AGENDA 2020 – PHASE II

Climatic and Geologic Controls on Volcanic Ash-Influenced Forest Soils

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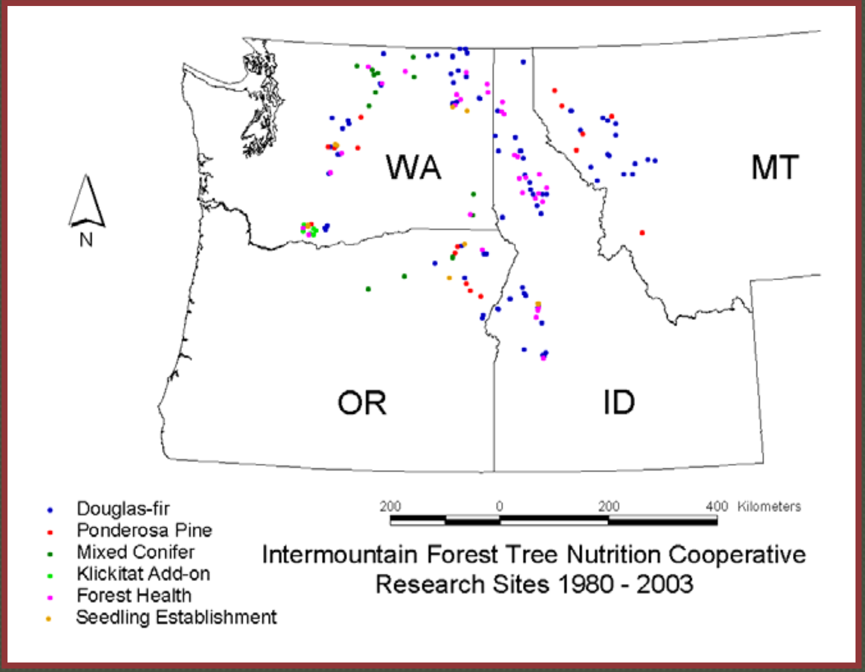
2008 IFTNC Annual Meeting

Summary: Phase I

- Productivity increased with increasing potentially available soil water, which in turn increased with increasing ash depth
- Productivity was greater on average when ash was present than when it was not, but increasing ash depth had no further effect
- N-fertilizer response was greater on average when ash was present than when it was not, but increasing ash depth had no further effect
- Something besides moisture regulates productivity with increasing ash depth (nutrition issue?)

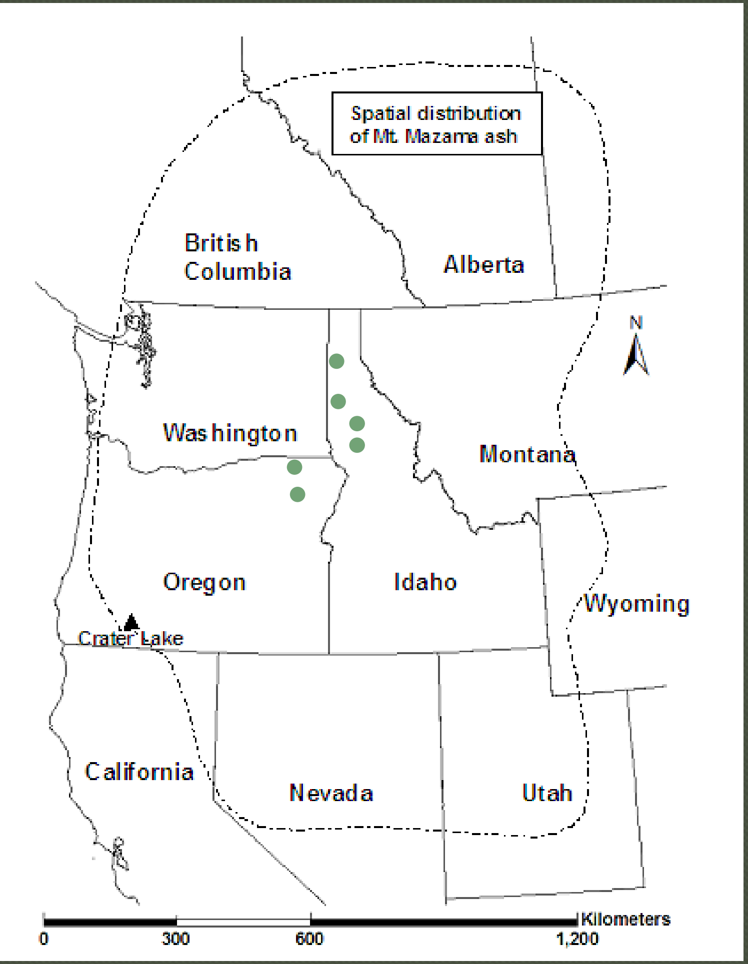


Site Selection & Location

Three paired sites included one pair without ash and two pairs with ash. Each pair represented two rock types. Each of the two 'with ash' pairs represented different vegetation series.

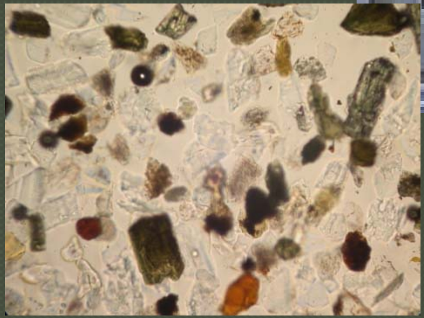
	Basalt
Dry GF (no ash)	Catherine Ck. (NE OR)
Moist GF (ash)	Tollgate II (NE OR)
WRC (ash)	Cranberry Ck. (N ID)

	Metasedimentary
Dry GF (no ash)	Lovell Valley (N ID)
Moist GF (ash)	Birch Ck. (N ID)
WRC (ash)	Renfro Pk. (N ID)

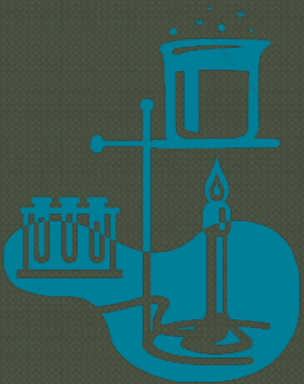


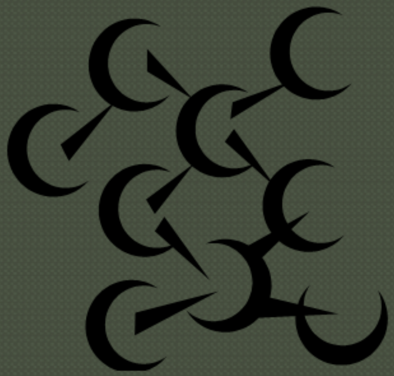
Agenda 2020: Phase II

- Six field sites intensively characterized for:
  - Soil Characteristics
    - Physical
    - Chemical
    - Mineralogical
  - Adsorption/Desorption Isotherms

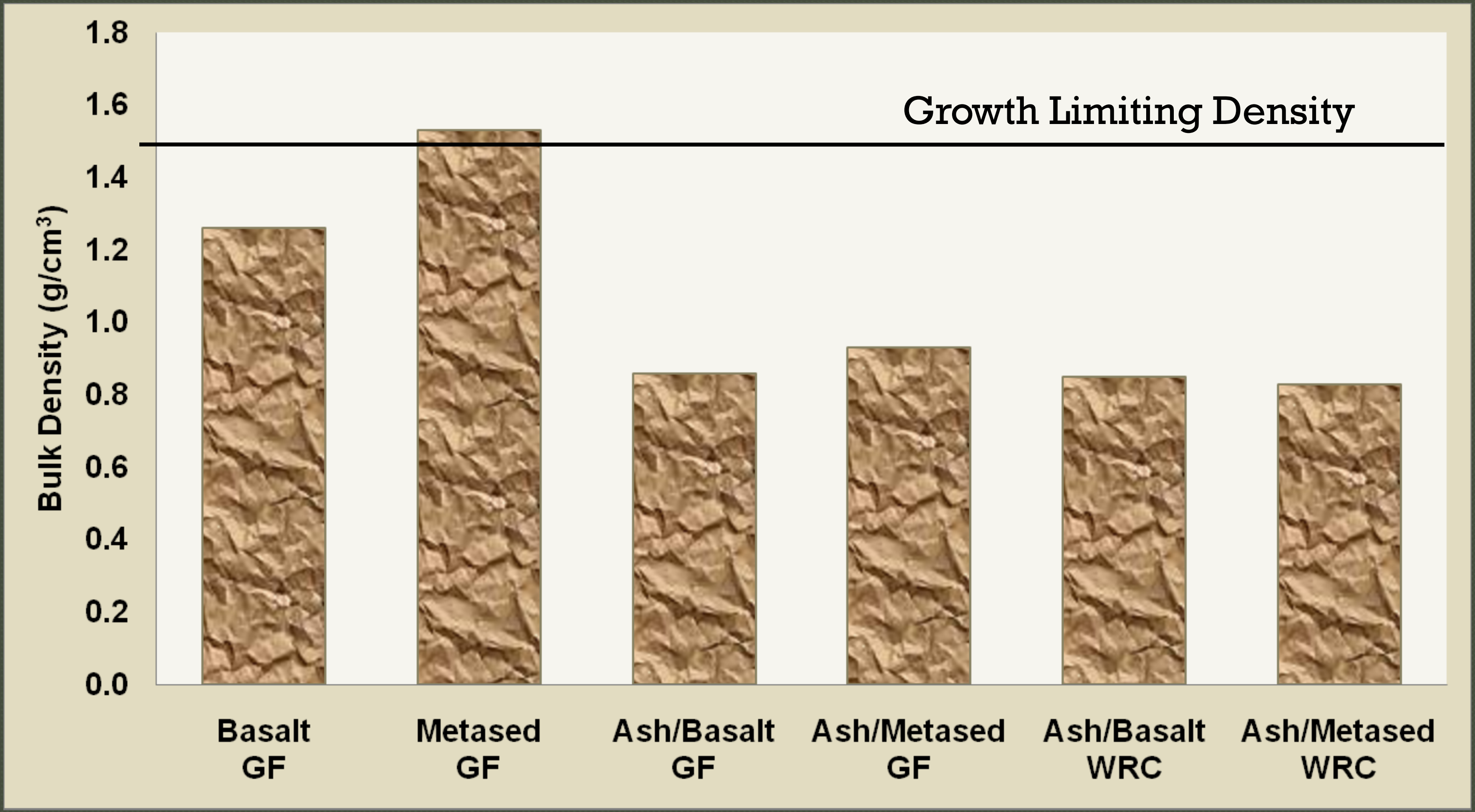


Results

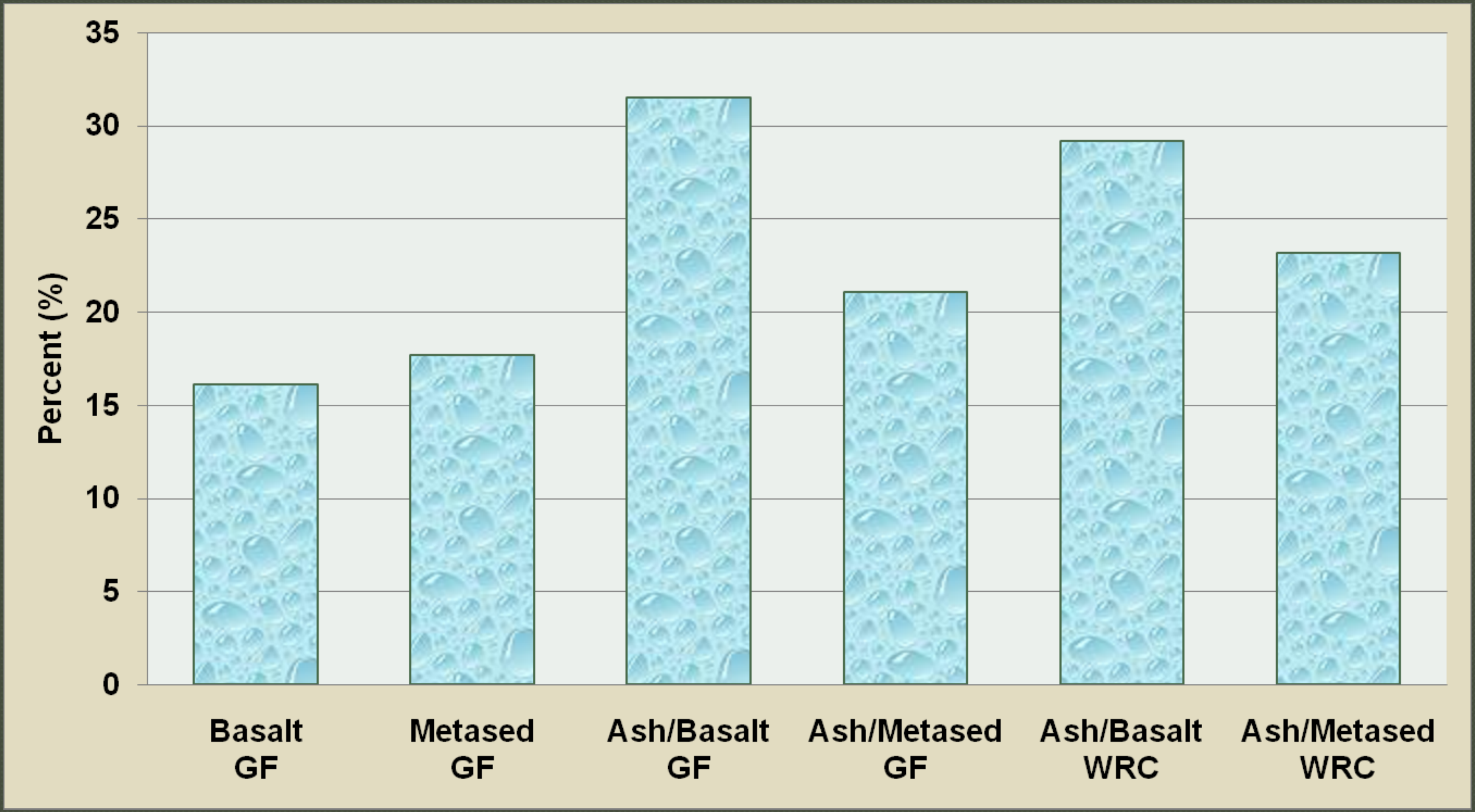




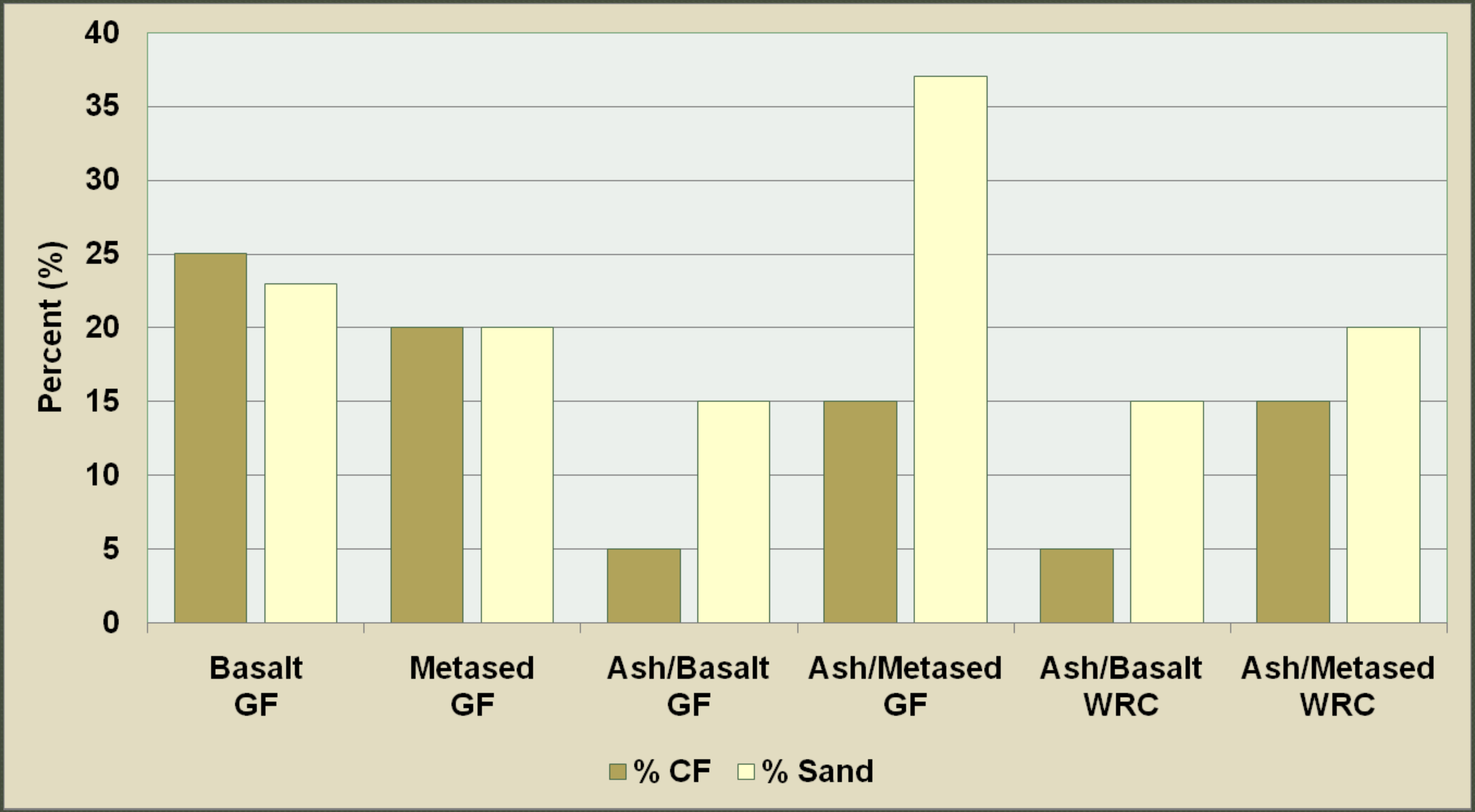
Soil Bulk Density



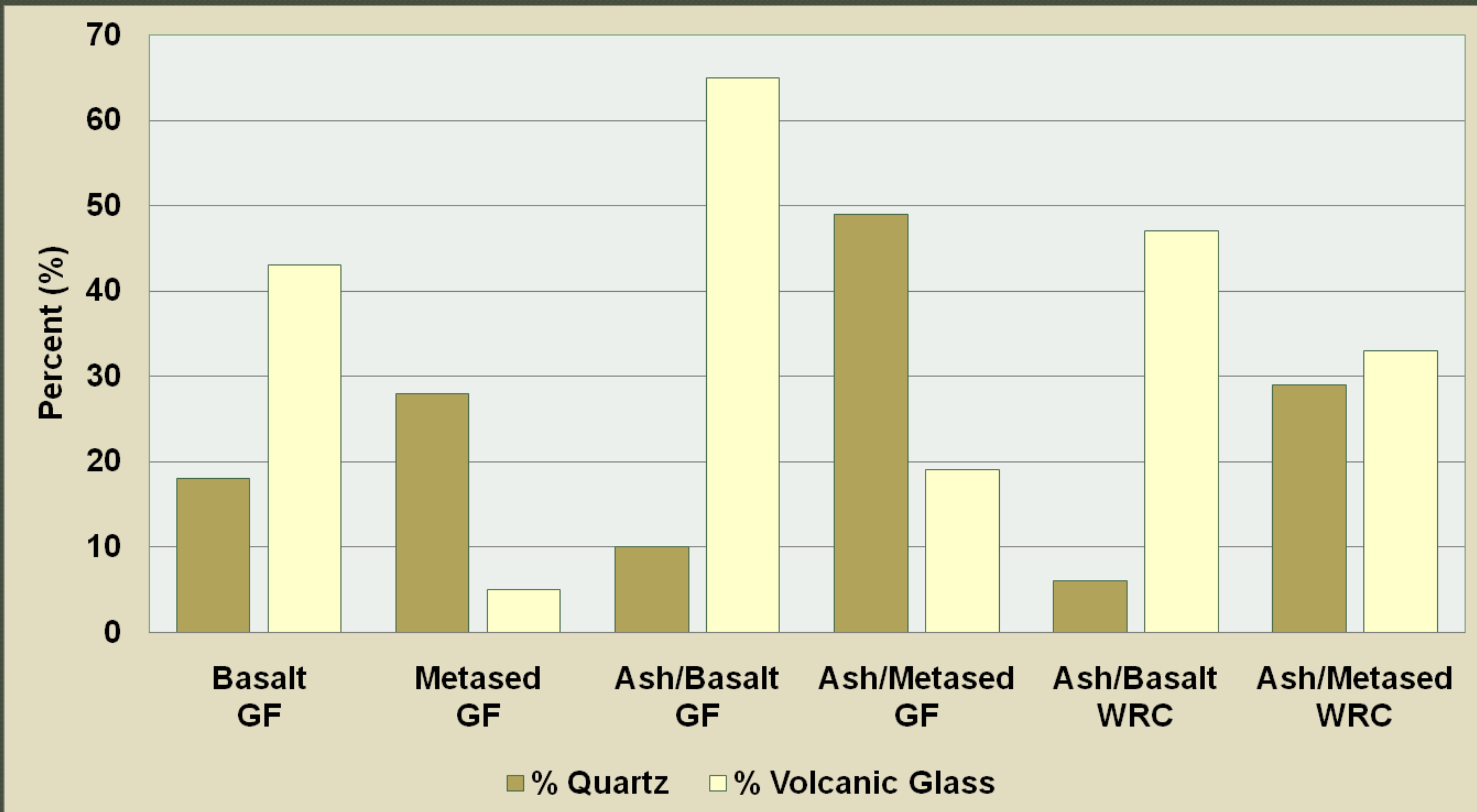
Plant Available Water



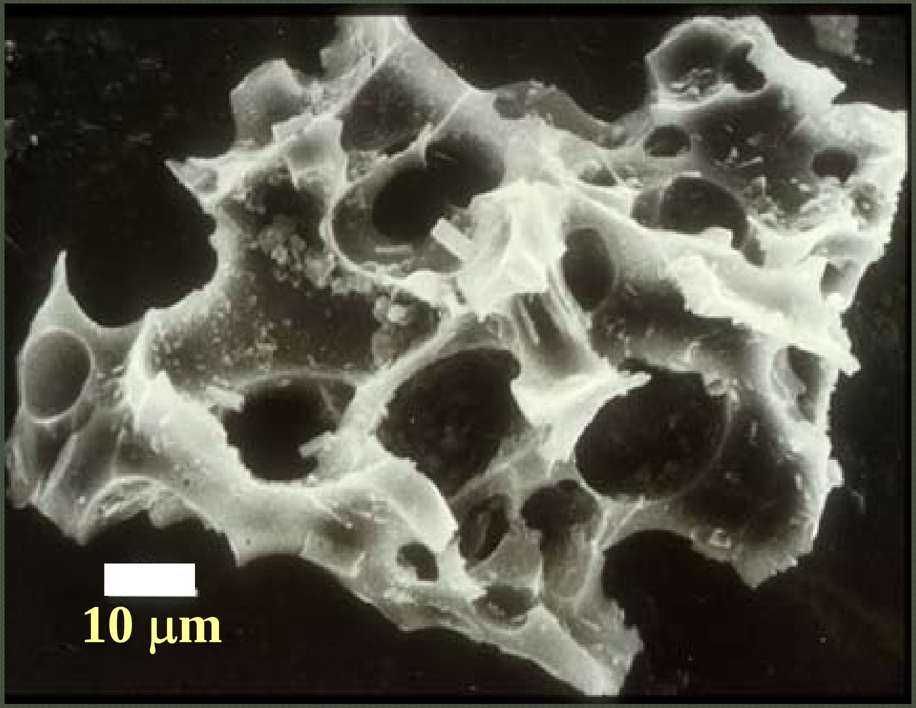
Soil Coarse Fraction



Quartz/Glass Content



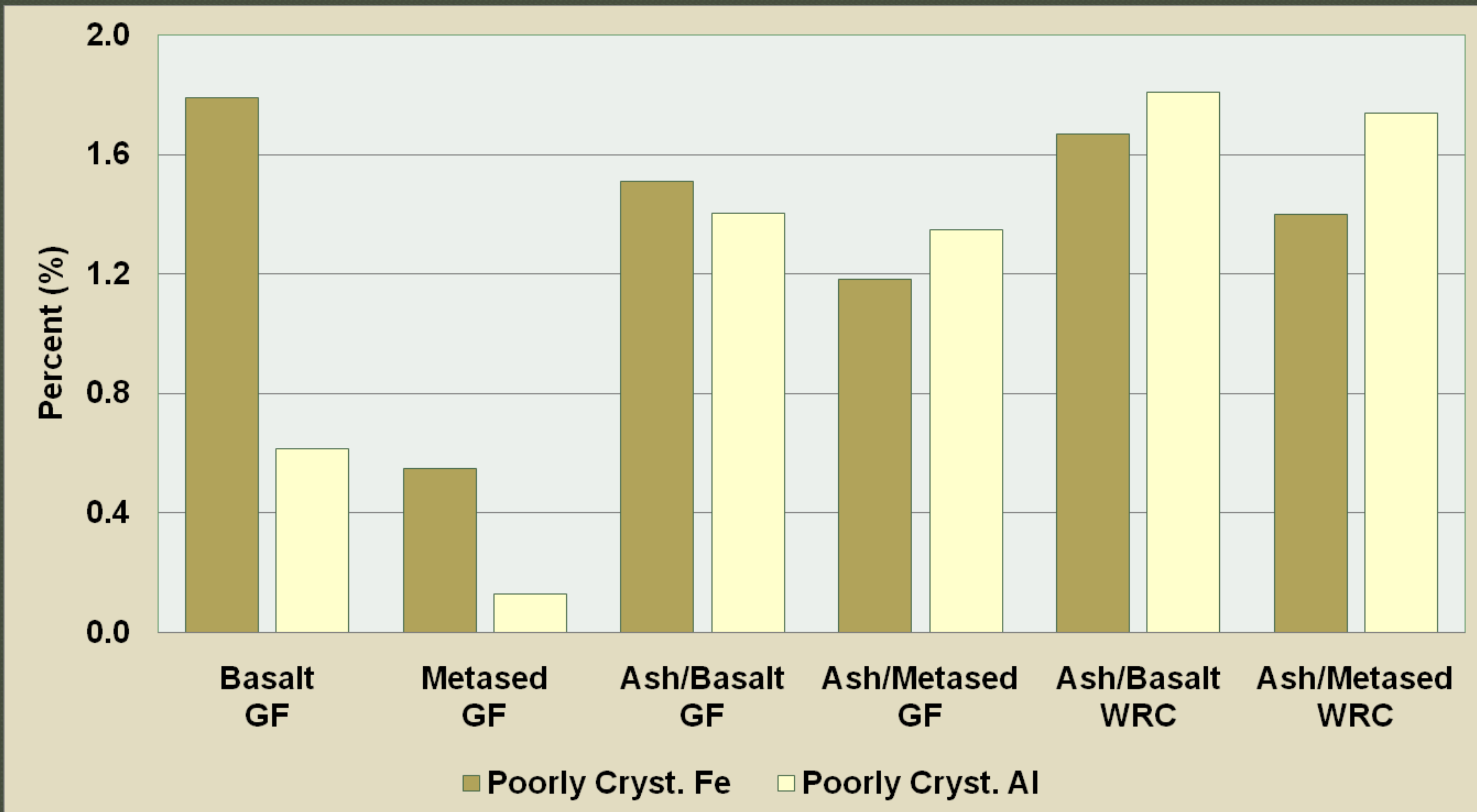
Volcanic Glass Composition



Element	%
SiO_2	72.0
Al_2O_3	**14.4**
Na_2O	5.1
Fe_2O_3	**2.1**
K_2O	2.7
CaO	1.6
MgO	0.5
TiO_2	0.4

(UI Soil Characterization Laboratory)

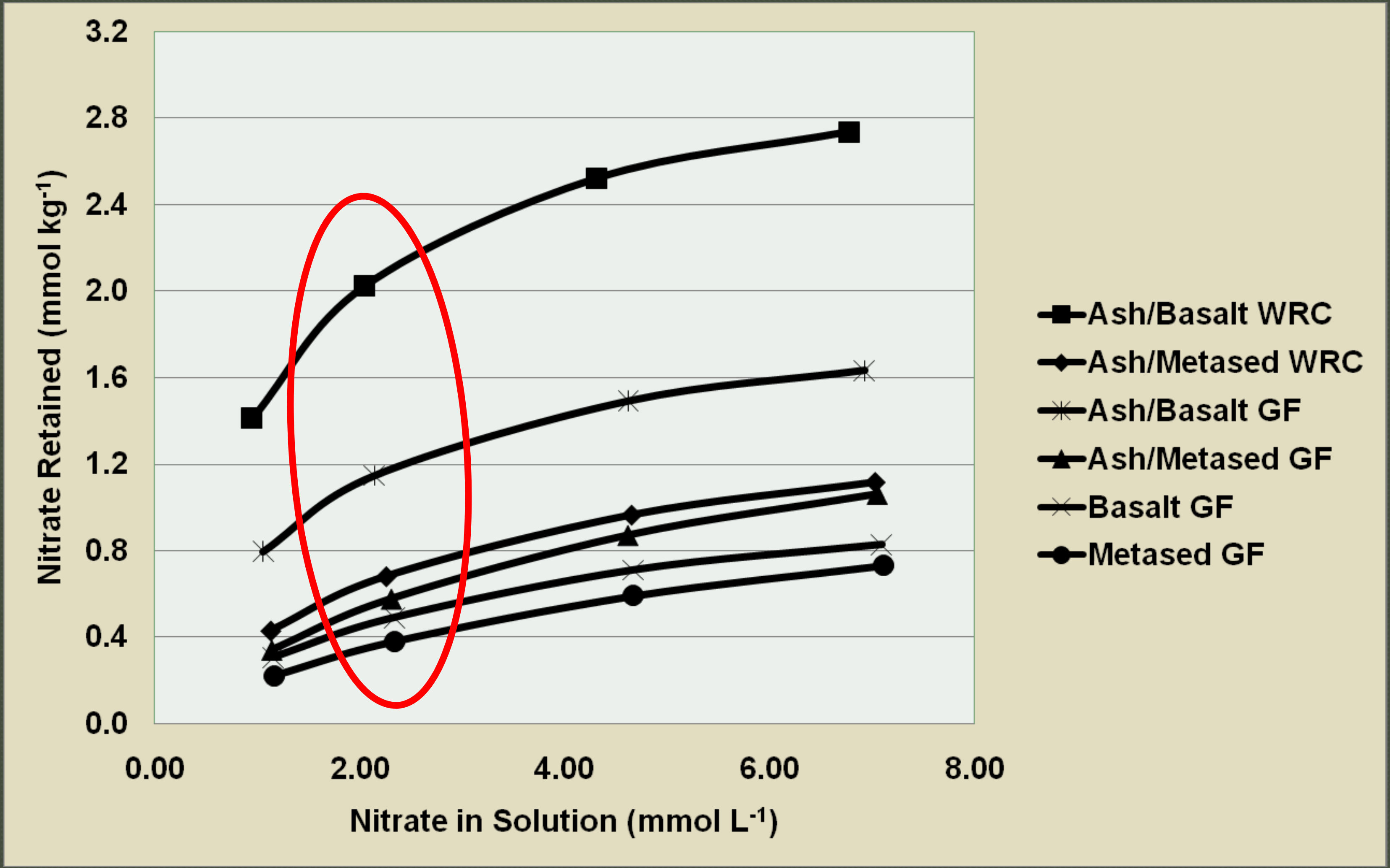
Poorly Crystalline Minerals



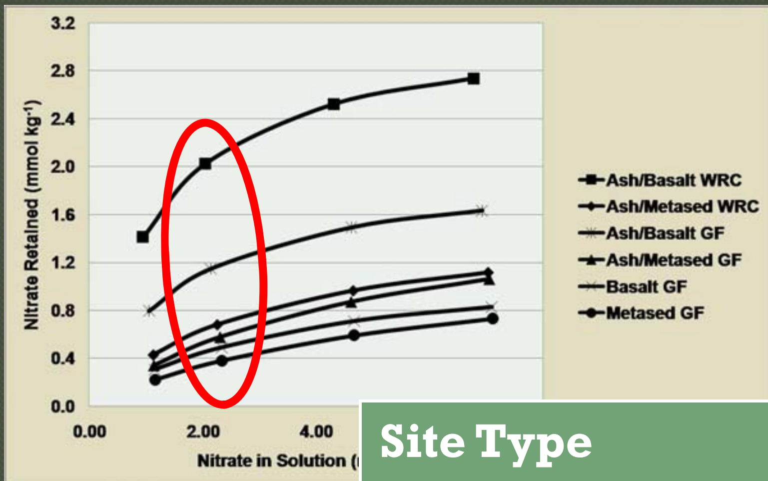
Why is mineralogy important??

- Poorly crystalline Al & Fe fraction positively correlated with nutrient retention

Nitrate Retention



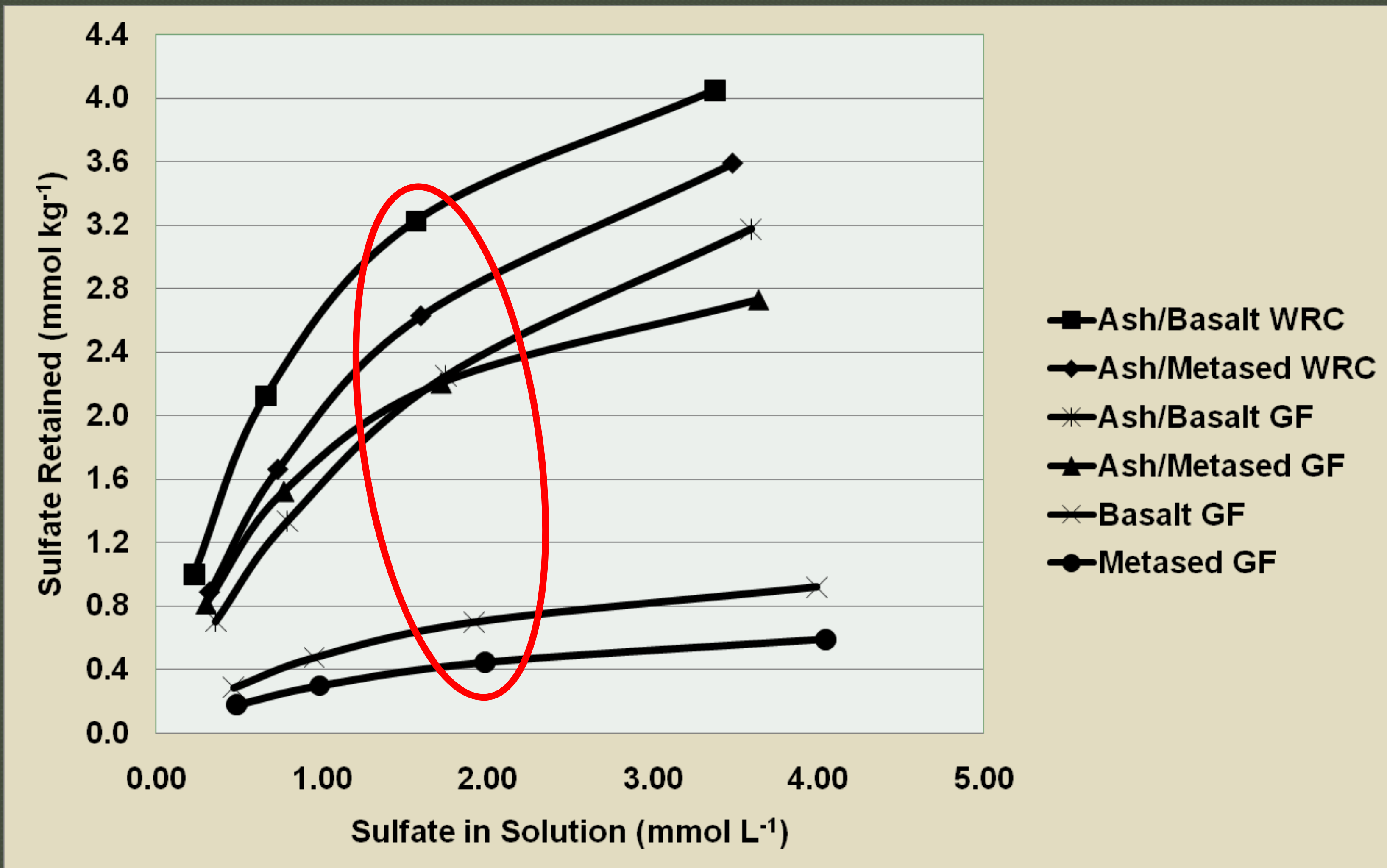
Nitrate Retention



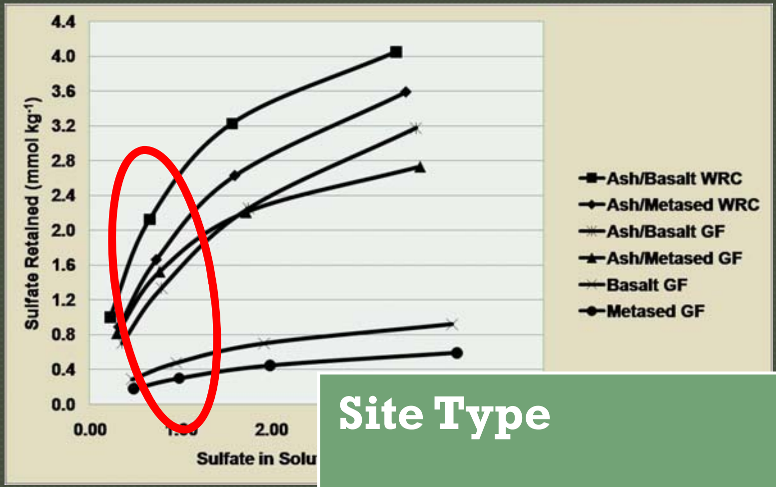
Application Rate: 200# N/ac

Site Type	% Nitrate Retained	#/ac Nitrate Retained
Basalt – GF	2	4
Metased – GF	1	2
Ash/Basalt – GF	4	8
Ash/Metased – GF	2	4
Ash/Basalt – WRC	3	6
Ash/Metased - WRC	5	10

Sulfate Retention



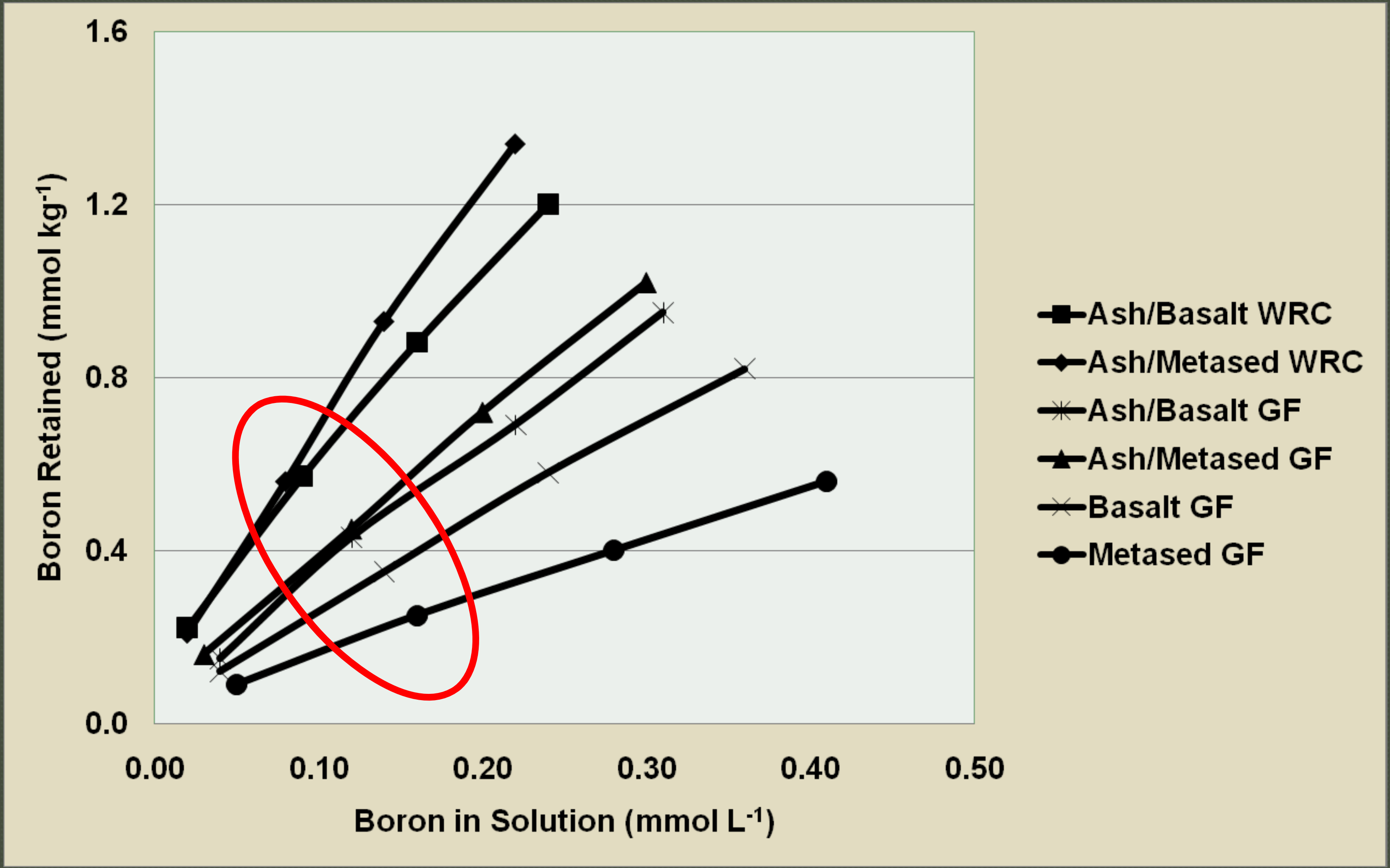
Sulfate Retention



Application Rate: 90# S/ac

Site Type	% Sulfate Retained	#/ac Sulfate Retained
Basalt – GF	9	8
Metased – GF	5	5
Ash/Basalt – GF	20	18
Ash/Metased – GF	13	12
Ash/Basalt – WRC	23	21
Ash/Metased - WRC	23	21

Boron Retention



Boron Retention

Application Rate: 3# B/ac

Site Type	% Boron Retained	#/ac Boron Retained
Basalt – GF	34	1.0
Metased – GF	23	0.7
Ash/Basalt – GF	40	1.2
Ash/Metased – GF	45	1.4
Ash/Basalt – WRC	63	1.9
Ash/Metased - WRC	62	1.9

Net Nutrient Retention

Site Type	% N Released	% S Released	% B Released	Net Soil N Retention (#/ac)	Net Soil S Retention (#/ac)	Net Soil B Retention (#/ac)
Basalt – GF	-	24	40	4	6	0.6
Metased – GF	-	16	41	2	4	0.4
Ash/Basalt – GF	-	6	37	8	17	0.8
Ash/Metased – GF	-	14	39	4	10	0.9
Ash/Basalt – WRC	-	9	31	6	19	1.3
Ash/Metased - WRC	-	-	27	10	21	1.4

Controls on Ash-Cap Properties

- Volcanic ash bulk density does not vary by underlying rock type
- Soil water holding capacity is higher in basalt ash caps due to a lower percentage of sand and coarse fraction
- Basalt ash caps contain less quartz and greater amounts of volcanic glass
- WRC vegetation series ash caps have greater amounts of poorly crystalline Al than GF series
- Poorly crystalline Al & Fe retain large quantities of S, B, and lesser amounts of N
- Ash caps over basalt (GF) retain larger quantities of N,S,B than ash caps over metasediments, suggesting a greater influence of poorly crystalline Fe on nutrient retention

Fertilizer Implications

- Applied N,S & B fertilizer will be retained longer on ash-cap soils than non-ash-cap soils
- Ash caps in WRC vegetation series will retard N,S & B fertilizers from leaching more than GF series
  - Greater concentrations of poorly crystalline minerals
  - Long-term plant availability is still unknown
  - Initial assessment is that the volcanic ash is acting as a slow release fertilizer
- Ash caps over basalt in GF vegetation series will retain more N & S fertilizer than its metasedimentary counterpart
  - Boron retention/release did not show a rock type effect – primarily a climatic effect

Acknowledgements

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