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Effect of stratovolcanic edifices on timescales of mafic magma ascent: case study from Puyehue-Cordón Caulle, Chile

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The Southern Volcanic Zone (SVZ) in Chile is an active continental arc with a complex history of volcanism, where a range of magmatic compositions have been erupted in a variety of eruptive styles. Understanding when and how eruptions will occur is thus a key question when constraining future hazards in the SVZ. In particular we focus here on the central SVZ where both monogenetic and polygenetic volcanoes exist, in close proximity to the Liquiñe-Ofqui Fault System (LOFS). Previous studies have inferred varying crustal storage timescales, controlled by the orientation of volcanic centres relative to the N-S striking LOFS in this region (Cembrano & Lara, 2009). Constraining the relationship between volcanism and crustal stress state (including large-scale tectonic structures and edifice controls) presents a challenge when trying to compare across different crustal thicknesses, magmatic source regions and melting regimes. Thus, here we present petrological evidence of mafic magmatic evolution from three volcanic centres, all erupted within the last 20 kyr, and all located within 50 km along strike of the LOFS in the central SVZ.

In this contribution we present whole rock and mineral-specific compositional data coupled with thermobarometry and Fe-Mg diffusion modelling in olivine crystals from mafic lavas from the stratovolcanic edifice of Puyehue-Cordón Caulle. We then compare the textures and compositions of Puyehue-Cordón Caulle mafic lavas with samples of N-S aligned Anticura and the NE-SW trending Carrán Los Venados basaltic monogenetic centres. Textural observations highlight differences in crystal maturation timescales, and only Puyehue-Cordón Caulle samples have any concentric zonation preserved within olivine crystals. Modelled isothermal 1D Fe-Mg diffusion timescales from these olivine crystals are all less than 20 days, suggesting rapid ascent of mafic magmas through the stratovolcano edifice. Yet, the impact of post-eruptive diffusion and growth is evident in these lava samples, and thus timescales presented are all maxima. These samples highlight the impact of both pre-eruptive and post-eruptive diffusive relaxation on modelled timescales, and the importance of collecting rapidly cooled samples for diffusion chronometry.

[1]Cembrano, J., & Lara, L. (2009)Tectonophysics, 471(1-2), 96-113.