Zircon inheritance from long-lived sources of Late Triassic post-orogenic plutons, High Andes, Central Chile (similar to 30 degrees S): Magmatic feedbacks and petrogenetic implications

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Abstract

A comprehensive understanding of the magmatic system evolution and petrogenetic environment is crucial for the correct interpretation of magmatic zircon age spectra. In the Central Andes, a protracted Late Paleozoic period of collisional to post-collisional magmatism was followed by Late Triassic emplacement of post-orogenic plutons and associated mantle precursors. Some of these magma products are crowded with inherited zircons with a large age span at the sample scale (>25 Myr). This work deals with two contrasting inheritance-rich plutons: the peraluminous cordierite-bearing Los Tilos pluton (LTp) and the peralkaline hypersolvus Ferro-edenite/hedenbergite-bearing Monte Grande pluton (MGp). Both plutons were derived from melting of the crust: the peraluminous S-type granite represents derivation from mixed materials, whereas the peralkaline A-type leucogranite embodies nearly eutectic melts enriched in incompatible elements. Rapid cooling of entrained assemblages suggests that segregation and subsequent ascent was rapid, following emplacement-site isobaric cooling at ca. 3.5 and 2 kbar, for LTp and MGp respectively. Most zircons were inherited; their disparate chemistry originates from contrasting sources, unveiling an open-system behavior.

The effects of variations in magma temperature, emplacement pressure, and water content were evaluated in light of zircon entrainment and dissolution potential, within a thermodynamically consistent framework. Relatively dry magmas (<3 H2O wt%) readily preserve inherited zircons whereas similar size intrusions in excess of water most probably dissolve zircons in less than 12 kyr. In this geological context, early zircon armoring and source enrichment is vital to enhance zircon preservation at high temperatures.

We suggest that the large age span observed in zircon samples of both plutons reflects a long-lived source that fed arc-related granites in the Early to Middle Triassic, culminating in the Late Triassic with the final extraction of highly enriched crustal melts, in a post-orogenic context. Dry high-silica (>75

SiO2 wt%) magmatic flare-ups, in extensional settings, fulfill the inheritance requisites presented here. Contrastingly, a broad zircon age span in large talc-alkaline batholiths emplaced at similar depths, reflect not source processes but rather magmatic erosion, crystal armoring and recycling of previous magma batches, and a complex crystallization history, spanning the whole duration of batholith construction.

Palabras clave

Palabras clave de autor: Zircon inheritance; Post-orogenic; Thermodynamic modeling; S-type granite; Ferroan granite

KeyWords Plus:TRACE-ELEMENT COMPOSITION; GRANITIC MELTS; IGNEOUS ROCKS; ICP-MS; LU-HF; BEARING; CORDIERITE; GROWTH; ARC; PB

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