



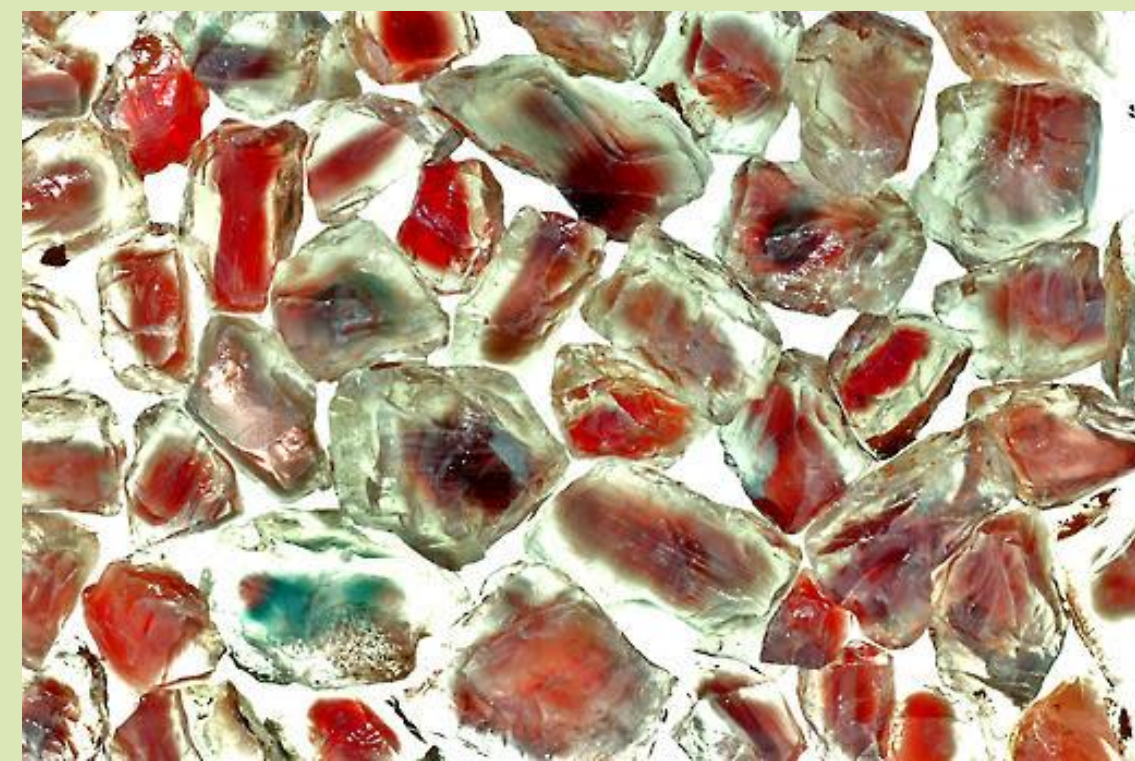
Sunstones: A Gemstone formed by a Magmatic or Hydrothermal Process?

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Oregon Sunstone 101

What: Plagioclase feldspar with macroscopic native copper (range in color from red, green, blue, schiller)



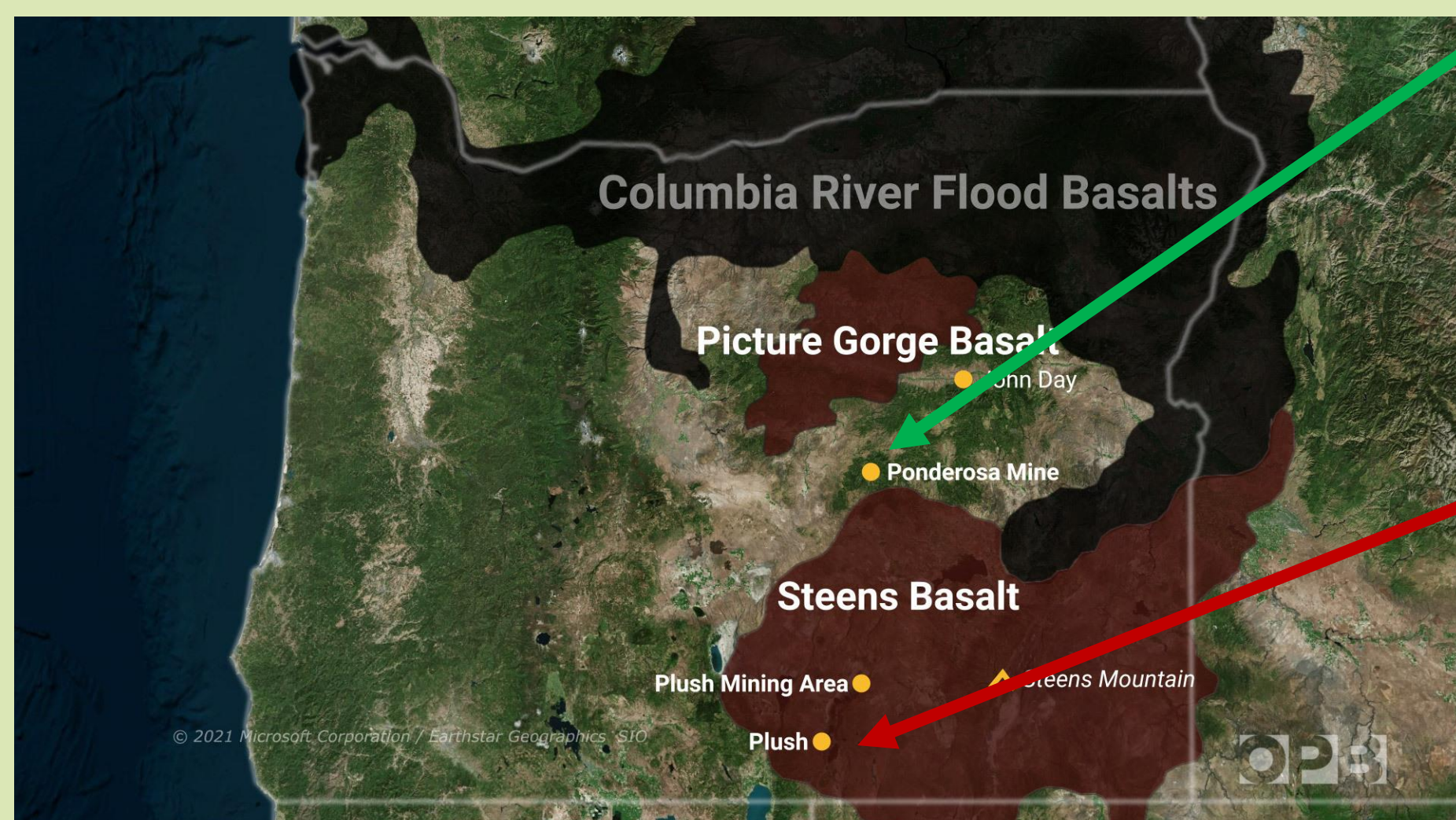
Where: Found within basaltic lavas in Eastern Oregon 2 localities are found ~100 miles apart

- Two main mines: Ponderosa (16.2Ma groundmasses), and Plush (9Ma groundmasses)
- The proximity suggests the two mines share a magmatic source.

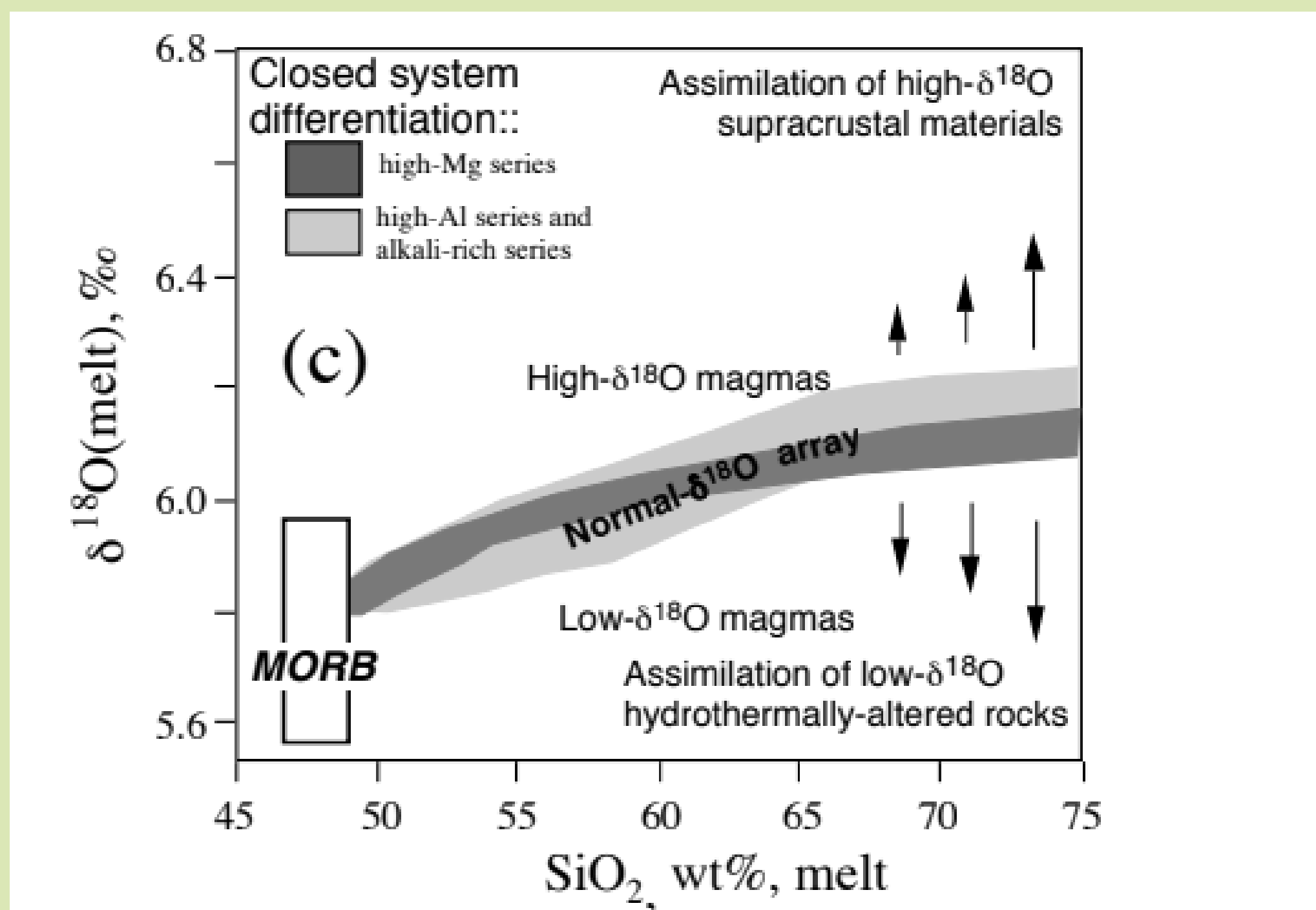
When: Preliminary geochronology work indicates that sunstone-bearing lava flows were not part of the same eruptive event (i.e. 16 Ma vs. 9 Ma)

Why / How Was copper leached from the hosting basaltic groundmass into the sunstone's lattice after fractioning near the surface?

- Or was the copper already within the lattice during the fractionation?



- If Delta 18 Oxygen is less than 5.5 ‰, then it can point to hydrothermal evidence
- If Delta 18 Oxygen is about 5.9-6.5 ‰, then it may reflect magmatic processes.
- SMOW stands for Standard Mean Ocean Water



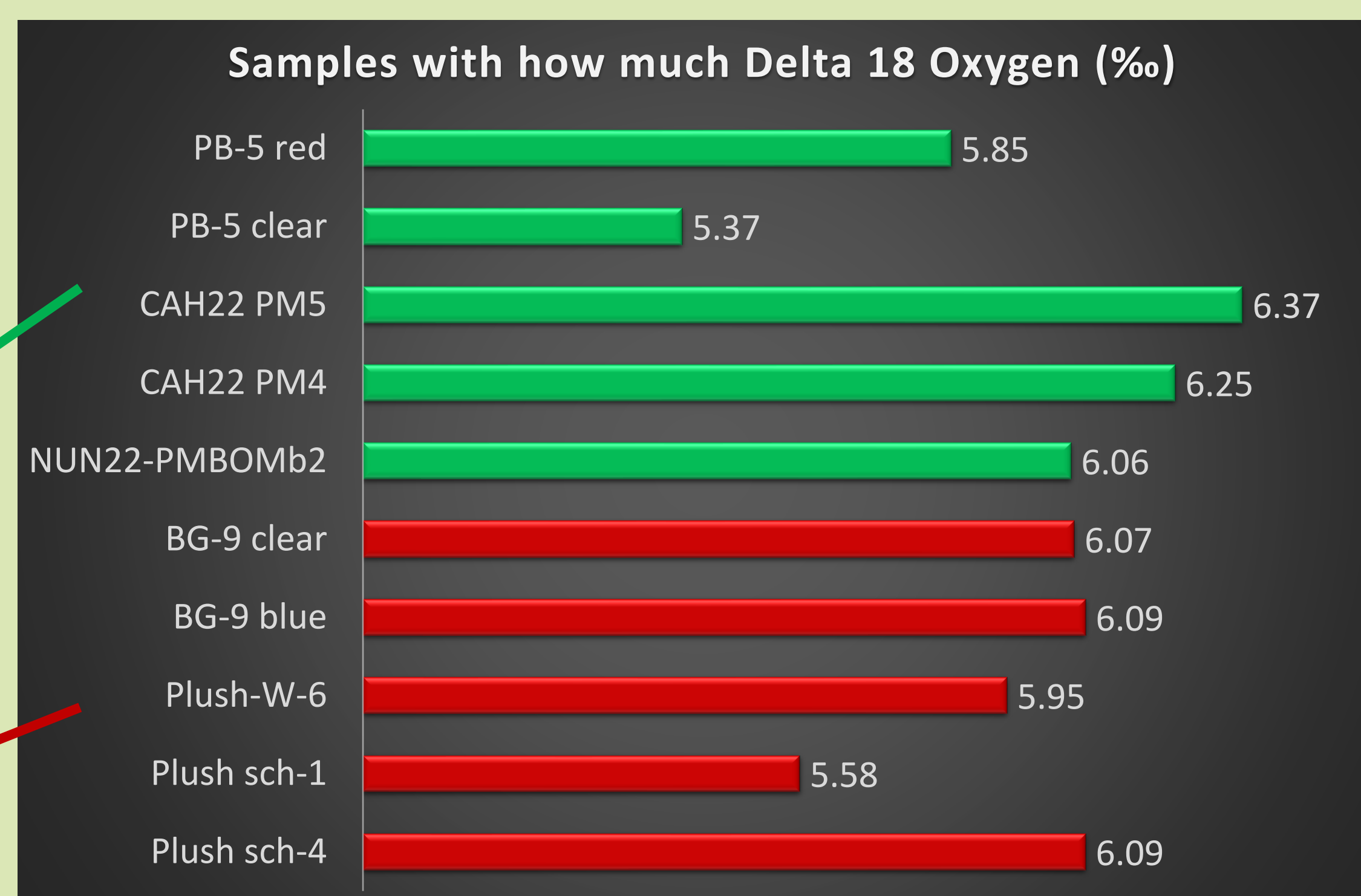
Sample Preparation and Analysis



- To get the desired result we had to use the mechanism at University of Oregon that would allow the delta 18 oxygen to be the only element that gets recorded.
- To achieve this, we had to turn multiple valves to release unwanted elements and freeze certain tubes to hold certain elements in place.
- As a result the spectrometer was able to output the necessary delta 18 oxygen we needed.

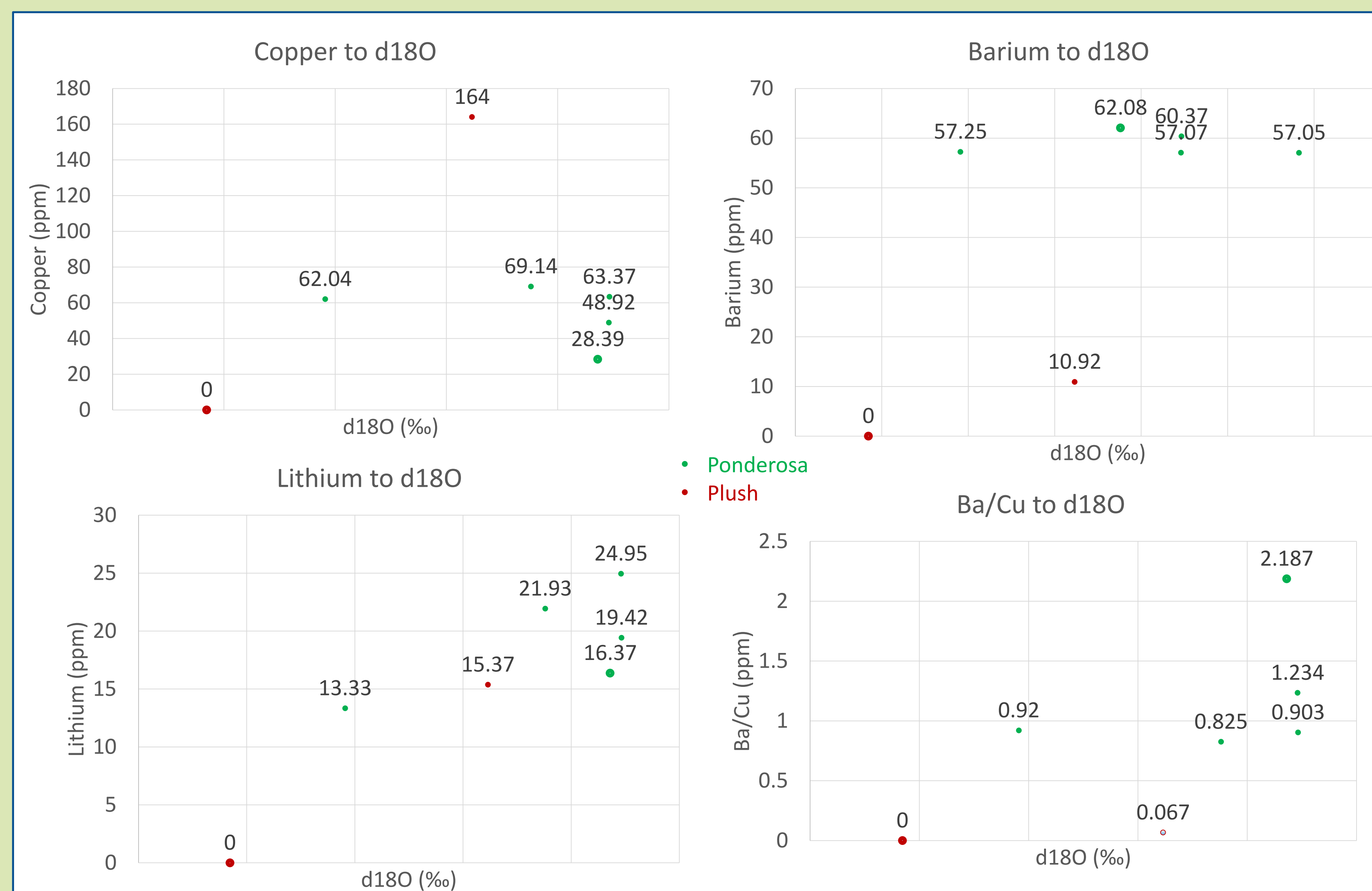
Green for Ponderosa
Red for Plush

Results



Samples

- PB5: is the core and rim from pigeon blood sunstone
- PM5 and PM4: Sunstone from lava flow
- PMBomb: Sunstone from basaltic bomb
- BG9: rim and core of schiller sunstone
- W-6: Watermelon Sunstone
- Sch1 and Sch4: Both schiller sunstone from Plush



Conclusions

- With the evidence that is presented to us as of this research and from previous studies, the evidence is there for both processes, and will need more even more data to get conclusive answers
- Oxygen data does not rule out hydrothermal alteration.
- The Ponderosa mine's sunstones reflect higher delta 18 oxygen, having higher change than 0.2 ‰
- The Plush mine's sunstones are just over 6 ‰ on average, (much less change between samples) hydrothermal processes (meteoric water) are possibly driving it down in delta 18 oxygen.
- Of the 10 analyses, 4 represented 2 crystals with analysis on both core and rim. Both analyses of crystal rims reflected less d18O than their respective cores.
- The sunstones seem to have high amounts of Copper, Barium, and Lithium.
- Barium is strange, so we ratio it with copper to get how much Barium there is to Copper with Delta 18 Oxygen. (see more from Cheyenne's research).

Discussion

- The samples that are the rim suggest to have been exposed to the elements compared to that of the cores.
- Evidence suggests that we might consider looking at the hydrothermal option which would mean copper entered post fractionation.
- Seeing how Ponderosa is lower in d18O ‰ could help in figuring out why one mine has such a older age of crystals. Its hard to say without more extensive research.
- Timing and the right conditions were needed to have the copper enrichment remain unconstrained
- Delta 18 oxygen may not reflect direct evidence of hydrothermal processes
- Samples: PMBomb, PM5, and PM4 were HF leached coming from which may play a factor in why those samples are much higher on the d18O ‰. (see more from Kyle's research).

Acknowledgements



Thanks to Dr. Emily Cahoon we have some of these lovely pictures of the sunstones and of the mechanism found at the University of Oregon

Thank you to Ilya Bindeman for allowing us to come to University of Oregon to utilize the mass spectrometer to achieve our desired results.

Also thank you to the Ponderosa mine owner for allowing us to come to the mine and gather the samples we needed for this project.(sunstones pictures provided throughout poster)