Hafnium isotopes as a geochemical tracer in zircon from tonalite plutons from Adamello, northern Italy

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Due to its similarity to Zr in ionic radius, tetravalent charge, and electronic configuration, Hf may substitute in the zircon crystal structure in concentrations up to several weight percent HfO_2. This high concentration of Hf may be used as an isotopic tracer, which in this study will be determined in situ by LA-MC-ICPMS, to better understand the petrogenesis of igneous intrusive suites. This can be done because hafnium is a high field-strength element, relatively immobile, with a low diffusion rate, and as such preserves isotopic information incorporated at the time the zircon crystallized. When incorporated into the crystal structure of zircon, the Hf composition will remain relatively consetant even when exposed to post-emplacement processes such as metamorphism, deformation, and alteration. The rocks that make up the Adamello Batholith in northern Italy have been essentially undisturbed since their post-Alpine Orogeny emplacement, making this region an ideal natural laboratory for studying magmatic pro-

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cesses. The geochemical attributes of Hf isotopes in the zircon crystals may provide insights into the magmatic history and emplacement of poly-intrusive tonalitic and related rocks of the Adamello Batholith.

Zircon samples from six tonalitic plutons (one sample per pluton) from the Adamello Batholith were previously dated using secondary ion mass spectrometry (SIMS). The SIMS analyses produced U-Th-Pb zircon rim ages ranging from ~43 Ma to ~33 Ma for samples from southwest to northeast, respectively, across the batholith. Although results from the SIMS analysis agree with geochronological results, zircon grains in some of the samples contain inherited cores (ranging from ~200–2500 Ma which are some of the oldest geological objects thus reported in the Eastern Alps). Furthermore, the SIMS U-Th-Pb results indicated that several individual zircon crystals have varying ages for rims and cores. Three types of core-rim age variations were identified: (1) rims and cores of statistically similar age; (2) rims with slightly older cores; and (3) young rims with significantly older inherited cores. This study is subdivided into three parts, each answering a very specific question regarding age differences of the zircon grains:

1. Determine whether there is a systematic variation in εHf values for the rims of zircons from oldest to youngest plutons. Epsilon hafnium for these plutons may give insight into the origin, evolution, and/or magmatic relationship between the plutonic events.
2. For zircons that show age variations, investigate if there is compositional change of Hf isotopic composition in the rims and cores of these grains and if so, establish a unifying explanation for why this is so.
3. The third question to be addressed is why some zircons show core inheritance (i.e., young rim-very old core) and the nature of the inheritance whereas other zircon crystals from the same rock do not. Using Hf isotope data, it is believed that a concrete explanation will be established.

