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Surveying Magmatic Processes Within the Cascades Arc

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Identification of the processes proceeding past eruptions at active arc volcanoes is critical for forecasting hazards, as well as building better models for arc volcanic systems. Magmatic trees provide a method to summarize these processes once identified through petrological, geochemical, geophysical and other methods [1]. Here I compile the last several decades of research to construct magmatic trees for well-studied eruptions in the modern Cascades Arc to both survey the state of our knowledge and compare processes between volcanoes. In total, there is sufficient data to construct trees for approximately 40 eruptions or eruptive periods in the US Cascades. One less commonly discussed finding arising from the tree compilation is that crustal melting appears to be an important process contributing to the majority of intermediate to felsic magmas erupted in the Cascades, consistent with recent experimental work by Blatter et al. [2, 3, 4]. Unsurprisingly, magma mixing is inferred to have initiated most eruptions with mafic recharge (the injection of more mafic magma into a silicic one: [5]) being the most commonly invoked type of mixing. Just a handful of silicic eruptions are interpreted to have been initiated by volatile accumulation or second boiling. In addition, many studies focus only on one stage of a magma's evolution, such that many trees are incomplete and/or multiple studies are required to construct a tree for a single erupted unit. Only a few volcanoes have been sufficiently studied to compare the variations in their magmatic processes across successive eruptions, including Mount Hood, Mount St. Helens, Mount Shasta, Medicine Lake and Lassen. In these cases, the relative diversity of the magmatic processes giving rise to recent past eruptions can be used to infer the most likely processes to operate should these volcanoes erupt again in the future.

[1] Till (2025), *Volcanica* 8(1), 135-157

[2] Blatter, Sisson & Hankins (2013) *Cont. Min. Pet.* 166, 861-886

[3] Blatter, Sisson & Hankins (2017) *Cont. Min. Pet.* 172, 27-64

[4] Blatter, Sisson & Hankins (2023) *Cont. Min. Pet.* 178, 33-73

[5] Kent, Till & Cooper (2023) *Volcanica* 6(2), 161-172