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July 31, 1968

Dr. H. W. Green II  
Institute of Geophysics and Planetary Physics  
University of California  
Los Angeles, California

Dear Dr. Green:

I am very interested in your article in Science, Sept. 22, 1967, "Quartz: Extreme Preferred Orientation Produced by Annealing". For years I have contended that the aboriginal peoples in many parts of the world annealed their flints and siliceous rocks by heating prior to flaking and forming their stone tools. (Heat Treatment of Silica Minerals, Tebiwa, Vol 7, # 1, 1964) This is an article I wrote which appeared in the Tebiwa Journal of the Idaho State University Museum.

I have been doing thermal alteration experiments with stone for many years and find that alteration occurs when the stone reaches from 450 to 600 degrees F, depending on the type of material being altered. This heat treatment makes the material more vitreous and, therefore, it lends itself more easily to pressure flaking and also produces a much sharper edge. I note that my temperatures are considerably less than those you have used in your experiments.

I contend that the crystal size of the stone is reduced by the slow heating and cooling of the material. If the specimen is large, then the time of heating and cooling must be increased accordingly. The alteration can be detected and verified by fracturing the stone after treatment. The exterior surface will retain the original texture but the interior will be vitreous. I wonder if you, also, have noticed this change in your experiments. Color changes are often apparent - for instance, yellows change to reds, probably due to contained mineral salts and the presence of oxygen.

I have also noted that some aboriginal altered artifacts and flakes have reverted - to a degree - to their original texture. Possibly, this reversion could be a useful media for dating surface finds if the change is constant and uniform. Would it be possible to measure the crystal of unaltered material found in situ, then reduce the size of the crystalline structure by heating and then make a comparison with artifacts dated by C-14. If so, this could be very useful to the archaeological profession for dating stone artifacts. Unfortunately, neither I nor Idaho State Univ. have the necessary equipment for this type of experiment.

I would be interested to know if you have considered early mans' annealing and alteration of lithic material prior to knapping. If so, I would like your opinion and would be glad to send you some samples of my work. I would be interested in your opinion as to what molecular changes occur when siliceous rocks are subjected to comparatively low temperatures.

Sincerely yours,

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Cc. 4.3.58