INTRODUCTION & GEOLOGIC BACKGROUND

- Sunstones are large plagioclase feldspar crystals (An65 to An67) that contain Sc, Li, Zn, Ba, and Cu.
- Sunstones exhibit a variety of colors, including pink, yellow, red, and green; and areas of dense color correspond to higher concentrations of Cu within the crystal.
- Age data indicates that the basaltic lavas containing sunstones have a notable age discrepancy.
- The two leading hypotheses for the sunstone source includes magmatic source due to proximity and uniqueness of the lavas. However, heavy weathering and oxidation present in the groundmass of the basalt flows hosting the sunstones suggests that hydrothermal activity played a role.

OUTSTANDING QUESTIONS & HYPOTHESES

This work is a part of a larger collaborative research project surrounding the source and processes involved in copper enrichment within Oregon’s state gemstone. The occurrence of these copper-rich plagioclase is rare, and it is unlikely that the same anomaly would occur only 150 km apart and be unrelated in source.

The goals of this collaborative project are to confirm age discrepancies and characterize geochemical features of sunstones of different colors and source locations.

Potential Sources:
- Copper entered the lattice during plagioclase fractionation (magmatic)
- Copper entered the lattice post plagioclase fractionation at some depth (hydrothermal)

Motivation for this project:
- Are sunstones zoned in major or trace elements? (This Work)
- What is the age of the basaltic lavas that contain sunstones? (Kyle Nunley)
- Is there a systematic relationship between oxygen isotope values of the sunstones and the hosting basalt? (Scott Toney)

RESULTS

Element concentration of individual crystals from rim (colorless) to core (color dense)

<table>
<thead>
<tr>
<th>Location</th>
<th>Groundmass Age (Ma)</th>
<th>Plagioclase Age (Ma)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ponderosa</td>
<td>16.2</td>
<td>8.2</td>
</tr>
<tr>
<td>Plush</td>
<td>~9</td>
<td>10.13</td>
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</tbody>
</table>

Table 1. (Below) Represents the age discrepancies between the ground mass and plagioclase at each mine location.

Oxygen isotope testing will provide insight to the origins of the color varieties possible within Oregon Sunstones. Samples were selected by color intensity and divided as blue-green, watermelon, shiller, and deep red. Note the gradual change from rim to core, this was the focus to determine potential elemental changes not only between mines, but within the stone as well.

CONCLUSIONS

- Sunstones from the two source locations exhibit geochemical fingerprints (i.e. Ba is higher in Plush than Ponderosa)
- Cu variability through Plush crystals is independent decoupled with other elements of interests (i.e. Li, Zn, Ba, Sc)
- In some sunstones Cu and Ba appear anti-correlated (p2_sch8), however in other sunstone Cu seems to have a lot of variability that is not reflected in Ba concentration (p02_sch8)
- Relative to other colors, in shiller sunstones from both locations there is a significant increase in the variability in Cu concentrations in sunstone that does not seem to be reflected in other colors of interest
- Cu and U at both locations seem to be correlated, however there is possibility that sunstones originating from the Plush location sat at higher temperatures longer creating a more flatline correlation.
- Ponderosa element concentrations are more constrained with lower values than that of Plush.

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