Investigation of Miocene age Rhyolite Tuffs Along the Yellowstone Hot Spot Track

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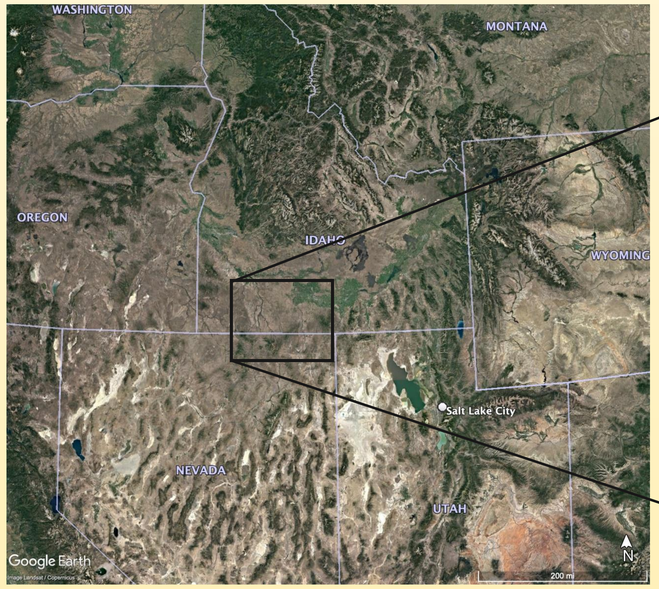
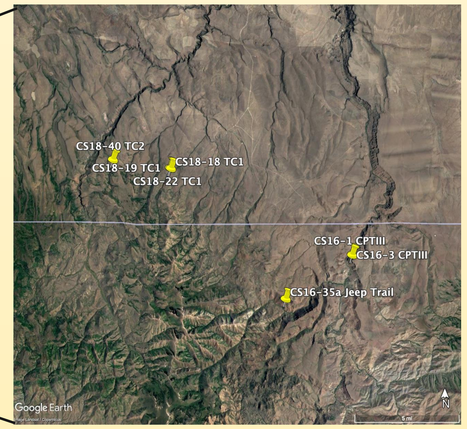
Introduction

Cougar Point Tuff (CPT) (Bonnichsen, 1982), in the Central Snake River Plain (CSRP) was deposited approximately 12.67 to 9.50 Ma in southern Idaho and northern Nevada. This investigation attempts to correlate the lowest exposed unit found in three areas: the Bruneau Canyon area in Nevada (CPTIII), a nearby previously unmapped jeep trail (JT), and the Tokembamy area of Idaho (Tc1) (Bernt and Bonnichsen, 1982). We compare the composition, modal percent, and size of the crystals in these samples to determine if they are from the same eruption, which will help determine the magnitude of the earliest CPT eruption. My research will continue from previous research done by Gabe Carbone, Christian Schrader, and John Bernt with a goal of working towards further knowledge of eruption sizes and provide more information on super eruptions.

Locator Maps





Discussion

- Table 3 shows the area percent of each mineral, CS18-35a has the greatest percentage of overall crystals and the highest percent of alkali feldspars and quartz. Meanwhile, CS16-1 has the lowest overall crystal percentage with the lowest percent for alkali feldspars and plagioclase.
- Table 1 has an average elongation measurement for each sample for alkali feldspar, quartz, and plagioclase. There is a consistent trend between all samples that quartz has the lowest elongation while plagioclase and alkali feldspars have a similar measurement. This fits with the crystal structure for these minerals.
- Images 1-8 are WDS scans of Na concentrations. CS16-1, -1b, and -3 are of known CPTIII units. CS18-18, -19, and -22 are of Tc1 units, CS18-40 is of Tc2 added for comparison and CS18-35a is a Jeep Trail sample.
- Figure 1,2, and 3 show a comparison between the studied samples total area percent of alkali feldspars, quartz, and plagioclase.
- The known CPTIII has more alkali feldspar and has a greater ratio of alkali feldspar, to plagioclase with all being >7 while the rest are all <5.

Methods

- Scans were taken of previously collected thin sections
- XPL scans were used in comparison to wavelength dispersal spectroscopy (WDS) to count and measure individual phenocrysts in ImageJ.
- Any crystals with an area less than 0.106 mm were excluded
- The elongation was calculated by dividing the major and minor (mm) axes. These two measurements were also used in the area calculation.
- The total percentage of phenocrysts was calculated using the area of the scans and the percent of sum of the areas for the crystals.

Sample	Unit	AVG afs elongation	AVG qtz elongation	AVG plag elongation
CS16-1	CPTIII	2.1	1.5	2.2
CS16-1b	CPTIII	1.9	1.9	1.8
CS16-3	CPTIII	1.9	1.7	1.9
CS18-18	Tc1	1.8	1.9	1.9
CS18-19	Tc1	2.1	1.9	1.8
CS18-22	Tc1	1.9	1.6	1.9
CS18-40	Tc2	1.9	1.9	1.9
CS18-35a	Jeep Trail	1.9	1.7	1.8

Table 1

CAT Group	Main BJ units	Main product	Age range (Ma)	Volume (km^3)	Total volume (%)	Cumulative volume (%)	Effusion rate (km^3/Ma)
1	CP III	ign	12.8–12.4	100	1.4	1.4	250
2	CP V	ign	12.4–11.9	300	4.3	5.7	600
3	CP VII	ign	11.9–11.7	1200	17.1	22.9	6000
4	CP IX	ign	11.7–11.5	300	4.3	27.1	1500
5	CP XI	ign	11.5–11.2	1800	25.7	52.9	6000
6	CP XII	ign	11.2–11.0	200	2.9	55.7	1000
7	CP XIII	ign	11.0–10.7	1800	25.7	81.4	6000
8	CP XV	ign	10.7–10.4	200	2.9	84.3	667
9	CT	ign	10.4–10.0	100	1.4	85.7	250
10	LD-BJ	lf	10.0–9.5	200	2.9	88.6	400
11	SC	lf	9.5–9.0	400	5.7	94.3	800
12	DC	lf	9.0–7.5	300	4.3	98.6	200
13	SF	lf	7.5–5.5	100	1.4	100.0	60

Table 2 Leeman et. Al. 2008

Sample	Unit	afs %	qtz %	plag %	Ratio afs/plag
CS16-1	CPTIII	4.8	6.5	0.2	24.0
CS16-1b	CPTIII	6.4	6.8	0.6	11.5
CS16-3	CPTIII	16.0	19.8	2.0	7.9
CS18-18	Tc1	7.6	1.6	5.9	1.3
CS18-19	Tc1	7.7	4.0	1.6	4.9
CS18-22	Tc1	19.8	7.9	7.9	2.5
CS18-40	Tc2	11.4	12.5	5.9	1.9
CS18-35a	Jeep Trail	26.3	35.2	6.8	3.9

Table 3 Total modal percent as determined through ImageJ

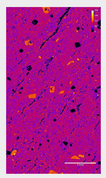


Image 1 CS16-1 Na

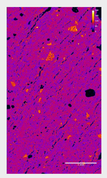


Image 2 CS16-1b Na

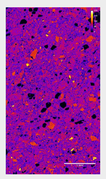


Image 3 CS16-3

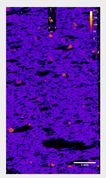


Image 4 CS18-18

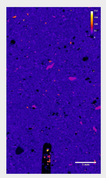


Image 5 CS18-19

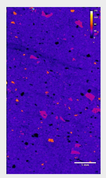


Image 6 CS18-22

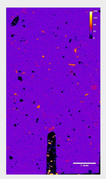


Image 7 CS18-40

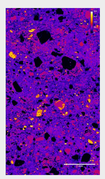


Image 8 CS18-35a

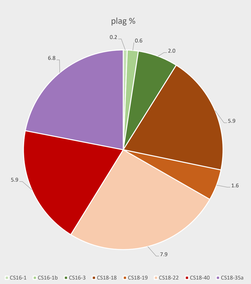


Figure 1

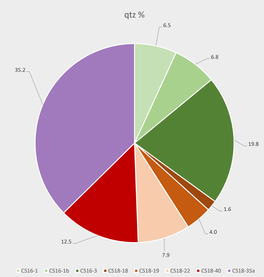


Figure 2

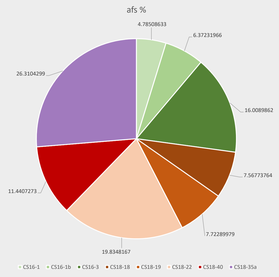


Figure 3

Conclusion

Due to the general structure and appearance of CS18-35a, I find it unlikely that it is part of CPTIII but perhaps an airfall or preliminary deposit prior or after the deposition of the CPTIII unit. The larger amount and size of the phenocrysts could showcase the evolution of the magma chamber between the eruptions. However, I believe that the CPTIII samples are more likely to represent evolution within a magma chamber, with a visible gradient of crystal size, and elongation steadily decreasing from CS16-1 to CS16-3. The calculated elongation shows no significant correlation while the ratio percent of alkali feldspar to plagioclase shows a minor pattern, with the known CPTIII units having the highest ratio. The alkali feldspar to plagioclase ratio supports that CPTIII is a separate eruption from the other units studied.

Acknowledgments

- Cheyenne White
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- Gabe Carbone, 2019, Petrologic Correlations to Expand Volume Estimates of the Miocene Cougar Point tuff, Yellowstone Hot Spot Track
- Bill Bonnichsen, 1982, The Bruneau-Jarbridge Eruptive Center, Southwestern Idaho
- John Bernt and Bill Bonnichsen, 1982, Pre-Cougar Point Tuff Volcanic Rocks Near the Idaho-Nevada Border, Owyhee County, Idaho
- William P. Leeman, er. Al., 2008, Snake River Plain – Yellowstone silic volcanism: implications for magma genesis and magma fluxes.
- Dr. Schrader and his previous work on the topic.