

SESSION 3 - PLANETS, MAGMAS AND VOLCANOLOGY

Title:

What modulates eruptive styles at Villarrica and Osorno volcanoes (Chile)?

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Abstract

Villarrica and Osorno are two active stratovolcanoes in the Central Southern Volcanic Zone (CSVZ) of the Chilean Andes that share several geochemical characteristics: near-primary, tholeiitic parent magmas (50-53 wt. % SiO₂), overlapping major/trace element differentiation trends, and comparable storage conditions [1-4]. Yet, their eruptive styles contrast each other significantly. Villarrica is a steady-state, open-vent stratovolcano with a lava lake since 1985, which produced ~100 low to moderate intensity Strombolian eruptions and lava flows since 1579 CE. Osorno is a closed-vent stratovolcano with 10x less eruptions for the same period. We initially proposed that differences in eruptive style and frequency could be due to a relatively higher degree of crustal permeability under Villarrica than Osorno due to the Liquiñe-Ofqui Fault Zone [5]. Preliminary analyses show that both volcanoes have broadly similar olivine chemistry ranges and multimodal distributions, with minor differences in olivine and melt chemistry/textures between Villarrica (Fo₇₂₋₈₇) and Osorno (Fo₆₆₋₈₂) [4,5]. Diffusion timescales for both volcanoes are mostly < 150 days, with few crystals recording > 250 days. This suggests the degree of crustal permeability underneath the volcanoes are likely comparable, prompting consideration of other factors. In this contribution, we evaluate the role of magma supply rate, storage conditions, and slab input in modulating eruptive styles at Osorno and Villarrica based on an updated dataset of magma storage conditions, diffusion timescales, geochemical data compilations, and inferences drawn from published literature. We find that magma storage conditions of both volcanoes are similar to each other at T~1100°C, P~200 MPa, along with comparable input of fluids released from the down-going slab. The multimodality in olivine chemistry, diversity in types of olivine growth zones and textures, timescale ranges, coupled with the relatively high magma supply rate estimates for Villarrica from the literature suggest magma supply rate could modulate eruptive style at Villarrica and Osorno. With this contribution, we aim to further current understanding of subduction zone magmatism and geodynamics, with implications on volcanic hazard reduction.

1. Vergara et al. (2004). *J. S. Am. Earth Sci.* 17: 227-238.
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3. Pizarro et al. (2019). *JVGR*. 384: 48-63.
4. Bechon et al. (2022). *Lithos*. 106777.
5. Romero et al. (2022). *Bull. Volc.* 85 (2).