 PCO2     1.913E-04 4.897E-02   -3.718   -1.310  3.906E-03   -2.408
 44 H2 gas   2.213E-18 8.035E-04  -17.655   -3.095  2.754E-15  -14.560
```

**19. MCGREEVY**

INITIAL SOLUTION

TEMPERATURE = 15.90 DEGREES C PH = 7.350
ANALYTICAL EPMCAT = 3.538 ANALYTICAL EPMAN = 3.002

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.39134E-04 | -3.1944 | 2.56100E+01 |
| Mg+2 | 2.0 | 8.03922E-04 | -3.0948 | 1.95400E+01 |
| Na+ | 1.0 | 5.61261E-04 | -3.2508 | 1.29000E+01 |
| K+ | 1.0 | 8.54393E-05 | -4.0683 | 3.34000E+00 |
| Ba+2 | 2.0 | 7.28305E-07 | -6.1377 | 1.00000E-01 |
| Sr+2 | 2.0 | 1.36990E-06 | -5.8633 | 1.20000E-01 |
| H4SiO4 | 0.0 | 4.61465E-04 | -3.3359 | 2.77200E+01 |
| Cl- | -1.0 | 4.76809E-05 | -4.3217 | 1.69000E+00 |
| HCO3- | -1.0 | 2.51993E-03 | -2.5986 | 1.53720E+02 |
| SO4-2 | -2.0 | 4.39413E-05 | -4.3571 | 4.22000E+00 |
| NO3- | -1.0 | 3.26355E-04 | -3.4863 | 4.57000E+00 |
| HPO4-2 | -2.0 | 3.87523E-06 | -5.4117 | 1.20000E-01 |
| F- | -1.0 | 1.15829E-05 | -4.9362 | 2.20000E-01 |
| Br- | -1.0 | 2.50364E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

```
         ANALYT.   COMP.         PH           ACTIVITY H2O =  0.9999
EPMCAT     3.54      3.49       7.350         PCO2=  5.995730E-03
EPMAN      3.00      2.95                     LOG PCO2 =  -2.2222
                               TEMPERATURE    PO2 =  1.244325E-57
EH = 0.0000  PE =   0.000     15.90 DEG C     PCH4 =  1.903928E-37
PE CALC S =    0.000                         CO2 TOT =  2.776616E-03
PE CALC DOX=  0.000          IONIC STRENGTH  DENSITY =   1.0000
PE SATO DOX=  0.000           4.668906E-03   TDS =     253.9MG/L
TOT ALK =  2.520E+00 MEQ                     CARB ALK =  2.516E+00 MEQ
ELECT   =  5.395E-01 MEQ                     CHARGE IMBALANCE =    8.4%

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE =   0.000     EQUIVALENT EH =  0.000VOLTS
```

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 4.7713E-08 | 4.4668E-08 | -7.350 | 9.3620E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 6.2246E-04 | 4.6896E-04 | -3.329 | 7.5340E-01 |
| 5 | Mg+2 | 2. | 7.8226E-04 | 5.9125E-04 | -3.228 | 7.5582E-01 |
| 6 | Na+ | 1. | 5.6050E-04 | 5.2162E-04 | -3.283 | 9.3063E-01 |
| 7 | K+ | 1. | 8.5424E-05 | 7.9388E-05 | -4.100 | 9.2933E-01 |
| 11 | Ba+2 | 2. | 7.1062E-07 | 5.3443E-07 | -6.272 | 7.5206E-01 |
| 12 | Sr+2 | 2. | 1.3359E-06 | 1.0075E-06 | -5.997 | 7.5416E-01 |
| 13 | H4SiO4 | 0. | 4.6030E-04 | 4.6079E-04 | -3.336 | 1.0011E+00 |
| 14 | Cl- | -1. | 4.7681E-05 | 4.4311E-05 | -4.353 | 9.2933E-01 |
| 15 | CO3-2 | -2. | 2.6147E-06 | 1.9709E-06 | -5.705 | 7.5377E-01 |
| 16 | SO4-2 | -2. | 3.8250E-05 | 2.8754E-05 | -4.541 | 7.5174E-01 |
| 17 | NO3- | -1. | 4.3033E-19 | 3.9955E-19 | -18.398 | 9.2847E-01 |
| 19 | PO4-3 | -3. | 2.2390E-11 | 1.1639E-11 | -10.934 | 5.1982E-01 |
| 20 | F- | -1. | 1.1175E-05 | 1.0383E-05 | -4.984 | 9.2918E-01 |
| 22 | Br- | -1. | 2.5036E-07 | 2.3245E-07 | -6.634 | 9.2847E-01 |
| 31 | OH- | -1. | 1.1709E-07 | 1.0880E-07 | -6.963 | 9.2918E-01 |
| 33 | H2 AQ | 0. | 1.5493E-18 | 1.5509E-18 | -17.809 | 1.0011E+00 |
| 34 | HCO3- | -1. | 2.4762E-03 | 2.3073E-03 | -2.637 | 9.3177E-01 |
| 35 | H2CO3 | 0. | 2.6563E-04 | 2.6592E-04 | -3.575 | 1.0011E+00 |
| 40 | HSO4- | -1. | 1.1093E-10 | 1.0317E-10 | -9.986 | 9.3006E-01 |
| 48 | NO2- | -1. | 3.2636E-04 | 3.0301E-04 | -3.519 | 9.2847E-01 |
| 65 | HPO4-2 | -2. | 1.8606E-06 | 1.3911E-06 | -5.857 | 7.4767E-01 |
| 66 | H2PO4- | -1. | 1.1336E-06 | 1.0549E-06 | -5.977 | 9.3057E-01 |
| 69 | HF AQ | 0. | 5.9171E-10 | 5.9235E-10 | -9.227 | 1.0011E+00 |
| 70 | HF2- | -1. | 2.3397E-14 | 2.1760E-14 | -13.662 | 9.3006E-01 |
| 75 | CaOH+ | 1. | 1.8732E-09 | 1.7422E-09 | -8.759 | 9.3006E-01 |
| 76 | CaCO3 | 0. | 1.3347E-06 | 1.3362E-06 | -5.874 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.2512E-05 | 1.1658E-05 | -4.933 | 9.3177E-01 |
| 78 | CaSO4 | 0. | 2.4620E-06 | 2.4646E-06 | -5.608 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 7.5739E-13 | 7.0442E-13 | -12.152 | 9.3006E-01 |
| 80 | CaPO4- | -1. | 1.4322E-08 | 1.3320E-08 | -7.875 | 9.3006E-01 |
| 81 | CaHPO4 | 0. | 2.9984E-07 | 3.0016E-07 | -6.523 | 1.0011E+00 |
| 82 | CaH2PO4+ | 1. | 1.1360E-08 | 1.0565E-08 | -7.976 | 9.3006E-01 |
| 83 | CaF+ | 1. | 3.6634E-08 | 3.4072E-08 | -7.468 | 9.3006E-01 |
| 85 | MgOH+ | 1. | 2.2563E-08 | 2.0985E-08 | -7.678 | 9.3006E-01 |
| 86 | MgCO3 | 0. | 9.6588E-07 | 9.6692E-07 | -6.015 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 1.6628E-05 | 1.5465E-05 | -4.811 | 9.3006E-01 |
| 88 | MgSO4 | 0. | 3.1260E-06 | 3.1294E-06 | -5.505 | 1.0011E+00 |
| 89 | MgPO4- | -1. | 2.4357E-08 | 2.2654E-08 | -7.645 | 9.3006E-01 |
| 90 | MgHPO4 | 0. | 5.1111E-07 | 5.1166E-07 | -6.291 | 1.0011E+00 |
| 91 | MgH2PO4+ | 1. | 1.8239E-08 | 1.6964E-08 | -7.770 | 9.3006E-01 |
| 92 | MgF+ | 1. | 3.6791E-07 | 3.4218E-07 | -6.466 | 9.3006E-01 |
| 93 | NaOH | 0. | 7.7063E-11 | 7.7146E-11 | -10.113 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 1.2820E-08 | 1.1923E-08 | -7.924 | 9.3006E-01 |
| 95 | NaHCO3 | 0. | 6.6485E-07 | 6.6557E-07 | -6.177 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 7.6154E-08 | 7.0828E-08 | -7.150 | 9.3006E-01 |
| 97 | NaHPO4- | -1. | 1.5213E-09 | 1.4149E-09 | -8.849 | 9.3006E-01 |
| 98 | NaF aq | 0. | 3.1133E-09 | 3.1167E-09 | -8.506 | 1.0011E+00 |
| 99 | KOH | 0. | 6.1552E-12 | 6.1618E-12 | -11.210 | 1.0011E+00 |
| 100 | KSO4- | -1. | 1.4640E-08 | 1.3616E-08 | -7.866 | 9.3006E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 101 | KHPO4- | -1. | 2.3153E-10 | 2.1534E-10 | -9.667 | 9.3006E-01 |
| 164 | H3SiO4- | -1. | 1.1686E-06 | 1.0869E-06 | -5.964 | 9.3006E-01 |
| 165 | H2SiO4-2 | -2. | 1.1832E-12 | 8.8532E-13 | -12.053 | 7.4823E-01 |
| 166 | SiF6-2 | -2. | 1.1037E-32 | 8.2586E-33 | -32.083 | 7.4823E-01 |
| 170 | BaOH+ | 1. | 4.3585E-13 | 4.0536E-13 | -12.392 | 9.3006E-01 |
| 171 | BaCO3 | 0. | 4.5278E-10 | 4.5326E-10 | -9.344 | 1.0011E+00 |
| 172 | BaHCO3+ | 1. | 9.5433E-09 | 8.8758E-09 | -8.052 | 9.3006E-01 |
| 173 | BaSO4 | 0. | 7.6933E-09 | 7.7016E-09 | -8.113 | 1.0011E+00 |
| 176 | SrOH+ | 1. | 1.2421E-12 | 1.1567E-12 | -11.937 | 9.3124E-01 |
| 177 | SrHCO3+ | 1. | 2.7947E-08 | 2.6040E-08 | -7.584 | 9.3177E-01 |
| 178 | SrCO3 | 0. | 9.6781E-10 | 9.6886E-10 | -9.014 | 1.0011E+00 |
| 179 | SrSO4 | 0. | 5.0521E-09 | 5.0575E-09 | -8.296 | 1.0011E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 9.243E-10 | 3.681E-09 | -9.034 | -8.434 | 2.511E-01 | -0.600 |
| 2 | Aragonit | 9.243E-10 | 5.205E-09 | -9.034 | -8.284 | 1.776E-01 | -0.751 |
| 3 | Dolomite | 1.077E-18 | 1.342E-17 | -17.968 | -16.872 | 8.025E-02 | -1.096 |
| 6 | Strontit | 1.986E-12 | 5.331E-10 | -11.702 | -9.273 | 3.725E-03 | -2.429 |
| 7 | Witherit | 1.053E-12 | 2.552E-09 | -11.977 | -8.593 | 4.127E-04 | -3.384 |
| 8 | Gypsum | 1.348E-08 | 2.608E-05 | -7.870 | -4.584 | 5.169E-04 | -3.287 |
| 9 | Anhydrit | 1.348E-08 | 4.611E-05 | -7.870 | -4.336 | 2.924E-04 | -3.534 |
| 10 | Celestit | 2.897E-11 | 2.395E-07 | -10.538 | -6.621 | 1.210E-04 | -3.917 |
| 11 | Barite | 1.537E-11 | 7.461E-11 | -10.813 | -10.127 | 2.060E-01 | -0.686 |
| 12 | Hydroxap | 1.534E-05 | 2.590E-03 | -4.814 | -2.587 | 5.921E-03 | -2.228 |
| 13 | Fluorite | 5.056E-14 | 1.935E-11 | -13.296 | -10.713 | 2.613E-03 | -2.583 |
| 14 | SiO2 (a) | 4.609E-04 | 1.626E-03 | -3.336 | -2.789 | 2.835E-01 | -0.547 |
| 15 | Chalcedy | 4.609E-04 | 2.186E-04 | -3.336 | -3.660 | 2.108E+00 | 0.324 |
| 16 | Quartz | 4.609E-04 | 7.610E-05 | -3.336 | -4.119 | 6.056E+00 | 0.782 |
| 26 | Talc | 1.174E+21 | 2.942E+22 | 21.069 | 22.469 | 3.989E-02 | -1.399 |
| 28 | Chrysotl | 5.524E+27 | 2.308E+33 | 27.742 | 33.363 | 2.394E-06 | -5.621 |
| 29 | Sepiol c | 8.592E+12 | 1.016E+16 | 12.934 | 16.007 | 8.456E-04 | -3.073 |
| 30 | Sepiol d | 8.592E+12 | 4.571E+18 | 12.934 | 18.660 | 1.880E-06 | -5.726 |
| 42 | PCO2 | 2.659E-04 | 4.435E-02 | -3.575 | -1.353 | 5.996E-03 | -2.222 |
| 44 | H2 gas | 1.551E-18 | 7.773E-04 | -17.809 | -3.109 | 1.995E-15 | -14.700 |

**20. PAULSON**

INITIAL SOLUTION

TEMPERATURE = 27.60 DEGREES C PH = 7.210
ANALYTICAL EPMCAT = 4.089 ANALYTICAL EPMAN = 1.826

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|

| | | | | |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.47346E-04 | -3.1889 | 2.59400E+01 |
| Mg+2 | 2.0 | 7.08034E-04 | -3.1499 | 1.72100E+01 |
| Na+ | 1.0 | 1.23516E-03 | -2.9083 | 2.83900E+01 |
| K+ | 1.0 | 1.33526E-04 | -3.8744 | 5.22000E+00 |
| Mn+2 | 2.0 | 3.64126E-07 | -6.4387 | 2.00000E-02 |
| Ba+2 | 2.0 | 8.73934E-07 | -6.0585 | 1.20000E-01 |
| Sr+2 | 2.0 | 2.85385E-06 | -5.5446 | 2.50000E-01 |
| H4SiO4 | 0.0 | 6.14265E-04 | -3.2116 | 3.69000E+01 |
| Cl- | -1.0 | 5.86820E-05 | -4.2315 | 2.08000E+00 |
| HCO3- | -1.0 | 1.43990E-03 | -2.8417 | 8.78400E+01 |
| SO4-2 | -2.0 | 1.22240E-04 | -3.9128 | 1.17400E+01 |
| NO3- | -1.0 | 5.99843E-05 | -4.2220 | 8.40000E-01 |
| HPO4-2 | -2.0 | 2.90631E-06 | -5.5367 | 9.00000E-02 |
| F- | -1.0 | 1.63207E-05 | -4.7873 | 3.10000E-01 |
| Br- | -1.0 | 1.25177E-07 | -6.9025 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 4.09 | 4.03 | 7.210 | PCO2= 5.574740E-03 |
| EPMAN | 1.83 | 1.76 | | LOG PCO2 = -2.2538 |
| | | | TEMPERATURE | PO2 = 3.946440E-54 |
| EH = 0.0000 | PE = 0.000 | | 27.60 DEG C | PCH4 = 4.042950E-38 |
| PE CALC S = | 0.000 | | | CO2 TOT = 1.610177E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.322488E-03 | TDS = 217.0MG/L |
| TOT ALK = | 1.440E+00 MEQ | | | CARB ALK = 1.436E+00 MEQ |
| ELECT = | 2.265E+00 MEQ | | | CHARGE IMBALANCE = 39.1% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 6.5802E-08 | 6.1659E-08 | -7.210 | 9.3705E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 6.2958E-04 | 4.7642E-04 | -3.322 | 7.5674E-01 |
| 5 | Mg+2 | 2. | 6.8750E-04 | 5.2185E-04 | -3.282 | 7.5905E-01 |
| 6 | Na+ | 1. | 1.2338E-03 | 1.1495E-03 | -2.939 | 9.3170E-01 |
| 7 | K+ | 1. | 1.3345E-04 | 1.2417E-04 | -3.906 | 9.3047E-01 |
| 9 | Mn+2 | 2. | 3.1097E-07 | 2.3620E-07 | -6.627 | 7.5956E-01 |
| 11 | Ba+2 | 2. | 8.3936E-07 | 6.3413E-07 | -6.198 | 7.5549E-01 |
| 12 | Sr+2 | 2. | 2.7698E-06 | 2.0981E-06 | -5.678 | 7.5748E-01 |
| 13 | H4SiO4 | 0. | 6.1254E-04 | 6.1315E-04 | -3.212 | 1.0010E+00 |
| 14 | Cl- | -1. | 5.8682E-05 | 5.4602E-05 | -4.263 | 9.3047E-01 |
| 15 | CO3-2 | -2. | 1.3916E-06 | 1.0536E-06 | -5.977 | 7.5714E-01 |
| 16 | SO4-2 | -2. | 1.0375E-04 | 7.8354E-05 | -4.106 | 7.5519E-01 |
| 17 | NO3- | -1. | 8.0409E-19 | 7.4752E-19 | -18.126 | 9.2965E-01 |
| 19 | PO4-3 | -3. | 1.3622E-11 | 7.1583E-12 | -11.145 | 5.2549E-01 |
| 20 | F- | -1. | 1.5675E-05 | 1.4583E-05 | -4.836 | 9.3034E-01 |
| 22 | Br- | -1. | 1.2518E-07 | 1.1637E-07 | -6.934 | 9.2965E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 31 | OH- | -1. | 2.1186E-07 | 1.9710E-07 | -6.705 | 9.3034E-01 |
| 33 | H2 AQ | 0. | 2.6207E-18 | 2.6233E-18 | -17.581 | 1.0010E+00 |
| 34 | HCO3- | -1. | 1.4117E-03 | 1.3169E-03 | -2.880 | 9.3281E-01 |
| 35 | H2CO3 | 0. | 1.7698E-04 | 1.7716E-04 | -3.752 | 1.0010E+00 |
| 40 | HSO4- | -1. | 5.3422E-10 | 4.9743E-10 | -9.303 | 9.3113E-01 |
| 48 | NO2- | -1. | 5.9984E-05 | 5.5765E-05 | -4.254 | 9.2965E-01 |
| 65 | HPO4-2 | -2. | 1.2377E-06 | 9.2990E-07 | -6.032 | 7.5129E-01 |
| 66 | H2PO4- | -1. | 9.7703E-07 | 9.1026E-07 | -6.041 | 9.3166E-01 |
| 69 | HF AQ | 0. | 1.4121E-09 | 1.4135E-09 | -8.850 | 1.0010E+00 |
| 70 | HF2- | -1. | 8.6598E-14 | 8.0634E-14 | -13.093 | 9.3113E-01 |
| 75 | CaOH+ | 1. | 1.3770E-09 | 1.2822E-09 | -8.892 | 9.3113E-01 |
| 76 | CaCO3 | 0. | 8.8963E-07 | 8.9051E-07 | -6.050 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 8.9088E-06 | 8.3102E-06 | -5.080 | 9.3281E-01 |
| 78 | CaSO4 | 0. | 7.6221E-06 | 7.6297E-06 | -5.117 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 2.8910E-12 | 2.6919E-12 | -11.570 | 9.3113E-01 |
| 80 | CaPO4- | -1. | 1.1026E-08 | 1.0267E-08 | -7.989 | 9.3113E-01 |
| 81 | CaHPO4 | 0. | 2.5463E-07 | 2.5488E-07 | -6.594 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 1.2523E-08 | 1.1660E-08 | -7.933 | 9.3113E-01 |
| 83 | CaF+ | 1. | 6.9013E-08 | 6.4260E-08 | -7.192 | 9.3113E-01 |
| 85 | MgOH+ | 1. | 4.1428E-08 | 3.8575E-08 | -7.414 | 9.3113E-01 |
| 86 | MgCO3 | 0. | 5.4551E-07 | 5.4605E-07 | -6.263 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 8.7421E-06 | 8.1400E-06 | -5.089 | 9.3113E-01 |
| 88 | MgSO4 | 0. | 1.0233E-05 | 1.0243E-05 | -4.990 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 1.6292E-08 | 1.5170E-08 | -7.819 | 9.3113E-01 |
| 90 | MgHPO4 | 0. | 3.7710E-07 | 3.7748E-07 | -6.423 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 1.7468E-08 | 1.6265E-08 | -7.789 | 9.3113E-01 |
| 92 | MgF+ | 1. | 5.6579E-07 | 5.2682E-07 | -6.278 | 9.3113E-01 |
| 93 | NaOH | 0. | 1.2304E-10 | 1.2316E-10 | -9.910 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 2.7584E-08 | 2.5684E-08 | -7.590 | 9.3113E-01 |
| 95 | NaHCO3 | 0. | 8.4958E-07 | 8.5043E-07 | -6.070 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 4.9279E-07 | 4.5885E-07 | -6.338 | 9.3113E-01 |
| 97 | NaHPO4- | -1. | 2.2384E-09 | 2.0843E-09 | -8.681 | 9.3113E-01 |
| 98 | NaF aq | 0. | 9.6366E-09 | 9.6462E-09 | -8.016 | 1.0010E+00 |
| 99 | KOH | 0. | 6.9751E-12 | 6.9820E-12 | -11.156 | 1.0010E+00 |
| 100 | KSO4- | -1. | 7.6795E-08 | 7.1506E-08 | -7.146 | 9.3113E-01 |
| 101 | KHPO4- | -1. | 2.4179E-10 | 2.2514E-10 | -9.648 | 9.3113E-01 |
| 134 | MnOH+ | 1. | 1.3046E-10 | 1.2148E-10 | -9.916 | 9.3113E-01 |
| 136 | MnCl+ | 1. | 5.6426E-11 | 5.2540E-11 | -10.280 | 9.3113E-01 |
| 137 | MnCl2 | 0. | 1.2510E-15 | 1.2523E-15 | -14.902 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 2.0225E-20 | 1.8832E-20 | -19.725 | 9.3113E-01 |
| 139 | MnCO3 | 0. | 1.9749E-08 | 1.9768E-08 | -7.704 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 2.9743E-08 | 2.7695E-08 | -7.558 | 9.3113E-01 |
| 141 | MnSO4 | 0. | 3.4535E-09 | 3.4570E-09 | -8.461 | 1.0010E+00 |
| 143 | MnF+ | 1. | 2.5592E-11 | 2.3830E-11 | -10.623 | 9.3113E-01 |
| 144 | Mn+3 | 3. | 2.0215E-32 | 1.0636E-32 | -31.973 | 5.2614E-01 |
| 164 | H3SiO4- | -1. | 1.7211E-06 | 1.6026E-06 | -5.795 | 9.3113E-01 |
| 165 | H2SiO4-2 | -2. | 2.7787E-12 | 2.0887E-12 | -11.680 | 7.5170E-01 |
| 166 | SiF6-2 | -2. | 1.3542E-31 | 1.0180E-31 | -30.992 | 7.5170E-01 |
| 170 | BaOH+ | 1. | 3.7422E-13 | 3.4845E-13 | -12.458 | 9.3113E-01 |
| 171 | BaCO3 | 0. | 3.6331E-10 | 3.6367E-10 | -9.439 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 9.3297E-09 | 8.6872E-09 | -8.061 | 9.3113E-01 |
| 173 | BaSO4 | 0. | 2.4878E-08 | 2.4902E-08 | -7.604 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 1.8716E-12 | 1.7449E-12 | -11.758 | 9.3230E-01 |
| 177 | SrHCO3+ | 1. | 4.9524E-08 | 4.6197E-08 | -7.335 | 9.3281E-01 |
| 178 | SrCO3 | 0. | 1.5223E-09 | 1.5238E-09 | -8.817 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 3.3008E-08 | 3.3041E-08 | -7.481 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 5.020E-10 | 3.199E-09 | -9.299 | -8.495 | 1.569E-01 | -0.804 |
| 2 | Aragonit | 5.020E-10 | 4.436E-09 | -9.299 | -8.353 | 1.132E-01 | -0.946 |
| 3 | Dolomite | 2.760E-19 | 7.083E-18 | -18.559 | -17.150 | 3.897E-02 | -1.409 |
| 5 | Rhodochr | 2.489E-13 | 7.260E-12 | -12.604 | -11.139 | 3.428E-02 | -1.465 |
| 6 | Strontit | 2.211E-12 | 5.321E-10 | -11.655 | -9.274 | 4.154E-03 | -2.382 |
| 7 | Witherit | 6.681E-13 | 2.765E-09 | -12.175 | -8.558 | 2.417E-04 | -3.617 |
| 8 | Gypsum | 3.732E-08 | 2.618E-05 | -7.428 | -4.582 | 1.426E-03 | -2.846 |
| 9 | Anhydrit | 3.733E-08 | 4.239E-05 | -7.428 | -4.373 | 8.807E-04 | -3.055 |
| 10 | Celestit | 1.644E-10 | 2.294E-07 | -9.784 | -6.639 | 7.166E-04 | -3.145 |
| 11 | Barite | 4.969E-11 | 1.172E-10 | -10.304 | -9.931 | 4.238E-01 | -0.373 |
| 12 | Hydroxap | 1.365E-06 | 2.238E-04 | -5.865 | -3.650 | 6.100E-03 | -2.215 |
| 13 | Fluorite | 1.013E-13 | 2.689E-11 | -12.994 | -10.570 | 3.767E-03 | -2.424 |
| 14 | SiO2 (a) | 6.133E-04 | 2.039E-03 | -3.212 | -2.691 | 3.008E-01 | -0.522 |
| 15 | Chalcedy | 6.133E-04 | 3.010E-04 | -3.212 | -3.521 | 2.037E+00 | 0.309 |
| 16 | Quartz | 6.133E-04 | 1.142E-04 | -3.212 | -3.942 | 5.372E+00 | 0.730 |
| 26 | Talc | 3.656E+20 | 1.274E+21 | 20.563 | 21.105 | 2.869E-01 | -0.542 |
| 28 | Chrysotl | 9.721E+26 | 7.611E+31 | 26.988 | 31.881 | 1.277E-05 | -4.894 |
| 29 | Sepiol c | 4.343E+12 | 4.923E+15 | 12.638 | 15.692 | 8.823E-04 | -3.054 |
| 30 | Sepiol d | 4.343E+12 | 4.571E+18 | 12.638 | 18.660 | 9.502E-07 | -6.022 |
| 38 | Pyrolusi | 1.634E+22 | 9.277E+40 | 22.213 | 40.967 | 1.761E-19 | -18.754 |
| 39 | Hausmani | 6.305E+37 | 2.467E+60 | 37.800 | 60.392 | 2.555E-23 | -22.593 |
| 40 | Manganit | 1.007E+15 | 2.188E+25 | 15.003 | 25.340 | 4.605E-11 | -10.337 |
| 41 | Pyrochro | 6.212E+07 | 1.585E+15 | 7.793 | 15.200 | 3.919E-08 | -7.407 |
| 42 | PCO2 | 1.772E-04 | 3.178E-02 | -3.752 | -1.498 | 5.575E-03 | -2.254 |
| 44 | H2 gas | 2.623E-18 | 6.900E-04 | -17.581 | -3.161 | 3.802E-15 | -14.420 |

**21. CHAMPION ELECTRIC**

INITIAL SOLUTION

TEMPERATURE = 15.90 DEGREES C PH = 7.140
ANALYTICAL EPMCAT = 3.501 ANALYTICAL EPMAN = 2.734

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.72503E-04 | -3.2422 | 2.29400E+01 |
| Mg+2 | 2.0 | 6.34007E-04 | -3.1979 | 1.54100E+01 |
| Na+ | 1.0 | 9.44576E-04 | -3.0248 | 2.17100E+01 |
| K+ | 1.0 | 1.34811E-04 | -3.8703 | 5.27000E+00 |
| Mn+2 | 2.0 | 1.82070E-07 | -6.7398 | 1.00000E-02 |

| | | | | |
|---|---|---|---|---|
| Ba+2 | 2.0 | 1.01963E-06 | -5.9916 | 1.40000E-01 |
| Sr+2 | 2.0 | 2.85397E-06 | -5.5446 | 2.50000E-01 |
| H4SiO4 | 0.0 | 5.25227E-04 | -3.2797 | 3.15500E+01 |
| Cl- | -1.0 | 5.55809E-05 | -4.2551 | 1.97000E+00 |
| HCO3- | -1.0 | 2.51994E-03 | -2.5986 | 1.53720E+02 |
| SO4-2 | -2.0 | 4.07136E-05 | -4.3903 | 3.91000E+00 |
| NO3- | -1.0 | 5.35596E-05 | -4.2712 | 7.50000E-01 |
| HPO4-2 | -2.0 | 2.58349E-06 | -5.5878 | 8.00000E-02 |
| F- | -1.0 | 1.68479E-05 | -4.7735 | 3.20000E-01 |
| Br- | -1.0 | 2.50365E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.50 | 3.46 | 7.140 | PCO2= 9.787695E-03 |
| EPMAN | 2.73 | 2.69 | | LOG PCO2 = -2.0093 |
| | | | TEMPERATURE | PO2 = 1.798586E-58 |
| EH = 0.0000 | PE = 0.000 | | 15.90 DEG C | PCH4 = 1.487619E-35 |
| PE CALC S = | 0.000 | | | CO2 TOT = 2.948420E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.294341E-03 | TDS = 258.1MG/L |
| TOT ALK = | 2.520E+00 MEQ | | | CARB ALK = 2.518E+00 MEQ |
| ELECT = | 7.703E-01 MEQ | | | CHARGE IMBALANCE = 12.5% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 7.7206E-08 | 7.2444E-08 | -7.140 | 9.3832E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.5803E-04 | 4.2481E-04 | -3.372 | 7.6127E-01 |
| 5 | Mg+2 | 2. | 6.1715E-04 | 4.7122E-04 | -3.327 | 7.6354E-01 |
| 6 | Na+ | 1. | 9.4330E-04 | 8.8022E-04 | -3.055 | 9.3313E-01 |
| 7 | K+ | 1. | 1.3479E-04 | 1.2561E-04 | -3.901 | 9.3192E-01 |
| 9 | Mn+2 | 2. | 1.4631E-07 | 1.1178E-07 | -6.952 | 7.6400E-01 |
| 11 | Ba+2 | 2. | 9.9530E-07 | 7.5646E-07 | -6.121 | 7.6003E-01 |
| 12 | Sr+2 | 2. | 2.7835E-06 | 2.1210E-06 | -5.673 | 7.6198E-01 |
| 13 | H4SiO4 | 0. | 5.2441E-04 | 5.2493E-04 | -3.280 | 1.0010E+00 |
| 14 | Cl- | -1. | 5.5581E-05 | 5.1797E-05 | -4.286 | 9.3192E-01 |
| 15 | CO3-2 | -2. | 1.6060E-06 | 1.2232E-06 | -5.913 | 7.6163E-01 |
| 16 | SO4-2 | -2. | 3.6050E-05 | 2.7389E-05 | -4.562 | 7.5973E-01 |
| 17 | NO3- | -1. | 2.6850E-20 | 2.5001E-20 | -19.602 | 9.3112E-01 |
| 19 | PO4-3 | -3. | 7.8799E-12 | 4.1985E-12 | -11.377 | 5.3281E-01 |
| 20 | F- | -1. | 1.6361E-05 | 1.5245E-05 | -4.817 | 9.3179E-01 |
| 22 | Br- | -1. | 2.5036E-07 | 2.3312E-07 | -6.632 | 9.3112E-01 |
| 31 | OH- | -1. | 7.1996E-08 | 6.7085E-08 | -7.173 | 9.3179E-01 |
| 33 | H2 AQ | 0. | 4.0753E-18 | 4.0794E-18 | -17.389 | 1.0010E+00 |
| 34 | HCO3- | -1. | 2.4860E-03 | 2.3224E-03 | -2.634 | 9.3419E-01 |
| 35 | H2CO3 | 0. | 4.3367E-04 | 4.3410E-04 | -3.362 | 1.0010E+00 |
| 40 | HSO4- | -1. | 1.7090E-10 | 1.5938E-10 | -9.798 | 9.3259E-01 |
| 48 | NO2- | -1. | 5.3560E-05 | 4.9871E-05 | -4.302 | 9.3112E-01 |
| 65 | HPO4-2 | -2. | 1.0767E-06 | 8.1387E-07 | -6.089 | 7.5592E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 66 | H2PO4- | -1. | 1.0727E-06 | 1.0009E-06 | -6.000 | 9.3307E-01 |
| 69 | HF AQ | 0. | 1.4091E-09 | 1.4105E-09 | -8.851 | 1.0010E+00 |
| 70 | HF2- | -1. | 8.1574E-14 | 7.6075E-14 | -13.119 | 9.3259E-01 |
| 75 | CaOH+ | 1. | 1.0434E-09 | 9.7308E-10 | -9.012 | 9.3259E-01 |
| 76 | CaCO3 | 0. | 7.5046E-07 | 7.5120E-07 | -6.124 | 1.0010E+00 |
| 77 | CaHCO3+ | 1. | 1.1378E-05 | 1.0630E-05 | -4.973 | 9.3419E-01 |
| 78 | CaSO4 | 0. | 2.1245E-06 | 2.1266E-06 | -5.672 | 1.0010E+00 |
| 79 | CaHSO4 | 1. | 1.0570E-12 | 9.8574E-13 | -12.006 | 9.3259E-01 |
| 80 | CaPO4- | -1. | 4.6672E-09 | 4.3526E-09 | -8.361 | 9.3259E-01 |
| 81 | CaHPO4 | 0. | 1.5891E-07 | 1.5907E-07 | -6.798 | 1.0010E+00 |
| 82 | CaH2PO4+ | 1. | 9.7374E-09 | 9.0810E-09 | -8.042 | 9.3259E-01 |
| 83 | CaF+ | 1. | 4.8590E-08 | 4.5314E-08 | -7.344 | 9.3259E-01 |
| 85 | MgOH+ | 1. | 1.1058E-08 | 1.0313E-08 | -7.987 | 9.3259E-01 |
| 86 | MgCO3 | 0. | 4.7781E-07 | 4.7828E-07 | -6.320 | 1.0010E+00 |
| 87 | MgHCO3+ | 1. | 1.3303E-05 | 1.2407E-05 | -4.906 | 9.3259E-01 |
| 88 | MgSO4 | 0. | 2.3734E-06 | 2.3757E-06 | -5.624 | 1.0010E+00 |
| 89 | MgPO4- | -1. | 6.9837E-09 | 6.5130E-09 | -8.186 | 9.3259E-01 |
| 90 | MgHPO4 | 0. | 2.3834E-07 | 2.3858E-07 | -6.622 | 1.0010E+00 |
| 91 | MgH2PO4+ | 1. | 1.3755E-08 | 1.2828E-08 | -7.892 | 9.3259E-01 |
| 92 | MgF+ | 1. | 4.2935E-07 | 4.0040E-07 | -6.398 | 9.3259E-01 |
| 93 | NaOH | 0. | 8.0190E-11 | 8.0269E-11 | -10.095 | 1.0010E+00 |
| 94 | NaCO3- | -1. | 1.3390E-08 | 1.2487E-08 | -7.904 | 9.3259E-01 |
| 95 | NaHCO3 | 0. | 1.1294E-06 | 1.1305E-06 | -5.947 | 1.0010E+00 |
| 96 | NaSO4- | -1. | 1.2207E-07 | 1.1385E-07 | -6.944 | 9.3259E-01 |
| 97 | NaHPO4- | -1. | 1.4978E-09 | 1.3968E-09 | -8.855 | 9.3259E-01 |
| 98 | NaF aq | 0. | 7.7141E-09 | 7.7217E-09 | -8.112 | 1.0010E+00 |
| 99 | KOH | 0. | 6.0056E-12 | 6.0116E-12 | -11.221 | 1.0010E+00 |
| 100 | KSO4- | -1. | 2.2005E-08 | 2.0521E-08 | -7.688 | 9.3259E-01 |
| 101 | KHPO4- | -1. | 2.1375E-10 | 1.9934E-10 | -9.700 | 9.3259E-01 |
| 134 | MnOH+ | 1. | 1.9785E-11 | 1.8451E-11 | -10.734 | 9.3259E-01 |
| 136 | MnCl+ | 1. | 2.5292E-11 | 2.3587E-11 | -10.627 | 9.3259E-01 |
| 137 | MnCl2 | 0. | 5.3278E-16 | 5.3331E-16 | -15.273 | 1.0010E+00 |
| 138 | MnCl3- | -1. | 8.1582E-21 | 7.6082E-21 | -20.119 | 9.3259E-01 |
| 139 | MnCO3 | 0. | 1.0850E-08 | 1.0861E-08 | -7.964 | 1.0010E+00 |
| 140 | MnHCO3+ | 1. | 2.4398E-08 | 2.2753E-08 | -7.643 | 9.3259E-01 |
| 141 | MnSO4 | 0. | 4.5471E-10 | 4.5516E-10 | -9.342 | 1.0010E+00 |
| 143 | MnF+ | 1. | 1.2641E-11 | 1.1789E-11 | -10.929 | 9.3259E-01 |
| 144 | Mn+3 | 3. | 1.6435E-33 | 8.7697E-34 | -33.057 | 5.3359E-01 |
| 164 | H3SiO4- | -1. | 8.1861E-07 | 7.6343E-07 | -6.117 | 9.3259E-01 |
| 165 | H2SiO4-2 | -2. | 5.0691E-13 | 3.8344E-13 | -12.416 | 7.5642E-01 |
| 166 | SiF6-2 | -2. | 8.6192E-31 | 6.5197E-31 | -30.186 | 7.5642E-01 |
| 170 | BaOH+ | 1. | 3.7936E-13 | 3.5379E-13 | -12.451 | 9.3259E-01 |
| 171 | BaCO3 | 0. | 3.9779E-10 | 3.9818E-10 | -9.400 | 1.0010E+00 |
| 172 | BaHCO3+ | 1. | 1.3560E-08 | 1.2646E-08 | -7.898 | 9.3259E-01 |
| 173 | BaSO4 | 0. | 1.0373E-08 | 1.0384E-08 | -7.984 | 1.0010E+00 |
| 176 | SrOH+ | 1. | 1.6080E-12 | 1.5014E-12 | -11.824 | 9.3370E-01 |
| 177 | SrHCO3+ | 1. | 5.9067E-08 | 5.5180E-08 | -7.258 | 9.3419E-01 |
| 178 | SrCO3 | 0. | 1.2646E-09 | 1.2659E-09 | -8.898 | 1.0010E+00 |
| 179 | SrSO4 | 0. | 1.0132E-08 | 1.0142E-08 | -7.994 | 1.0010E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 5.196E-10 | 3.681E-09 | -9.284 | -8.434 | 1.412E-01 | -0.850 |
| 2 | Aragonit | 5.196E-10 | 5.205E-09 | -9.284 | -8.284 | 9.983E-02 | -1.001 |
| 3 | Dolomite | 2.995E-19 | 1.342E-17 | -18.524 | -16.872 | 2.232E-02 | -1.651 |
| 5 | Rhodochr | 1.367E-13 | 7.998E-12 | -12.864 | -11.097 | 1.709E-02 | -1.767 |
| 6 | Strontit | 2.594E-12 | 5.331E-10 | -11.586 | -9.273 | 4.867E-03 | -2.313 |

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 7 | Witherit | 9.253E-13 | 2.552E-09 | -12.034 | -8.593 | 3.625E-04 | -3.441 |
| 8 | Gypsum | 1.163E-08 | 2.608E-05 | -7.934 | -4.584 | 4.460E-04 | -3.351 |
| 9 | Anhydrit | 1.163E-08 | 4.611E-05 | -7.934 | -4.336 | 2.523E-04 | -3.598 |
| 10 | Celestit | 5.809E-11 | 2.395E-07 | -10.236 | -6.621 | 2.426E-04 | -3.615 |
| 11 | Barite | 2.072E-11 | 7.461E-11 | -10.684 | -10.127 | 2.777E-01 | -0.556 |
| 12 | Hydroxap | 2.708E-07 | 2.590E-03 | -6.567 | -2.587 | 1.045E-04 | -3.981 |
| 13 | Fluorite | 9.873E-14 | 1.935E-11 | -13.006 | -10.713 | 5.102E-03 | -2.292 |
| 14 | SiO2 (a) | 5.250E-04 | 1.626E-03 | -3.280 | -2.789 | 3.230E-01 | -0.491 |
| 15 | Chalcedy | 5.250E-04 | 2.186E-04 | -3.280 | -3.660 | 2.402E+00 | 0.381 |
| 16 | Quartz | 5.250E-04 | 7.610E-05 | -3.280 | -4.119 | 6.899E+00 | 0.839 |
| 26 | Talc | 5.498E+19 | 2.942E+22 | 19.740 | 22.469 | 1.869E-03 | -2.728 |
| 28 | Chrysotl | 1.994E+26 | 2.308E+33 | 26.300 | 33.363 | 8.642E-08 | -7.063 |
| 29 | Sepiol c | 1.166E+12 | 1.016E+16 | 12.067 | 16.007 | 1.148E-04 | -3.940 |
| 30 | Sepiol d | 1.166E+12 | 4.571E+18 | 12.067 | 18.660 | 2.551E-07 | -6.593 |
| 38 | Pyrolusi | 4.058E+21 | 7.630E+42 | 21.608 | 42.883 | 5.318E-22 | -21.274 |
| 39 | Hausmani | 1.840E+36 | 2.251E+63 | 36.265 | 63.352 | 8.175E-28 | -27.088 |
| 40 | Manganit | 2.940E+14 | 2.188E+25 | 14.468 | 25.340 | 1.344E-11 | -10.872 |
| 41 | Pyrochro | 2.130E+07 | 1.585E+15 | 7.328 | 15.200 | 1.344E-08 | -7.872 |
| 42 | PCO2 | 4.341E-04 | 4.435E-02 | -3.362 | -1.353 | 9.788E-03 | -2.009 |
| 44 | H2 gas | 4.079E-18 | 7.773E-04 | -17.389 | -3.109 | 5.248E-15 | -14.280 |

PALOUSE BASIN: WANAPUM SAMPLES

**22. UI5**

INITIAL SOLUTION

TEMPERATURE = 16.30 DEGREES C PH = 7.240
ANALYTICAL EPMCAT = 4.750 ANALYTICAL EPMAN = 6.462

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 1.24295E-03 | -2.9055 | 4.97970E+01 |
| Mg+2 | 2.0 | 8.20838E-04 | -3.0857 | 1.99480E+01 |
| Na+ | 1.0 | 5.23839E-04 | -3.2808 | 1.20380E+01 |
| K+ | 1.0 | 9.11582E-05 | -4.0402 | 3.56300E+00 |
| Fe+2 | 2.0 | 6.44884E-07 | -6.1905 | 3.60000E-02 |
| Mn+2 | 2.0 | 8.92282E-07 | -6.0495 | 4.90000E-02 |
| Ba+2 | 2.0 | 9.54230E-07 | -6.0203 | 1.31000E-01 |
| H4SiO4 | 0.0 | 3.89161E-04 | -3.4099 | 2.33730E+01 |
| Cl- | -1.0 | 4.74909E-04 | -3.3234 | 1.68300E+01 |
| HCO3- | -1.0 | 3.68047E-03 | -2.4341 | 2.24480E+02 |
| SO4-2 | -2.0 | 4.30839E-04 | -3.3657 | 4.13700E+01 |
| NO3- | -1.0 | 1.43348E-03 | -2.8436 | 2.00700E+01 |

| | | | | |
|---|---|---|---|---|
| H3BO3 | 0.0 | 1.58252E-05 | -4.8007 | 1.71000E-01 |
| HPO4-2 | -2.0 | 9.68960E-07 | -6.0137 | 3.00000E-02 |
| F- | -1.0 | 6.31892E-06 | -5.1994 | 1.20000E-01 |
| Br- | -1.0 | 1.25202E-07 | -6.9024 | 1.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9998 |
|---|---|---|---|---|
| EPMCAT | 4.75 | 4.55 | 7.240 | PCO2= 1.112159E-02 |
| EPMAN | 6.46 | 6.26 | | LOG PCO2 = -1.9538 |
| | | | TEMPERATURE | PO2 = 6.293442E-58 |
| EH = 0.0000 | PE = 0.000 | | 16.30 DEG C | PCH4 = 2.321328E-36 |
| PE CALC S = | 0.000 | | | CO2 TOT = 4.158222E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 7.721114E-03 | TDS = 412.0MG/L |
| TOT ALK = | 3.680E+00 MEQ | | | CARB ALK = 3.679E+00 MEQ |
| ELECT = | -1.710E+00 MEQ | | | CHARGE IMBALANCE = -15.8% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 6.2396E-08 | 5.7544E-08 | -7.240 | 9.2223E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 1.1695E-03 | 8.2125E-04 | -3.086 | 7.0225E-01 |
| 5 | Mg+2 | 2. | 7.7129E-04 | 5.4438E-04 | -3.264 | 7.0581E-01 |
| 6 | Na+ | 1. | 5.2232E-04 | 4.7733E-04 | -3.321 | 9.1387E-01 |
| 7 | K+ | 1. | 9.1018E-05 | 8.2991E-05 | -4.081 | 9.1181E-01 |
| 8 | Fe+2 | 2. | 4.8851E-07 | 3.4506E-07 | -6.462 | 7.0634E-01 |
| 9 | Mn+2 | 2. | 6.4801E-07 | 4.5772E-07 | -6.339 | 7.0634E-01 |
| 11 | Ba+2 | 2. | 8.6063E-07 | 6.0261E-07 | -6.220 | 7.0019E-01 |
| 13 | H4SiO4 | 0. | 3.8837E-04 | 3.8906E-04 | -3.410 | 1.0018E+00 |
| 14 | Cl- | -1. | 4.7491E-04 | 4.3302E-04 | -3.363 | 9.1181E-01 |
| 15 | CO3-2 | -2. | 3.1498E-06 | 2.2133E-06 | -5.655 | 7.0268E-01 |
| 16 | SO4-2 | -2. | 3.6560E-04 | 2.5581E-04 | -3.592 | 6.9970E-01 |
| 17 | NO3- | -1. | 1.2653E-18 | 1.1520E-18 | -17.939 | 9.1045E-01 |
| 18 | H3BO3 | 0. | 1.5679E-05 | 1.5707E-05 | -4.804 | 1.0018E+00 |
| 19 | PO4-3 | -3. | 4.3859E-12 | 1.9267E-12 | -11.715 | 4.3930E-01 |
| 20 | F- | -1. | 6.0955E-06 | 5.5565E-06 | -5.255 | 9.1157E-01 |
| 22 | Br- | -1. | 1.2520E-07 | 1.1399E-07 | -6.943 | 9.1045E-01 |
| 31 | OH- | -1. | 9.5776E-08 | 8.7306E-08 | -7.059 | 9.1157E-01 |
| 33 | H2 AQ | 0. | 2.5585E-18 | 2.5630E-18 | -17.591 | 1.0018E+00 |
| 34 | HCO3- | -1. | 3.6093E-03 | 3.3045E-03 | -2.481 | 9.1557E-01 |
| 35 | H2CO3 | 0. | 4.8630E-04 | 4.8716E-04 | -3.312 | 1.0018E+00 |
| 40 | HSO4- | -1. | 1.3056E-09 | 1.1920E-09 | -8.924 | 9.1302E-01 |
| 48 | NO2- | -1. | 1.4335E-03 | 1.3051E-03 | -2.884 | 9.1045E-01 |
| 57 | H2BO3- | -1. | 1.4608E-07 | 1.3337E-07 | -6.875 | 9.1302E-01 |
| 58 | BFOH3- | -1. | 3.4646E-11 | 3.1632E-11 | -10.500 | 9.1302E-01 |
| 59 | BF2OH2- | -1. | 1.2012E-15 | 1.0968E-15 | -14.960 | 9.1302E-01 |
| 60 | BF3OH- | -1. | 4.9626E-22 | 4.5309E-22 | -21.344 | 9.1302E-01 |
| 61 | BF4- | -1. | 6.5416E-28 | 5.9726E-28 | -27.224 | 9.1302E-01 |
| 65 | HPO4-2 | -2. | 4.2400E-07 | 2.9417E-07 | -6.531 | 6.9379E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 66 | H2PO4- | -1. | 3.1376E-07 | 2.8669E-07 | -6.543 | 9.1372E-01 |
| 69 | HF AQ | 0. | 4.1047E-10 | 4.1120E-10 | -9.386 | 1.0018E+00 |
| 70 | HF2- | -1. | 8.8893E-15 | 8.1162E-15 | -14.091 | 9.1302E-01 |
| 75 | CaOH+ | 1. | 2.5937E-09 | 2.3681E-09 | -8.626 | 9.1302E-01 |
| 76 | CaCO3 | 0. | 2.6365E-06 | 2.6412E-06 | -5.578 | 1.0018E+00 |
| 77 | CaHCO3+ | 1. | 3.2220E-05 | 2.9500E-05 | -4.530 | 9.1557E-01 |
| 78 | CaSO4 | 0. | 3.8483E-05 | 3.8552E-05 | -4.414 | 1.0018E+00 |
| 79 | CaHSO4 | 1. | 1.5485E-11 | 1.4138E-11 | -10.850 | 9.1302E-01 |
| 80 | CaPO4- | -1. | 4.2610E-09 | 3.8904E-09 | -8.410 | 9.1302E-01 |
| 81 | CaHPO4 | 0. | 1.1184E-07 | 1.1204E-07 | -6.951 | 1.0018E+00 |
| 82 | CaH2PO4+ | 1. | 5.5525E-09 | 5.0696E-09 | -8.295 | 9.1302E-01 |
| 83 | CaF+ | 1. | 3.5320E-08 | 3.2248E-08 | -7.491 | 9.1302E-01 |
| 85 | MgOH+ | 1. | 1.7054E-08 | 1.5571E-08 | -7.808 | 9.1302E-01 |
| 86 | MgCO3 | 0. | 1.0042E-06 | 1.0060E-06 | -5.997 | 1.0018E+00 |
| 87 | MgHCO3+ | 1. | 2.2359E-05 | 2.0415E-05 | -4.690 | 9.1302E-01 |
| 88 | MgSO4 | 0. | 2.5871E-05 | 2.5917E-05 | -4.586 | 1.0018E+00 |
| 89 | MgPO4- | -1. | 3.8102E-09 | 3.4788E-09 | -8.459 | 9.1302E-01 |
| 90 | MgHPO4 | 0. | 1.0024E-07 | 1.0041E-07 | -6.998 | 1.0018E+00 |
| 91 | MgH2PO4+ | 1. | 4.6873E-09 | 4.2796E-09 | -8.369 | 9.1302E-01 |
| 92 | MgF+ | 1. | 1.8609E-07 | 1.6990E-07 | -6.770 | 9.1302E-01 |
| 93 | NaOH | 0. | 5.4699E-11 | 5.4796E-11 | -10.261 | 1.0018E+00 |
| 94 | NaCO3- | -1. | 1.3711E-08 | 1.2519E-08 | -7.902 | 9.1302E-01 |
| 95 | NaHCO3 | 0. | 8.7206E-07 | 8.7362E-07 | -6.059 | 1.0018E+00 |
| 96 | NaSO4- | -1. | 6.3326E-07 | 5.7818E-07 | -6.238 | 9.1302E-01 |
| 97 | NaHPO4- | -1. | 2.9987E-10 | 2.7379E-10 | -9.563 | 9.1302E-01 |
| 98 | NaF aq | 0. | 1.5235E-09 | 1.5262E-09 | -8.816 | 1.0018E+00 |
| 99 | KOH | 0. | 4.9910E-12 | 4.9999E-12 | -11.301 | 1.0018E+00 |
| 100 | KSO4- | -1. | 1.3973E-07 | 1.2758E-07 | -6.894 | 9.1302E-01 |
| 101 | KHPO4- | -1. | 5.2137E-11 | 4.7602E-11 | -10.322 | 9.1302E-01 |
| 102 | FeOH+ | 1. | 1.0630E-09 | 9.7050E-10 | -9.013 | 9.1302E-01 |
| 105 | FeCl+ | 1. | 2.2590E-10 | 2.0625E-10 | -9.686 | 9.1302E-01 |
| 106 | FeCO3 | 0. | 1.8288E-08 | 1.8320E-08 | -7.737 | 1.0018E+00 |
| 107 | FeHCO3+ | 1. | 1.2300E-07 | 1.1230E-07 | -6.950 | 9.1302E-01 |
| 108 | FeSO4 | 0. | 1.3301E-08 | 1.3324E-08 | -7.875 | 1.0018E+00 |
| 109 | FeHSO4+ | 1. | 6.5062E-15 | 5.9403E-15 | -14.226 | 9.1302E-01 |
| 112 | FeHPO4 | 0. | 4.0338E-10 | 4.0410E-10 | -9.394 | 1.0018E+00 |
| 113 | FeH2PO4+ | 1. | 5.4302E-11 | 4.9579E-11 | -10.305 | 9.1302E-01 |
| 114 | FeF+ | 1. | 2.0999E-11 | 1.9173E-11 | -10.717 | 9.1302E-01 |
| 115 | Fe+3 | 3. | 4.1788E-20 | 2.0166E-20 | -19.695 | 4.8258E-01 |
| 117 | FeOH+2 | 2. | 1.9208E-15 | 1.3348E-15 | -14.875 | 6.9491E-01 |
| 118 | FeOH2+ | 1. | 5.9875E-12 | 5.4668E-12 | -11.262 | 9.1302E-01 |
| 119 | FeOH3 | 0. | 8.2650E-12 | 8.2797E-12 | -11.082 | 1.0018E+00 |
| 120 | FeOH4- | -1. | 1.0024E-13 | 9.1520E-14 | -13.038 | 9.1302E-01 |
| 121 | Fe2OH2+4 | 4. | 2.9782E-28 | 6.9449E-29 | -28.158 | 2.3319E-01 |
| 122 | Fe3OH4+5 | 5. | 1.7639E-36 | 1.8135E-37 | -36.741 | 1.0281E-01 |
| 123 | FeCl+2 | 2. | 2.8564E-22 | 1.9850E-22 | -21.702 | 6.9491E-01 |
| 124 | FeCl2+ | 1. | 5.5868E-25 | 5.1009E-25 | -24.292 | 9.1302E-01 |
| 125 | FeCl3 | 0. | 2.2049E-29 | 2.2088E-29 | -28.656 | 1.0018E+00 |
| 126 | FeSO4+ | 1. | 5.0806E-20 | 4.6387E-20 | -19.334 | 9.1302E-01 |
| 127 | FeHSO4+2 | 2. | 2.0506E-26 | 1.4250E-26 | -25.846 | 6.9491E-01 |
| 128 | FeSO42- | -1. | 2.7456E-22 | 2.5068E-22 | -21.601 | 9.1302E-01 |
| 129 | FeHPO4+ | 1. | 1.3057E-21 | 1.1921E-21 | -20.924 | 9.1302E-01 |
| 130 | FeH2P+2 | 2. | 2.2032E-21 | 1.5310E-21 | -20.815 | 6.9491E-01 |
| 131 | FeF+2 | 2. | 2.2285E-19 | 1.5486E-19 | -18.810 | 6.9491E-01 |
| 132 | FeF2+ | 1. | 3.3727E-20 | 3.0794E-20 | -19.512 | 9.1302E-01 |
| 133 | FeF3 | 0. | 2.6258E-22 | 2.6305E-22 | -21.580 | 1.0018E+00 |
| 134 | MnOH+ | 1. | 1.0784E-10 | 9.8461E-11 | -10.007 | 9.1302E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 136 | MnCl+ | 1. | 8.8435E-10 | 8.0744E-10 | -9.093 | 9.1302E-01 |
| 137 | MnCl2 | 0. | 1.5235E-13 | 1.5262E-13 | -12.816 | 1.0018E+00 |
| 138 | MnCl3- | -1. | 1.9937E-17 | 1.8203E-17 | -16.740 | 9.1302E-01 |
| 139 | MnCO3 | 0. | 8.0328E-08 | 8.0471E-08 | -7.094 | 1.0018E+00 |
| 140 | MnHCO3+ | 1. | 1.4542E-07 | 1.3277E-07 | -6.877 | 9.1302E-01 |
| 141 | MnSO4 | 0. | 1.7518E-08 | 1.7550E-08 | -7.756 | 1.0018E+00 |
| 143 | MnF+ | 1. | 1.9271E-11 | 1.7595E-11 | -10.755 | 9.1302E-01 |
| 144 | Mn+3 | 3. | 8.6662E-33 | 3.8209E-33 | -32.418 | 4.4090E-01 |
| 164 | H3SiO4- | -1. | 7.9249E-07 | 7.2356E-07 | -6.141 | 9.1302E-01 |
| 165 | H2SiO4-2 | -2. | 6.7771E-13 | 4.7095E-13 | -12.327 | 6.9491E-01 |
| 166 | SiF6-2 | -2. | 6.2431E-34 | 4.3384E-34 | -33.363 | 6.9491E-01 |
| 170 | BaOH+ | 1. | 3.8858E-13 | 3.5479E-13 | -12.450 | 9.1302E-01 |
| 171 | BaCO3 | 0. | 5.7756E-10 | 5.7859E-10 | -9.238 | 1.0018E+00 |
| 172 | BaHCO3+ | 1. | 1.5899E-08 | 1.4516E-08 | -7.838 | 9.1302E-01 |
| 173 | BaSO4 | 0. | 7.7123E-08 | 7.7260E-08 | -7.112 | 1.0018E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.818E-09 | 3.666E-09 | -8.740 | -8.436 | 4.959E-01 | -0.305 |
| 2 | Aragonit | 1.818E-09 | 5.180E-09 | -8.740 | -8.286 | 3.509E-01 | -0.455 |
| 3 | Dolomite | 2.190E-18 | 1.312E-17 | -17.660 | -16.882 | 1.669E-01 | -0.777 |
| 4 | Siderite | 7.637E-13 | 1.461E-11 | -12.117 | -10.835 | 5.228E-02 | -1.282 |
| 5 | Rhodochr | 1.013E-12 | 7.971E-12 | -11.994 | -11.098 | 1.271E-01 | -0.896 |
| 7 | Witherit | 1.334E-12 | 2.565E-09 | -11.875 | -8.591 | 5.200E-04 | -3.284 |
| 8 | Gypsum | 2.100E-07 | 2.610E-05 | -6.678 | -4.583 | 8.046E-03 | -2.094 |
| 9 | Anhydrit | 2.101E-07 | 4.606E-05 | -6.678 | -4.337 | 4.561E-03 | -2.341 |
| 11 | Barite | 1.542E-10 | 7.592E-11 | -9.812 | -10.120 | 2.031E+00 | 0.308 |
| 12 | Hydroxap | 8.671E-07 | 2.374E-03 | -6.062 | -2.624 | 3.652E-04 | -3.437 |
| 13 | Fluorite | 2.536E-14 | 1.959E-11 | -13.596 | -10.708 | 1.294E-03 | -2.888 |
| 14 | SiO2 (a) | 3.892E-04 | 1.639E-03 | -3.410 | -2.785 | 2.375E-01 | -0.624 |
| 15 | Chalcedy | 3.892E-04 | 2.211E-04 | -3.410 | -3.655 | 1.760E+00 | 0.246 |
| 16 | Quartz | 3.892E-04 | 7.720E-05 | -3.410 | -4.112 | 5.041E+00 | 0.703 |
| 26 | Talc | 1.019E+20 | 2.632E+22 | 20.008 | 22.420 | 3.871E-03 | -2.412 |
| 28 | Chrysotl | 6.725E+26 | 2.045E+33 | 26.828 | 33.311 | 3.289E-07 | -6.483 |
| 29 | Sepiol c | 1.592E+12 | 9.902E+15 | 12.202 | 15.996 | 1.607E-04 | -3.794 |
| 30 | Sepiol d | 1.592E+12 | 4.571E+18 | 12.202 | 18.660 | 3.482E-07 | -6.458 |
| 31 | Hematite | 1.120E+04 | 4.694E-04 | 4.049 | -3.328 | 2.385E+07 | 7.377 |
| 32 | Goethite | 1.058E+02 | 4.797E-02 | 2.024 | -1.319 | 2.205E+03 | 3.344 |
| 33 | Fe(OH)3a | 1.058E+02 | 7.780E+04 | 2.024 | 4.891 | 1.360E-03 | -2.867 |
| 37 | Vivianit | 1.523E-43 | 1.000E-36 | -42.817 | -36.000 | 1.523E-07 | -6.817 |
| 38 | Pyrolusi | 4.173E+22 | 6.524E+42 | 22.620 | 42.815 | 6.397E-21 | -20.194 |
| 39 | Hausmani | 7.971E+38 | 1.767E+63 | 38.902 | 63.247 | 4.510E-25 | -24.346 |
| 40 | Manganit | 2.401E+15 | 2.188E+25 | 15.380 | 25.340 | 1.098E-10 | -9.960 |
| 41 | Pyrochro | 1.382E+08 | 1.585E+15 | 8.140 | 15.200 | 8.719E-08 | -7.060 |
| 42 | PCO2 | 4.872E-04 | 4.380E-02 | -3.312 | -1.358 | 1.112E-02 | -1.954 |
| 44 | H2 gas | 2.563E-18 | 7.740E-04 | -17.591 | -3.111 | 3.311E-15 | -14.480 |
| 49 | Melanter | 8.817E-11 | 4.779E-03 | -10.055 | -2.321 | 1.845E-08 | -7.734 |
| 51 | K-Jarosi | 1.225E-27 | 3.014E-09 | -26.912 | -8.521 | 4.066E-19 | -18.391 |

**23. STALNAKER**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 6.850
ANALYTICAL EPMCAT = 5.902 ANALYTICAL EPMAN = 3.628

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 1.21151E-03 | -2.9167 | 4.85400E+01 |
| Mg+2 | 2.0 | 8.97000E-04 | -3.0472 | 2.18000E+01 |
| Na+ | 1.0 | 9.52505E-04 | -3.0211 | 2.18900E+01 |
| K+ | 1.0 | 9.23559E-05 | -4.0345 | 3.61000E+00 |
| Fe+2 | 2.0 | 3.10961E-04 | -3.5073 | 1.73600E+01 |
| Mn+2 | 2.0 | 3.27760E-06 | -5.4844 | 1.80000E-01 |
| Ba+2 | 2.0 | 1.45676E-06 | -5.8366 | 2.00000E-01 |
| Sr+2 | 2.0 | 3.31094E-06 | -5.4800 | 2.90000E-01 |
| H4SiO4 | 0.0 | 5.44260E-04 | -3.2642 | 3.26900E+01 |
| Cl- | -1.0 | 5.92547E-05 | -4.2273 | 2.10000E+00 |
| HCO3- | -1.0 | 3.16024E-03 | -2.5003 | 1.92760E+02 |
| SO4-2 | -2.0 | 1.92342E-04 | -3.7159 | 1.84700E+01 |
| NO3- | -1.0 | 1.85692E-05 | -4.7312 | 2.60000E-01 |
| H3BO3 | 0.0 | 6.47782E-06 | -5.1886 | 7.00000E-02 |
| HPO4-2 | -2.0 | 3.22970E-07 | -6.4908 | 1.00000E-02 |
| F- | -1.0 | 3.15930E-06 | -5.5004 | 6.00000E-02 |
| Br- | -1.0 | 2.50391E-07 | -6.6014 | 2.00000E-02 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | |
|---|---|---|---|---|
| EPMCAT | 5.90 | 5.71 | 6.850 | ACTIVITY H2O = 0.9999 |
| EPMAN | 3.63 | 3.44 | | PCO2= 2.361188E-02 |
| | | | | LOG PCO2 = -1.6269 |
| | | | TEMPERATURE | PO2 = 7.026419E-59 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 3.545000E-33 |
| PE CALC S = | 0.000 | | | CO2 TOT = 4.133670E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 7.021191E-03 | TDS = 360.3MG/L |
| TOT ALK = | 3.160E+00 MEQ | | | CARB ALK = 3.159E+00 MEQ |
| ELECT = | 2.273E+00 MEQ | | | CHARGE IMBALANCE = 24.8% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.5273E-07 | 1.4125E-07 | -6.850 | 9.2483E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 4 | Ca+2 | 2. | 1.1648E-03 | 8.2900E-04 | -3.081 | 7.1172E-01 |
| 5 | Mg+2 | 2. | 8.6160E-04 | 6.1608E-04 | -3.210 | 7.1504E-01 |
| 6 | Na+ | 1. | 9.5063E-04 | 8.7177E-04 | -3.060 | 9.1705E-01 |
| 7 | K+ | 1. | 9.2292E-05 | 8.4461E-05 | -4.073 | 9.1516E-01 |
| 8 | Fe+2 | 2. | 2.5006E-04 | 1.7894E-04 | -3.747 | 7.1558E-01 |
| 9 | Mn+2 | 2. | 2.6213E-06 | 1.8757E-06 | -5.727 | 7.1558E-01 |
| 11 | Ba+2 | 2. | 1.3787E-06 | 9.7860E-07 | -6.009 | 7.0982E-01 |
| 12 | Sr+2 | 2. | 3.1816E-06 | 2.2676E-06 | -5.644 | 7.1273E-01 |
| 13 | H4SiO4 | 0. | 5.4378E-04 | 5.4466E-04 | -3.264 | 1.0016E+00 |
| 14 | Cl- | -1. | 5.9240E-05 | 5.4213E-05 | -4.266 | 9.1516E-01 |
| 15 | CO3-2 | -2. | 1.1161E-06 | 7.9484E-07 | -6.100 | 7.1215E-01 |
| 16 | SO4-2 | -2. | 1.5781E-04 | 1.1194E-04 | -3.951 | 7.0936E-01 |
| 17 | NO3- | -1. | 4.2416E-21 | 3.8764E-21 | -20.412 | 9.1390E-01 |
| 18 | H3BO3 | 0. | 6.4526E-06 | 6.4630E-06 | -5.190 | 1.0016E+00 |
| 19 | PO4-3 | -3. | 3.3649E-13 | 1.5268E-13 | -12.816 | 4.5373E-01 |
| 20 | F- | -1. | 3.0255E-06 | 2.7681E-06 | -5.558 | 9.1493E-01 |
| 22 | Br- | -1. | 2.5039E-07 | 2.2883E-07 | -6.640 | 9.1390E-01 |
| 31 | OH- | -1. | 4.4705E-08 | 4.0902E-08 | -7.388 | 9.1493E-01 |
| 33 | H2 AQ | 0. | 1.5146E-17 | 1.5170E-17 | -16.819 | 1.0016E+00 |
| 34 | HCO3- | -1. | 3.0415E-03 | 2.7940E-03 | -2.554 | 9.1864E-01 |
| 35 | H2CO3 | 0. | 9.8030E-04 | 9.8189E-04 | -3.008 | 1.0016E+00 |
| 40 | HSO4- | -1. | 1.4467E-09 | 1.3255E-09 | -8.878 | 9.1625E-01 |
| 48 | NO2- | -1. | 1.8569E-05 | 1.6970E-05 | -4.770 | 9.1390E-01 |
| 57 | H2BO3- | -1. | 2.5212E-08 | 2.3100E-08 | -7.636 | 9.1625E-01 |
| 58 | BFOH3- | -1. | 7.2111E-12 | 6.6072E-12 | -11.180 | 9.1625E-01 |
| 59 | BF2OH2- | -1. | 3.0503E-16 | 2.7948E-16 | -15.554 | 9.1625E-01 |
| 60 | BF3OH- | -1. | 1.4912E-22 | 1.3663E-22 | -21.864 | 9.1625E-01 |
| 61 | BF4- | -1. | 2.3982E-28 | 2.1973E-28 | -27.658 | 9.1625E-01 |
| 65 | HPO4-2 | -2. | 7.8437E-08 | 5.5206E-08 | -7.258 | 7.0383E-01 |
| 66 | H2PO4- | -1. | 1.4259E-07 | 1.3075E-07 | -6.884 | 9.1692E-01 |
| 69 | HF AQ | 0. | 5.1710E-10 | 5.1794E-10 | -9.286 | 1.0016E+00 |
| 70 | HF2- | -1. | 5.6516E-15 | 5.1783E-15 | -14.286 | 9.1625E-01 |
| 75 | CaOH+ | 1. | 1.0629E-09 | 9.7385E-10 | -9.012 | 9.1625E-01 |
| 76 | CaCO3 | 0. | 9.7845E-07 | 9.8003E-07 | -6.009 | 1.0016E+00 |
| 77 | CaHCO3+ | 1. | 2.8412E-05 | 2.6101E-05 | -4.583 | 9.1864E-01 |
| 78 | CaSO4 | 0. | 1.7289E-05 | 1.7317E-05 | -4.762 | 1.0016E+00 |
| 79 | CaHSO4 | 1. | 1.6731E-11 | 1.5330E-11 | -10.814 | 9.1625E-01 |
| 80 | CaPO4- | -1. | 3.5050E-10 | 3.2114E-10 | -9.493 | 9.1625E-01 |
| 81 | CaHPO4 | 0. | 2.1912E-08 | 2.1948E-08 | -7.659 | 1.0016E+00 |
| 82 | CaH2PO4+ | 1. | 2.6367E-09 | 2.4159E-09 | -8.617 | 9.1625E-01 |
| 83 | CaF+ | 1. | 1.8455E-08 | 1.6910E-08 | -7.772 | 9.1625E-01 |
| 85 | MgOH+ | 1. | 9.1785E-09 | 8.4098E-09 | -8.075 | 9.1625E-01 |
| 86 | MgCO3 | 0. | 4.1897E-07 | 4.1965E-07 | -6.377 | 1.0016E+00 |
| 87 | MgHCO3+ | 1. | 2.1419E-05 | 1.9625E-05 | -4.707 | 9.1625E-01 |
| 88 | MgSO4 | 0. | 1.3419E-05 | 1.3441E-05 | -4.872 | 1.0016E+00 |
| 89 | MgPO4- | -1. | 3.5137E-10 | 3.2194E-10 | -9.492 | 9.1625E-01 |
| 90 | MgHPO4 | 0. | 2.2017E-08 | 2.2053E-08 | -7.657 | 1.0016E+00 |
| 91 | MgH2PO4+ | 1. | 2.4954E-09 | 2.2864E-09 | -8.641 | 9.1625E-01 |
| 92 | MgF+ | 1. | 1.0800E-07 | 9.8952E-08 | -7.005 | 9.1625E-01 |
| 93 | NaOH | 0. | 4.0704E-11 | 4.0770E-11 | -10.390 | 1.0016E+00 |
| 94 | NaCO3- | -1. | 9.8094E-09 | 8.9879E-09 | -8.046 | 9.1625E-01 |
| 95 | NaHCO3 | 0. | 1.3544E-06 | 1.3566E-06 | -5.868 | 1.0016E+00 |
| 96 | NaSO4- | -1. | 5.1008E-07 | 4.6737E-07 | -6.330 | 9.1625E-01 |
| 97 | NaHPO4- | -1. | 1.0242E-10 | 9.3841E-11 | -10.028 | 9.1625E-01 |
| 98 | NaF aq | 0. | 1.3864E-09 | 1.3886E-09 | -8.857 | 1.0016E+00 |
| 99 | KOH | 0. | 2.0696E-12 | 2.0730E-12 | -11.683 | 1.0016E+00 |
| 100 | KSO4- | -1. | 6.3981E-08 | 5.8623E-08 | -7.232 | 9.1625E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 101 | KHPO4- | -1. | 9.9227E-12 | 9.0918E-12 | -11.041 | 9.1625E-01 |
| 102 | FeOH+ | 1. | 2.5586E-07 | 2.3443E-07 | -6.630 | 9.1625E-01 |
| 105 | FeCl+ | 1. | 1.4615E-08 | 1.3391E-08 | -7.873 | 9.1625E-01 |
| 106 | FeCO3 | 0. | 3.4063E-06 | 3.4118E-06 | -5.467 | 1.0016E+00 |
| 107 | FeHCO3+ | 1. | 5.4042E-05 | 4.9516E-05 | -4.305 | 9.1625E-01 |
| 108 | FeSO4 | 0. | 3.1194E-06 | 3.1245E-06 | -5.505 | 1.0016E+00 |
| 109 | FeHSO4+ | 1. | 3.6115E-12 | 3.3090E-12 | -11.480 | 9.1625E-01 |
| 112 | FeHPO4 | 0. | 3.9264E-08 | 3.9328E-08 | -7.405 | 1.0016E+00 |
| 113 | FeH2PO4+ | 1. | 1.2798E-08 | 1.1726E-08 | -7.931 | 9.1625E-01 |
| 114 | FeF+ | 1. | 5.4060E-09 | 4.9533E-09 | -8.305 | 9.1625E-01 |
| 115 | Fe+3 | 3. | 2.3310E-17 | 1.1538E-17 | -16.938 | 4.9496E-01 |
| 117 | FeOH+2 | 2. | 4.9057E-13 | 3.4576E-13 | -12.461 | 7.0480E-01 |
| 118 | FeOH2+ | 1. | 6.7393E-10 | 6.1749E-10 | -9.209 | 9.1625E-01 |
| 119 | FeOH3 | 0. | 4.1131E-10 | 4.1197E-10 | -9.385 | 1.0016E+00 |
| 120 | FeOH4- | -1. | 2.1760E-12 | 1.9938E-12 | -11.700 | 9.1625E-01 |
| 121 | Fe2OH2+4 | 4. | 1.7536E-23 | 4.3270E-24 | -23.364 | 2.4675E-01 |
| 122 | Fe3OH4+5 | 5. | 9.6313E-30 | 1.0816E-30 | -29.966 | 1.1230E-01 |
| 123 | FeCl+2 | 2. | 2.1353E-20 | 1.5050E-20 | -19.822 | 7.0480E-01 |
| 124 | FeCl2+ | 1. | 4.9924E-24 | 4.5743E-24 | -23.340 | 9.1625E-01 |
| 125 | FeCl3 | 0. | 2.4759E-29 | 2.4799E-29 | -28.606 | 1.0016E+00 |
| 126 | FeSO4+ | 1. | 1.3188E-17 | 1.2084E-17 | -16.918 | 9.1625E-01 |
| 127 | FeHSO4+2 | 2. | 1.1263E-23 | 7.9378E-24 | -23.100 | 7.0480E-01 |
| 128 | FeSO42- | -1. | 3.1406E-20 | 2.8776E-20 | -19.541 | 9.1625E-01 |
| 129 | FeHPO4+ | 1. | 1.4811E-19 | 1.3570E-19 | -18.867 | 9.1625E-01 |
| 130 | FeH2P+2 | 2. | 5.6865E-19 | 4.0078E-19 | -18.397 | 7.0480E-01 |
| 131 | FeF+2 | 2. | 6.4365E-17 | 4.5365E-17 | -16.343 | 7.0480E-01 |
| 132 | FeF2+ | 1. | 5.0104E-18 | 4.5908E-18 | -17.338 | 9.1625E-01 |
| 133 | FeF3 | 0. | 1.9625E-20 | 1.9656E-20 | -19.706 | 1.0016E+00 |
| 134 | MnOH+ | 1. | 2.0764E-10 | 1.9025E-10 | -9.721 | 9.1625E-01 |
| 136 | MnCl+ | 1. | 4.5213E-10 | 4.1426E-10 | -9.383 | 9.1625E-01 |
| 137 | MnCl2 | 0. | 9.7877E-15 | 9.8035E-15 | -14.009 | 1.0016E+00 |
| 138 | MnCl3- | -1. | 1.5976E-19 | 1.4638E-19 | -18.835 | 9.1625E-01 |
| 139 | MnCO3 | 0. | 1.1823E-07 | 1.1843E-07 | -6.927 | 1.0016E+00 |
| 140 | MnHCO3+ | 1. | 5.0488E-07 | 4.6260E-07 | -6.335 | 9.1625E-01 |
| 141 | MnSO4 | 0. | 3.2514E-08 | 3.2566E-08 | -7.487 | 1.0016E+00 |
| 143 | MnF+ | 1. | 3.9205E-11 | 3.5921E-11 | -10.445 | 9.1625E-01 |
| 144 | Mn+3 | 3. | 4.4703E-32 | 2.0346E-32 | -31.692 | 4.5514E-01 |
| 164 | H3SiO4- | -1. | 4.8088E-07 | 4.4061E-07 | -6.356 | 9.1625E-01 |
| 165 | H2SiO4-2 | -2. | 1.8717E-13 | 1.3192E-13 | -12.880 | 7.0480E-01 |
| 166 | SiF6-2 | -2. | 4.0549E-34 | 2.8579E-34 | -33.544 | 7.0480E-01 |
| 170 | BaOH+ | 1. | 2.5617E-13 | 2.3472E-13 | -12.629 | 9.1625E-01 |
| 171 | BaCO3 | 0. | 3.4858E-10 | 3.4914E-10 | -9.457 | 1.0016E+00 |
| 172 | BaHCO3+ | 1. | 2.2948E-08 | 2.1026E-08 | -7.677 | 9.1625E-01 |
| 173 | BaSO4 | 0. | 5.4814E-08 | 5.4903E-08 | -7.260 | 1.0016E+00 |
| 176 | SrOH+ | 1. | 8.9685E-13 | 8.2320E-13 | -12.084 | 9.1788E-01 |
| 177 | SrHCO3+ | 1. | 8.3019E-08 | 7.6265E-08 | -7.118 | 9.1864E-01 |
| 178 | SrCO3 | 0. | 9.3419E-10 | 9.3570E-10 | -9.029 | 1.0016E+00 |
| 179 | SrSO4 | 0. | 4.5415E-08 | 4.5489E-08 | -7.342 | 1.0016E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 6.589E-10 | 3.601E-09 | -9.181 | -8.444 | 1.830E-01 | -0.738 |
| 2 | Aragonit | 6.589E-10 | 5.073E-09 | -9.181 | -8.295 | 1.299E-01 | -0.886 |
| 3 | Dolomite | 3.227E-19 | 1.192E-17 | -18.491 | -16.924 | 2.707E-02 | -1.568 |
| 4 | Siderite | 1.422E-10 | 1.425E-11 | -9.847 | -10.846 | 9.983E+00 | 0.999 |
| 5 | Rhodochr | 1.491E-12 | 7.856E-12 | -11.827 | -11.105 | 1.898E-01 | -0.722 |
| 6 | Strontit | 1.802E-12 | 5.365E-10 | -11.744 | -9.270 | 3.360E-03 | -2.474 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 7 | Witherit | 7.778E-13 | 2.613E-09 | -12.109 | -8.583 | 2.977E-04 | -3.526 |
| 8 | Gypsum | 9.277E-08 | 2.618E-05 | -7.033 | -4.582 | 3.544E-03 | -2.450 |
| 9 | Anhydrit | 9.280E-08 | 4.577E-05 | -7.032 | -4.339 | 2.027E-03 | -2.693 |
| 10 | Celestit | 2.538E-10 | 2.394E-07 | -9.595 | -6.621 | 1.060E-03 | -2.975 |
| 11 | Barite | 1.095E-10 | 8.160E-11 | -9.960 | -10.088 | 1.342E+00 | 0.128 |
| 12 | Hydroxap | 1.655E-10 | 1.645E-03 | -9.781 | -2.784 | 1.006E-07 | -6.997 |
| 13 | Fluorite | 6.352E-15 | 2.063E-11 | -14.197 | -10.686 | 3.079E-04 | -3.512 |
| 14 | SiO2 (a) | 5.448E-04 | 1.695E-03 | -3.264 | -2.771 | 3.214E-01 | -0.493 |
| 15 | Chalcedy | 5.448E-04 | 2.320E-04 | -3.264 | -3.635 | 2.349E+00 | 0.371 |
| 16 | Quartz | 5.448E-04 | 8.204E-05 | -3.264 | -4.086 | 6.641E+00 | 0.822 |
| 26 | Talc | 2.592E+18 | 1.644E+22 | 18.414 | 22.216 | 1.577E-04 | -3.802 |
| 28 | Chrysotl | 8.732E+24 | 1.227E+33 | 24.941 | 33.089 | 7.117E-09 | -8.148 |
| 29 | Sepiol c | 1.541E+11 | 8.883E+15 | 11.188 | 15.949 | 1.734E-05 | -4.761 |
| 30 | Sepiol d | 1.541E+11 | 4.571E+18 | 11.188 | 18.660 | 3.370E-08 | -7.472 |
| 31 | Hematite | 1.675E+07 | 3.432E-04 | 7.224 | -3.464 | 4.880E+10 | 10.688 |
| 32 | Goethite | 4.093E+03 | 5.557E-02 | 3.612 | -1.255 | 7.365E+04 | 4.867 |
| 33 | Fe(OH)3a | 4.092E+03 | 7.780E+04 | 3.612 | 4.891 | 5.259E-02 | -1.279 |
| 37 | Vivianit | 1.334E-37 | 1.000E-36 | -36.875 | -36.000 | 1.334E-01 | -0.875 |
| 38 | Pyrolusi | 4.710E+21 | 3.369E+42 | 21.673 | 42.527 | 1.398E-21 | -20.854 |
| 39 | Hausmani | 4.162E+37 | 6.362E+62 | 37.619 | 62.804 | 6.541E-26 | -25.184 |
| 40 | Manganit | 6.653E+14 | 2.188E+25 | 14.823 | 25.340 | 3.041E-11 | -10.517 |
| 41 | Pyrochro | 9.398E+07 | 1.585E+15 | 7.973 | 15.200 | 5.930E-08 | -7.227 |
| 42 | PCO2 | 9.819E-04 | 4.158E-02 | -3.008 | -1.381 | 2.361E-02 | -1.627 |
| 44 | H2 gas | 1.517E-17 | 7.603E-04 | -16.819 | -3.119 | 1.995E-14 | -13.700 |
| 49 | Melanter | 2.001E-08 | 5.037E-03 | -7.699 | -2.298 | 3.973E-06 | -5.401 |
| 51 | K-Jarosi | 2.045E-22 | 2.194E-09 | -21.689 | -8.659 | 9.319E-14 | -13.031 |

PALOUSE BASIN: GRANITE SAMPLES

**24. BUTTERS**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 8.950
ANALYTICAL EPMCAT = 2.214 ANALYTICAL EPMAN = 1.861

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.23535E-04 | -3.2811 | 2.09800E+01 |
| Mg+2 | 2.0 | 1.86768E-04 | -3.7287 | 4.54000E+00 |
| Na+ | 1.0 | 7.25218E-04 | -3.1395 | 1.66700E+01 |
| K+ | 1.0 | 6.44570E-05 | -4.1907 | 2.52000E+00 |
| Ba+2 | 2.0 | 7.28234E-08 | -7.1377 | 1.00000E-02 |

| | | | | |
|---|---|---|---|---|
| Sr+2 | 2.0 | 1.59806E-06 | -5.7964 | 1.40000E-01 |
| H4SiO4 | 0.0 | 4.89385E-05 | -4.3103 | 2.94000E+00 |
| Cl- | -1.0 | 2.65181E-05 | -4.5765 | 9.40000E-01 |
| HCO3- | -1.0 | 1.63979E-03 | -2.7852 | 1.00040E+02 |
| SO4-2 | -2.0 | 8.22518E-05 | -4.0849 | 7.90000E+00 |
| NO3- | -1.0 | 2.85622E-06 | -5.5442 | 4.00000E-02 |
| F- | -1.0 | 1.78991E-05 | -4.7472 | 3.40000E-01 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 2.21 | 2.12 | 8.950 | PCO2= 9.081100E-05 |
| EPMAN | 1.86 | 1.76 | | LOG PCO2 = -4.0419 |
| | | | TEMPERATURE | PO2 = 1.765262E-50 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 2.160476E-52 |
| PE CALC S = | 0.000 | | | CO2 TOT = 1.538183E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 2.741936E-03 | TDS = 157.1MG/L |
| TOT ALK = | 1.640E+00 MEQ | | | CARB ALK = 1.629E+00 MEQ |
| ELECT = | 3.621E-01 MEQ | | | CHARGE IMBALANCE = 9.3% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.1828E-09 | 1.1220E-09 | -8.950 | 9.4862E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 4.8485E-04 | 3.8782E-04 | -3.411 | 7.9988E-01 |
| 5 | Mg+2 | 2. | 1.7651E-04 | 1.4147E-04 | -3.849 | 8.0146E-01 |
| 6 | Na+ | 1. | 7.2403E-04 | 6.8425E-04 | -3.165 | 9.4506E-01 |
| 7 | K+ | 1. | 6.4433E-05 | 6.0841E-05 | -4.216 | 9.4426E-01 |
| 11 | Ba+2 | 2. | 6.9324E-08 | 5.5393E-08 | -7.257 | 7.9904E-01 |
| 12 | Sr+2 | 2. | 1.5327E-06 | 1.2268E-06 | -5.911 | 8.0039E-01 |
| 13 | H4SiO4 | 0. | 4.4173E-05 | 4.4201E-05 | -4.355 | 1.0006E+00 |
| 14 | Cl- | -1. | 2.6518E-05 | 2.5040E-05 | -4.601 | 9.4426E-01 |
| 15 | CO3-2 | -2. | 6.0554E-05 | 4.8453E-05 | -4.315 | 8.0017E-01 |
| 16 | SO4-2 | -2. | 7.5943E-05 | 6.0666E-05 | -4.217 | 7.9884E-01 |
| 17 | NO3- | -1. | 1.0341E-17 | 9.7592E-18 | -17.011 | 9.4373E-01 |
| 20 | F- | -1. | 1.7697E-05 | 1.6709E-05 | -4.777 | 9.4417E-01 |
| 31 | OH- | -1. | 5.4543E-06 | 5.1498E-06 | -5.288 | 9.4417E-01 |
| 33 | H2 AQ | 0. | 9.5659E-22 | 9.5719E-22 | -21.019 | 1.0006E+00 |
| 34 | HCO3- | -1. | 1.4305E-03 | 1.3529E-03 | -2.869 | 9.4579E-01 |
| 35 | H2CO3 | 0. | 3.7739E-06 | 3.7763E-06 | -5.423 | 1.0006E+00 |
| 40 | HSO4- | -1. | 6.0402E-12 | 5.7061E-12 | -11.244 | 9.4468E-01 |
| 48 | NO2- | -1. | 2.8562E-06 | 2.6955E-06 | -5.569 | 9.4373E-01 |
| 69 | HF AQ | 0. | 2.4818E-11 | 2.4833E-11 | -10.605 | 1.0006E+00 |
| 70 | HF2- | -1. | 1.5864E-15 | 1.4987E-15 | -14.824 | 9.4468E-01 |
| 75 | CaOH+ | 1. | 6.0719E-08 | 5.7360E-08 | -7.241 | 9.4468E-01 |
| 76 | CaCO3 | 0. | 2.7931E-05 | 2.7949E-05 | -4.554 | 1.0006E+00 |
| 77 | CaHCO3+ | 1. | 6.2514E-06 | 5.9126E-06 | -5.228 | 9.4579E-01 |
| 78 | CaSO4 | 0. | 4.3876E-06 | 4.3904E-06 | -5.357 | 1.0006E+00 |
| 79 | CaHSO4 | 1. | 3.2681E-14 | 3.0873E-14 | -13.510 | 9.4468E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 83 | CaF+ | 1. | 5.0546E-08 | 4.7750E-08 | -7.321 | 9.4468E-01 |
| 85 | MgOH+ | 1. | 2.5738E-07 | 2.4314E-07 | -6.614 | 9.4468E-01 |
| 86 | MgCO3 | 0. | 5.8706E-06 | 5.8743E-06 | -5.231 | 1.0006E+00 |
| 87 | MgHCO3+ | 1. | 2.3099E-06 | 2.1821E-06 | -5.661 | 9.4468E-01 |
| 88 | MgSO4 | 0. | 1.6717E-06 | 1.6727E-06 | -5.777 | 1.0006E+00 |
| 92 | MgF+ | 1. | 1.4519E-07 | 1.3715E-07 | -6.863 | 9.4468E-01 |
| 93 | NaOH | 0. | 4.0264E-09 | 4.0289E-09 | -8.395 | 1.0006E+00 |
| 94 | NaCO3- | -1. | 4.5522E-07 | 4.3004E-07 | -6.366 | 9.4468E-01 |
| 95 | NaHCO3 | 0. | 5.1525E-07 | 5.1558E-07 | -6.288 | 1.0006E+00 |
| 96 | NaSO4- | -1. | 2.1044E-07 | 1.9880E-07 | -6.702 | 9.4468E-01 |
| 98 | NaF aq | 0. | 6.5748E-09 | 6.5789E-09 | -8.182 | 1.0006E+00 |
| 99 | KOH | 0. | 1.8789E-10 | 1.8801E-10 | -9.726 | 1.0006E+00 |
| 100 | KSO4- | -1. | 2.4226E-08 | 2.2886E-08 | -7.640 | 9.4468E-01 |
| 164 | H3SiO4- | -1. | 4.7651E-06 | 4.5015E-06 | -5.347 | 9.4468E-01 |
| 165 | H2SiO4-2 | -2. | 2.1304E-10 | 1.6967E-10 | -9.770 | 7.9642E-01 |
| 170 | BaOH+ | 1. | 1.7707E-12 | 1.6728E-12 | -11.777 | 9.4468E-01 |
| 171 | BaCO3 | 0. | 1.2040E-09 | 1.2048E-09 | -8.919 | 1.0006E+00 |
| 172 | BaHCO3+ | 1. | 6.1006E-10 | 5.7631E-10 | -9.239 | 9.4468E-01 |
| 173 | BaSO4 | 0. | 1.6832E-09 | 1.6842E-09 | -8.774 | 1.0006E+00 |
| 176 | SrOH+ | 1. | 5.9305E-11 | 5.6071E-11 | -10.251 | 9.4546E-01 |
| 177 | SrHCO3+ | 1. | 2.1123E-08 | 1.9978E-08 | -7.699 | 9.4579E-01 |
| 178 | SrCO3 | 0. | 3.0839E-08 | 3.0858E-08 | -7.511 | 1.0006E+00 |
| 179 | SrSO4 | 0. | 1.3328E-08 | 1.3337E-08 | -7.875 | 1.0006E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.879E-08 | 3.601E-09 | -7.726 | -8.444 | 5.219E+00 | 0.718 |
| 2 | Aragonit | 1.879E-08 | 5.073E-09 | -7.726 | -8.295 | 3.704E+00 | 0.569 |
| 3 | Dolomite | 1.288E-16 | 1.192E-17 | -15.890 | -16.924 | 1.081E+01 | 1.034 |
| 6 | Strontit | 5.944E-11 | 5.365E-10 | -10.226 | -9.270 | 1.108E-01 | -0.955 |
| 7 | Witherit | 2.684E-12 | 2.613E-09 | -11.571 | -8.583 | 1.027E-03 | -2.988 |
| 8 | Gypsum | 2.353E-08 | 2.618E-05 | -7.628 | -4.582 | 8.987E-04 | -3.046 |
| 9 | Anhydrit | 2.353E-08 | 4.577E-05 | -7.628 | -4.339 | 5.140E-04 | -3.289 |
| 10 | Celestit | 7.442E-11 | 2.394E-07 | -10.128 | -6.621 | 3.109E-04 | -3.507 |
| 11 | Barite | 3.360E-12 | 8.160E-11 | -11.474 | -10.088 | 4.118E-02 | -1.385 |
| 13 | Fluorite | 1.083E-13 | 2.063E-11 | -12.965 | -10.686 | 5.249E-03 | -2.280 |
| 14 | SiO2 (a) | 4.421E-05 | 1.695E-03 | -4.355 | -2.771 | 2.607E-02 | -1.584 |
| 15 | Chalcedy | 4.421E-05 | 2.320E-04 | -4.355 | -3.635 | 1.906E-01 | -0.720 |
| 16 | Quartz | 4.421E-05 | 8.204E-05 | -4.355 | -4.086 | 5.388E-01 | -0.269 |
| 26 | Talc | 5.418E+24 | 1.644E+22 | 24.734 | 22.216 | 3.296E+02 | 2.518 |
| 28 | Chrysotl | 2.772E+33 | 1.227E+33 | 33.443 | 33.089 | 2.259E+00 | 0.354 |
| 29 | Sepiol c | 1.091E+15 | 8.883E+15 | 15.038 | 15.949 | 1.228E-01 | -0.911 |
| 30 | Sepiol d | 1.091E+15 | 4.571E+18 | 15.038 | 18.660 | 2.386E-04 | -3.622 |
| 42 | PCO2 | 3.776E-06 | 4.158E-02 | -5.423 | -1.381 | 9.081E-05 | -4.042 |
| 44 | H2 gas | 9.572E-22 | 7.603E-04 | -21.019 | -3.119 | 1.259E-18 | -17.900 |

**25. GENTRY**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.300
ANALYTICAL EPMCAT = 1.554 ANALYTICAL EPMAN = 1.621

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O

```
 EH MEASURED WITH CALOMEL =  9.9000 VOLTS         FLAG CORALK PECALC
IDAVES
 MEASURED EH OF ZOBELL SOLUTION =  9.9000 VOLTS     2    0      1      0
 CORRECTED EH =  0.0000 VOLTS
 PE COMPUTED FROM CORRECTED EH =   0.000
```

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 2.70753E-04 | -3.5674 | 1.08500E+01 |
| Mg+2 | 2.0 | 1.07783E-04 | -3.9674 | 2.62000E+00 |
| Na+ | 1.0 | 7.53935E-04 | -3.1227 | 1.73300E+01 |
| K+ | 1.0 | 3.93906E-05 | -4.4046 | 1.54000E+00 |
| Ba+2 | 2.0 | 2.18472E-07 | -6.6606 | 3.00000E-02 |
| Sr+2 | 2.0 | 1.25563E-06 | -5.9011 | 1.10000E-01 |
| H4SiO4 | 0.0 | 4.57262E-04 | -3.3398 | 2.74700E+01 |
| Cl- | -1.0 | 2.12428E-04 | -3.6728 | 7.53000E+00 |
| HCO3- | -1.0 | 7.59908E-04 | -3.1192 | 4.63600E+01 |
| SO4-2 | -2.0 | 3.63368E-05 | -4.4397 | 3.49000E+00 |
| HPO4-2 | -2.0 | 3.55197E-06 | -5.4495 | 1.10000E-01 |
| F- | -1.0 | 3.68512E-06 | -5.4335 | 7.00000E-02 |
| Br- | -1.0 | 5.64769E-04 | -3.2481 | 4.51200E+01 |

****DESCRIPTION OF SOLUTION ****

```
         ANALYT.   COMP.          PH            ACTIVITY H2O =  0.9999
EPMCAT     1.55      1.55       7.300           PCO2=  2.148193E-03
EPMAN      1.62      1.61                       LOG PCO2 =  -2.6679
                               TEMPERATURE      PO2 =  4.434135E-57
EH = 0.0000  PE =   0.000      18.00 DEG C      PCH4 =  8.099959E-38
PE CALC S =    0.000                           CO2 TOT =  8.449232E-04
PE CALC DOX=  0.000          IONIC STRENGTH    DENSITY =   1.0000
PE SATO DOX=  0.000           1.990161E-03     TDS =     162.6MG/L
TOT ALK =  7.599E-01 MEQ                       CARB ALK =  7.566E-01 MEQ
ELECT   = -6.367E-02 MEQ                       CHARGE IMBALANCE =   -2.0%

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE =   0.000     EQUIVALENT EH =  0.000VOLTS
```

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 5.2470E-08 | 5.0119E-08 | -7.300 | 9.5519E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 2.6734E-04 | 2.2050E-04 | -3.657 | 8.2478E-01 |
| 5 | Mg+2 | 2. | 1.0638E-04 | 8.7870E-05 | -4.056 | 8.2600E-01 |
| 6 | Na+ | 1. | 7.5354E-04 | 7.1774E-04 | -3.144 | 9.5249E-01 |
| 7 | K+ | 1. | 3.9384E-05 | 3.7489E-05 | -4.426 | 9.5191E-01 |
| 11 | Ba+2 | 2. | 2.1487E-07 | 1.7709E-07 | -6.752 | 8.2416E-01 |
| 12 | Sr+2 | 2. | 1.2408E-06 | 1.0239E-06 | -5.990 | 8.2518E-01 |
| 13 | H4SiO4 | 0. | 4.5617E-04 | 4.5638E-04 | -3.341 | 1.0005E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 14 | Cl- | -1. | 2.1243E-04 | 2.0221E-04 | -3.694 | 9.5191E-01 |
| 15 | CO3-2 | -2. | 6.9629E-07 | 5.7446E-07 | -6.241 | 8.2503E-01 |
| 16 | SO4-2 | -2. | 3.4560E-05 | 2.8478E-05 | -4.545 | 8.2401E-01 |
| 19 | PO4-3 | -3. | 1.8904E-11 | 1.2161E-11 | -10.915 | 6.4331E-01 |
| 20 | F- | -1. | 3.6589E-06 | 3.4827E-06 | -5.458 | 9.5184E-01 |
| 22 | Br- | -1. | 5.6477E-04 | 5.3739E-04 | -3.270 | 9.5151E-01 |
| 31 | OH- | -1. | 1.2112E-07 | 1.1529E-07 | -6.938 | 9.5184E-01 |
| 33 | H2 AQ | 0. | 1.9090E-18 | 1.9099E-18 | -17.719 | 1.0005E+00 |
| 34 | HCO3- | -1. | 7.5178E-04 | 7.1649E-04 | -3.145 | 9.5305E-01 |
| 35 | H2CO3 | 0. | 8.9291E-05 | 8.9332E-05 | -4.049 | 1.0005E+00 |
| 40 | HSO4- | -1. | 1.2565E-10 | 1.1965E-10 | -9.922 | 9.5221E-01 |
| 65 | HPO4-2 | -2. | 1.8981E-06 | 1.5602E-06 | -5.807 | 8.2196E-01 |
| 66 | H2PO4- | -1. | 1.3765E-06 | 1.3111E-06 | -5.882 | 9.5249E-01 |
| 69 | HF AQ | 0. | 2.3110E-10 | 2.3121E-10 | -9.636 | 1.0005E+00 |
| 70 | HF2- | -1. | 3.0542E-15 | 2.9083E-15 | -14.536 | 9.5221E-01 |
| 75 | CaOH+ | 1. | 7.6674E-10 | 7.3010E-10 | -9.137 | 9.5221E-01 |
| 76 | CaCO3 | 0. | 1.8831E-07 | 1.8839E-07 | -6.725 | 1.0005E+00 |
| 77 | CaHCO3+ | 1. | 1.8679E-06 | 1.7802E-06 | -5.750 | 9.5305E-01 |
| 78 | CaSO4 | 0. | 1.1712E-06 | 1.1718E-06 | -5.931 | 1.0005E+00 |
| 79 | CaHSO4 | 1. | 3.8653E-13 | 3.6806E-13 | -12.434 | 9.5221E-01 |
| 80 | CaPO4- | -1. | 7.1451E-09 | 6.8036E-09 | -8.167 | 9.5221E-01 |
| 81 | CaHPO4 | 0. | 1.6490E-07 | 1.6498E-07 | -6.783 | 1.0005E+00 |
| 82 | CaH2PO4+ | 1. | 6.7667E-09 | 6.4433E-09 | -8.191 | 9.5221E-01 |
| 83 | CaF+ | 1. | 5.9426E-09 | 5.6586E-09 | -8.247 | 9.5221E-01 |
| 85 | MgOH+ | 1. | 3.5506E-09 | 3.3809E-09 | -8.471 | 9.5221E-01 |
| 86 | MgCO3 | 0. | 4.3238E-08 | 4.3258E-08 | -7.364 | 1.0005E+00 |
| 87 | MgHCO3+ | 1. | 7.5382E-07 | 7.1779E-07 | -6.144 | 9.5221E-01 |
| 88 | MgSO4 | 0. | 4.8749E-07 | 4.8771E-07 | -6.312 | 1.0005E+00 |
| 89 | MgPO4- | -1. | 3.8410E-09 | 3.6574E-09 | -8.437 | 9.5221E-01 |
| 90 | MgHPO4 | 0. | 8.8851E-08 | 8.8892E-08 | -7.051 | 1.0005E+00 |
| 91 | MgH2PO4+ | 1. | 3.4341E-09 | 3.2700E-09 | -8.485 | 9.5221E-01 |
| 92 | MgF+ | 1. | 1.8648E-08 | 1.7756E-08 | -7.751 | 9.5221E-01 |
| 93 | NaOH | 0. | 9.4568E-11 | 9.4611E-11 | -10.024 | 1.0005E+00 |
| 94 | NaCO3- | -1. | 5.6165E-09 | 5.3481E-09 | -8.272 | 9.5221E-01 |
| 95 | NaHCO3 | 0. | 2.8627E-07 | 2.8641E-07 | -6.543 | 1.0005E+00 |
| 96 | NaSO4- | -1. | 1.0280E-07 | 9.7890E-08 | -7.009 | 9.5221E-01 |
| 97 | NaHPO4- | -1. | 2.2930E-09 | 2.1835E-09 | -8.661 | 9.5221E-01 |
| 98 | NaF aq | 0. | 1.4377E-09 | 1.4384E-09 | -8.842 | 1.0005E+00 |
| 99 | KOH | 0. | 2.5923E-12 | 2.5935E-12 | -11.586 | 1.0005E+00 |
| 100 | KSO4- | -1. | 6.9519E-09 | 6.6197E-09 | -8.179 | 9.5221E-01 |
| 101 | KHPO4- | -1. | 1.1977E-10 | 1.1405E-10 | -9.943 | 9.5221E-01 |
| 164 | H3SiO4- | -1. | 1.0927E-06 | 1.0405E-06 | -5.983 | 9.5221E-01 |
| 165 | H2SiO4-2 | -2. | 1.0680E-12 | 8.7802E-13 | -12.056 | 8.2211E-01 |
| 166 | SiF6-2 | -2. | 1.8303E-35 | 1.5047E-35 | -34.823 | 8.2211E-01 |
| 170 | BaOH+ | 1. | 1.2573E-13 | 1.1972E-13 | -12.922 | 9.5221E-01 |
| 171 | BaCO3 | 0. | 4.5643E-11 | 4.5664E-11 | -10.340 | 1.0005E+00 |
| 172 | BaHCO3+ | 1. | 1.0247E-09 | 9.7574E-10 | -9.011 | 9.5221E-01 |
| 173 | BaSO4 | 0. | 2.5264E-09 | 2.5276E-09 | -8.597 | 1.0005E+00 |
| 176 | SrOH+ | 1. | 1.0996E-12 | 1.0477E-12 | -11.980 | 9.5280E-01 |
| 177 | SrHCO3+ | 1. | 9.2657E-09 | 8.8307E-09 | -8.054 | 9.5305E-01 |
| 178 | SrCO3 | 0. | 3.0522E-10 | 3.0536E-10 | -9.515 | 1.0005E+00 |
| 179 | SrSO4 | 0. | 5.2230E-09 | 5.2254E-09 | -8.282 | 1.0005E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.267E-10 | 3.601E-09 | -9.897 | -8.444 | 3.518E-02 | -1.454 |
| 2 | Aragonit | 1.267E-10 | 5.073E-09 | -9.897 | -8.295 | 2.497E-02 | -1.603 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 | Dolomite | 6.394E-21 | 1.192E-17 | -20.194 | -16.924 | 5.364E-04 | -3.271 |
| 6 | Strontit | 5.882E-13 | 5.365E-10 | -12.230 | -9.270 | 1.096E-03 | -2.960 |
| 7 | Witherit | 1.017E-13 | 2.613E-09 | -12.993 | -8.583 | 3.893E-05 | -4.410 |
| 8 | Gypsum | 6.279E-09 | 2.618E-05 | -8.202 | -4.582 | 2.399E-04 | -3.620 |
| 9 | Anhydrit | 6.279E-09 | 4.577E-05 | -8.202 | -4.339 | 1.372E-04 | -3.863 |
| 10 | Celestit | 2.916E-11 | 2.394E-07 | -10.535 | -6.621 | 1.218E-04 | -3.914 |
| 11 | Barite | 5.043E-12 | 8.160E-11 | -11.297 | -10.088 | 6.181E-02 | -1.209 |
| 12 | Hydroxap | 3.137E-07 | 1.645E-03 | -6.503 | -2.784 | 1.907E-04 | -3.720 |
| 13 | Fluorite | 2.674E-15 | 2.063E-11 | -14.573 | -10.686 | 1.296E-04 | -3.887 |
| 14 | SiO2 (a) | 4.564E-04 | 1.695E-03 | -3.341 | -2.771 | 2.692E-01 | -0.570 |
| 15 | Chalcedy | 4.564E-04 | 2.320E-04 | -3.341 | -3.635 | 1.968E+00 | 0.294 |
| 16 | Quartz | 4.564E-04 | 8.204E-05 | -3.341 | -4.086 | 5.563E+00 | 0.745 |
| 26 | Talc | 1.857E+18 | 1.644E+22 | 18.269 | 22.216 | 1.130E-04 | -3.947 |
| 28 | Chrysotl | 8.915E+24 | 1.227E+33 | 24.950 | 33.089 | 7.267E-09 | -8.139 |
| 29 | Sepiol c | 1.163E+11 | 8.883E+15 | 11.066 | 15.949 | 1.309E-05 | -4.883 |
| 30 | Sepiol d | 1.163E+11 | 4.571E+18 | 11.066 | 18.660 | 2.545E-08 | -7.594 |
| 42 | PCO2 | 8.933E-05 | 4.158E-02 | -4.049 | -1.381 | 2.148E-03 | -2.668 |
| 44 | H2 gas | 1.910E-18 | 7.603E-04 | -17.719 | -3.119 | 2.512E-15 | -14.600 |

PALOUSE BASIN: ALLUVIUM SAMPLE
**26. UIGRS**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 7.720
ANALYTICAL EPMCAT = 16.680 ANALYTICAL EPMAN = 11.005

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 4.06179E-03 | -2.3913 | 1.62650E+02 |
| Mg+2 | 2.0 | 2.43350E-03 | -2.6138 | 5.91100E+01 |
| Na+ | 1.0 | 3.44462E-03 | -2.4629 | 7.91200E+01 |
| K+ | 1.0 | 2.00938E-04 | -3.6969 | 7.85000E+00 |
| Mn+2 | 2.0 | 3.09718E-06 | -5.5090 | 1.70000E-01 |
| Ba+2 | 2.0 | 2.18633E-06 | -5.6603 | 3.00000E-01 |
| Sr+2 | 2.0 | 9.36702E-06 | -5.0284 | 8.20000E-01 |
| H4SiO4 | 0.0 | 4.44605E-04 | -3.3520 | 2.66900E+01 |
| Cl- | -1.0 | 3.21277E-04 | -3.4931 | 1.13800E+01 |
| HCO3- | -1.0 | 7.52463E-03 | -2.1235 | 4.58720E+02 |
| SO4-2 | -2.0 | 7.06641E-04 | -3.1508 | 6.78200E+01 |
| NO3- | -1.0 | 1.71286E-03 | -2.7663 | 2.39700E+01 |
| H3BO3 | 0.0 | 7.40721E-06 | -5.1303 | 8.00000E-02 |
| F- | -1.0 | 2.16002E-05 | -4.6655 | 4.10000E-01 |

Br- -1.0 6.26314E-07 -6.2032 5.00000E-02

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9997 |
|---|---|---|---|---|
| EPMCAT | 16.68 | 15.83 | 7.720 | PCO2= 7.069589E-03 |
| EPMAN | 11.00 | 10.17 | | LOG PCO2 = -2.1506 |
| | | | TEMPERATURE | PO2 = 2.121058E-55 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 1.164292E-40 |
| PE CALC S = | 0.000 | | | CO2 TOT = 7.732218E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 1.950102E-02 | TDS = 899.1MG/L |
| TOT ALK = | 7.525E+00 MEQ | | | CARB ALK = 7.521E+00 MEQ |
| ELECT = | 5.671E+00 MEQ | | | CHARGE IMBALANCE = 21.8% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.1378E-08 | 1.9055E-08 | -7.720 | 8.9133E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 3.7214E-03 | 2.2097E-03 | -2.656 | 5.9377E-01 |
| 5 | Mg+2 | 2. | 2.2315E-03 | 1.3400E-03 | -2.873 | 6.0047E-01 |
| 6 | Na+ | 1. | 3.4288E-03 | 2.9991E-03 | -2.523 | 8.7467E-01 |
| 7 | K+ | 1. | 2.0057E-04 | 1.7449E-04 | -3.758 | 8.6996E-01 |
| 9 | Mn+2 | 2. | 1.5284E-06 | 9.1808E-07 | -6.037 | 6.0067E-01 |
| 11 | Ba+2 | 2. | 1.9476E-06 | 1.1479E-06 | -5.940 | 5.8938E-01 |
| 12 | Sr+2 | 2. | 8.6246E-06 | 5.1369E-06 | -5.289 | 5.9561E-01 |
| 13 | H4SiO4 | 0. | 4.4156E-04 | 4.4355E-04 | -3.353 | 1.0045E+00 |
| 14 | Cl- | -1. | 3.2128E-04 | 2.7950E-04 | -3.554 | 8.6996E-01 |
| 15 | CO3-2 | -2. | 2.2013E-05 | 1.3075E-05 | -4.884 | 5.9397E-01 |
| 16 | SO4-2 | -2. | 5.0265E-04 | 2.9572E-04 | -3.529 | 5.8833E-01 |
| 17 | NO3- | -1. | 2.1497E-17 | 1.8636E-17 | -16.730 | 8.6693E-01 |
| 18 | H3BO3 | 0. | 7.1880E-06 | 7.2204E-06 | -5.141 | 1.0045E+00 |
| 20 | F- | -1. | 1.9723E-05 | 1.7147E-05 | -4.766 | 8.6937E-01 |
| 22 | Br- | -1. | 6.2631E-07 | 5.4297E-07 | -6.265 | 8.6693E-01 |
| 31 | OH- | -1. | 3.4870E-07 | 3.0315E-07 | -6.518 | 8.6937E-01 |
| 33 | H2 AQ | 0. | 2.7482E-19 | 2.7606E-19 | -18.559 | 1.0045E+00 |
| 34 | HCO3- | -1. | 7.0625E-03 | 6.2001E-03 | -2.208 | 8.7789E-01 |
| 35 | H2CO3 | 0. | 2.9267E-04 | 2.9399E-04 | -3.532 | 1.0045E+00 |
| 40 | HSO4- | -1. | 5.4101E-10 | 4.7236E-10 | -9.326 | 8.7311E-01 |
| 48 | NO2- | -1. | 1.7129E-03 | 1.4849E-03 | -2.828 | 8.6693E-01 |
| 57 | H2BO3- | -1. | 2.1912E-07 | 1.9131E-07 | -6.718 | 8.7311E-01 |
| 58 | BFOH3- | -1. | 5.2369E-11 | 4.5724E-11 | -10.340 | 8.7311E-01 |
| 59 | BF2OH2- | -1. | 1.8514E-15 | 1.6165E-15 | -14.791 | 8.7311E-01 |
| 60 | BF3OH- | -1. | 7.5649E-22 | 6.6050E-22 | -21.180 | 8.7311E-01 |
| 61 | BF4- | -1. | 1.0168E-27 | 8.8777E-28 | -27.052 | 8.7311E-01 |
| 69 | HF AQ | 0. | 4.3085E-10 | 4.3279E-10 | -9.364 | 1.0045E+00 |
| 70 | HF2- | -1. | 3.0699E-14 | 2.6803E-14 | -13.572 | 8.7311E-01 |
| 75 | CaOH+ | 1. | 2.2035E-08 | 1.9239E-08 | -7.716 | 8.7311E-01 |
| 76 | CaCO3 | 0. | 4.2779E-05 | 4.2972E-05 | -4.367 | 1.0045E+00 |
| 77 | CaHCO3+ | 1. | 1.7585E-04 | 1.5438E-04 | -3.811 | 8.7789E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 78 | CaSO4 | 0. | 1.2139E-04 | 1.2194E-04 | -3.914 | 1.0045E+00 |
| 79 | CaHSO4 | 1. | 1.6678E-11 | 1.4562E-11 | -10.837 | 8.7311E-01 |
| 83 | CaF+ | 1. | 3.1977E-07 | 2.7919E-07 | -6.554 | 8.7311E-01 |
| 85 | MgOH+ | 1. | 1.5527E-07 | 1.3557E-07 | -6.868 | 8.7311E-01 |
| 86 | MgCO3 | 0. | 1.4947E-05 | 1.5015E-05 | -4.823 | 1.0045E+00 |
| 87 | MgHCO3+ | 1. | 1.0849E-04 | 9.4720E-05 | -4.024 | 8.7311E-01 |
| 88 | MgSO4 | 0. | 7.6885E-05 | 7.7231E-05 | -4.112 | 1.0045E+00 |
| 92 | MgF+ | 1. | 1.5269E-06 | 1.3332E-06 | -5.875 | 8.7311E-01 |
| 93 | NaOH | 0. | 1.0349E-09 | 1.0395E-09 | -8.983 | 1.0045E+00 |
| 94 | NaCO3- | -1. | 5.8257E-07 | 5.0865E-07 | -6.294 | 8.7311E-01 |
| 95 | NaHCO3 | 0. | 1.0310E-05 | 1.0356E-05 | -4.985 | 1.0045E+00 |
| 96 | NaSO4- | -1. | 4.8648E-06 | 4.2475E-06 | -5.372 | 8.7311E-01 |
| 98 | NaF aq | 0. | 2.9460E-08 | 2.9592E-08 | -7.529 | 1.0045E+00 |
| 99 | KOH | 0. | 3.1598E-11 | 3.1740E-11 | -10.498 | 1.0045E+00 |
| 100 | KSO4- | -1. | 3.6644E-07 | 3.1994E-07 | -6.495 | 8.7311E-01 |
| 134 | MnOH+ | 1. | 7.9047E-10 | 6.9016E-10 | -9.161 | 8.7311E-01 |
| 136 | MnCl+ | 1. | 1.1973E-09 | 1.0453E-09 | -8.981 | 8.7311E-01 |
| 137 | MnCl2 | 0. | 1.2696E-13 | 1.2754E-13 | -12.894 | 1.0045E+00 |
| 138 | MnCl3- | -1. | 1.1245E-17 | 9.8177E-18 | -17.008 | 8.7311E-01 |
| 139 | MnCO3 | 0. | 9.4926E-07 | 9.5353E-07 | -6.021 | 1.0045E+00 |
| 140 | MnHCO3+ | 1. | 5.7547E-07 | 5.0245E-07 | -6.299 | 8.7311E-01 |
| 141 | MnSO4 | 0. | 4.1921E-08 | 4.2109E-08 | -7.376 | 1.0045E+00 |
| 143 | MnF+ | 1. | 1.2474E-10 | 1.0891E-10 | -9.963 | 8.7311E-01 |
| 144 | Mn+3 | 3. | 3.3774E-32 | 9.9586E-33 | -32.002 | 2.9486E-01 |
| 164 | H3SiO4- | -1. | 3.0465E-06 | 2.6599E-06 | -5.575 | 8.7311E-01 |
| 165 | H2SiO4-2 | -2. | 1.0159E-11 | 5.9036E-12 | -11.229 | 5.8113E-01 |
| 166 | SiF6-2 | -2. | 7.4982E-33 | 4.3574E-33 | -32.361 | 5.8113E-01 |
| 170 | BaOH+ | 1. | 2.3371E-12 | 2.0405E-12 | -11.690 | 8.7311E-01 |
| 171 | BaCO3 | 0. | 6.7067E-09 | 6.7369E-09 | -8.172 | 1.0045E+00 |
| 172 | BaHCO3+ | 1. | 6.2683E-08 | 5.4729E-08 | -7.262 | 8.7311E-01 |
| 173 | BaSO4 | 0. | 1.6937E-07 | 1.7013E-07 | -6.769 | 1.0045E+00 |
| 176 | SrOH+ | 1. | 1.5774E-11 | 1.3821E-11 | -10.859 | 8.7619E-01 |
| 177 | SrHCO3+ | 1. | 4.3670E-07 | 3.8338E-07 | -6.416 | 8.7789E-01 |
| 178 | SrCO3 | 0. | 3.4713E-08 | 3.4869E-08 | -7.458 | 1.0045E+00 |
| 179 | SrSO4 | 0. | 2.7100E-07 | 2.7222E-07 | -6.565 | 1.0045E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 2.889E-08 | 3.601E-09 | -7.539 | -8.444 | 8.024E+00 | 0.904 |
| 2 | Aragonit | 2.889E-08 | 5.073E-09 | -7.539 | -8.295 | 5.695E+00 | 0.755 |
| 3 | Dolomite | 5.062E-16 | 1.192E-17 | -15.296 | -16.924 | 4.246E+01 | 1.628 |
| 5 | Rhodochr | 1.200E-11 | 7.856E-12 | -10.921 | -11.105 | 1.528E+00 | 0.184 |
| 6 | Strontit | 6.717E-11 | 5.365E-10 | -10.173 | -9.270 | 1.252E-01 | -0.902 |
| 7 | Witherit | 1.501E-11 | 2.613E-09 | -10.824 | -8.583 | 5.744E-03 | -2.241 |
| 8 | Gypsum | 6.530E-07 | 2.618E-05 | -6.185 | -4.582 | 2.495E-02 | -1.603 |
| 9 | Anhydrit | 6.534E-07 | 4.577E-05 | -6.185 | -4.339 | 1.428E-02 | -1.845 |
| 10 | Celestit | 1.519E-09 | 2.394E-07 | -8.818 | -6.621 | 6.346E-03 | -2.198 |
| 11 | Barite | 3.395E-10 | 8.160E-11 | -9.469 | -10.088 | 4.160E+00 | 0.619 |
| 13 | Fluorite | 6.497E-13 | 2.063E-11 | -12.187 | -10.686 | 3.149E-02 | -1.502 |
| 14 | SiO2 (a) | 4.439E-04 | 1.695E-03 | -3.353 | -2.771 | 2.618E-01 | -0.582 |
| 15 | Chalcedy | 4.439E-04 | 2.320E-04 | -3.353 | -3.635 | 1.913E+00 | 0.282 |
| 16 | Quartz | 4.439E-04 | 8.204E-05 | -3.353 | -4.086 | 5.410E+00 | 0.733 |
| 26 | Talc | 1.948E+24 | 1.644E+22 | 24.290 | 22.216 | 1.185E+02 | 2.074 |
| 28 | Chrysotl | 9.885E+30 | 1.227E+33 | 30.995 | 33.089 | 8.057E-03 | -2.094 |
| 29 | Sepiol c | 1.189E+15 | 8.883E+15 | 15.075 | 15.949 | 1.338E-01 | -0.873 |
| 30 | Sepiol d | 1.189E+15 | 4.571E+18 | 15.075 | 18.660 | 2.601E-04 | -3.585 |
| 38 | Pyrolusi | 6.960E+24 | 3.369E+42 | 24.843 | 42.527 | 2.066E-18 | -17.685 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 39 | Hausmani | 4.447E+43 | 6.362E+62 | 43.648 | 62.804 | 6.989E-20 | -19.156 |
| 40 | Manganit | 1.326E+17 | 2.188E+25 | 17.123 | 25.340 | 6.061E-09 | -8.217 |
| 41 | Pyrochro | 2.527E+09 | 1.585E+15 | 9.403 | 15.200 | 1.594E-06 | -5.797 |
| 42 | PCO2 | 2.940E-04 | 4.158E-02 | -3.532 | -1.381 | 7.070E-03 | -2.151 |
| 44 | H2 gas | 2.761E-19 | 7.603E-04 | -18.559 | -3.119 | 3.631E-16 | -15.440 |

PALOUSE BASIN: LOESS SAMPLE

**27. Loess6A**

INITIAL SOLUTION

TEMPERATURE = 18.00 DEGREES C PH = 8.210
ANALYTICAL EPMCAT = 3.628 ANALYTICAL EPMAN = 2.380

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 6.54100E-04 | -3.1844 | 2.62100E+01 |
| Mg+2 | 2.0 | 3.57111E-04 | -3.4472 | 8.68000E+00 |
| Na+ | 1.0 | 1.57586E-03 | -2.8025 | 3.62200E+01 |
| K+ | 1.0 | 2.58361E-05 | -4.5878 | 1.01000E+00 |
| Sr+2 | 2.0 | 1.59819E-06 | -5.7964 | 1.40000E-01 |
| H4SiO4 | 0.0 | 3.23954E-04 | -3.4895 | 1.94600E+01 |
| Cl- | -1.0 | 5.75548E-05 | -4.2399 | 2.04000E+00 |
| HCO3- | -1.0 | 1.23995E-03 | -2.9066 | 7.56400E+01 |
| SO4-2 | -2.0 | 2.15851E-04 | -3.6658 | 2.07300E+01 |
| HPO4-2 | -2.0 | 6.13569E-06 | -5.2121 | 1.90000E-01 |
| F- | -1.0 | 7.37082E-06 | -5.1325 | 1.40000E-01 |
| Br- | -1.0 | 6.28530E-04 | -3.2017 | 5.02100E+01 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | | |
|---|---|---|---|---|
| EPMCAT | 3.63 | 3.56 | PH 8.210 | ACTIVITY H2O = 0.9999 |
| EPMAN | 2.38 | 2.30 | | PCO2= 4.080245E-04 |
| | | | | LOG PCO2 = -3.3893 |
| | | | TEMPERATURE | PO2 = 1.935452E-53 |
| EH = 0.0000 | PE = 0.000 | | 18.00 DEG C | PCH4 = 8.074634E-46 |
| PE CALC S = | 0.000 | | | CO2 TOT = 1.226907E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.108788E-03 | TDS = 240.7MG/L |
| TOT ALK = | 1.240E+00 MEQ | | | CARB ALK = 1.226E+00 MEQ |
| ELECT = | 1.256E+00 MEQ | | | CHARGE IMBALANCE = 21.4% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,

PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 6.5649E-09 | 6.1659E-09 | -8.210 | 9.3923E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 6.2829E-04 | 4.8044E-04 | -3.318 | 7.6469E-01 |
| 5 | Mg+2 | 2. | 3.4342E-04 | 2.6337E-04 | -3.579 | 7.6689E-01 |
| 6 | Na+ | 1. | 1.5737E-03 | 1.4701E-03 | -2.833 | 9.3421E-01 |
| 7 | K+ | 1. | 2.5812E-05 | 2.4084E-05 | -4.618 | 9.3305E-01 |
| 12 | Sr+2 | 2. | 1.5456E-06 | 1.1830E-06 | -5.927 | 7.6539E-01 |
| 13 | H4SiO4 | 0. | 3.1764E-04 | 3.1794E-04 | -3.498 | 1.0009E+00 |
| 14 | Cl- | -1. | 5.7555E-05 | 5.3701E-05 | -4.270 | 9.3305E-01 |
| 15 | CO3-2 | -2. | 9.4225E-06 | 7.2087E-06 | -5.142 | 7.6505E-01 |
| 16 | SO4-2 | -2. | 1.9384E-04 | 1.4794E-04 | -3.830 | 7.6321E-01 |
| 19 | PO4-3 | -3. | 3.6508E-10 | 1.9661E-10 | -9.706 | 5.3853E-01 |
| 20 | F- | -1. | 7.2291E-06 | 6.7441E-06 | -5.171 | 9.3292E-01 |
| 22 | Br- | -1. | 6.2853E-04 | 5.8596E-04 | -3.232 | 9.3228E-01 |
| 31 | OH- | -1. | 1.0045E-06 | 9.3707E-07 | -6.028 | 9.3292E-01 |
| 33 | H2 AQ | 0. | 2.8879E-20 | 2.8907E-20 | -19.539 | 1.0009E+00 |
| 34 | HCO3- | -1. | 1.1827E-03 | 1.1061E-03 | -2.956 | 9.3524E-01 |
| 35 | H2CO3 | 0. | 1.6951E-05 | 1.6968E-05 | -4.770 | 1.0009E+00 |
| 40 | HSO4- | -1. | 8.1900E-11 | 7.6468E-11 | -10.117 | 9.3368E-01 |
| 65 | HPO4-2 | -2. | 4.0857E-06 | 3.1032E-06 | -5.508 | 7.5952E-01 |
| 66 | H2PO4- | -1. | 3.4343E-07 | 3.2082E-07 | -6.494 | 9.3416E-01 |
| 69 | HF AQ | 0. | 5.5031E-11 | 5.5083E-11 | -10.259 | 1.0009E+00 |
| 70 | HF2- | -1. | 1.4370E-15 | 1.3417E-15 | -14.872 | 9.3368E-01 |
| 75 | CaOH+ | 1. | 1.3849E-08 | 1.2930E-08 | -7.888 | 9.3368E-01 |
| 76 | CaCO3 | 0. | 5.1463E-06 | 5.1512E-06 | -5.288 | 1.0009E+00 |
| 77 | CaHCO3+ | 1. | 6.4032E-06 | 5.9885E-06 | -5.223 | 9.3524E-01 |
| 78 | CaSO4 | 0. | 1.3251E-05 | 1.3263E-05 | -4.877 | 1.0009E+00 |
| 79 | CaHSO4 | 1. | 5.4895E-13 | 5.1255E-13 | -12.290 | 9.3368E-01 |
| 80 | CaPO4- | -1. | 2.5669E-07 | 2.3967E-07 | -6.620 | 9.3368E-01 |
| 81 | CaHPO4 | 0. | 7.1430E-07 | 7.1498E-07 | -6.146 | 1.0009E+00 |
| 82 | CaH2PO4+ | 1. | 3.6794E-09 | 3.4354E-09 | -8.464 | 9.3368E-01 |
| 83 | CaF+ | 1. | 2.5572E-08 | 2.3876E-08 | -7.622 | 9.3368E-01 |
| 85 | MgOH+ | 1. | 8.8214E-08 | 8.2364E-08 | -7.084 | 9.3368E-01 |
| 86 | MgCO3 | 0. | 1.6255E-06 | 1.6270E-06 | -5.789 | 1.0009E+00 |
| 87 | MgHCO3+ | 1. | 3.5573E-06 | 3.3214E-06 | -5.479 | 9.3368E-01 |
| 88 | MgSO4 | 0. | 7.5867E-06 | 7.5939E-06 | -5.120 | 1.0009E+00 |
| 89 | MgPO4- | -1. | 1.8981E-07 | 1.7723E-07 | -6.751 | 9.3368E-01 |
| 90 | MgHPO4 | 0. | 5.2942E-07 | 5.2992E-07 | -6.276 | 1.0009E+00 |
| 91 | MgH2PO4+ | 1. | 2.5686E-09 | 2.3983E-09 | -8.620 | 9.3368E-01 |
| 92 | MgF+ | 1. | 1.1038E-07 | 1.0306E-07 | -6.987 | 9.3368E-01 |
| 93 | NaOH | 0. | 1.5737E-09 | 1.5751E-09 | -8.803 | 1.0009E+00 |
| 94 | NaCO3- | -1. | 1.4723E-07 | 1.3746E-07 | -6.862 | 9.3368E-01 |
| 95 | NaHCO3 | 0. | 9.0482E-07 | 9.0568E-07 | -6.043 | 1.0009E+00 |
| 96 | NaSO4- | -1. | 1.1156E-06 | 1.0416E-06 | -5.982 | 9.3368E-01 |
| 97 | NaHPO4- | -1. | 9.5273E-09 | 8.8954E-09 | -8.051 | 9.3368E-01 |
| 98 | NaF aq | 0. | 5.7000E-09 | 5.7054E-09 | -8.244 | 1.0009E+00 |
| 99 | KOH | 0. | 1.3530E-11 | 1.3542E-11 | -10.868 | 1.0009E+00 |
| 100 | KSO4- | -1. | 2.3661E-08 | 2.2092E-08 | -7.656 | 9.3368E-01 |
| 101 | KHPO4- | -1. | 1.5608E-10 | 1.4573E-10 | -9.836 | 9.3368E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 164 | H3SiO4- | -1. | 6.3107E-06 | 5.8922E-06 | -5.230 | 9.3368E-01 |
| 165 | H2SiO4-2 | -2. | 5.3178E-11 | 4.0414E-11 | -10.393 | 7.5997E-01 |
| 166 | SiF6-2 | -2. | 1.6666E-37 | 1.2665E-37 | -36.897 | 7.5997E-01 |
| 176 | SrOH+ | 1. | 1.0525E-11 | 9.8387E-12 | -11.007 | 9.3476E-01 |
| 177 | SrHCO3+ | 1. | 1.6842E-08 | 1.5751E-08 | -7.803 | 9.3524E-01 |
| 178 | SrCO3 | 0. | 4.4229E-09 | 4.4271E-09 | -8.354 | 1.0009E+00 |
| 179 | SrSO4 | 0. | 3.1333E-08 | 3.1362E-08 | -7.504 | 1.0009E+00 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 3.463E-09 | 3.601E-09 | -8.460 | -8.444 | 9.619E-01 | -0.017 |
| 2 | Aragonit | 3.463E-09 | 5.073E-09 | -8.460 | -8.295 | 6.827E-01 | -0.166 |
| 3 | Dolomite | 6.575E-18 | 1.192E-17 | -17.182 | -16.924 | 5.516E-01 | -0.258 |
| 6 | Strontit | 8.528E-12 | 5.365E-10 | -11.069 | -9.270 | 1.590E-02 | -1.799 |
| 8 | Gypsum | 7.107E-08 | 2.618E-05 | -7.148 | -4.582 | 2.715E-03 | -2.566 |
| 9 | Anhydrit | 7.108E-08 | 4.577E-05 | -7.148 | -4.339 | 1.553E-03 | -2.809 |
| 10 | Celestit | 1.750E-10 | 2.394E-07 | -9.757 | -6.621 | 7.311E-04 | -3.136 |
| 12 | Hydroxap | 5.292E-01 | 1.645E-03 | -0.276 | -2.784 | 3.217E+02 | 2.507 |
| 13 | Fluorite | 2.185E-14 | 2.063E-11 | -13.661 | -10.686 | 1.059E-03 | -2.975 |
| 14 | SiO2 (a) | 3.180E-04 | 1.695E-03 | -3.498 | -2.771 | 1.876E-01 | -0.727 |
| 15 | Chalcedy | 3.180E-04 | 2.320E-04 | -3.498 | -3.635 | 1.371E+00 | 0.137 |
| 16 | Quartz | 3.180E-04 | 8.204E-05 | -3.498 | -4.086 | 3.876E+00 | 0.588 |
| 26 | Talc | 3.398E+24 | 1.644E+22 | 24.531 | 22.216 | 2.067E+02 | 2.315 |
| 28 | Chrysotl | 3.360E+31 | 1.227E+33 | 31.526 | 33.089 | 2.739E-02 | -1.562 |
| 29 | Sepiol c | 1.542E+15 | 8.883E+15 | 15.188 | 15.949 | 1.736E-01 | -0.760 |
| 30 | Sepiol d | 1.542E+15 | 4.571E+18 | 15.188 | 18.660 | 3.374E-04 | -3.472 |
| 42 | PCO2 | 1.697E-05 | 4.158E-02 | -4.770 | -1.381 | 4.080E-04 | -3.389 |
| 44 | H2 gas | 2.891E-20 | 7.603E-04 | -19.539 | -3.119 | 3.802E-17 | -16.420 |

## DATA USED FROM NELSON (2003)

PALOUSE BASIN: WANAPUM SAMPLES
**28. COM2**

INITIAL SOLUTION

TEMPERATURE = 12.60 DEGREES C PH = 6.600
ANALYTICAL EPMCAT = 3.404 ANALYTICAL EPMAN = 2.986

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 8.58507E-04 | -3.0663 | 3.44000E+01 |

| | | | | |
|---|---|---|---|---|
| Mg+2 | 2.0 | 4.97827E-04 | -3.3029 | 1.21000E+01 |
| Na+ | 1.0 | 5.61265E-04 | -3.2508 | 1.29000E+01 |
| K+ | 1.0 | 8.18586E-05 | -4.0869 | 3.20000E+00 |
| Fe+2 | 2.0 | 2.09556E-05 | -4.6787 | 1.17000E+00 |
| Mn+2 | 2.0 | 2.54899E-06 | -5.5936 | 1.40000E-01 |
| H4SiO4 | 0.0 | 4.64465E-04 | -3.3330 | 2.79000E+01 |
| Cl- | -1.0 | 1.42197E-04 | -3.8471 | 5.04000E+00 |
| HCO3- | -1.0 | 2.17192E-03 | -2.6632 | 1.32490E+02 |
| SO4-2 | -2.0 | 3.22794E-04 | -3.4911 | 3.10000E+01 |
| H3BO3 | 0.0 | 5.55186E-06 | -5.2556 | 6.00000E-02 |
| F- | -1.0 | 2.57984E-05 | -4.5884 | 4.90000E-01 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 3.40 | 3.30 | 6.600 | PCO2= 2.800390E-02 |
| EPMAN | 2.99 | 2.88 | | LOG PCO2 = -1.5528 |
| | | | TEMPERATURE | PO2 = 7.800798E-62 |
| EH = 0.0000 | PE = 0.000 | | 12.60 DEG C | PCH4 = 2.943327E-30 |
| PE CALC S = | 0.000 | | | CO2 TOT = 3.550028E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.695473E-03 | TDS = 260.9MG/L |
| TOT ALK = | 2.172E+00 MEQ | | | CARB ALK = 2.172E+00 MEQ |
| ELECT = | 4.173E-01 MEQ | | | CHARGE IMBALANCE = 6.7% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 2.6826E-07 | 2.5119E-07 | -6.600 | 9.3635E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 8.2146E-04 | 6.1932E-04 | -3.208 | 7.5392E-01 |
| 5 | Mg+2 | 2. | 4.7562E-04 | 3.5973E-04 | -3.444 | 7.5634E-01 |
| 6 | Na+ | 1. | 5.6013E-04 | 5.2137E-04 | -3.283 | 9.3080E-01 |
| 7 | K+ | 1. | 8.1760E-05 | 7.5996E-05 | -4.119 | 9.2949E-01 |
| 8 | Fe+2 | 2. | 1.7668E-05 | 1.3371E-05 | -4.874 | 7.5681E-01 |
| 9 | Mn+2 | 2. | 2.1597E-06 | 1.6345E-06 | -5.787 | 7.5681E-01 |
| 13 | H4SiO4 | 0. | 4.6428E-04 | 4.6478E-04 | -3.333 | 1.0011E+00 |
| 14 | Cl- | -1. | 1.4219E-04 | 1.3217E-04 | -3.879 | 9.2949E-01 |
| 15 | CO3-2 | -2. | 3.6908E-07 | 2.7839E-07 | -6.555 | 7.5429E-01 |
| 16 | SO4-2 | -2. | 2.8526E-04 | 2.1459E-04 | -3.668 | 7.5225E-01 |
| 18 | H3BO3 | 0. | 5.5410E-06 | 5.5470E-06 | -5.256 | 1.0011E+00 |
| 20 | F- | -1. | 2.5207E-05 | 2.3426E-05 | -4.630 | 9.2934E-01 |
| 31 | OH- | -1. | 1.5735E-08 | 1.4623E-08 | -7.835 | 9.2934E-01 |
| 33 | H2 AQ | 0. | 5.0755E-17 | 5.0810E-17 | -16.294 | 1.0011E+00 |
| 34 | HCO3- | -1. | 2.1448E-03 | 1.9988E-03 | -2.699 | 9.3193E-01 |
| 35 | H2CO3 | 0. | 1.3789E-03 | 1.3804E-03 | -2.860 | 1.0011E+00 |
| 40 | HSO4- | -1. | 4.3608E-09 | 4.0565E-09 | -8.392 | 9.3023E-01 |
| 57 | H2BO3- | -1. | 1.0787E-08 | 1.0035E-08 | -7.998 | 9.3023E-01 |
| 58 | BFOH3- | -1. | 4.8564E-11 | 4.5176E-11 | -10.345 | 9.3023E-01 |
| 59 | BF2OH2- | -1. | 3.1148E-14 | 2.8975E-14 | -13.538 | 9.3023E-01 |
| 60 | BF3OH- | -1. | 2.5467E-19 | 2.3690E-19 | -18.625 | 9.3023E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 61 | BF4- | -1. | 6.2101E-24 | 5.7768E-24 | -23.238 | 9.3023E-01 |
| 69 | HF AQ | 0. | 7.0938E-09 | 7.1015E-09 | -8.149 | 1.0011E+00 |
| 70 | HF2- | -1. | 6.1103E-13 | 5.6840E-13 | -12.245 | 9.3023E-01 |
| 75 | CaOH+ | 1. | 4.3982E-10 | 4.0913E-10 | -9.388 | 9.3023E-01 |
| 76 | CaCO3 | 0. | 2.4018E-07 | 2.4044E-07 | -6.619 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.3230E-05 | 1.2329E-05 | -4.909 | 9.3193E-01 |
| 78 | CaSO4 | 0. | 2.3473E-05 | 2.3498E-05 | -4.629 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 4.1969E-11 | 3.9040E-11 | -10.408 | 9.3023E-01 |
| 83 | CaF+ | 1. | 1.0045E-07 | 9.3444E-08 | -7.029 | 9.3023E-01 |
| 85 | MgOH+ | 1. | 1.7839E-09 | 1.6595E-09 | -8.780 | 9.3023E-01 |
| 86 | MgCO3 | 0. | 7.8906E-08 | 7.8991E-08 | -7.102 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 8.7033E-06 | 8.0960E-06 | -5.092 | 9.3023E-01 |
| 88 | MgSO4 | 0. | 1.2953E-05 | 1.2967E-05 | -4.887 | 1.0011E+00 |
| 92 | MgF+ | 1. | 4.7347E-07 | 4.4043E-07 | -6.356 | 9.3023E-01 |
| 93 | NaOH | 0. | 1.3697E-11 | 1.3712E-11 | -10.863 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 1.5128E-09 | 1.4073E-09 | -8.852 | 9.3023E-01 |
| 95 | NaHCO3 | 0. | 5.6702E-07 | 5.6764E-07 | -6.246 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 5.5531E-07 | 5.1656E-07 | -6.287 | 9.3023E-01 |
| 98 | NaF aq | 0. | 7.0205E-09 | 7.0281E-09 | -8.153 | 1.0011E+00 |
| 99 | KOH | 0. | 1.0478E-12 | 1.0489E-12 | -11.979 | 1.0011E+00 |
| 100 | KSO4- | -1. | 9.8287E-08 | 9.1429E-08 | -7.039 | 9.3023E-01 |
| 102 | FeOH+ | 1. | 6.8812E-09 | 6.4011E-09 | -8.194 | 9.3023E-01 |
| 105 | FeCl+ | 1. | 2.6225E-09 | 2.4395E-09 | -8.613 | 9.3023E-01 |
| 106 | FeCO3 | 0. | 8.9199E-08 | 8.9296E-08 | -7.049 | 1.0011E+00 |
| 107 | FeHCO3+ | 1. | 2.7830E-06 | 2.5888E-06 | -5.587 | 9.3023E-01 |
| 108 | FeSO4 | 0. | 4.0232E-07 | 4.0275E-07 | -6.395 | 1.0011E+00 |
| 109 | FeHSO4+ | 1. | 9.0613E-13 | 8.4291E-13 | -12.074 | 9.3023E-01 |
| 114 | FeF+ | 1. | 3.3673E-09 | 3.1323E-09 | -8.504 | 9.3023E-01 |
| 115 | Fe+3 | 3. | 1.1359E-18 | 6.2845E-19 | -18.202 | 5.5328E-01 |
| 117 | FeOH+2 | 2. | 1.0071E-14 | 7.5407E-15 | -14.123 | 7.4878E-01 |
| 118 | FeOH2+ | 1. | 6.5412E-12 | 6.0848E-12 | -11.216 | 9.3023E-01 |
| 119 | FeOH3 | 0. | 1.7734E-12 | 1.7753E-12 | -11.751 | 1.0011E+00 |
| 120 | FeOH4- | -1. | 4.1190E-15 | 3.8316E-15 | -14.417 | 9.3023E-01 |
| 121 | Fe2OH2+4 | 4. | 8.3101E-27 | 2.6123E-27 | -26.583 | 3.1436E-01 |
| 122 | Fe3OH4+5 | 5. | 6.6840E-35 | 1.0959E-35 | -34.960 | 1.6395E-01 |
| 123 | FeCl+2 | 2. | 2.2229E-21 | 1.6644E-21 | -20.779 | 7.4878E-01 |
| 124 | FeCl2+ | 1. | 1.5920E-24 | 1.4809E-24 | -23.829 | 9.3023E-01 |
| 125 | FeCl3 | 0. | 1.9552E-29 | 1.9573E-29 | -28.708 | 1.0011E+00 |
| 126 | FeSO4+ | 1. | 1.1937E-18 | 1.1105E-18 | -17.954 | 9.3023E-01 |
| 127 | FeHSO4+2 | 2. | 2.7004E-24 | 2.0220E-24 | -23.694 | 7.4878E-01 |
| 128 | FeSO42- | -1. | 5.3280E-21 | 4.9563E-21 | -20.305 | 9.3023E-01 |
| 131 | FeF+2 | 2. | 2.5570E-17 | 1.9146E-17 | -16.718 | 7.4878E-01 |
| 132 | FeF2+ | 1. | 1.6458E-17 | 1.5310E-17 | -16.815 | 9.3023E-01 |
| 133 | FeF3 | 0. | 5.4339E-19 | 5.4397E-19 | -18.264 | 1.0011E+00 |
| 134 | MnOH+ | 1. | 6.2619E-11 | 5.8250E-11 | -10.235 | 9.3023E-01 |
| 136 | MnCl+ | 1. | 9.4607E-10 | 8.8006E-10 | -9.055 | 9.3023E-01 |
| 137 | MnCl2 | 0. | 5.0719E-14 | 5.0774E-14 | -13.294 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 1.9869E-18 | 1.8483E-18 | -17.733 | 9.3023E-01 |
| 139 | MnCO3 | 0. | 3.6105E-08 | 3.6144E-08 | -7.442 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 3.0319E-07 | 2.8204E-07 | -6.550 | 9.3023E-01 |
| 141 | MnSO4 | 0. | 4.8677E-08 | 4.8729E-08 | -7.312 | 1.0011E+00 |
| 143 | MnF+ | 1. | 2.8477E-10 | 2.6490E-10 | -9.577 | 9.3023E-01 |
| 144 | Mn+3 | 3. | 1.4636E-32 | 7.6335E-33 | -32.117 | 5.2155E-01 |
| 164 | H3SiO4- | -1. | 1.8361E-07 | 1.7080E-07 | -6.768 | 9.3023E-01 |
| 165 | H2SiO4-2 | -2. | 2.5888E-14 | 1.9384E-14 | -13.713 | 7.4878E-01 |
| 166 | SiF6-2 | -2. | 2.0344E-27 | 1.5233E-27 | -26.817 | 7.4878E-01 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.724E-10 | 3.799E-09 | -9.763 | -8.420 | 4.538E-02 | -1.343 |
| 2 | Aragonit | 1.724E-10 | 5.405E-09 | -9.763 | -8.267 | 3.190E-02 | -1.496 |
| 3 | Dolomite | 1.727E-20 | 1.622E-17 | -19.763 | -16.790 | 1.064E-03 | -2.973 |
| 4 | Siderite | 3.722E-12 | 1.545E-11 | -11.429 | -10.811 | 2.410E-01 | -0.618 |
| 5 | Rhodochr | 4.550E-13 | 8.232E-12 | -12.342 | -11.085 | 5.528E-02 | -1.257 |
| 8 | Gypsum | 1.329E-07 | 2.586E-05 | -6.877 | -4.587 | 5.139E-03 | -2.289 |
| 9 | Anhydrit | 1.329E-07 | 4.631E-05 | -6.876 | -4.334 | 2.870E-03 | -2.542 |
| 13 | Fluorite | 3.399E-13 | 1.742E-11 | -12.469 | -10.759 | 1.951E-02 | -1.710 |
| 14 | SiO2 (a) | 4.649E-04 | 1.520E-03 | -3.333 | -2.818 | 3.059E-01 | -0.514 |
| 15 | Chalcedy | 4.649E-04 | 1.988E-04 | -3.333 | -3.702 | 2.338E+00 | 0.369 |
| 16 | Quartz | 4.649E-04 | 6.746E-05 | -3.333 | -4.171 | 6.891E+00 | 0.838 |
| 26 | Talc | 8.652E+15 | 7.471E+22 | 15.937 | 22.873 | 1.158E-07 | -6.936 |
| 28 | Chrysotl | 4.003E+22 | 6.343E+33 | 22.602 | 33.802 | 6.311E-12 | -11.200 |
| 29 | Sepiol c | 3.264E+09 | 1.260E+16 | 9.514 | 16.100 | 2.590E-07 | -6.587 |
| 30 | Sepiol d | 3.264E+09 | 4.571E+18 | 9.514 | 18.660 | 7.140E-10 | -9.146 |
| 31 | Hematite | 1.572E+03 | 9.400E-04 | 3.196 | -3.027 | 1.672E+06 | 6.223 |
| 32 | Goethite | 3.964E+01 | 3.463E-02 | 1.598 | -1.461 | 1.145E+03 | 3.059 |
| 33 | Fe(OH)3a | 3.964E+01 | 7.780E+04 | 1.598 | 4.891 | 5.095E-04 | -3.293 |
| 38 | Pyrolusi | 4.105E+20 | 2.825E+43 | 20.613 | 43.451 | 1.453E-23 | -22.838 |
| 39 | Hausmani | 2.754E+35 | 1.703E+64 | 35.440 | 64.231 | 1.617E-29 | -28.791 |
| 40 | Manganit | 1.031E+14 | 2.188E+25 | 14.013 | 25.340 | 4.713E-12 | -11.327 |
| 41 | Pyrochro | 2.590E+07 | 1.585E+15 | 7.413 | 15.200 | 1.634E-08 | -7.787 |
| 42 | PCO2 | 1.380E-03 | 4.929E-02 | -2.860 | -1.307 | 2.800E-02 | -1.553 |
| 44 | H2 gas | 5.081E-17 | 8.053E-04 | -16.294 | -3.094 | 6.310E-14 | -13.200 |
| 49 | Melanter | 2.867E-09 | 4.244E-03 | -8.543 | -2.372 | 6.755E-07 | -6.170 |
| 51 | K-Jarosi | 3.456E-27 | 6.095E-09 | -26.461 | -8.215 | 5.669E-19 | -18.246 |

**29. COM3**

INITIAL SOLUTION

TEMPERATURE = 12.00 DEGREES C PH = 6.400
ANALYTICAL EPMCAT = 5.138 ANALYTICAL EPMAN = 4.084

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 1.29037E-03 | -2.8893 | 5.17000E+01 |
| Mg+2 | 2.0 | 8.22924E-04 | -3.0846 | 2.00000E+01 |
| Na+ | 1.0 | 6.17879E-04 | -3.2091 | 1.42000E+01 |
| K+ | 1.0 | 7.41907E-05 | -4.1297 | 2.90000E+00 |
| Fe+2 | 2.0 | 1.00309E-04 | -3.9987 | 5.60000E+00 |

| | | | | |
|---|---|---|---|---|
| Mn+2 | 2.0 | 8.19389E-06 | -5.0865 | 4.50000E-01 |
| H4SiO4 | 0.0 | 4.79488E-04 | -3.3192 | 2.88000E+01 |
| Cl- | -1.0 | 1.49545E-04 | -3.8252 | 5.30000E+00 |
| HCO3- | -1.0 | 2.22079E-03 | -2.6535 | 1.35460E+02 |
| SO4-2 | -2.0 | 8.44542E-04 | -3.0734 | 8.11000E+01 |
| H3BO3 | 0.0 | 6.47773E-06 | -5.1886 | 7.00000E-02 |
| F- | -1.0 | 2.31679E-05 | -4.6351 | 4.40000E-01 |

****DESCRIPTION OF SOLUTION ****

| | | | |
|---|---|---|---|
| | ANALYT. | COMP. | PH |
| EPMCAT | 5.14 | 4.83 | 6.400 |
| EPMAN | 4.08 | 3.78 | |

TEMPERATURE
12.00 DEG C

IONIC STRENGTH
7.072262E-03

ACTIVITY H2O = 0.9999
PCO2= 4.403733E-02
LOG PCO2 = -1.3562
PO2 = 7.422643E-63
PCH4 = 2.296783E-28
CO2 TOT = 4.430729E-03
DENSITY = 1.0000
TDS = 346.0MG/L
CARB ALK = 2.221E+00 MEQ
CHARGE IMBALANCE = 12.2%

EH = 0.0000 PE = 0.000
PE CALC S = 0.000
PE CALC DOX= 0.000
PE SATO DOX= 0.000
TOT ALK = 2.221E+00 MEQ
ELECT = 1.053E+00 MEQ

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 4.3027E-07 | 3.9811E-07 | -6.400 | 9.2526E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 1.1957E-03 | 8.5271E-04 | -3.069 | 7.1315E-01 |
| 5 | Mg+2 | 2. | 7.6293E-04 | 5.4661E-04 | -3.262 | 7.1646E-01 |
| 6 | Na+ | 1. | 6.1582E-04 | 5.6503E-04 | -3.248 | 9.1753E-01 |
| 7 | K+ | 1. | 7.3982E-05 | 6.7740E-05 | -4.169 | 9.1563E-01 |
| 8 | Fe+2 | 2. | 8.3251E-05 | 5.9689E-05 | -4.224 | 7.1697E-01 |
| 9 | Mn+2 | 2. | 6.8578E-06 | 4.9168E-06 | -5.308 | 7.1697E-01 |
| 13 | H4SiO4 | 0. | 4.7937E-04 | 4.8015E-04 | -3.319 | 1.0016E+00 |
| 14 | Cl- | -1. | 1.4953E-04 | 1.3691E-04 | -3.864 | 9.1563E-01 |
| 15 | CO3-2 | -2. | 2.4203E-07 | 1.7270E-07 | -6.763 | 7.1356E-01 |
| 16 | SO4-2 | -2. | 7.1627E-04 | 5.0910E-04 | -3.293 | 7.1077E-01 |
| 18 | H3BO3 | 0. | 6.4697E-06 | 6.4802E-06 | -5.188 | 1.0016E+00 |
| 20 | F- | -1. | 2.2385E-05 | 2.0492E-05 | -4.688 | 9.1540E-01 |
| 31 | OH- | -1. | 9.5684E-09 | 8.7589E-09 | -8.058 | 9.1540E-01 |
| 33 | H2 AQ | 0. | 1.2826E-16 | 1.2846E-16 | -15.891 | 1.0016E+00 |
| 34 | HCO3- | -1. | 2.1738E-03 | 1.9979E-03 | -2.699 | 9.1909E-01 |
| 35 | H2CO3 | 0. | 2.2105E-03 | 2.2141E-03 | -2.655 | 1.0016E+00 |
| 40 | HSO4- | -1. | 1.6446E-08 | 1.5077E-08 | -7.822 | 9.1674E-01 |
| 57 | H2BO3- | -1. | 7.9727E-09 | 7.3089E-09 | -8.136 | 9.1674E-01 |
| 58 | BFOH3- | -1. | 5.0015E-11 | 4.5851E-11 | -10.339 | 9.1674E-01 |
| 59 | BF2OH2- | -1. | 4.4513E-14 | 4.0807E-14 | -13.389 | 9.1674E-01 |
| 60 | BF3OH- | -1. | 5.1067E-19 | 4.6815E-19 | -18.330 | 9.1674E-01 |
| 61 | BF4- | -1. | 1.7280E-23 | 1.5841E-23 | -22.800 | 9.1674E-01 |
| 69 | HF AQ | 0. | 9.7297E-09 | 9.7455E-09 | -8.011 | 1.0016E+00 |
| 70 | HF2- | -1. | 7.3936E-13 | 6.7780E-13 | -12.169 | 9.1674E-01 |
| 75 | CaOH+ | 1. | 3.8769E-10 | 3.5542E-10 | -9.449 | 9.1674E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 76 | CaCO3 | 0. | 2.0394E-07 | 2.0427E-07 | -6.690 | 1.0016E+00 |
| 77 | CaHCO3+ | 1. | 1.8179E-05 | 1.6708E-05 | -4.777 | 9.1909E-01 |
| 78 | CaSO4 | 0. | 7.6166E-05 | 7.6290E-05 | -4.118 | 1.0016E+00 |
| 79 | CaHSO4 | 1. | 2.2047E-10 | 2.0212E-10 | -9.694 | 9.1674E-01 |
| 83 | CaF+ | 1. | 1.2091E-07 | 1.1084E-07 | -6.955 | 9.1674E-01 |
| 85 | MgOH+ | 1. | 1.6380E-09 | 1.5016E-09 | -8.823 | 9.1674E-01 |
| 86 | MgCO3 | 0. | 7.3657E-08 | 7.3777E-08 | -7.132 | 1.0016E+00 |
| 87 | MgHCO3+ | 1. | 1.3400E-05 | 1.2285E-05 | -4.911 | 9.1674E-01 |
| 88 | MgSO4 | 0. | 4.5891E-05 | 4.5965E-05 | -4.338 | 1.0016E+00 |
| 92 | MgF+ | 1. | 6.3106E-07 | 5.7852E-07 | -6.238 | 9.1674E-01 |
| 93 | NaOH | 0. | 9.3605E-12 | 9.3757E-12 | -11.028 | 1.0016E+00 |
| 94 | NaCO3- | -1. | 9.9853E-10 | 9.1539E-10 | -9.038 | 9.1674E-01 |
| 95 | NaHCO3 | 0. | 6.1186E-07 | 6.1286E-07 | -6.213 | 1.0016E+00 |
| 96 | NaSO4- | -1. | 1.4428E-06 | 1.3227E-06 | -5.879 | 9.1674E-01 |
| 98 | NaF aq | 0. | 6.6518E-09 | 6.6626E-09 | -8.176 | 1.0016E+00 |
| 99 | KOH | 0. | 5.8894E-13 | 5.8990E-13 | -12.229 | 1.0016E+00 |
| 100 | KSO4- | -1. | 2.0852E-07 | 1.9116E-07 | -6.719 | 9.1674E-01 |
| 102 | FeOH+ | 1. | 1.8727E-08 | 1.7168E-08 | -7.765 | 9.1674E-01 |
| 105 | FeCl+ | 1. | 1.2305E-08 | 1.1281E-08 | -7.948 | 9.1674E-01 |
| 106 | FeCO3 | 0. | 2.4688E-07 | 2.4728E-07 | -6.607 | 1.0016E+00 |
| 107 | FeHCO3+ | 1. | 1.2559E-05 | 1.1513E-05 | -4.939 | 9.1674E-01 |
| 108 | FeSO4 | 0. | 4.2078E-06 | 4.2146E-06 | -5.375 | 1.0016E+00 |
| 109 | FeHSO4+ | 1. | 1.5433E-11 | 1.4148E-11 | -10.849 | 9.1674E-01 |
| 114 | FeF+ | 1. | 1.3342E-08 | 1.2231E-08 | -7.913 | 9.1674E-01 |
| 115 | Fe+3 | 3. | 5.4456E-18 | 2.7065E-18 | -17.568 | 4.9701E-01 |
| 117 | FeOH+2 | 2. | 2.7913E-14 | 1.9715E-14 | -13.705 | 7.0630E-01 |
| 118 | FeOH2+ | 1. | 1.0680E-11 | 9.7911E-12 | -11.009 | 9.1674E-01 |
| 119 | FeOH3 | 0. | 1.7488E-12 | 1.7517E-12 | -11.757 | 1.0016E+00 |
| 120 | FeOH4- | -1. | 2.5344E-15 | 2.3234E-15 | -14.634 | 9.1674E-01 |
| 121 | Fe2OH2+4 | 4. | 7.3719E-26 | 1.8346E-26 | -25.736 | 2.4886E-01 |
| 122 | Fe3OH4+5 | 5. | 1.1558E-33 | 1.3155E-34 | -33.881 | 1.1381E-01 |
| 123 | FeCl+2 | 2. | 1.0297E-20 | 7.2730E-21 | -20.138 | 7.0630E-01 |
| 124 | FeCl2+ | 1. | 7.4654E-24 | 6.8439E-24 | -23.165 | 9.1674E-01 |
| 125 | FeCl3 | 0. | 9.3550E-29 | 9.3702E-29 | -28.028 | 1.0016E+00 |
| 126 | FeSO4+ | 1. | 1.2198E-17 | 1.1183E-17 | -16.951 | 9.1674E-01 |
| 127 | FeHSO4+2 | 2. | 4.8052E-23 | 3.3939E-23 | -22.469 | 7.0630E-01 |
| 128 | FeSO42- | -1. | 1.2884E-19 | 1.1811E-19 | -18.928 | 9.1674E-01 |
| 131 | FeF+2 | 2. | 1.0110E-16 | 7.1409E-17 | -16.146 | 7.0630E-01 |
| 132 | FeF2+ | 1. | 5.4064E-17 | 4.9563E-17 | -16.305 | 9.1674E-01 |
| 133 | FeF3 | 0. | 1.5345E-18 | 1.5370E-18 | -17.813 | 1.0016E+00 |
| 134 | MnOH+ | 1. | 1.1433E-10 | 1.0481E-10 | -9.980 | 9.1674E-01 |
| 136 | MnCl+ | 1. | 2.9915E-09 | 2.7424E-09 | -8.562 | 9.1674E-01 |
| 137 | MnCl2 | 0. | 1.6363E-13 | 1.6390E-13 | -12.785 | 1.0016E+00 |
| 138 | MnCl3- | -1. | 6.7419E-18 | 6.1806E-18 | -17.209 | 9.1674E-01 |
| 139 | MnCO3 | 0. | 6.7340E-08 | 6.7449E-08 | -7.171 | 1.0016E+00 |
| 140 | MnHCO3+ | 1. | 9.2200E-07 | 8.4524E-07 | -6.073 | 9.1674E-01 |
| 141 | MnSO4 | 0. | 3.4290E-07 | 3.4346E-07 | -6.464 | 1.0016E+00 |
| 143 | MnF+ | 1. | 7.6035E-10 | 6.9705E-10 | -9.157 | 9.1674E-01 |
| 144 | Mn+3 | 3. | 4.5632E-32 | 2.0869E-32 | -31.680 | 4.5733E-01 |
| 164 | H3SiO4- | -1. | 1.1848E-07 | 1.0861E-07 | -6.964 | 9.1674E-01 |
| 165 | H2SiO4-2 | -2. | 1.0523E-14 | 7.4327E-15 | -14.129 | 7.0630E-01 |
| 166 | SiF6-2 | -2. | 6.6908E-27 | 4.7258E-27 | -26.326 | 7.0630E-01 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 1.473E-10 | 3.820E-09 | -9.832 | -8.418 | 3.855E-02 | -1.414 |
| 2 | Aragonit | 1.473E-10 | 5.440E-09 | -9.832 | -8.264 | 2.707E-02 | -1.568 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 3 Dolomite | 1.390E-20 | 1.680E-17 | -19.857 | -16.775 | 8.274E-04 | -3.082 |
| 4 Siderite | 1.031E-11 | 1.559E-11 | -10.987 | -10.807 | 6.612E-01 | -0.180 |
| 5 Rhodochr | 8.491E-13 | 8.275E-12 | -12.071 | -11.082 | 1.026E-01 | -0.989 |
| 8 Gypsum | 4.340E-07 | 2.581E-05 | -6.363 | -4.588 | 1.682E-02 | -1.774 |
| 9 Anhydrit | 4.341E-07 | 4.630E-05 | -6.362 | -4.334 | 9.376E-03 | -2.028 |
| 13 Fluorite | 3.581E-13 | 1.708E-11 | -12.446 | -10.768 | 2.097E-02 | -1.678 |
| 14 SiO2 (a) | 4.803E-04 | 1.501E-03 | -3.318 | -2.824 | 3.199E-01 | -0.495 |
| 15 Chalcedy | 4.803E-04 | 1.954E-04 | -3.318 | -3.709 | 2.458E+00 | 0.391 |
| 16 Quartz | 4.803E-04 | 6.598E-05 | -3.318 | -4.181 | 7.279E+00 | 0.862 |
| 26 Talc | 2.182E+15 | 8.871E+22 | 15.339 | 22.948 | 2.459E-08 | -7.609 |
| 28 Chrysotl | 9.456E+21 | 7.642E+33 | 21.976 | 33.883 | 1.237E-12 | -11.907 |
| 29 Sepiol c | 1.317E+09 | 1.311E+16 | 9.120 | 16.118 | 1.004E-07 | -6.998 |
| 30 Sepiol d | 1.317E+09 | 4.571E+18 | 9.120 | 18.660 | 2.881E-10 | -9.540 |
| 31 Hematite | 1.839E+03 | 1.054E-03 | 3.265 | -2.977 | 1.745E+06 | 6.242 |
| 32 Goethite | 4.288E+01 | 3.282E-02 | 1.632 | -1.484 | 1.307E+03 | 3.116 |
| 33 Fe(OH)3a | 4.288E+01 | 7.780E+04 | 1.632 | 4.891 | 5.511E-04 | -3.259 |
| 38 Pyrolusi | 1.957E+20 | 3.596E+43 | 20.292 | 43.556 | 5.441E-24 | -23.264 |
| 39 Hausmani | 1.883E+35 | 2.473E+64 | 35.275 | 64.393 | 7.614E-30 | -29.118 |
| 40 Manganit | 7.790E+13 | 2.188E+25 | 13.892 | 25.340 | 3.561E-12 | -11.448 |
| 41 Pyrochro | 3.101E+07 | 1.585E+15 | 7.492 | 15.200 | 1.957E-08 | -7.708 |
| 42 PCO2 | 2.214E-03 | 5.028E-02 | -2.655 | -1.299 | 4.404E-02 | -1.356 |
| 44 H2 gas | 1.285E-16 | 8.106E-04 | -15.891 | -3.091 | 1.585E-13 | -12.800 |
| 49 Melanter | 3.036E-08 | 4.161E-03 | -7.518 | -2.381 | 7.295E-06 | -5.137 |
| 51 K-Jarosi | 8.736E-26 | 6.844E-09 | -25.059 | -8.165 | 1.276E-17 | -16.894 |

PALOUSE BASIN: GRANDE RONDE SAMPLES

**30. COM6**

INITIAL SOLUTION

TEMPERATURE = 19.60 DEGREES C PH = 7.900
ANALYTICAL EPMCAT = 4.384 ANALYTICAL EPMAN = 3.878

***** OXIDATION - REDUCTION *****

DISSOLVED OXYGEN = 0.000 MMOLES/KG H2O
EH MEASURED WITH CALOMEL = 9.9000 VOLTS FLAG CORALK PECALC IDAVES
MEASURED EH OF ZOBELL SOLUTION = 9.9000 VOLTS 2 0 1 0
CORRECTED EH = 0.0000 VOLTS
PE COMPUTED FROM CORRECTED EH = 0.000

*** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

| SPECIES | | TOTAL MOLALITY | LOG TOTAL MOLALITY | TOTAL MG/LITRE |
|---|---|---|---|---|
| Ca+2 | 2.0 | 5.65318E-04 | -3.2477 | 2.26500E+01 |
| Mg+2 | 2.0 | 1.78575E-04 | -3.7482 | 4.34000E+00 |
| Na+ | 1.0 | 2.77612E-03 | -2.5566 | 6.38000E+01 |
| K+ | 1.0 | 1.18194E-04 | -3.9274 | 4.62000E+00 |
| Mn+2 | 2.0 | 1.45670E-07 | -6.8366 | 8.00000E-03 |
| H4SiO4 | 0.0 | 4.10564E-04 | -3.3866 | 2.46600E+01 |

| | | | | |
|---|---|---|---|---|
| Cl- | -1.0 | 7.87233E-05 | -4.1039 | 2.79000E+00 |
| HCO3- | -1.0 | 3.61155E-03 | -2.4423 | 2.20290E+02 |
| SO4-2 | -2.0 | 5.62336E-05 | -4.2500 | 5.40000E+00 |
| NO3- | -1.0 | 7.14194E-06 | -5.1462 | 1.00000E-01 |
| H3BO3 | 0.0 | 7.40315E-06 | -5.1306 | 8.00000E-02 |
| F- | -1.0 | 6.58180E-05 | -4.1817 | 1.25000E+00 |

****DESCRIPTION OF SOLUTION ****

| | ANALYT. | COMP. | PH | ACTIVITY H2O = 0.9999 |
|---|---|---|---|---|
| EPMCAT | 4.38 | 4.33 | 7.900 | PCO2= 2.530815E-03 |
| EPMAN | 3.88 | 3.82 | | LOG PCO2 = -2.5967 |
| | | | TEMPERATURE | PO2 = 4.098816E-54 |
| EH = 0.0000 | PE = 0.000 | | 19.60 DEG C | PCH4 = 8.602362E-43 |
| PE CALC S = | 0.000 | | | CO2 TOT = 3.683719E-03 |
| PE CALC DOX= | 0.000 | | IONIC STRENGTH | DENSITY = 1.0000 |
| PE SATO DOX= | 0.000 | | 4.852773E-03 | TDS = 350.0MG/L |
| TOT ALK = | 3.612E+00 MEQ | | | CARB ALK = 3.606E+00 MEQ |
| ELECT = | 5.067E-01 MEQ | | | CHARGE IMBALANCE = 6.2% |

IN COMPUTING THE DISTRIBUTION OF SPECIES,
PE = 0.000 EQUIVALENT EH = 0.000VOLTS

DISTRIBUTION OF SPECIES

| I | SPECIES | | MOLALITY | ACTIVITY | LOG ACT | GAMMA |
|---|---|---|---|---|---|---|
| 1 | H+ | 1. | 1.3467E-08 | 1.2589E-08 | -7.900 | 9.3485E-01 |
| 2 | E- | -1. | 1.0000E+00 | 1.0000E+00 | 0.000 | 1.0000E+00 |
| 4 | Ca+2 | 2. | 5.3889E-04 | 4.0334E-04 | -3.394 | 7.4846E-01 |
| 5 | Mg+2 | 2. | 1.7062E-04 | 1.2813E-04 | -3.892 | 7.5097E-01 |
| 6 | Na+ | 1. | 2.7704E-03 | 2.5738E-03 | -2.589 | 9.2906E-01 |
| 7 | K+ | 1. | 1.1816E-04 | 1.0962E-04 | -3.960 | 9.2771E-01 |
| 9 | Mn+2 | 2. | 7.6999E-08 | 5.7862E-08 | -7.238 | 7.5147E-01 |
| 13 | H4SiO4 | 0. | 4.0634E-04 | 4.0679E-04 | -3.391 | 1.0011E+00 |
| 14 | Cl- | -1. | 7.8723E-05 | 7.3032E-05 | -4.136 | 9.2771E-01 |
| 15 | CO3-2 | -2. | 1.4552E-05 | 1.0897E-05 | -4.963 | 7.4885E-01 |
| 16 | SO4-2 | -2. | 5.1730E-05 | 3.8629E-05 | -4.413 | 7.4674E-01 |
| 17 | NO3- | -1. | 3.1051E-19 | 2.8779E-19 | -18.541 | 9.2680E-01 |
| 18 | H3BO3 | 0. | 7.0870E-06 | 7.0950E-06 | -5.149 | 1.0011E+00 |
| 20 | F- | -1. | 6.5029E-05 | 6.0318E-05 | -4.220 | 9.2755E-01 |
| 31 | OH- | -1. | 5.6304E-07 | 5.2225E-07 | -6.282 | 9.2755E-01 |
| 33 | H2 AQ | 0. | 1.1839E-19 | 1.1852E-19 | -18.926 | 1.0011E+00 |
| 34 | HCO3- | -1. | 3.5340E-03 | 3.2875E-03 | -2.483 | 9.3025E-01 |
| 35 | H2CO3 | 0. | 1.0023E-04 | 1.0034E-04 | -3.999 | 1.0011E+00 |
| 40 | HSO4- | -1. | 4.5384E-11 | 4.2137E-11 | -10.375 | 9.2846E-01 |
| 48 | NO2- | -1. | 7.1419E-06 | 6.6192E-06 | -5.179 | 9.2680E-01 |
| 57 | H2BO3- | -1. | 3.1593E-07 | 2.9333E-07 | -6.533 | 9.2846E-01 |
| 58 | BFOH3- | -1. | 1.7323E-10 | 1.6084E-10 | -9.794 | 9.2846E-01 |
| 59 | BF2OH2- | -1. | 1.4199E-14 | 1.3183E-14 | -13.880 | 9.2846E-01 |
| 60 | BF3OH- | -1. | 1.3076E-20 | 1.2140E-20 | -19.916 | 9.2846E-01 |
| 61 | BF4- | -1. | 4.0748E-26 | 3.7832E-26 | -25.422 | 9.2846E-01 |
| 69 | HF AQ | 0. | 1.0333E-09 | 1.0345E-09 | -8.985 | 1.0011E+00 |
| 70 | HF2- | -1. | 2.4638E-13 | 2.2875E-13 | -12.641 | 9.2846E-01 |
| 75 | CaOH+ | 1. | 5.7260E-09 | 5.3163E-09 | -8.274 | 9.2846E-01 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 76 | CaCO3 | 0. | 6.6903E-06 | 6.6978E-06 | -5.174 | 1.0011E+00 |
| 77 | CaHCO3+ | 1. | 1.6579E-05 | 1.5423E-05 | -4.812 | 9.3025E-01 |
| 78 | CaSO4 | 0. | 2.9498E-06 | 2.9531E-06 | -5.530 | 1.0011E+00 |
| 79 | CaHSO4 | 1. | 2.4707E-13 | 2.2939E-13 | -12.639 | 9.2846E-01 |
| 83 | CaF+ | 1. | 2.0075E-07 | 1.8638E-07 | -6.730 | 9.2846E-01 |
| 85 | MgOH+ | 1. | 2.4492E-08 | 2.2740E-08 | -7.643 | 9.2846E-01 |
| 86 | MgCO3 | 0. | 1.2250E-06 | 1.2263E-06 | -5.911 | 1.0011E+00 |
| 87 | MgHCO3+ | 1. | 5.1986E-06 | 4.8266E-06 | -5.316 | 9.2846E-01 |
| 88 | MgSO4 | 0. | 1.0059E-06 | 1.0071E-06 | -5.997 | 1.0011E+00 |
| 92 | MgF+ | 1. | 4.9782E-07 | 4.6221E-07 | -6.335 | 9.2846E-01 |
| 93 | NaOH | 0. | 1.3491E-09 | 1.3506E-09 | -8.869 | 1.0011E+00 |
| 94 | NaCO3- | -1. | 4.2624E-07 | 3.9574E-07 | -6.403 | 9.2846E-01 |
| 95 | NaHCO3 | 0. | 4.7266E-06 | 4.7318E-06 | -5.325 | 1.0011E+00 |
| 96 | NaSO4- | -1. | 5.1831E-07 | 4.8123E-07 | -6.318 | 9.2846E-01 |
| 98 | NaF aq | 0. | 8.9235E-08 | 8.9335E-08 | -7.049 | 1.0011E+00 |
| 99 | KOH | 0. | 3.0155E-11 | 3.0188E-11 | -10.520 | 1.0011E+00 |
| 100 | KSO4- | -1. | 2.9115E-08 | 2.7032E-08 | -7.568 | 9.2846E-01 |
| 134 | MnOH+ | 1. | 8.1260E-11 | 7.5446E-11 | -10.122 | 9.2846E-01 |
| 136 | MnCl+ | 1. | 1.8542E-11 | 1.7215E-11 | -10.764 | 9.2846E-01 |
| 137 | MnCl2 | 0. | 5.4820E-16 | 5.4881E-16 | -15.261 | 1.0011E+00 |
| 138 | MnCl3- | -1. | 1.1890E-20 | 1.1039E-20 | -19.957 | 9.2846E-01 |
| 139 | MnCO3 | 0. | 5.0028E-08 | 5.0084E-08 | -7.300 | 1.0011E+00 |
| 140 | MnHCO3+ | 1. | 1.8159E-08 | 1.6860E-08 | -7.773 | 9.2846E-01 |
| 141 | MnSO4 | 0. | 3.5749E-10 | 3.5789E-10 | -9.446 | 1.0011E+00 |
| 143 | MnF+ | 1. | 2.6006E-11 | 2.4146E-11 | -10.617 | 9.2846E-01 |
| 144 | Mn+3 | 3. | 1.5621E-33 | 8.0086E-34 | -33.096 | 5.1268E-01 |
| 164 | H3SiO4- | -1. | 4.2243E-06 | 3.9220E-06 | -5.406 | 9.2846E-01 |
| 165 | H2SiO4-2 | -2. | 1.9834E-11 | 1.4739E-11 | -10.832 | 7.4309E-01 |
| 166 | SiF6-2 | -2. | 1.6637E-30 | 1.2363E-30 | -29.908 | 7.4309E-01 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 4.395E-09 | 3.537E-09 | -8.357 | -8.451 | 1.242E+00 | 0.094 |
| 2 | Aragonit | 4.395E-09 | 4.971E-09 | -8.357 | -8.304 | 8.842E-01 | -0.053 |
| 3 | Dolomite | 6.137E-18 | 1.090E-17 | -17.212 | -16.962 | 5.628E-01 | -0.250 |
| 5 | Rhodochr | 6.305E-13 | 7.751E-12 | -12.200 | -11.111 | 8.135E-02 | -1.090 |
| 8 | Gypsum | 1.558E-08 | 2.623E-05 | -7.808 | -4.581 | 5.939E-04 | -3.226 |
| 9 | Anhydrit | 1.558E-08 | 4.541E-05 | -7.807 | -4.343 | 3.431E-04 | -3.465 |
| 13 | Fluorite | 1.467E-12 | 2.163E-11 | -11.833 | -10.665 | 6.785E-02 | -1.168 |
| 14 | SiO2 (a) | 4.069E-04 | 1.750E-03 | -3.391 | -2.757 | 2.325E-01 | -0.633 |
| 15 | Chalcedy | 4.069E-04 | 2.426E-04 | -3.391 | -3.615 | 1.678E+00 | 0.225 |
| 16 | Quartz | 4.069E-04 | 8.682E-05 | -3.391 | -4.061 | 4.687E+00 | 0.671 |
| 26 | Talc | 1.448E+22 | 1.061E+22 | 22.161 | 22.026 | 1.365E+00 | 0.135 |
| 28 | Chrysotl | 8.743E+28 | 7.626E+32 | 28.942 | 32.882 | 1.147E-04 | -3.941 |
| 29 | Sepiol c | 4.400E+13 | 8.029E+15 | 13.643 | 15.905 | 5.480E-03 | -2.261 |
| 30 | Sepiol d | 4.400E+13 | 4.571E+18 | 13.643 | 18.660 | 9.627E-06 | -5.017 |
| 38 | Pyrolusi | 2.303E+24 | 1.821E+42 | 24.362 | 42.260 | 1.265E-18 | -17.898 |
| 39 | Hausmani | 3.069E+41 | 2.459E+62 | 41.487 | 62.391 | 1.248E-21 | -20.904 |
| 40 | Manganit | 2.899E+16 | 2.188E+25 | 16.462 | 25.340 | 1.325E-09 | -8.878 |
| 41 | Pyrochro | 3.650E+08 | 1.585E+15 | 8.562 | 15.200 | 2.303E-07 | -6.638 |
| 42 | PCO2 | 1.003E-04 | 3.965E-02 | -3.999 | -1.402 | 2.531E-03 | -2.597 |
| 44 | H2 gas | 1.185E-19 | 7.478E-04 | -18.926 | -3.126 | 1.585E-16 | -15.800 |

**31. COM9**

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INITIAL SOLUTION

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        TEMPERATURE =  19.10 DEGREES C    PH =  7.800
        ANALYTICAL EPMCAT =    3.096    ANALYTICAL EPMAN =    2.597

    ***** OXIDATION - REDUCTION *****

 DISSOLVED OXYGEN =  0.000 MMOLES/KG H2O
 EH MEASURED WITH CALOMEL =  9.9000 VOLTS         FLAG CORALK PECALC
IDAVES
 MEASURED EH OF ZOBELL SOLUTION =  9.9000 VOLTS     2    0      1      0
 CORRECTED EH =  0.0000 VOLTS
 PE COMPUTED FROM CORRECTED EH =   0.000

             *** TOTAL CONCENTRATIONS OF INPUT SPECIES ***

                      TOTAL             LOG TOTAL            TOTAL
       SPECIES        MOLALITY          MOLALITY           MG/LITRE
       -------        --------          --------           --------

       Ca+2      2.0  5.61518E-04          -3.2506         2.25000E+01
       Mg+2      2.0  4.77251E-04          -3.3213         1.16000E+01
       Na+       1.0  8.39714E-04          -3.0759         1.93000E+01
       K+        1.0  1.43251E-04          -3.8439         5.60000E+00
       Fe+2      2.0  1.59404E-05          -4.7975         8.90000E-01
       Mn+2      2.0  1.27448E-06          -5.8947         7.00000E-02
       H4SiO4    0.0  6.02633E-04          -3.2199         3.62000E+01
       Cl-      -1.0  5.64269E-05          -4.2485         2.00000E+00
       HCO3-    -1.0  2.47533E-03          -2.6064         1.51000E+02
       SO4-2    -2.0  1.97840E-05          -4.7037         1.90000E+00
       F-       -1.0  2.42187E-05          -4.6158         4.60000E-01

                    ****DESCRIPTION OF SOLUTION ****

         ANALYT.   COMP.         PH           ACTIVITY H2O =  0.9999
 EPMCAT     3.10      3.05       7.800        PCO2=  2.177905E-03
 EPMAN      2.60      2.55                    LOG PCO2 =  -2.6620
                              TEMPERATURE     PO2 =  1.087636E-54
 EH = 0.0000  PE =   0.000     19.10 DEG C    PCH4 =  5.568029E-42
 PE CALC S =    0.000                        CO2 TOT =  2.542555E-03
 PE CALC DOX=  0.000         IONIC STRENGTH  DENSITY =   1.0000
 PE SATO DOX=  0.000          3.848000E-03   TDS =     251.5MG/L
 TOT ALK =  2.475E+00 MEQ                    CARB ALK =  2.470E+00 MEQ
 ELECT   =  4.994E-01 MEQ                    CHARGE IMBALANCE =    8.9%

 IN COMPUTING THE DISTRIBUTION OF SPECIES,
 PE =   0.000     EQUIVALENT EH =  0.000VOLTS

                      ----------------------
                      DISTRIBUTION OF SPECIES
                      ----------------------

  I  SPECIES         MOLALITY   ACTIVITY    LOG ACT    GAMMA

   1 H+       1.    1.6847E-08  1.5849E-08  -7.800  9.4074E-01
   2 E-      -1.    1.0000E+00  1.0000E+00   0.000  1.0000E+00
   4 Ca+2     2.    5.4495E-04  4.1980E-04  -3.377  7.7033E-01
   5 Mg+2     2.    4.6397E-04  3.5838E-04  -3.446  7.7242E-01
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| | | | | | | |
|---|---|---|---|---|---|---|
| 6 | Na+ | 1. | 8.3859E-04 | 7.8490E-04 | -3.105 | 9.3597E-01 |
| 7 | K+ | 1. | 1.4324E-04 | 1.3391E-04 | -3.873 | 9.3488E-01 |
| 8 | Fe+2 | 2. | 1.2176E-05 | 9.4108E-06 | -5.026 | 7.7287E-01 |
| 9 | Mn+2 | 2. | 8.3327E-07 | 6.4401E-07 | -6.191 | 7.7287E-01 |
| 13 | H4SiO4 | 0. | 5.9783E-04 | 5.9836E-04 | -3.223 | 1.0009E+00 |
| 14 | Cl- | -1. | 5.6426E-05 | 5.2752E-05 | -4.278 | 9.3488E-01 |
| 15 | CO3-2 | -2. | 7.6412E-06 | 5.8890E-06 | -5.230 | 7.7069E-01 |
| 16 | SO4-2 | -2. | 1.7646E-05 | 1.3569E-05 | -4.867 | 7.6894E-01 |
| 20 | F- | -1. | 2.3630E-05 | 2.2088E-05 | -4.656 | 9.3476E-01 |
| 31 | OH- | -1. | 4.2634E-07 | 3.9853E-07 | -6.400 | 9.3476E-01 |
| 33 | H2 AQ | 0. | 1.8864E-19 | 1.8881E-19 | -18.724 | 1.0009E+00 |
| 34 | HCO3- | -1. | 2.4151E-03 | 2.2628E-03 | -2.645 | 9.3696E-01 |
| 35 | H2CO3 | 0. | 8.7558E-05 | 8.7636E-05 | -4.057 | 1.0009E+00 |
| 40 | HSO4- | -1. | 1.9713E-11 | 1.8441E-11 | -10.734 | 9.3548E-01 |
| 69 | HF AQ | 0. | 4.7231E-10 | 4.7273E-10 | -9.325 | 1.0009E+00 |
| 70 | HF2- | -1. | 4.0733E-14 | 3.8105E-14 | -13.419 | 9.3548E-01 |
| 75 | CaOH+ | 1. | 4.6986E-09 | 4.3954E-09 | -8.357 | 9.3548E-01 |
| 76 | CaCO3 | 0. | 3.7347E-06 | 3.7380E-06 | -5.427 | 1.0009E+00 |
| 77 | CaHCO3+ | 1. | 1.1679E-05 | 1.0942E-05 | -4.961 | 9.3696E-01 |
| 78 | CaSO4 | 0. | 1.0734E-06 | 1.0744E-06 | -5.969 | 1.0009E+00 |
| 79 | CaHSO4 | 1. | 1.1286E-13 | 1.0558E-13 | -12.976 | 9.3548E-01 |
| 83 | CaF+ | 1. | 7.5023E-08 | 7.0182E-08 | -7.154 | 9.3548E-01 |
| 85 | MgOH+ | 1. | 5.1587E-08 | 4.8258E-08 | -7.316 | 9.3548E-01 |
| 86 | MgCO3 | 0. | 1.8378E-06 | 1.8395E-06 | -5.735 | 1.0009E+00 |
| 87 | MgHCO3+ | 1. | 9.9170E-06 | 9.2771E-06 | -5.033 | 9.3548E-01 |
| 88 | MgSO4 | 0. | 9.7537E-07 | 9.7623E-07 | -6.010 | 1.0009E+00 |
| 92 | MgF+ | 1. | 5.0132E-07 | 4.6897E-07 | -6.329 | 9.3548E-01 |
| 93 | NaOH | 0. | 3.2688E-10 | 3.2717E-10 | -9.485 | 1.0009E+00 |
| 94 | NaCO3- | -1. | 6.7915E-08 | 6.3533E-08 | -7.197 | 9.3548E-01 |
| 95 | NaHCO3 | 0. | 9.9121E-07 | 9.9208E-07 | -6.003 | 1.0009E+00 |
| 96 | NaSO4- | -1. | 5.4922E-08 | 5.1378E-08 | -7.289 | 9.3548E-01 |
| 98 | NaF aq | 0. | 9.9675E-09 | 9.9763E-09 | -8.001 | 1.0009E+00 |
| 99 | KOH | 0. | 2.9268E-11 | 2.9294E-11 | -10.533 | 1.0009E+00 |
| 100 | KSO4- | -1. | 1.2287E-08 | 1.1494E-08 | -7.940 | 9.3548E-01 |
| 102 | FeOH+ | 1. | 1.2800E-07 | 1.1974E-07 | -6.922 | 9.3548E-01 |
| 105 | FeCl+ | 1. | 7.3254E-10 | 6.8527E-10 | -9.164 | 9.3548E-01 |
| 106 | FeCO3 | 0. | 1.3283E-06 | 1.3294E-06 | -5.876 | 1.0009E+00 |
| 107 | FeHCO3+ | 1. | 2.2611E-06 | 2.1152E-06 | -5.675 | 9.3548E-01 |
| 108 | FeSO4 | 0. | 2.0323E-08 | 2.0341E-08 | -7.692 | 1.0009E+00 |
| 109 | FeHSO4+ | 1. | 2.5301E-15 | 2.3668E-15 | -14.626 | 9.3548E-01 |
| 114 | FeF+ | 1. | 2.2220E-09 | 2.0786E-09 | -8.682 | 9.3548E-01 |
| 115 | Fe+3 | 3. | 1.1198E-18 | 6.4622E-19 | -18.190 | 5.7707E-01 |
| 117 | FeOH+2 | 2. | 2.4116E-13 | 1.8469E-13 | -12.734 | 7.6582E-01 |
| 118 | FeOH2+ | 1. | 3.2826E-09 | 3.0708E-09 | -8.513 | 9.3548E-01 |
| 119 | FeOH3 | 0. | 1.9182E-08 | 1.9199E-08 | -7.717 | 1.0009E+00 |
| 120 | FeOH4- | -1. | 9.2711E-10 | 8.6729E-10 | -9.062 | 9.3548E-01 |
| 121 | Fe2OH2+4 | 4. | 3.4229E-24 | 1.1774E-24 | -23.929 | 3.4397E-01 |
| 122 | Fe3OH4+5 | 5. | 6.9753E-30 | 1.3163E-30 | -29.881 | 1.8872E-01 |
| 123 | FeCl+2 | 2. | 1.1108E-21 | 8.5064E-22 | -21.070 | 7.6582E-01 |
| 124 | FeCl2+ | 1. | 2.5931E-25 | 2.4258E-25 | -24.615 | 9.3548E-01 |
| 125 | FeCl3 | 0. | 1.2785E-30 | 1.2797E-30 | -29.893 | 1.0009E+00 |
| 126 | FeSO4+ | 1. | 8.9956E-20 | 8.4151E-20 | -19.075 | 9.3548E-01 |
| 127 | FeHSO4+2 | 2. | 7.4137E-27 | 5.6776E-27 | -26.246 | 7.6582E-01 |
| 128 | FeSO42- | -1. | 2.6083E-23 | 2.4400E-23 | -22.613 | 9.3548E-01 |
| 131 | FeF+2 | 2. | 2.6943E-17 | 2.0634E-17 | -16.685 | 7.6582E-01 |
| 132 | FeF2+ | 1. | 1.8056E-17 | 1.6891E-17 | -16.772 | 9.3548E-01 |
| 133 | FeF3 | 0. | 5.7883E-19 | 5.7934E-19 | -18.237 | 1.0009E+00 |

| | | | | | | |
|---|---|---|---|---|---|---|
| 134 | MnOH+ | 1. | 6.8348E-10 | 6.3938E-10 | -9.194 | 9.3548E-01 |
| 136 | MnCl+ | 1. | 1.4794E-10 | 1.3840E-10 | -9.859 | 9.3548E-01 |
| 137 | MnCl2 | 0. | 3.1841E-15 | 3.1869E-15 | -14.497 | 1.0009E+00 |
| 138 | MnCl3- | -1. | 4.9496E-20 | 4.6303E-20 | -19.334 | 9.3548E-01 |
| 139 | MnCO3 | 0. | 3.0099E-07 | 3.0125E-07 | -6.521 | 1.0009E+00 |
| 140 | MnHCO3+ | 1. | 1.3791E-07 | 1.2901E-07 | -6.889 | 9.3548E-01 |
| 141 | MnSO4 | 0. | 1.3841E-09 | 1.3854E-09 | -8.858 | 1.0009E+00 |
| 143 | MnF+ | 1. | 1.0520E-10 | 9.8412E-11 | -10.007 | 9.3548E-01 |
| 144 | Mn+3 | 3. | 1.5059E-32 | 8.2623E-33 | -32.083 | 5.4864E-01 |
| 164 | H3SiO4- | -1. | 4.8077E-06 | 4.4975E-06 | -5.347 | 9.3548E-01 |
| 165 | H2SiO4-2 | -2. | 1.6930E-11 | 1.2966E-11 | -10.887 | 7.6582E-01 |
| 166 | SiF6-2 | -2. | 1.5085E-32 | 1.1552E-32 | -31.937 | 7.6582E-01 |

| | PHASE | IAP | KT | LOG IAP | LOG KT | IAP/KT | LOG IAP/KT |
|---|---|---|---|---|---|---|---|
| 1 | Calcite | 2.472E-09 | 3.557E-09 | -8.607 | -8.449 | 6.950E-01 | -0.158 |
| 2 | Aragonit | 2.472E-09 | 5.003E-09 | -8.607 | -8.301 | 4.941E-01 | -0.306 |
| 3 | Dolomite | 5.217E-18 | 1.121E-17 | -17.283 | -16.950 | 4.654E-01 | -0.332 |
| 4 | Siderite | 5.542E-11 | 1.402E-11 | -10.256 | -10.853 | 3.953E+00 | 0.597 |
| 5 | Rhodochr | 3.793E-12 | 7.783E-12 | -11.421 | -11.109 | 4.873E-01 | -0.312 |
| 8 | Gypsum | 5.695E-09 | 2.621E-05 | -8.244 | -4.581 | 2.173E-04 | -3.663 |
| 9 | Anhydrit | 5.696E-09 | 4.553E-05 | -8.244 | -4.342 | 1.251E-04 | -3.903 |
| 13 | Fluorite | 2.048E-13 | 2.131E-11 | -12.689 | -10.671 | 9.610E-03 | -2.017 |
| 14 | SiO2 (a) | 5.985E-04 | 1.733E-03 | -3.223 | -2.761 | 3.454E-01 | -0.462 |
| 15 | Chalcedy | 5.985E-04 | 2.392E-04 | -3.223 | -3.621 | 2.502E+00 | 0.398 |
| 16 | Quartz | 5.985E-04 | 8.530E-05 | -3.223 | -4.069 | 7.016E+00 | 0.846 |
| 26 | Talc | 3.724E+23 | 1.216E+22 | 23.571 | 22.085 | 3.063E+01 | 1.486 |
| 28 | Chrysotl | 1.040E+30 | 8.843E+32 | 30.017 | 32.947 | 1.176E-03 | -2.930 |
| 29 | Sepiol c | 4.361E+14 | 8.286E+15 | 14.640 | 15.918 | 5.263E-02 | -1.279 |
| 30 | Sepiol d | 4.361E+14 | 4.571E+18 | 14.640 | 18.660 | 9.541E-05 | -4.020 |
| 31 | Hematite | 2.634E+10 | 2.808E-04 | 10.421 | -3.552 | 9.380E+13 | 13.972 |
| 32 | Goethite | 1.623E+05 | 6.106E-02 | 5.210 | -1.214 | 2.658E+06 | 6.425 |
| 33 | Fe(OH)3a | 1.623E+05 | 7.780E+04 | 5.210 | 4.891 | 2.086E+00 | 0.319 |
| 38 | Pyrolusi | 1.021E+25 | 2.206E+42 | 25.009 | 42.344 | 4.627E-18 | -17.335 |
| 39 | Hausmani | 6.707E+43 | 3.306E+62 | 43.827 | 62.519 | 2.029E-19 | -18.693 |
| 40 | Manganit | 1.617E+17 | 2.188E+25 | 17.209 | 25.340 | 7.393E-09 | -8.131 |
| 41 | Pyrochro | 2.563E+09 | 1.585E+15 | 9.409 | 15.200 | 1.617E-06 | -5.791 |
| 42 | PCO2 | 8.764E-05 | 4.024E-02 | -4.057 | -1.395 | 2.178E-03 | -2.662 |
| 44 | H2 gas | 1.888E-19 | 7.517E-04 | -18.724 | -3.124 | 2.512E-16 | -15.600 |
| 49 | Melanter | 1.276E-10 | 5.207E-03 | -9.894 | -2.283 | 2.451E-08 | -7.611 |
| 51 | K-Jarosi | 4.196E-22 | 1.790E-09 | -21.377 | -8.747 | 2.344E-13 | -12.630 |

# APPENDIX IV:

# NETPATH MODELING RESULTS OF UI5 AS INITIAL WATER

**1.) Initial Well : UI5**
**Final Well : UI3**

| | Final | Initial |
|---|---|---|
| C | 2.7512 | 4.1582 |
| FE | 0.0163 | 0.0006 |
| MG | 0.5007 | 0.8208 |
| CA | 0.6093 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.6034 | 0.3892 |
| NA | 0.7159 | 0.5238 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI 1.9000 |
| | RS | 1.4000 | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | |

36 models checked
8 models found
(Ignoring 1 dissolution/precipitation constraints)

| MODEL 1 | | |
|---|---|---|
| AUGITE | + | 1.71651 |
| CHLORITE | + | 0.07832 |
| Ca-MONT | - | 4.08427 (Constraint ignored) |
| GOETHITE | - | -0.66466 |
| MONT-MAF | - | -5.21251 |
| CALCITE | | -1.40702 |
| PLAGAN30 | + | 0.27430 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.1768 | -15.9000 |
| C-14 (% mod) | 104.1044* | 8.4100 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 20799.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.94 | 8.41 | 17148. |
| Mass Balance | 60.73 | 60.67 | 8.41 | 16335. |
| Vogel | 85.00 | 84.92 | 8.41 | 19115. |
| Tamers | 55.86 | 55.80 | 8.41 | 15644. |
| Ingerson and Pearson | 68.26 | 68.19 | 8.41 | 17302. |
| Mook | 104.21 | 104.10 | 8.41 | 20799. |

```
Fontes and Garnier       76.41     76.33      8.41    18234.
Eichinger                66.44     66.38      8.41    17079.
User-defined            100.00     99.90      8.41    20458.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1768

           MODEL   2
 AUGITE    +          1.73134
 CHLORITE  +         -0.34105      (Constraint ignored)
 Ca-MONT   -         -0.00891
 GOETHITE  -         -1.19630
 CALCITE             -1.40702
 SiO2      -         -2.77375
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.94      8.41    17148.
Mass Balance             60.73     60.67      8.41    16335.
Vogel                    85.00     84.92      8.41    19115.
Tamers                   55.86     55.80      8.41    15644.
Ingerson and Pearson     68.26     68.19      8.41    17302.
Mook                    104.21    104.10      8.41    20799.
Fontes and Garnier       76.41     76.33      8.41    18234.
Eichinger                66.44     66.38      8.41    17079.
User-defined            100.00     99.90      8.41    20458.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1768

           MODEL   3
 AUGITE    +          1.71651
 CHLORITE  +          0.07832
 Ca-MONT   -          4.08427      (Constraint ignored)
 PYRITE    -         -0.66466
 MONT-MAF  -         -5.21251
 CALCITE             -1.40702
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook
```

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.94 | 8.41 | 17148. |
| Mass Balance | 60.73 | 60.67 | 8.41 | 16335. |
| Vogel | 85.00 | 84.92 | 8.41 | 19115. |
| Tamers | 55.86 | 55.80 | 8.41 | 15644. |
| Ingerson and Pearson | 68.26 | 68.19 | 8.41 | 17302. |
| Mook | 104.21 | 104.10 | 8.41 | 20799. |
| Fontes and Garnier | 76.41 | 76.33 | 8.41 | 18234. |
| Eichinger | 66.44 | 66.38 | 8.41 | 17079. |
| User-defined | 100.00 | 99.90 | 8.41 | 20458. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.1768

| | MODEL 4 | | |
|---|---|---|---|
| AUGITE | + | 1.73134 | |
| CHLORITE | + | -0.34105 | (Constraint ignored) |
| Ca-MONT | - | -0.00891 | |
| PYRITE | - | -1.19630 | |
| CALCITE | | -1.40702 | |
| SiO2 | - | -2.77375 | |
| PLAGAN30 | + | 0.27430 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.1768 | -15.9000 |
| C-14 (% mod) | 104.1044* | 8.4100 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 20799.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.94 | 8.41 | 17148. |
| Mass Balance | 60.73 | 60.67 | 8.41 | 16335. |
| Vogel | 85.00 | 84.92 | 8.41 | 19115. |
| Tamers | 55.86 | 55.80 | 8.41 | 15644. |
| Ingerson and Pearson | 68.26 | 68.19 | 8.41 | 17302. |
| Mook | 104.21 | 104.10 | 8.41 | 20799. |
| Fontes and Garnier | 76.41 | 76.33 | 8.41 | 18234. |
| Eichinger | 66.44 | 66.38 | 8.41 | 17079. |
| User-defined | 100.00 | 99.90 | 8.41 | 20458. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.1768

| | MODEL 5 | | |
|---|---|---|---|
| AUGITE | + | 1.73131 | |
| CHLORITE | + | -0.34014 | (Constraint ignored) |
| GOETHITE | - | -1.19514 | |
| MONT-MAF | - | -0.01134 | |
| CALCITE | | -1.40702 | |
| SiO2 | - | -2.76772 | |

```
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-----------------------------------------------------------------
Original Data            67.00     66.94      8.41    17148.
Mass Balance             60.73     60.67      8.41    16335.
Vogel                    85.00     84.92      8.41    19115.
Tamers                   55.86     55.80      8.41    15644.
Ingerson and Pearson     68.26     68.19      8.41    17302.
Mook                    104.21    104.10      8.41    20799.
Fontes and Garnier       76.41     76.33      8.41    18234.
Eichinger                66.44     66.38      8.41    17079.
User-defined            100.00     99.90      8.41    20458.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1768

           MODEL   6
 AUGITE    +          1.73131
 CHLORITE  +         -0.34014      (Constraint ignored)
 PYRITE    -         -1.19514
 MONT-MAF  -         -0.01134
 CALCITE             -1.40702
 SiO2      -         -2.76772
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-----------------------------------------------------------------
Original Data            67.00     66.94      8.41    17148.
Mass Balance             60.73     60.67      8.41    16335.
Vogel                    85.00     84.92      8.41    19115.
Tamers                   55.86     55.80      8.41    15644.
Ingerson and Pearson     68.26     68.19      8.41    17302.
Mook                    104.21    104.10      8.41    20799.
Fontes and Garnier       76.41     76.33      8.41    18234.
Eichinger                66.44     66.38      8.41    17079.
User-defined            100.00     99.90      8.41    20458.

Data used for Carbon-13
```

```
Initial Value:    -15.7000        Modeled Final Value:    -16.1768

           MODEL   7
 AUGITE    +          1.71928
 Ca-MONT   -          3.31982      (Constraint ignored)
 GOETHITE  -         -0.76395
 MONT-MAF  -         -4.23901
 CALCITE             -1.40702
 SiO2      -         -0.51803
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.94      8.41    17148.
Mass Balance             60.73     60.67      8.41    16335.
Vogel                    85.00     84.92      8.41    19115.
Tamers                   55.86     55.80      8.41    15644.
Ingerson and Pearson     68.26     68.19      8.41    17302.
Mook                    104.21    104.10      8.41    20799.
Fontes and Garnier       76.41     76.33      8.41    18234.
Eichinger                66.44     66.38      8.41    17079.
User-defined            100.00     99.90      8.41    20458.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1768

           MODEL   8
 AUGITE    +          1.71928
 Ca-MONT   -          3.31982      (Constraint ignored)
 PYRITE    -         -0.76395
 MONT-MAF  -         -4.23901
 CALCITE             -1.40702
 SiO2      -         -0.51803
 PLAGAN30  +          0.27430
               Computed    Observed
Carbon-13      -16.1768    -15.9000
C-14 (% mod)   104.1044*     8.4100
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  20799.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.94      8.41    17148.
Mass Balance             60.73     60.67      8.41    16335.
```

| | | | | |
|---|---|---|---|---|
| Vogel | 85.00 | 84.92 | 8.41 | 19115. |
| Tamers | 55.86 | 55.80 | 8.41 | 15644. |
| Ingerson and Pearson | 68.26 | 68.19 | 8.41 | 17302. |
| Mook | 104.21 | 104.10 | 8.41 | 20799. |
| Fontes and Garnier | 76.41 | 76.33 | 8.41 | 18234. |
| Eichinger | 66.44 | 66.38 | 8.41 | 17079. |
| User-defined | 100.00 | 99.90 | 8.41 | 20458. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.1768

**2.) Initial Well : UI5**
**Final Well : COM9**

| | Final | Initial |
|---|---|---|
| C | 3.2423 | 4.1582 |
| FE | 0.0013 | 0.0006 |
| MG | 0.5472 | 0.8208 |
| CA | 0.5643 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.6704 | 0.3892 |
| NA | 1.0717 | 0.5238 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI | 1.9000 |
| | RS | 1.4000 | | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL | 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 | 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | | |

36 models checked
8 models found
(Ignoring 1 dissolution/precipitation constraints)

| | MODEL 1 | |
|---|---|---|
| AUGITE | + | 0.16241 |
| CHLORITE | + | 0.00087 |
| Ca-MONT | - | 0.41956 (Constraint ignored) |
| GOETHITE | - | -0.01110 |
| MONT-MAF | - | -1.01969 |
| CALCITE | | -0.91591 |
| PLAGAN30 | + | 0.78260 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0439 | -14.6000 |
| C-14 (% mod) | 104.1326* | 9.8900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 19461.* * = based on Mook

| Model | A0 | Computed | Observed | age |
|---|---|---|---|---|

| (for initial A0) | (initial) | (no decay) | | (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 9.89 | 15810. |
| Mass Balance | 60.73 | 60.69 | 9.89 | 14997. |
| Vogel | 85.00 | 84.94 | 9.89 | 17777. |
| Tamers | 55.86 | 55.82 | 9.89 | 14306. |
| Ingerson and Pearson | 68.26 | 68.21 | 9.89 | 15964. |
| Mook | 104.21 | 104.13 | 9.89 | 19461. |
| Fontes and Garnier | 76.41 | 76.36 | 9.89 | 16896. |
| Eichinger | 66.44 | 66.40 | 9.89 | 15741. |
| User-defined | 100.00 | 99.93 | 9.89 | 19120. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0439

| MODEL 2 | | | |
|---|---|---|---|
| AUGITE | + | 0.16531 | |
| CHLORITE | + | -0.08117 | (Constraint ignored) |
| Ca-MONT | - | -0.38116 | |
| GOETHITE | - | -0.11511 | |
| CALCITE | | -0.91591 | |
| SiO2 | - | -0.54261 | |
| PLAGAN30 | + | 0.78260 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0439 | -14.6000 |
| C-14 (% mod) | 104.1326* | 9.8900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 19461.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 9.89 | 15810. |
| Mass Balance | 60.73 | 60.69 | 9.89 | 14997. |
| Vogel | 85.00 | 84.94 | 9.89 | 17777. |
| Tamers | 55.86 | 55.82 | 9.89 | 14306. |
| Ingerson and Pearson | 68.26 | 68.21 | 9.89 | 15964. |
| Mook | 104.21 | 104.13 | 9.89 | 19461. |
| Fontes and Garnier | 76.41 | 76.36 | 9.89 | 16896. |
| Eichinger | 66.44 | 66.40 | 9.89 | 15741. |
| User-defined | 100.00 | 99.93 | 9.89 | 19120. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0439

| MODEL 3 | | | |
|---|---|---|---|
| AUGITE | + | 0.16241 | |
| CHLORITE | + | 0.00087 | |
| Ca-MONT | - | 0.41956 | (Constraint ignored) |
| PYRITE | - | -0.01110 | |
| MONT-MAF | - | -1.01969 | |
| CALCITE | | -0.91591 | |
| PLAGAN30 | + | 0.78260 | |

| | Computed | Observed |
|---|---|---|

```
Carbon-13      -16.0439    -14.6000
C-14 (% mod)   104.1326*     9.8900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  19461.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.95      9.89    15810.
Mass Balance             60.73     60.69      9.89    14997.
Vogel                    85.00     84.94      9.89    17777.
Tamers                   55.86     55.82      9.89    14306.
Ingerson and Pearson     68.26     68.21      9.89    15964.
Mook                    104.21    104.13      9.89    19461.
Fontes and Garnier       76.41     76.36      9.89    16896.
Eichinger                66.44     66.40      9.89    15741.
User-defined            100.00     99.93      9.89    19120.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0439

           MODEL   4
 AUGITE    +          0.16531
 CHLORITE  +         -0.08117      (Constraint ignored)
 Ca-MONT   -         -0.38116
 PYRITE    -         -0.11511
 CALCITE             -0.91591
 SiO2      -         -0.54261
 PLAGAN30  +          0.78260
               Computed    Observed
Carbon-13      -16.0439    -14.6000
C-14 (% mod)   104.1326*     9.8900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  19461.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.95      9.89    15810.
Mass Balance             60.73     60.69      9.89    14997.
Vogel                    85.00     84.94      9.89    17777.
Tamers                   55.86     55.82      9.89    14306.
Ingerson and Pearson     68.26     68.21      9.89    15964.
Mook                    104.21    104.13      9.89    19461.
Fontes and Garnier       76.41     76.36      9.89    16896.
Eichinger                66.44     66.40      9.89    15741.
User-defined            100.00     99.93      9.89    19120.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0439
```

```
          MODEL   5
 AUGITE    +          0.16393
 CHLORITE  +         -0.04212      (Constraint ignored)
 GOETHITE  -         -0.06560
 MONT-MAF  -         -0.48539
 CALCITE             -0.91591
 SiO2      -         -0.28432
 PLAGAN30  +          0.78260
              Computed    Observed
Carbon-13      -16.0439    -14.6000
C-14 (% mod)   104.1326*     9.8900
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  19461.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.95      9.89    15810.
Mass Balance             60.73     60.69      9.89    14997.
Vogel                    85.00     84.94      9.89    17777.
Tamers                   55.86     55.82      9.89    14306.
Ingerson and Pearson     68.26     68.21      9.89    15964.
Mook                    104.21    104.13      9.89    19461.
Fontes and Garnier       76.41     76.36      9.89    16896.
Eichinger                66.44     66.40      9.89    15741.
User-defined            100.00     99.93      9.89    19120.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0439

          MODEL   6
 AUGITE    +          0.16393
 CHLORITE  +         -0.04212      (Constraint ignored)
 PYRITE    -         -0.06560
 MONT-MAF  -         -0.48539
 CALCITE             -0.91591
 SiO2      -         -0.28432
 PLAGAN30  +          0.78260
              Computed    Observed
Carbon-13      -16.0439    -14.6000
C-14 (% mod)   104.1326*     9.8900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  19461.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.95      9.89    15810.
Mass Balance             60.73     60.69      9.89    14997.
Vogel                    85.00     84.94      9.89    17777.
Tamers                   55.86     55.82      9.89    14306.
```

| | | | | |
|---|---|---|---|---|
| Ingerson and Pearson | 68.26 | 68.21 | 9.89 | 15964. |
| Mook | 104.21 | 104.13 | 9.89 | 19461. |
| Fontes and Garnier | 76.41 | 76.36 | 9.89 | 16896. |
| Eichinger | 66.44 | 66.40 | 9.89 | 15741. |
| User-defined | 100.00 | 99.93 | 9.89 | 19120. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0439

MODEL 7

| | | | |
|---|---|---|---|
| AUGITE | + | 0.16244 | |
| Ca-MONT | - | 0.41111 | (Constraint ignored) |
| GOETHITE | - | -0.01220 | |
| MONT-MAF | - | -1.00892 | |
| CALCITE | | -0.91591 | |
| SiO2 | - | -0.00573 | |
| PLAGAN30 | + | 0.78260 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0439 | -14.6000 |
| C-14 (% mod) | 104.1326* | 9.8900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 19461.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 9.89 | 15810. |
| Mass Balance | 60.73 | 60.69 | 9.89 | 14997. |
| Vogel | 85.00 | 84.94 | 9.89 | 17777. |
| Tamers | 55.86 | 55.82 | 9.89 | 14306. |
| Ingerson and Pearson | 68.26 | 68.21 | 9.89 | 15964. |
| Mook | 104.21 | 104.13 | 9.89 | 19461. |
| Fontes and Garnier | 76.41 | 76.36 | 9.89 | 16896. |
| Eichinger | 66.44 | 66.40 | 9.89 | 15741. |
| User-defined | 100.00 | 99.93 | 9.89 | 19120. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0439

MODEL 8

| | | | |
|---|---|---|---|
| AUGITE | + | 0.16244 | |
| Ca-MONT | - | 0.41111 | (Constraint ignored) |
| PYRITE | - | -0.01220 | |
| MONT-MAF | - | -1.00892 | |
| CALCITE | | -0.91591 | |
| SiO2 | - | -0.00573 | |
| PLAGAN30 | + | 0.78260 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0439 | -14.6000 |
| C-14 (% mod) | 104.1326* | 9.8900 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 19461.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 9.89 | 15810. |
| Mass Balance | 60.73 | 60.69 | 9.89 | 14997. |
| Vogel | 85.00 | 84.94 | 9.89 | 17777. |
| Tamers | 55.86 | 55.82 | 9.89 | 14306. |
| Ingerson and Pearson | 68.26 | 68.21 | 9.89 | 15964. |
| Mook | 104.21 | 104.13 | 9.89 | 19461. |
| Fontes and Garnier | 76.41 | 76.36 | 9.89 | 16896. |
| Eichinger | 66.44 | 66.40 | 9.89 | 15741. |
| User-defined | 100.00 | 99.93 | 9.89 | 19120. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0439

**3.) Initial Well : UI5**
**Final Well : COM6**

| | Final | Initial |
|---|---|---|
| C | 4.5412 | 4.1582 |
| FE | 0.0000 | 0.0006 |
| MG | 0.1872 | 0.8208 |
| CA | 0.5978 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.4674 | 0.3892 |
| NA | 3.4495 | 0.5238 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI | 1.9000 |
| | RS | 1.4000 | | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL | 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 | 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | | |
| CO2 GAS | C | 1.0000 | RS | 4.0000 | I1 | -25.0000 | I2 | 100.0000 | | |

120 models checked
4 models found

| | MODEL 1 |
|---|---|
| AUGITE | + 0.39971 |
| CHLORITE | + 0.03367 |
| MONT-MAF | - -2.80436 |
| CALCITE | -1.69432 |
| SiO2 | - -2.04005 |
| PLAGAN30 | + 4.17953 |
| CO2 GAS | 2.07729 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -19.5408 | -11.5000 |

```
C-14 (% mod)   102.5430*     6.1000
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  23328.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     79.49      6.10    21223.
Mass Balance             60.73     75.61      6.10    20809.
Vogel                    85.00     90.64      6.10    22309.
Tamers                   55.86     72.59      6.10    20472.
Ingerson and Pearson     68.26     80.27      6.10    21304.
Mook                    104.21    102.54      6.10    23328.
Fontes and Garnier       76.41     85.32      6.10    21808.
Eichinger                66.44     79.15      6.10    21187.
User-defined            100.00     99.94      6.10    23116.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -19.5408

           MODEL   2
 AUGITE    +          0.31552
 Ca-MONT   -         -0.46716
 MONT-MAF  -         -2.21508
 CALCITE             -1.65923
 SiO2      -         -2.21547
 PLAGAN30  +          4.17953
 CO2 GAS              2.04220
               Computed    Observed
Carbon-13      -19.4889    -11.5000
C-14 (% mod)   102.5652*     6.1000
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  23330.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     79.33      6.10    21206.
Mass Balance             60.73     75.41      6.10    20788.
Vogel                    85.00     90.57      6.10    22302.
Tamers                   55.86     72.37      6.10    20447.
Ingerson and Pearson     68.26     80.11      6.10    21288.
Mook                    104.21    102.57      6.10    23330.
Fontes and Garnier       76.41     85.20      6.10    21797.
Eichinger                66.44     78.98      6.10    21170.
User-defined            100.00     99.94      6.10    23116.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -19.4889
```

```
          MODEL   3
 AUGITE    +          0.60349
 GOETHITE  -         -0.14398
 MONT-MAF  -         -2.79100
 CALCITE             -1.77756
 SiO2      -         -2.37498
 PLAGAN30  +          4.17953
 CO2 GAS              2.16053
              Computed    Observed
Carbon-13      -19.6625    -11.5000
C-14 (% mod)   102.4910*     6.1000
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  23324.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     79.88      6.10    21263.
Mass Balance             60.73     76.07      6.10    20859.
Vogel                    85.00     90.82      6.10    22325.
Tamers                   55.86     73.10      6.10    20531.
Ingerson and Pearson     68.26     80.64      6.10    21342.
Mook                    104.21    102.49      6.10    23324.
Fontes and Garnier       76.41     85.60      6.10    21835.
Eichinger                66.44     79.54      6.10    21228.
User-defined            100.00     99.93      6.10    23115.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -19.6625

           MODEL   4
 AUGITE    +          0.60349
 PYRITE    -         -0.14398
 MONT-MAF  -         -2.79100
 CALCITE             -1.77756
 SiO2      -         -2.37498
 PLAGAN30  +          4.17953
 CO2 GAS              2.16053
              Computed    Observed
Carbon-13      -19.6625    -11.5000
C-14 (% mod)   102.4910*     6.1000
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  23324.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     79.88      6.10    21263.
Mass Balance             60.73     76.07      6.10    20859.
Vogel                    85.00     90.82      6.10    22325.
Tamers                   55.86     73.10      6.10    20531.
```

| | | | |
|---|---|---|---|
| Ingerson and Pearson | 68.26 | 80.64 | 6.10 | 21342. |
| Mook | 104.21 | 102.49 | 6.10 | 23324. |
| Fontes and Garnier | 76.41 | 85.60 | 6.10 | 21835. |
| Eichinger | 66.44 | 79.54 | 6.10 | 21228. |
| User-defined | 100.00 | 99.93 | 6.10 | 23115. |

**4.) Initial Well : UI5**
**Final Well : WSU7**

| | Final | Initial |
|---|---|---|
| C | 3.6402 | 4.1582 |
| FE | 0.0004 | 0.0006 |
| MG | 0.8077 | 0.8208 |
| CA | 0.5905 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.5636 | 0.3892 |
| NA | 1.1143 | 0.5238 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI | 1.9000 |
| | RS | 1.4000 | | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL | 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 | 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | | |
| CO2 GAS | C | 1.0000 | RS | 4.0000 | I1 | -25.0000 | I2 | 100.0000 | | |

120 models checked
4 models found

| | MODEL | 1 |
|---|---|---|
| AUGITE | + | 0.08401 |
| CHLORITE | + | 0.03120 |
| MONT-MAF | - | -0.59088 |
| CALCITE | | -0.86229 |
| SiO2 | - | -0.24194 |
| PLAGAN30 | + | 0.84357 |
| CO2 GAS | | 0.34423 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.7535 | -15.1000 |
| C-14 (% mod) | 103.7931* | 11.3900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 18267.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 69.76 | 11.39 | 14981. |
| Mass Balance | 60.73 | 64.02 | 11.39 | 14272. |
| Vogel | 85.00 | 86.22 | 11.39 | 16733. |

| | | | | |
|---|---|---|---|---|
| Tamers | 55.86 | 59.56 | 11.39 | 13675. |
| Ingerson and Pearson | 68.26 | 70.91 | 11.39 | 15117. |
| Mook | 104.21 | 103.79 | 11.39 | 18267. |
| Fontes and Garnier | 76.41 | 78.36 | 11.39 | 15943. |
| Eichinger | 66.44 | 69.25 | 11.39 | 14921. |
| User-defined | 100.00 | 99.95 | 11.39 | 17954. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.7535

| MODEL 2 | | |
|---|---|---|
| AUGITE | + | 0.00601 |
| Ca-MONT | - | -0.43283 |
| MONT-MAF | - | -0.04490 |
| CALCITE | | -0.82979 |
| SiO2 | - | -0.40447 |
| PLAGAN30 | + | 0.84357 |
| CO2 GAS | | 0.31173 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.6732 | -15.1000 |
| C-14 (% mod) | 103.8273* | 11.3900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 18269.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 69.50 | 11.39 | 14951. |
| Mass Balance | 60.73 | 63.72 | 11.39 | 14233. |
| Vogel | 85.00 | 86.11 | 11.39 | 16722. |
| Tamers | 55.86 | 59.22 | 11.39 | 13628. |
| Ingerson and Pearson | 68.26 | 70.67 | 11.39 | 15089. |
| Mook | 104.21 | 103.83 | 11.39 | 18269. |
| Fontes and Garnier | 76.41 | 78.18 | 11.39 | 15924. |
| Eichinger | 66.44 | 68.99 | 11.39 | 14890. |
| User-defined | 100.00 | 99.95 | 11.39 | 17954. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.6732

| MODEL 3 | | |
|---|---|---|
| AUGITE | + | 0.27281 |
| GOETHITE | - | -0.13340 |
| MONT-MAF | - | -0.57849 |
| CALCITE | | -0.93942 |
| SiO2 | - | -0.55225 |
| PLAGAN30 | + | 0.84357 |
| CO2 GAS | | 0.42136 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.9415 | -15.1000 |
| C-14 (% mod) | 103.7132* | 11.3900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 18260.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 70.34 | 11.39 | 15051. |
| Mass Balance | 60.73 | 64.72 | 11.39 | 14362. |
| Vogel | 85.00 | 86.49 | 11.39 | 16759. |
| Tamers | 55.86 | 60.35 | 11.39 | 13784. |
| Ingerson and Pearson | 68.26 | 71.48 | 11.39 | 15183. |
| Mook | 104.21 | 103.71 | 11.39 | 18260. |
| Fontes and Garnier | 76.41 | 78.78 | 11.39 | 15987. |
| Eichinger | 66.44 | 69.85 | 11.39 | 14992. |
| User-defined | 100.00 | 99.94 | 11.39 | 17954. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.9415

| | MODEL 4 |
|---|---|
| AUGITE | + 0.27281 |
| PYRITE | - -0.13340 |
| MONT-MAF | - -0.57849 |
| CALCITE | -0.93942 |
| SiO2 | - -0.55225 |
| PLAGAN30 | + 0.84357 |
| CO2 GAS | 0.42136 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.9415 | -15.1000 |
| C-14 (% mod) | 103.7132* | 11.3900 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 18260.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 70.34 | 11.39 | 15051. |
| Mass Balance | 60.73 | 64.72 | 11.39 | 14362. |
| Vogel | 85.00 | 86.49 | 11.39 | 16759. |
| Tamers | 55.86 | 60.35 | 11.39 | 13784. |
| Ingerson and Pearson | 68.26 | 71.48 | 11.39 | 15183. |
| Mook | 104.21 | 103.71 | 11.39 | 18260. |
| Fontes and Garnier | 76.41 | 78.78 | 11.39 | 15987. |
| Eichinger | 66.44 | 69.85 | 11.39 | 14992. |
| User-defined | 100.00 | 99.94 | 11.39 | 17954. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.9415

**5.) Initial Well : UI5**
**Final Well : COP7**

| | Final | Initial |
|---|---|---|
| C | 2.8476 | 4.1582 |

```
FE      0.0014      0.0006
MG      0.6830      0.8208
CA      0.5258      1.2430
AL      0.0000      0.0000
SI      0.5502      0.3892
NA      1.1369      0.5238

AUGITE   CA   0.4000 MG   0.8000 FE   0.7000 AL   0.2000 SI   1.9000
         RS   1.4000
CHLORITE MG   5.0000 AL   2.0000 SI   3.0000
Ca-MONT  CA   0.1670 AL   2.3300 SI   3.6700
GOETHITE FE   1.0000 RS   3.0000
PYRITE   FE   1.0000 S    2.0000 RS   0.0000 I3 -60.0000
MONT-MAF CA   0.1300 K    0.0700 MG   0.4000 FE   0.1000 AL   1.9900
         SI   3.6500 RS   0.3000
CALCITE  CA   1.0000 C    1.0000 RS   4.0000 I1   0.0000 I2   0.0000
SiO2     SI   1.0000
PLAGAN30 CA   0.3000 AL   1.3000 SI   2.7500 NA   0.7000

                  36 models checked
                   8 models found
        (Ignoring  1 dissolution/precipitation constraints)

           MODEL   1
 AUGITE    +          0.98860
 CHLORITE  +          0.12495
 Ca-MONT   -          2.63628      (Constraint ignored)
 GOETHITE  -         -0.30286
 MONT-MAF  -         -3.88376
 CALCITE             -1.31066
 PLAGAN30  +          0.87580
               Computed    Observed
Carbon-13      -16.0841    -15.1000
C-14 (% mod)   104.1240*    13.6500
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------------
Adjusted C-14 age in years:  16797.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data           67.00     66.95     13.65    13145.
Mass Balance            60.73     60.68     13.65    12333.
Vogel                   85.00     84.93     13.65    15113.
Tamers                  55.86     55.81     13.65    11642.
Ingerson and Pearson    68.26     68.21     13.65    13300.
Mook                   104.21    104.12     13.65    16797.
Fontes and Garnier      76.41     76.35     13.65    14232.
Eichinger               66.44     66.39     13.65    13077.
User-defined           100.00     99.92     13.65    16456.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0841
```

```
          MODEL   2
 AUGITE    +          0.99966
 CHLORITE  +         -0.18752      (Constraint ignored)
 Ca-MONT   -         -0.41349
 GOETHITE  -         -0.69897
 CALCITE             -1.31066
 SiO2      -         -2.06668
 PLAGAN30  +          0.87580
               Computed    Observed
Carbon-13      -16.0841    -15.1000
C-14 (% mod)   104.1240*    13.6500
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  16797.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.95     13.65    13145.
Mass Balance             60.73     60.68     13.65    12333.
Vogel                    85.00     84.93     13.65    15113.
Tamers                   55.86     55.81     13.65    11642.
Ingerson and Pearson     68.26     68.21     13.65    13300.
Mook                    104.21    104.12     13.65    16797.
Fontes and Garnier       76.41     76.35     13.65    14232.
Eichinger                66.44     66.39     13.65    13077.
User-defined            100.00     99.92     13.65    16456.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0841

          MODEL   3
 AUGITE    +          0.98860
 CHLORITE  +          0.12495
 Ca-MONT   -          2.63628      (Constraint ignored)
 PYRITE    -         -0.30286
 MONT-MAF  -         -3.88376
 CALCITE             -1.31066
 PLAGAN30  +          0.87580
               Computed    Observed
Carbon-13      -16.0841    -15.1000
C-14 (% mod)   104.1240*    13.6500
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  16797.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.95     13.65    13145.
Mass Balance             60.73     60.68     13.65    12333.
Vogel                    85.00     84.93     13.65    15113.
```

| | | | | |
|---|---|---|---|---|
| Tamers | 55.86 | 55.81 | 13.65 | 11642. |
| Ingerson and Pearson | 68.26 | 68.21 | 13.65 | 13300. |
| Mook | 104.21 | 104.12 | 13.65 | 16797. |
| Fontes and Garnier | 76.41 | 76.35 | 13.65 | 14232. |
| Eichinger | 66.44 | 66.39 | 13.65 | 13077. |
| User-defined | 100.00 | 99.92 | 13.65 | 16456. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0841

MODEL 4

| | | | |
|---|---|---|---|
| AUGITE | + | 0.99966 | |
| CHLORITE | + | -0.18752 | (Constraint ignored) |
| Ca-MONT | - | -0.41349 | |
| PYRITE | - | -0.69897 | |
| CALCITE | | -1.31066 | |
| SiO2 | - | -2.06668 | |
| PLAGAN30 | + | 0.87580 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0841 | -15.1000 |
| C-14 (% mod) | 104.1240* | 13.6500 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 16797.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 13.65 | 13145. |
| Mass Balance | 60.73 | 60.68 | 13.65 | 12333. |
| Vogel | 85.00 | 84.93 | 13.65 | 15113. |
| Tamers | 55.86 | 55.81 | 13.65 | 11642. |
| Ingerson and Pearson | 68.26 | 68.21 | 13.65 | 13300. |
| Mook | 104.21 | 104.12 | 13.65 | 16797. |
| Fontes and Garnier | 76.41 | 76.35 | 13.65 | 14232. |
| Eichinger | 66.44 | 66.39 | 13.65 | 13077. |
| User-defined | 100.00 | 99.92 | 13.65 | 16456. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0841

MODEL 5

| | | | |
|---|---|---|---|
| AUGITE | + | 0.99816 | |
| CHLORITE | + | -0.14515 | (Constraint ignored) |
| GOETHITE | - | -0.64526 | |
| MONT-MAF | - | -0.52657 | |
| CALCITE | | -1.31066 | |
| SiO2 | - | -1.78648 | |
| PLAGAN30 | + | 0.87580 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0841 | -15.1000 |
| C-14 (% mod) | 104.1240* | 13.6500 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 16797.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 13.65 | 13145. |
| Mass Balance | 60.73 | 60.68 | 13.65 | 12333. |
| Vogel | 85.00 | 84.93 | 13.65 | 15113. |
| Tamers | 55.86 | 55.81 | 13.65 | 11642. |
| Ingerson and Pearson | 68.26 | 68.21 | 13.65 | 13300. |
| Mook | 104.21 | 104.12 | 13.65 | 16797. |
| Fontes and Garnier | 76.41 | 76.35 | 13.65 | 14232. |
| Eichinger | 66.44 | 66.39 | 13.65 | 13077. |
| User-defined | 100.00 | 99.92 | 13.65 | 16456. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0841

MODEL 6

| | | | |
|---|---|---|---|
| AUGITE | + | 0.99816 | |
| CHLORITE | + | -0.14515 | (Constraint ignored) |
| PYRITE | - | -0.64526 | |
| MONT-MAF | - | -0.52657 | |
| CALCITE | | -1.31066 | |
| SiO2 | - | -1.78648 | |
| PLAGAN30 | + | 0.87580 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0841 | -15.1000 |
| C-14 (% mod) | 104.1240* | 13.6500 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 16797.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 13.65 | 13145. |
| Mass Balance | 60.73 | 60.68 | 13.65 | 12333. |
| Vogel | 85.00 | 84.93 | 13.65 | 15113. |
| Tamers | 55.86 | 55.81 | 13.65 | 11642. |
| Ingerson and Pearson | 68.26 | 68.21 | 13.65 | 13300. |
| Mook | 104.21 | 104.12 | 13.65 | 16797. |
| Fontes and Garnier | 76.41 | 76.35 | 13.65 | 14232. |
| Eichinger | 66.44 | 66.39 | 13.65 | 13077. |
| User-defined | 100.00 | 99.92 | 13.65 | 16456. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0841

MODEL 7

| | | | |
|---|---|---|---|
| AUGITE | + | 0.99302 | |
| Ca-MONT | - | 1.41671 | (Constraint ignored) |
| GOETHITE | - | -0.46126 | |
| MONT-MAF | - | -2.33070 | |

```
 CALCITE             -1.31066
 SiO2      -         -0.82644
 PLAGAN30  +          0.87580
               Computed    Observed
Carbon-13      -16.0841    -15.1000
C-14 (% mod)   104.1240*    13.6500
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  16797.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.95     13.65    13145.
Mass Balance             60.73     60.68     13.65    12333.
Vogel                    85.00     84.93     13.65    15113.
Tamers                   55.86     55.81     13.65    11642.
Ingerson and Pearson     68.26     68.21     13.65    13300.
Mook                    104.21    104.12     13.65    16797.
Fontes and Garnier       76.41     76.35     13.65    14232.
Eichinger                66.44     66.39     13.65    13077.
User-defined            100.00     99.92     13.65    16456.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.0841

           MODEL   8
 AUGITE    +          0.99302
 Ca-MONT   -          1.41671      (Constraint ignored)
 PYRITE    -         -0.46126
 MONT-MAF  -         -2.33070
 CALCITE             -1.31066
 SiO2      -         -0.82644
 PLAGAN30  +          0.87580
               Computed    Observed
Carbon-13      -16.0841    -15.1000
C-14 (% mod)   104.1240*    13.6500
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  16797.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.95     13.65    13145.
Mass Balance             60.73     60.68     13.65    12333.
Vogel                    85.00     84.93     13.65    15113.
Tamers                   55.86     55.81     13.65    11642.
Ingerson and Pearson     68.26     68.21     13.65    13300.
Mook                    104.21    104.12     13.65    16797.
Fontes and Garnier       76.41     76.35     13.65    14232.
Eichinger                66.44     66.39     13.65    13077.
User-defined            100.00     99.92     13.65    16456.
```

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0841

**6.) Initial Well : UI5**
**Final Well : Palouse2**

| | Final | Initial |
|---|---|---|
| C | 3.4216 | 4.1582 |
| FE | 0.0022 | 0.0006 |
| MG | 1.3615 | 0.8208 |
| CA | 1.1818 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.0543 | 0.3892 |
| NA | 1.5216 | 0.5238 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI 1.9000 |
| | RS | 1.4000 | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | |

36 models checked
4 models found

| | MODEL 1 |
|---|---|
| AUGITE | + 0.96652 |
| CHLORITE | + 0.03887 |
| GOETHITE | - -0.56832 |
| MONT-MAF | - -1.06735 |
| CALCITE | -0.73665 |
| SiO2 | - -2.31182 |
| PLAGAN30 | + 1.42536 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0952 | -13.7000 |
| C-14 (% mod) | 104.1217* | 4.1000 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 26739.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 4.10 | 23088. |
| Mass Balance | 60.73 | 60.68 | 4.10 | 22276. |
| Vogel | 85.00 | 84.93 | 4.10 | 25055. |
| Tamers | 55.86 | 55.81 | 4.10 | 21584. |
| Ingerson and Pearson | 68.26 | 68.21 | 4.10 | 23242. |
| Mook | 104.21 | 104.12 | 4.10 | 26739. |

| | | | | |
|---|---|---|---|---|
| Fontes and Garnier | 76.41 | 76.35 | 4.10 | 24174. |
| Eichinger | 66.44 | 66.39 | 4.10 | 23019. |
| User-defined | 100.00 | 99.92 | 4.10 | 26399. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0952

MODEL 2

| | | |
|---|---|---|
| AUGITE | + | 0.96652 |
| CHLORITE | + | 0.03887 |
| PYRITE | - | -0.56832 |
| MONT-MAF | - | -1.06735 |
| CALCITE | | -0.73665 |
| SiO2 | - | -2.31182 |
| PLAGAN30 | + | 1.42536 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0952 | -13.7000 |
| C-14 (% mod) | 104.1217* | 4.1000 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 26739.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 4.10 | 23088. |
| Mass Balance | 60.73 | 60.68 | 4.10 | 22276. |
| Vogel | 85.00 | 84.93 | 4.10 | 25055. |
| Tamers | 55.86 | 55.81 | 4.10 | 21584. |
| Ingerson and Pearson | 68.26 | 68.21 | 4.10 | 23242. |
| Mook | 104.21 | 104.12 | 4.10 | 26739. |
| Fontes and Garnier | 76.41 | 76.35 | 4.10 | 24174. |
| Eichinger | 66.44 | 66.39 | 4.10 | 23019. |
| User-defined | 100.00 | 99.92 | 4.10 | 26399. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0952

MODEL 3

| | | |
|---|---|---|
| AUGITE | + | 0.96789 |
| Ca-MONT | - | -0.37942 |
| GOETHITE | - | -0.61760 |
| MONT-MAF | - | -0.58416 |
| CALCITE | | -0.73665 |
| SiO2 | - | -2.56894 |
| PLAGAN30 | + | 1.42536 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0952 | -13.7000 |
| C-14 (% mod) | 104.1217* | 4.1000 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 26739.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 4.10 | 23088. |
| Mass Balance | 60.73 | 60.68 | 4.10 | 22276. |
| Vogel | 85.00 | 84.93 | 4.10 | 25055. |
| Tamers | 55.86 | 55.81 | 4.10 | 21584. |
| Ingerson and Pearson | 68.26 | 68.21 | 4.10 | 23242. |
| Mook | 104.21 | 104.12 | 4.10 | 26739. |
| Fontes and Garnier | 76.41 | 76.35 | 4.10 | 24174. |
| Eichinger | 66.44 | 66.39 | 4.10 | 23019. |
| User-defined | 100.00 | 99.92 | 4.10 | 26399. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0952

| | MODEL 4 | |
|---|---|---|
| AUGITE | + | 0.96789 |
| Ca-MONT | - | -0.37942 |
| PYRITE | - | -0.61760 |
| MONT-MAF | - | -0.58416 |
| CALCITE | | -0.73665 |
| SiO2 | - | -2.56894 |
| PLAGAN30 | + | 1.42536 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.0952 | -13.7000 |
| C-14 (% mod) | 104.1217* | 4.1000 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

Adjusted C-14 age in years: 26739.* * = based on Mook


| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.95 | 4.10 | 23088. |
| Mass Balance | 60.73 | 60.68 | 4.10 | 22276. |
| Vogel | 85.00 | 84.93 | 4.10 | 25055. |
| Tamers | 55.86 | 55.81 | 4.10 | 21584. |
| Ingerson and Pearson | 68.26 | 68.21 | 4.10 | 23242. |
| Mook | 104.21 | 104.12 | 4.10 | 26739. |
| Fontes and Garnier | 76.41 | 76.35 | 4.10 | 24174. |
| Eichinger | 66.44 | 66.39 | 4.10 | 23019. |
| User-defined | 100.00 | 99.92 | 4.10 | 26399. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.0952


**7.) Initial Well : UI5**
**Final Well : CLAYSTREET**

| | Final | Initial |
|---|---|---|
| C | 2.6035 | 4.1582 |
| FE | 0.0000 | 0.0006 |
| MG | 1.2203 | 0.8208 |
| CA | 1.0302 | 1.2430 |

```
AL       0.0000       0.0000
SI       0.0398       0.3892
NA       0.8684       0.5238

AUGITE    CA    0.4000 MG    0.8000 FE    0.7000 AL    0.2000 SI    1.9000
          RS    1.4000
CHLORITE  MG    5.0000 AL    2.0000 SI    3.0000
Ca-MONT   CA    0.1670 AL    2.3300 SI    3.6700
GOETHITE  FE    1.0000 RS    3.0000
PYRITE    FE    1.0000 S     2.0000 RS    0.0000 I3 -60.0000
MONT-MAF  CA    0.1300 K     0.0700 MG    0.4000 FE    0.1000 AL    1.9900
          SI    3.6500 RS    0.3000
CALCITE   CA    1.0000 C     1.0000 RS    4.0000 I1    0.0000 I2    0.0000
SiO2      SI    1.0000
PLAGAN30  CA    0.3000 AL    1.3000 SI    2.7500 NA    0.7000

                    36 models checked
                     8 models found
         (Ignoring  1 dissolution/precipitation constraints)

           MODEL   1
 AUGITE    +          3.03320
 CHLORITE  +          0.43826
 Ca-MONT   -          8.09591      (Constraint ignored)
 GOETHITE  -         -1.06928
 MONT-MAF  -        -10.54603
 CALCITE             -1.55474
 PLAGAN30  +          0.49229
                Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938


           MODEL   2
 AUGITE    +          3.06322
 CHLORITE  +         -0.41023      (Constraint ignored)
```

```
 Ca-MONT   -         -0.18548
 GOETHITE  -         -2.14490
 CALCITE             -1.55474
 SiO2      -         -5.61190
 PLAGAN30  +          0.49229
               Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938

          MODEL   3
 AUGITE    +          3.03320
 CHLORITE  +          0.43826
 Ca-MONT   -          8.09591      (Constraint ignored)
 PYRITE    -         -1.06928
 MONT-MAF  -        -10.54603
 CALCITE             -1.55474
 PLAGAN30  +          0.49229
               Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
```

```
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938

           MODEL   4
 AUGITE    +          3.06322
 CHLORITE  +         -0.41023      (Constraint ignored)
 Ca-MONT   -         -0.18548
 PYRITE    -         -2.14490
 CALCITE             -1.55474
 SiO2      -         -5.61190
 PLAGAN30  +          0.49229
               Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938

           MODEL   5
 AUGITE    +          3.06255
 CHLORITE  +         -0.39122      (Constraint ignored)
 GOETHITE  -         -2.12081
 MONT-MAF  -         -0.23620
 CALCITE             -1.55474
 SiO2      -         -5.48621
 PLAGAN30  +          0.49229
               Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                  A0     Computed  Observed    age
```

| (for initial A0) | (initial) | (no decay) | | (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.93 | 18.38 | 10684. |
| Mass Balance | 60.73 | 60.67 | 18.38 | 9872. |
| Vogel | 85.00 | 84.91 | 18.38 | 12651. |
| Tamers | 55.86 | 55.80 | 18.38 | 9180. |
| Ingerson and Pearson | 68.26 | 68.19 | 18.38 | 10838. |
| Mook | 104.21 | 104.10 | 18.38 | 14335. |
| Fontes and Garnier | 76.41 | 76.33 | 18.38 | 11770. |
| Eichinger | 66.44 | 66.38 | 18.38 | 10615. |
| User-defined | 100.00 | 99.90 | 18.38 | 13995. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.1938

MODEL 6

| | | | |
|---|---|---|---|
| AUGITE | + | 3.06255 | |
| CHLORITE | + | -0.39122 | (Constraint ignored) |
| PYRITE | - | -2.12081 | |
| MONT-MAF | - | -0.23620 | |
| CALCITE | | -1.55474 | |
| SiO2 | - | -5.48621 | |
| PLAGAN30 | + | 0.49229 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.1938 | -16.0000 |
| C-14 (% mod) | 104.1008* | 18.3800 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 14335.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.93 | 18.38 | 10684. |
| Mass Balance | 60.73 | 60.67 | 18.38 | 9872. |
| Vogel | 85.00 | 84.91 | 18.38 | 12651. |
| Tamers | 55.86 | 55.80 | 18.38 | 9180. |
| Ingerson and Pearson | 68.26 | 68.19 | 18.38 | 10838. |
| Mook | 104.21 | 104.10 | 18.38 | 14335. |
| Fontes and Garnier | 76.41 | 76.33 | 18.38 | 11770. |
| Eichinger | 66.44 | 66.38 | 18.38 | 10615. |
| User-defined | 100.00 | 99.90 | 18.38 | 13995. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.1938

MODEL 7

| | | | |
|---|---|---|---|
| AUGITE | + | 3.04871 | |
| Ca-MONT | - | 3.81841 | (Constraint ignored) |
| GOETHITE | - | -1.62486 | |
| MONT-MAF | - | -5.09879 | |
| CALCITE | | -1.55474 | |
| SiO2 | - | -2.89866 | |
| PLAGAN30 | + | 0.49229 | |

| | Computed | Observed |
|---|---|---|

```
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938

           MODEL   8
 AUGITE    +          3.04871
 Ca-MONT   -          3.81841      (Constraint ignored)
 PYRITE    -         -1.62486
 MONT-MAF  -         -5.09879
 CALCITE             -1.55474
 SiO2      -         -2.89866
 PLAGAN30  +          0.49229
               Computed    Observed
Carbon-13      -16.1938    -16.0000
C-14 (% mod)   104.1008*    18.3800
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  14335.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     18.38    10684.
Mass Balance             60.73     60.67     18.38     9872.
Vogel                    85.00     84.91     18.38    12651.
Tamers                   55.86     55.80     18.38     9180.
Ingerson and Pearson     68.26     68.19     18.38    10838.
Mook                    104.21    104.10     18.38    14335.
Fontes and Garnier       76.41     76.33     18.38    11770.
Eichinger                66.44     66.38     18.38    10615.
User-defined            100.00     99.90     18.38    13995.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.1938
```

**8.) Initial Well : UI5**
**Final Well : GLENWOOD**

| | Final | Initial |
|---|---|---|
| C | 2.5498 | 4.1582 |
| FE | 0.0000 | 0.0006 |
| MG | 0.5949 | 0.8208 |
| CA | 0.5343 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.5192 | 0.3892 |
| NA | 1.0581 | 0.5238 |

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI 1.9000 |
| | RS | 1.4000 | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | |

36 models checked
8 models found
(Ignoring 1 dissolution/precipitation constraints)

| | MODEL 1 | |
|---|---|---|
| AUGITE | + | 1.78213 |
| CHLORITE | + | 0.16711 |
| Ca-MONT | - | 4.58829 (Constraint ignored) |
| GOETHITE | - | -0.62634 |
| MONT-MAF | - | -6.21789 |
| CALCITE | | -1.60838 |
| PLAGAN30 | + | 0.76327 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.2149 | -15.3000 |
| C-14 (% mod) | 104.0964* | 15.2900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 15856.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.93 | 15.29 | 12205. |
| Mass Balance | 60.73 | 60.67 | 15.29 | 11393. |
| Vogel | 85.00 | 84.91 | 15.29 | 14172. |
| Tamers | 55.86 | 55.80 | 15.29 | 10702. |
| Ingerson and Pearson | 68.26 | 68.19 | 15.29 | 12359. |
| Mook | 104.21 | 104.10 | 15.29 | 15856. |
| Fontes and Garnier | 76.41 | 76.33 | 15.29 | 13292. |
| Eichinger | 66.44 | 66.37 | 15.29 | 12136. |

```
User-defined            100.00     99.90     15.29    15516.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

           MODEL   2
 AUGITE    +          1.79983
 CHLORITE  +         -0.33316      (Constraint ignored)
 Ca-MONT   -         -0.29438
 GOETHITE  -         -1.26052
 CALCITE             -1.60838
 SiO2      -         -3.30875
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

           MODEL   3
 AUGITE    +          1.78213
 CHLORITE  +          0.16711
 Ca-MONT   -          4.58829      (Constraint ignored)
 PYRITE    -         -0.62634
 MONT-MAF  -         -6.21789
 CALCITE             -1.60838
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                  A0     Computed  Observed    age
(for initial A0)       (initial) (no decay)           (final)
```

```
-------------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

           MODEL   4
 AUGITE    +          1.79983
 CHLORITE  +         -0.33316      (Constraint ignored)
 Ca-MONT   -         -0.29438
 PYRITE    -         -1.26052
 CALCITE             -1.60838
 SiO2      -         -3.30875
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

           MODEL   5
 AUGITE    +          1.79876
 CHLORITE  +         -0.30299      (Constraint ignored)
 GOETHITE  -         -1.22228
 MONT-MAF  -         -0.37488
 CALCITE             -1.60838
 SiO2      -         -3.10926
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
```

```
C-14 (% mod)   104.0964*    15.2900
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

           MODEL   6
 AUGITE    +          1.79876
 CHLORITE  +         -0.30299      (Constraint ignored)
 PYRITE    -         -1.22228
 MONT-MAF  -         -0.37488
 CALCITE             -1.60838
 SiO2      -         -3.10926
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149
```

```
          MODEL   7
 AUGITE    +          1.78804
 Ca-MONT   -          2.95729      (Constraint ignored)
 GOETHITE  -         -0.83818
 MONT-MAF  -         -4.14088
 CALCITE             -1.60838
 SiO2      -         -1.10525
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
Tamers                   55.86     55.80     15.29    10702.
Ingerson and Pearson     68.26     68.19     15.29    12359.
Mook                    104.21    104.10     15.29    15856.
Fontes and Garnier       76.41     76.33     15.29    13292.
Eichinger                66.44     66.37     15.29    12136.
User-defined            100.00     99.90     15.29    15516.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2149

          MODEL   8
 AUGITE    +          1.78804
 Ca-MONT   -          2.95729      (Constraint ignored)
 PYRITE    -         -0.83818
 MONT-MAF  -         -4.14088
 CALCITE             -1.60838
 SiO2      -         -1.10525
 PLAGAN30  +          0.76327
               Computed    Observed
Carbon-13      -16.2149    -15.3000
C-14 (% mod)   104.0964*    15.2900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:  15856.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-------------------------------------------------------------
Original Data            67.00     66.93     15.29    12205.
Mass Balance             60.73     60.67     15.29    11393.
Vogel                    85.00     84.91     15.29    14172.
```

| | | | | |
|---|---|---|---|---|
| Tamers | 55.86 | 55.80 | 15.29 | 10702. |
| Ingerson and Pearson | 68.26 | 68.19 | 15.29 | 12359. |
| Mook | 104.21 | 104.10 | 15.29 | 15856. |
| Fontes and Garnier | 76.41 | 76.33 | 15.29 | 13292. |
| Eichinger | 66.44 | 66.37 | 15.29 | 12136. |
| User-defined | 100.00 | 99.90 | 15.29 | 15516. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -16.2149

**9.) Initial Well : UI5**
**Final Well : MCGREEVY**

| | Final | Initial |
|---|---|---|
| C | 2.7766 | 4.1582 |
| FE | 0.0000 | 0.0006 |
| MG | 0.8039 | 0.8208 |
| CA | 0.6391 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.4615 | 0.3892 |
| NA | 0.5613 | 0.5238 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI | 1.9000 |
| | RS | 1.4000 | | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL | 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 | 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | | |

36 models checked
4 models found
(Ignoring 1 dissolution/precipitation constraints)

| | MODEL 1 | |
|---|---|---|
| AUGITE | + | 1.85932 |
| CHLORITE | + | 0.14760 |
| Ca-MONT | - | 4.47175 (Constraint ignored) |
| GOETHITE | - | -0.74157 |
| MONT-MAF | - | -5.60589 |
| CALCITE | | -1.38160 |
| PLAGAN30 | + | 0.05346 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -16.2639 | -16.1000 |
| C-14 (% mod) | 104.0860* | 44.8100 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 6967.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|

```
------------------------------------------------------------
Original Data            67.00     66.92     44.81     3316.
Mass Balance             60.73     60.66     44.81     2504.
Vogel                    85.00     84.90     44.81     5283.
Tamers                   55.86     55.79     44.81     1812.
Ingerson and Pearson     68.26     68.18     44.81     3470.
Mook                    104.21    104.09     44.81     6967.
Fontes and Garnier       76.41     76.32     44.81     4402.
Eichinger                66.44     66.37     44.81     3247.
User-defined            100.00     99.89     44.81     6626.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2639

          MODEL   2
 AUGITE    +          1.85932
 CHLORITE  +          0.14760
 Ca-MONT   -          4.47175      (Constraint ignored)
 PYRITE    -         -0.74157
 MONT-MAF  -         -5.60589
 CALCITE             -1.38160
 PLAGAN30  +          0.05346
              Computed    Observed
Carbon-13     -16.2639    -16.1000
C-14 (% mod)  104.0860*    44.8100
Sulfur-34        Insufficient data
Strontium-87     Insufficient data
Nitrogen-15     0.0000   Undefined
------------------------------------------------------------------------
Adjusted C-14 age in years:   6967.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
------------------------------------------------------------
Original Data            67.00     66.92     44.81     3316.
Mass Balance             60.73     60.66     44.81     2504.
Vogel                    85.00     84.90     44.81     5283.
Tamers                   55.86     55.79     44.81     1812.
Ingerson and Pearson     68.26     68.18     44.81     3470.
Mook                    104.21    104.09     44.81     6967.
Fontes and Garnier       76.41     76.32     44.81     4402.
Eichinger                66.44     66.37     44.81     3247.
User-defined            100.00     99.89     44.81     6626.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2639

          MODEL   3
 AUGITE    +          1.86454
 Ca-MONT   -          3.03118      (Constraint ignored)
 GOETHITE  -         -0.92868
 MONT-MAF  -         -3.77138
 CALCITE             -1.38160
 SiO2      -         -0.97621
 PLAGAN30  +          0.05346
              Computed    Observed
Carbon-13     -16.2639    -16.1000
```

```
C-14 (% mod)   104.0860*    44.8100
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:   6967.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.92     44.81     3316.
Mass Balance             60.73     60.66     44.81     2504.
Vogel                    85.00     84.90     44.81     5283.
Tamers                   55.86     55.79     44.81     1812.
Ingerson and Pearson     68.26     68.18     44.81     3470.
Mook                    104.21    104.09     44.81     6967.
Fontes and Garnier       76.41     76.32     44.81     4402.
Eichinger                66.44     66.37     44.81     3247.
User-defined            100.00     99.89     44.81     6626.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2639

           MODEL   4
 AUGITE    +          1.86454
 Ca-MONT   -          3.03118      (Constraint ignored)
 PYRITE    -         -0.92868
 MONT-MAF  -         -3.77138
 CALCITE             -1.38160
 SiO2      -         -0.97621
 PLAGAN30  +          0.05346
               Computed    Observed
Carbon-13      -16.2639    -16.1000
C-14 (% mod)   104.0860*    44.8100
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
-------------------------------------------------------------------------
Adjusted C-14 age in years:   6967.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.92     44.81     3316.
Mass Balance             60.73     60.66     44.81     2504.
Vogel                    85.00     84.90     44.81     5283.
Tamers                   55.86     55.79     44.81     1812.
Ingerson and Pearson     68.26     68.18     44.81     3470.
Mook                    104.21    104.09     44.81     6967.
Fontes and Garnier       76.41     76.32     44.81     4402.
Eichinger                66.44     66.37     44.81     3247.
User-defined            100.00     99.89     44.81     6626.


Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -16.2639
```

**10.) Initial Well : UI5**
**Final Well : BRAWDY**

| | Final | Initial |
|---|---|---|
| C | 1.6265 | 4.1582 |
| FE | 0.0000 | 0.0006 |
| MG | 0.5558 | 0.8208 |
| CA | 0.6935 | 1.2430 |
| AL | 0.0000 | 0.0000 |
| SI | 0.4478 | 0.3892 |
| NA | 0.6173 | 0.5238 |

| | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| AUGITE | CA | 0.4000 | MG | 0.8000 | FE | 0.7000 | AL | 0.2000 | SI | 1.9000 |
| | RS | 1.4000 | | | | | | | | |
| CHLORITE | MG | 5.0000 | AL | 2.0000 | SI | 3.0000 | | | | |
| Ca-MONT | CA | 0.1670 | AL | 2.3300 | SI | 3.6700 | | | | |
| GOETHITE | FE | 1.0000 | RS | 3.0000 | | | | | | |
| PYRITE | FE | 1.0000 | S | 2.0000 | RS | 0.0000 | I3 | -60.0000 | | |
| MONT-MAF | CA | 0.1300 | K | 0.0700 | MG | 0.4000 | FE | 0.1000 | AL | 1.9900 |
| | SI | 3.6500 | RS | 0.3000 | | | | | | |
| CALCITE | CA | 1.0000 | C | 1.0000 | RS | 4.0000 | I1 | 0.0000 | I2 | 0.0000 |
| SiO2 | SI | 1.0000 | | | | | | | | |
| PLAGAN30 | CA | 0.3000 | AL | 1.3000 | SI | 2.7500 | NA | 0.7000 | | |

36 models checked
4 models found
(Ignoring 1 dissolution/precipitation constraints)

| MODEL 1 | | |
|---|---|---|
| AUGITE | + | 4.72383 |
| CHLORITE | + | 0.35032 |
| Ca-MONT | - | 11.59424 (Constraint ignored) |
| GOETHITE | - | -1.85839 |
| MONT-MAF | - | -14.48927 |
| CALCITE | | -2.53170 |
| PLAGAN30 | + | 0.13359 |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -17.1058 | -15.7000 |
| C-14 (% mod) | 103.9079* | 58.5900 |
| Sulfur-34 | 0.0000 | Undefined |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 4736.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.81 | 58.59 | 1085. |
| Mass Balance | 60.73 | 60.56 | 58.59 | 273. |
| Vogel | 85.00 | 84.76 | 58.59 | 3052. |
| Tamers | 55.86 | 55.70 | 58.59 | -418. |
| Ingerson and Pearson | 68.26 | 68.07 | 58.59 | 1239. |
| Mook | 104.21 | 103.91 | 58.59 | 4736. |
| Fontes and Garnier | 76.41 | 76.19 | 58.59 | 2171. |
| Eichinger | 66.44 | 66.25 | 58.59 | 1016. |
| User-defined | 100.00 | 99.71 | 58.59 | 4396. |

```
Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -17.1058

           MODEL   2
 AUGITE    +          4.72383
 CHLORITE  +          0.35032
 Ca-MONT   -         11.59424      (Constraint ignored)
 PYRITE    -         -1.85839
 MONT-MAF  -        -14.48927
 CALCITE             -2.53170
 PLAGAN30  +          0.13359
               Computed    Observed
Carbon-13      -17.1058    -15.7000
C-14 (% mod)   103.9079*    58.5900
Sulfur-34         Insufficient data
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:   4736.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
Original Data            67.00     66.81     58.59     1085.
Mass Balance             60.73     60.56     58.59      273.
Vogel                    85.00     84.76     58.59     3052.
Tamers                   55.86     55.70     58.59     -418.
Ingerson and Pearson     68.26     68.07     58.59     1239.
Mook                    104.21    103.91     58.59     4736.
Fontes and Garnier       76.41     76.19     58.59     2171.
Eichinger                66.44     66.25     58.59     1016.
User-defined            100.00     99.71     58.59     4396.

Data used for Carbon-13
Initial Value:    -15.7000        Modeled Final Value:    -17.1058

             MODEL   3
 AUGITE    +          4.73622
 Ca-MONT   -          8.17504      (Constraint ignored)
 GOETHITE  -         -2.30249
 MONT-MAF  -        -10.13505
 CALCITE             -2.53170
 SiO2      -         -2.31703
 PLAGAN30  +          0.13359
               Computed    Observed
Carbon-13      -17.1058    -15.7000
C-14 (% mod)   103.9079*    58.5900
Sulfur-34        0.0000   Undefined
Strontium-87      Insufficient data
Nitrogen-15      0.0000   Undefined
--------------------------------------------------------------------------
Adjusted C-14 age in years:   4736.*     * = based on Mook

    Model                 A0     Computed  Observed    age
(for initial A0)      (initial) (no decay)           (final)
-----------------------------------------------------------
```

| | | | | |
|---|---|---|---|---|
| Original Data | 67.00 | 66.81 | 58.59 | 1085. |
| Mass Balance | 60.73 | 60.56 | 58.59 | 273. |
| Vogel | 85.00 | 84.76 | 58.59 | 3052. |
| Tamers | 55.86 | 55.70 | 58.59 | -418. |
| Ingerson and Pearson | 68.26 | 68.07 | 58.59 | 1239. |
| Mook | 104.21 | 103.91 | 58.59 | 4736. |
| Fontes and Garnier | 76.41 | 76.19 | 58.59 | 2171. |
| Eichinger | 66.44 | 66.25 | 58.59 | 1016. |
| User-defined | 100.00 | 99.71 | 58.59 | 4396. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -17.1058

MODEL 4

| | | | |
|---|---|---|---|
| AUGITE | + | 4.73622 | |
| Ca-MONT | - | 8.17504 | (Constraint ignored) |
| PYRITE | - | -2.30249 | |
| MONT-MAF | - | -10.13505 | |
| CALCITE | | -2.53170 | |
| SiO2 | - | -2.31703 | |
| PLAGAN30 | + | 0.13359 | |

| | Computed | Observed |
|---|---|---|
| Carbon-13 | -17.1058 | -15.7000 |
| C-14 (% mod) | 103.9079* | 58.5900 |
| Sulfur-34 | Insufficient data | |
| Strontium-87 | Insufficient data | |
| Nitrogen-15 | 0.0000 | Undefined |

---

Adjusted C-14 age in years: 4736.* * = based on Mook

| Model (for initial A0) | A0 (initial) | Computed (no decay) | Observed | age (final) |
|---|---|---|---|---|
| Original Data | 67.00 | 66.81 | 58.59 | 1085. |
| Mass Balance | 60.73 | 60.56 | 58.59 | 273. |
| Vogel | 85.00 | 84.76 | 58.59 | 3052. |
| Tamers | 55.86 | 55.70 | 58.59 | -418. |
| Ingerson and Pearson | 68.26 | 68.07 | 58.59 | 1239. |
| Mook | 104.21 | 103.91 | 58.59 | 4736. |
| Fontes and Garnier | 76.41 | 76.19 | 58.59 | 2171. |
| Eichinger | 66.44 | 66.25 | 58.59 | 1016. |
| User-defined | 100.00 | 99.71 | 58.59 | 4396. |

Data used for Carbon-13
Initial Value: -15.7000 Modeled Final Value: -17.1058