MAGM-3: Técnicas analíticas en geociencias

Timescales of pluton emplacement and rhyolite melt extraction within a late Miocene epizonal Andean pluton from U-Pb TIMS dating of zircon and $^{40}Ar/^{39}Ar$ thermochronology

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Rhyolite that fuels explosive silicic eruptions is thought to originate in the upper crust via extraction of melt from crystal-rich magma reservoirs. Although these reservoirs may grow incrementally over 10^4-10^5 yr, they can be remobilized prior to eruption much more rapidly within hundreds to thousands of years. Advances in U-Pb dating of zircon using Chemical Abrasion, Isotope Dilution Thermal Ionization Mass Spectrometry (CA-IDTIMS) methods now permit precise dating of the assembly and magmatic processes in young plutons. Thus connections between the timescales of long-term assembly and transient melt-forming events can be investigated. The 150 km^3 late Miocene (7.2 to 6.2 Ma) Risco Bayo-Huemul plutonic complex at 36°S in the Maule region of the Chilean Andes comprises 1-20 km^3 domains of calc-alkaline gabbro through high-silica granite emplaced at 3-7 km depth. The mafic to intermediate Risco Bayo pluton comprises incrementally emplaced magma batches that exhibit sharp internal field contacts. In contrast, textural, bulk rock, mineralogical, and petrochronologic data suggest the domains of the younger silicic Huemul pluton preserve near-end members of high-silica melt segregation and complementary residual silicic cumulate formation. U-Pb CA-IDTIMS dates from zircon and $^{40}Ar/^{39}Ar$ thermochronology from the biotite, amphibole, and orthoclase in the granitoids and hornfels wall-rock together illuminate the assembly and cooling durations of individual domains. Risco Bayo zircon dates range from 7.193±0.014 to 6.958±0.053 Ma documenting the emplacement of at least four magma batches over 240 kyr. The $^{40}Ar/^{39}Ar$ dates indicate that these batches cooled rapidly, yet imposed a modest thermal priming of the crust prior to intrusion of the Huemul pluton. Huemul U-Pb zircon dates span ~190 kyr, from 6.384±0.022 to 6.199±0.022 Ma and suggest that silicic cumulate compositions reach the solidus 7-234 kyr prior to the hypothesized extraction of the high-silica melt domain that caps the complex and is in contact with the exposed roof rocks. Numerical simulations are used to test the temporal and thermal viability that Huemul domains might have unmixed from a single parental magma. The geochronology implies long-term magma emplacement rates of $1\text{-}6\times10^{-4}$ km^3/yr akin to other plutonic systems, however, the numerical simulations and isotopic dates limit the duration of melt extraction within the Huemul pluton to volcanic timescales of only ~30-100 kyr.