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Pre-Plinian Perplexity: Constraining the Transition from the Blast to Plinian Phases of the 18 May 1980 Mount St. Helens Eruption

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Abstract

The Mount St. Helens 18 May 1980 eruption was a formative event for a generation of volcanologists. The eruption's massive size, as well as its location in the Pacific Northwest, have made it the subject of countless field studies. These studies have focused on discrete eruptive phases such as the Blast and Plinian stages, but relatively little has been done to study and constrain the transitional phases. The transition period in between the Blast and Plinian phases, which occurred between 0830 and 0920 on the morning of May 18, 1980, has yet to undergo a detailed review.

My project seeks to improve our understanding of specific events in this transition period, specifically through analyzing a lesser-known pyroclastic density current (PDC) deposit from this stage. I combine fieldwork with ongoing laboratory work at Boise State to develop a comprehensive picture of how and why this PDC occurred, and why it appears (based on eyewitness reports from the 1980 eruption) to have been unusually cool and pumice-rich. I am investigating the events that led to the creation of this PDC, as well as the impact that its genesis may have had on the main, Plinian eruption which followed a few minutes later. This research may help us to better understand how stratovolcanoes shift from blast to Plinian eruptions. It may also allow us to better understand how volcanic hazards evolve during major eruptions.

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Introduction

- The May 18, 1980 Mt St Helens (MSH) eruption devastated 600 km^2 of Washington State.
- Many of the eruption's phases have been studied in great detail. However, the 45-minute transition period between the Blast phase (the initial explosion, Fig. 1(a)) and the Plinian column (the main eruption, Fig. 1(c)) has not yet been closely examined.
- Photographs taken during this transition phase show a white ash cloud emerging from MSH. This cloud collapsed into a pyroclastic density current (PDC) and moved northwest down the Toutle River drainage (Fig. 1(b)), away from the volcano. Eyewitnesses describe the PDC as having been cool enough for people to survive. A weak plume also deposited ash and pumice to the northwest of the vent during the transition period.
- The objectives of this work are to compare pumice textures from the deposits of the weak plume and transition-phase PDC to those of the Plinian phase, to constrain how vent conditions evolved over time.

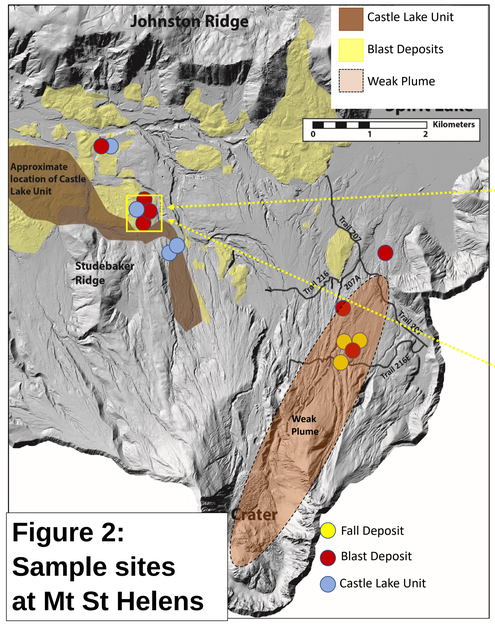

Figure 2: Sample sites at Mt St Helens

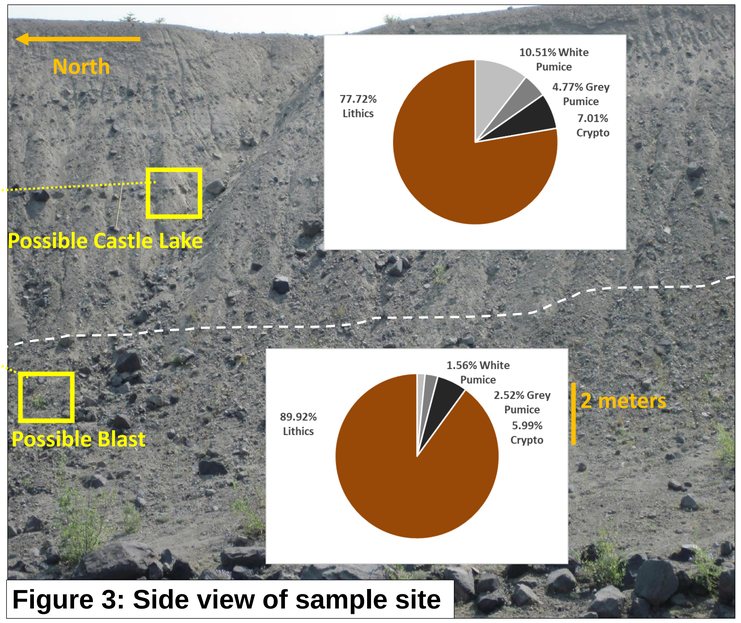

Figure 3: Side view of sample site

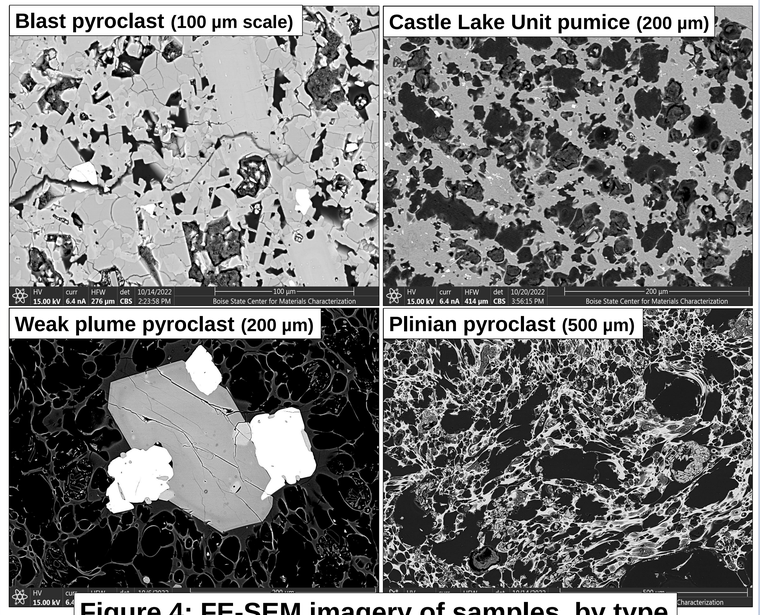

Figure 4: FE-SEM imagery of samples, by type

Methodology

- We took bulk ash, pumice and lithic samples at 14 different sites on Mt St Helens' Pumice Plain (Fig. 2). Samples include the (1) Blast unit (Fig. 1a), (2) Castle Lake Unit (Fig. 1b, Fig. 3), (3) the weak plume fall deposits (Fig. 1b), and (4) the Plinian column fall deposits (Fig. 1c)
- I sorted each of these samples by grain size and mineral componentry. I am comparing possible Castle Lake Unit samples with the other units to highlight any differences in origin or composition.

Results

- **Fig. 2** shows pie-chart analysis of two samples. Sieving and compositional analysis showed a higher proportion of white pumice, and slightly higher levels of grey pumice and cryptodome dacite, in the Castle Lake Unit layer compared to the (lower) Blast layer.
- This Castle Lake Unit layer also contained a palm-sized, embedded fragment of uncharred wood--additional evidence that this deposit was not the Blast, but a later, cooler PDC. Given the site's proximity to the crater (~6 km), any wood fragments should have been charred and fragmented by the Blast.

Next Steps

- We've collected FE-SEM (Field Emission Scanning Electron Microscope) images of selected pumice samples (Fig. 4) for further analysis.
- Vesicles are traces of gas bubbles in magma. These bubbles "froze" in nearly instantaneously, after being ejected during a volcanic eruption. Vesicle shape, size, degree of stretching, and number density provide insights into conduit conditions at the time of fragmentation (magma breakup).
- We will use FOAMS (Fast Object Acquisition and Measurement System) software to analyze the vesicle structures in the weak plume, Castle Lake, and Plinian samples.
- Comparing pumice from these different units will help us to better understand the transition phase of the eruption.

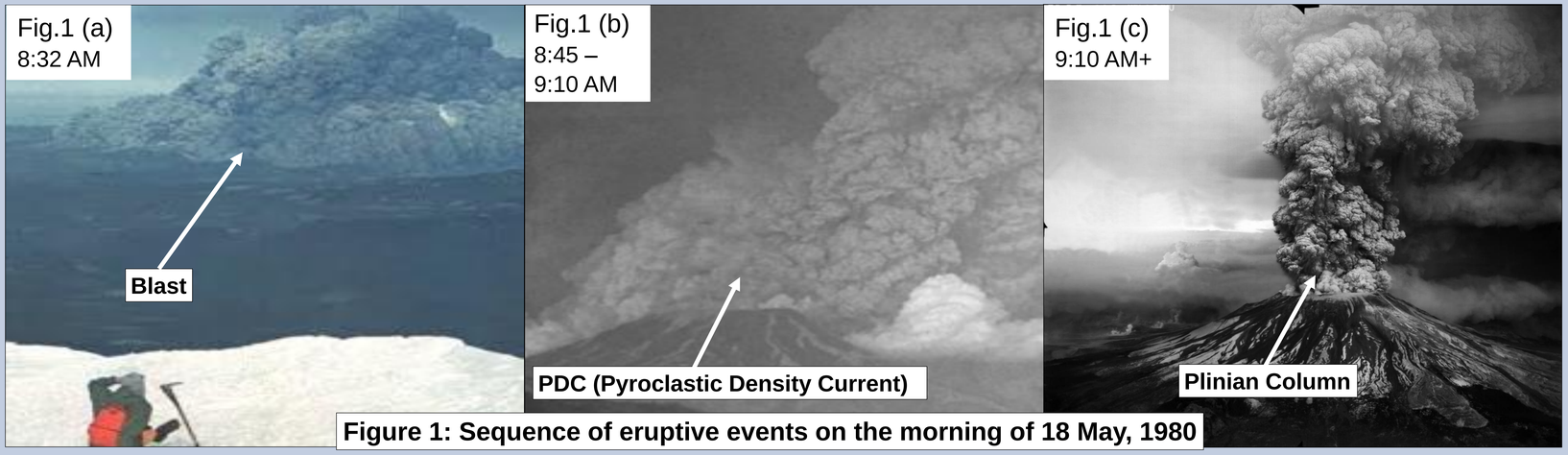

Figure 1: Sequence of eruptive events on the morning of 18 May, 1980

Acknowledgements

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