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Magmas of the El Quemado Complex (Chon Aike Silicic Igneous Province, Patagonia): Elevated Oxygen Isotope Signatures Across Space and Time

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The generation and source of ~230,000 km³ of total erupted volume of the predominately silicic (>90 %; Pankhurst et al., 2000) magmas which comprise the Jurassic Chon Aike Large Silicic Igneous Province (CASP) of Southern Patagonia is currently debated. In this study, we conducted a widespread sampling of multiple eruptive units, primarily ignimbrites and minor rhyolitic flows, along the Eastern Andean front (~47°S to 49°S), owing to the third and youngest eruptive episode of the CASP (El Quemado Complex; EQC). To determine the magmatic source and potential role of a significant crustal contribution proposed in the generation of these magmas, we analyzed the in-situ $\delta^{18}\text{O}$ composition of both quartz and zircon by SIMS. We combined these data with LA-ICP-MS U/Pb analyses on single zircon crystals to characterize the potential for changing oxygen isotopic values through time and space within the EQC units along this ~230 km long transect.

The northern-most units sampled have the lightest average $\delta^{18}\text{O}$ (relative for the EQC) analyzed in zircon and quartz (7.7 and 10.4 ‰, respectively). Oxygen isotope values increase towards the South, with the highest $\delta^{18}\text{O}$ values previously reported in El Chaltén, reaching up to 10.1 ‰ for zircon and 12.5 ‰ for quartz (Seitz et al., 2018). Eruptive units from the same locality appear to be homogeneous in their oxygen isotopic composition.

U/Pb zircon ages for the EQC range overall from ~148 to 155 Ma, though no obvious trend from North to South in zircon crystallization ages is noticeable. Multiple inherited zircon cores (at ~230, 460, 500, 1300 Ma) with Jurassic magmatic overgrowths were discovered. Isotopic compositions of these inherited magmatic cores are variable in their $\delta^{18}\text{O}$ values throughout time. However, and more significantly, most of these inherited cores record high $\delta^{18}\text{O}$ values, with the highest value at 9.5 ‰ measured for a ~460 Ma core. These high values measured within inherited cores are found at all locations sampled for the EQC.

The $\delta^{18}\text{O}$ values of the EQC rocks are significantly higher than what would be expected for silicic magmas formed by simple closed-system fractionation from any mantle-derived melt (6-7‰; Valley, 2003). Thus, our oxygen isotope data support significant input of crustal material - of either a sedimentary origin or from hydrothermally altered crust - to generate these ignimbrites and rhyolites with elevated $\delta^{18}\text{O}$ values all along this transect.