

Periods of magma propagation and homogenization preserved in an upper crustal pluton over 1.2 Ma

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Large, broadly homogeneous plutons are a major component of subduction-related batholiths. The Western Adamello Tonalite (WAT) in the Italian Alps is an excellent example of a homogeneous pluton, featuring rocks with similar texture and composition over 6 kilometers (100 km²). Locally, heterogeneous zones of up to a few hundred meters wide interrupt the homogeneous tonalite. They consist of basement xenoliths, mafic enclaves, schlieren, and hornblende-rich cumulates and are parallel to the host rock contact. Forty-five igneous samples from two transects perpendicular to the host rock contact were collected and analyzed for major and trace elements, stable and radiogenic isotopes (O, Sr, Nd), and U-Pb zircon geochronology.

U-Pb high precision dating on four samples yields ages of 37.6, 37.1, 36.7 and 36.4 Ma (youngest zircon from each sample), indicating a younging towards the internal parts of the pluton. The age spread within a single sample is over 200 ka, and no overlap between the four samples exists. Thermal models predict that a single batch intrusion of the size of the WAT would cool ten times faster than the age span of 1.2 Ma recorded by the samples. This, along with structural and chemical observations suggests incremental emplacement.

Major and trace elements show a trend towards more SiO₂-rich (evolved) compositions for the younger, internal parts. In contrast, stable isotopes only vary in the first couple of meters close to the host rock contact, indicating wall rock assimilation. A step-like increase of ⁸⁷Sr/⁸⁶Sr (and decrease of ¹⁴³Nd/¹⁴⁴Nd) coincides with the observed heterogeneous zones. The change in radiogenic isotopic values occurs over a few hundred meters, whereas the flat plateaus of similar isotope composition persist over areas that are a factor ~5 wider. This suggests that new feeder conduits are rapidly established and successive pulses of magma are isolated from the surrounding host rocks. Two such cycles can be seen in the WAT. We propose that this alternation results from processes at the level of an intermediate crustal reservoir. The general geochemical evolution, in contrast, mainly reflects changes in the deeper magma system.

Precise U-Pb ID-TIMS baddeleyite and zircon ages for the Florianópolis Dyke Swarm and its correlation to Paraná-Etendeka mafic to intermediate magmatism

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The coastal region of Santa Catarina, south Brazil, features abundant mafic to intermediate dykes from the Paraná-Etendeka Magmatic Province (PEMP), which compose the Florianópolis Dyke Swarm (FDS). These are hosted by Neoproterozoic granites which locally show evidence of remelting at the contacts with the mafic dykes. NE-trending, high-TiP dykes akin to the high-Sr Urubici lava-type are predominant, and are locally crosscut by thinner, NW-trending dykes similar to the low-TiP Gramado lava-type. Basalt compositions are largely predominant, but some dykes of intermediate composition occur showing evidence of magma mingling. U-Pb ID-TIMS dates obtained on baddeleyite and zircon from both mafic and intermediate dykes yield precise crystallization ages at *ca.* 134 (±0.5) Ma. These ages coincide with the best current estimates for the climax of volcanic activity in the neighbouring PEMP lava pile, as indicated by both U-Pb and ⁴⁰Ar/³⁹Ar dates. The close chemical and temporal relations with the lavas are good indicators that the dykes must correspond to feeders of the lava pile. The ~20 Ma span of ⁴⁰Ar/³⁹Ar dates (140-120 Ma) reported in the literature for the FDS may be an overestimate of the duration of dyke emplacement in the swarm, possibly reflecting both Ar loss and, in some cases, Ar excess resulting from the contamination of the magmas by K-rich melts derived from the host granites.