EGU2020-3519
https://doi.org/10.5194/egusphere-egu2020-3519
EGU General Assembly 2020

Ignimbrite flare-ups in the Central Andes: Crustal sources and processes of magma generation

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Silicic magmatism in the Central Andes forms rhyolitic to dacitic volcanic deposits that range from large-volume ignimbrites (>1000 km3) to small local dome eruptions. The mass proportion between mantle-derived magmatic contributions to crustal melting was previously estimated to range from 20 to 70 % based on Sr-O isotope data obtained on separated feldspar and quartz contained as crystal cargo. New O-Hf isotope data from in-situ ion-probe and laser ablation measurements of U-Pb-dated zircons further constrain type, proportion, and processes of crustal input into silicic magmas. Variations in time and space of these geochemical parameters are documented here using representative samples that cover the entire Central Andes over 20 Ma and 800 km distance. Systematic covariations in isotope tracers relate to increasing crustal thickening through time during Andean orogenesis. Collectively, Sr-Nd-Pb-Hf-O isotopic signatures vary in space and time and temporally reflect increasing crustal input during ignimbrite flare-ups as the crust becomes thermally matures. Spatial variations derive from different crustal domains in the Central Andes and reflect the different age and composition of crustal components.

Remarkably, inherited zircon representing basement involved in crustal assimilation is exceedingly rare over the entire province. This most probably reflects high temperatures that exceed zircon saturation temperatures of crustal melts in ignimbrite-forming magmas. This observation distinguishes silicic ignimbrite-forming magmatism from typical granitoid-forming magmatism in orogenic settings where abundant older zircons inherited from the crust are commonly found.