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So close, so different: Calbuco and Osorno volcanoes (Central Southern Volcanic Zone, Chile) tap into mantle sources that diverge only in their volatile content

JACQUELINE E. VANDER AUWERA[1], TONIN BECHON[1,2], SALVATRICE MONTALBANO[1,3], OLIVIER BOLLE[1], PIERRE SCHIANO[4], NICOLAS CLUZEL[4], JEAN-LUC DEVIDAL[4], LUISA OTTOLINI[5], LUIS E. LARA[6], OLIVIER NAMUR[7] AND THOMAS VAN GERVE[7]

[1]University of Liege
[2]University of French Polynesia
[3]ISSEP
[4]Laboratoire Magmas et Volcans, Université Clermont Auvergne
[5]National Research Council of Italy
[6]Universidad Austral de Chile
[7]KU Leuven

The H_2O content of mafic arc magmas varies within a narrow range (2-7 wt. %) globally as well as between geographically close volcanoes or within a single volcanic edifice. In these latter cases, the H_2O content and slab tracers are generally correlated. Along with the major and trace element (LA-ICPMS, SIMS) composition, we analyzed the volatile content (H_2O, S, Cl) (EPMA, FTIR, SIMS) of olivine-hosted melt inclusions (MI) from the Osorno (OS) and Calbuco (CL) stratovolcanoes, which are located just 20 km apart along the arc front of the Central Southern Volcanic Zone (Chile). The major and trace element composition of the MI align closely with their respective whole-rock datasets. A comparison of the MI compositions between the two volcanoes reveals the following: 1) overlapping differentiation trends for major elements, except for a slightly steeper increase in TiO_2 at OS; 2) overlapping trace element ratios, particularly those influenced by the slab flux; 3) significantly higher H_2O and Cl contents at CL compared to OS (1 wt. % (OS) versus 3 wt. % (CL) H_2O in the parent magmas). This difference is further supported by petrographic observations (presence of amphibole in intermediate magmas at CL, absence at OS), higher explosivity at CL relative to OS, petrological models, and the tholeiitic index (THI). The data shows that these different H_2O contents are not correlated with the ratios of incompatible elements that are sensitive to the slab flux. Using the calculated composition of the primary magmas, we quantified the mantle melting conditions beneath both volcanoes. The results indicate that both primary magmas were produced by similar partial meting fractions of mantle sources, differing only in H_2O content. This suggests that the mantle source beneath CL underwent partial melting at lower temperature. We further propose that this could be linked to the slightly more trenchward position of CL, that projects vertically into a cooler part of the mantle wedge “nose”. These findings also suggest that, during the interaction between the slab flux and the mantle wedge, shortly before partial melting and magma transport to the lower crust, H_2O was decoupled from the incompatible elements.