Thermodynamic modeling of evolving magma storage conditions beneath Mocho-Choshuenco Volcanic Complex, Chile

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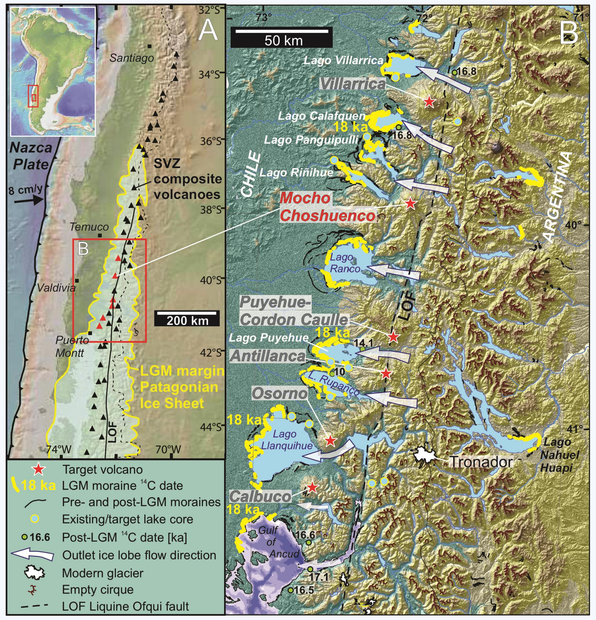
Motivation and goals

- The role of surface loading and unloading by glaciers on magma reservoir systems beneath continental arc volcanoes is poorly understood
- The Southern Volcanic Zone (Chile) is a natural laboratory to investigate the impact of the >1 km thick Patagonian ice sheet (PIS) during the Last Glacial Maximum (LGM, ~18 ka) on composition and eruption rates of several volcanoes, including Mocho-Choshuenco Volcanic Complex (MCVC)
- A model based MCVC tephras (Rawson et al., 2016) suggest the eruption of long-stored rhyolitic magma (13 to 6 ka), followed by mafic eruptions (7 to 3 ka), and andesites at 2.4 ka
- Here, we study the pre-LGM lava record to extent the Rawson et al. (2016) model approach from ~50 ka to present and evaluate the role of rapid glacier retreat

Geologic background

- MCVC is a 110 km^3 composite volcano in the SVZ (39.9°S, 72.1°W). Mocho and Choshuenco stratovolcanoes and the 40 minor scoria cones form a NW alignment (Moreno and Lara, 2007)
- During the LGM, the MCVC was extensively glaciated until 17.8 ka when the ice retreat began (Moreno et al., 2015)



Methods

- Whole-rock compositions and $^{40}Ar/^{39}Ar$ dating of pre-LGM lava flows
- Thermodynamic modelling on the pre- and post-LGM products using AlphaMELTS
- Mineral chemistry using electron probe micro-analysis (EPMA) to test thermodynamic models

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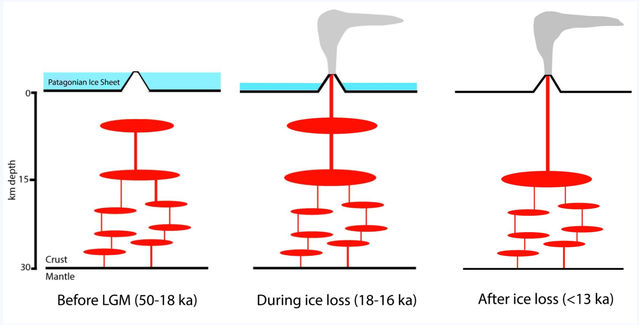
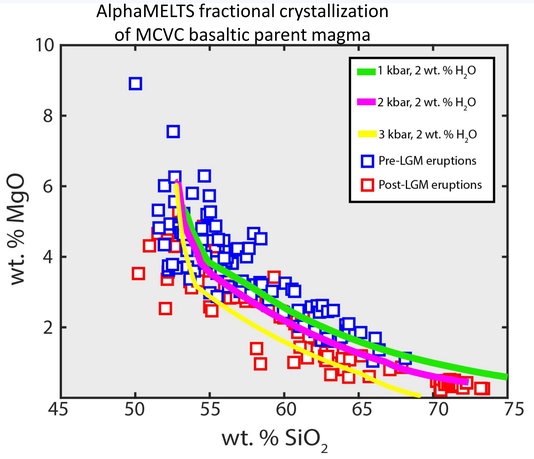
Magma storage conditions

- No radiogenic Ar found in the pre-LGM lava flows collected above 1000 masl suggest that the upper portion of the edifice is much younger than previous age determinations suggest
- Disequilibrium textures in the stratigraphically lower/older lavas indicate magma mixing/mingling and crustal contamination, which are not observed in the younger, upper part of the edifice





- Thermodynamic models of fractional crystallization indicate that the pre-LGM magmas crystalized at 1-3 kbar (4-12 km depth), whereas post-LGM magmas originated from >12 km depth
- The results suggest a change in crustal stress during ice loss that emptied the shallowly stored pre-LGM magma, followed by tapping of deeper source after ice loss

Future work

- $^{40}Ar/^{39}Ar$ measurements on lower portion of the edifice are underway
- Clinopyroxene-liquid and two-pyroxene geothermobarometers will provide P-T-X-fO_2 constrains that will be used to test the thermodynamic models above