Geophysical Research Abstracts
Vol. 21, EGU2019-6446, 2019
EGU General Assembly 2019

Argon geochronology provides evidence of multiple episodes of magmatic growth of highly retentive potassium feldspar in the Naxos granodiorite

Marnie Forster (1), Sue Keay (2), and Gordon Lister (1)

(1) ANU, RSES, Structure–Tectonics Team, Canberra, Australia (marnie.forster@anu.edu.au), (2) CSIRO, Data61, Cyber Physical Systems, Brisbane, Australia

Here we analyse and model the results of an ultra-high-vacuum (UHV) diffusion experiment on potassium feldspar from the Miocene Naxos granodiorite. The UHV diffusion experiment was conducted using the 39Ar isotope produced during neutron irradiation. Measurements were made at the same time as a conventional step-heating argon geochronology analysis, allowing conjoint inversion of the different datasets. We show that, in this way, argon geochronology using potassium feldspar provides a versatile thermochronometer, because different diffusion domains have a wide range of closure temperatures. We take particular note of highly retentive core domains that appear to be able to retain radiogenic 40Ar at temperatures that approach or exceed the granite solidus. The argon age spectrum shows multiple partial plateaux, at ∼11.7 Ma, ∼11.0 Ma and ∼10.1 Ma, consistent with previous U–Pb SHRIMP zircon analyses. The zircons show magmatic rims from earlier episodes of zircon growth, but they also show magmatic rims from the same time interval as recorded by the argon analyses. Therefore, we suppose that the argon data record growth while the granodiorite was still partially molten. This is physically possible because the UHV diffusion experiments yielded Arrhenius data that show the core domains of the potassium feldspar were sufficiently retentive as to be able to retain radiogenic 40Ar at or above the solidus for wet melting. The diffusion data also allow modelling of the effect of arbitrary pressure-temperature-time (P-T-t) paths, and the results show that such elevated temperatures need to have been maintained until the onset of rapid cooling beneath the Naxos detachment fault, at ∼10.1 Ma. Rapid cooling then led to final solidification of the granite, with temperatures falling below ∼120°C by ∼10 Ma, consistent with the formation of seismic melt veins (pseudotachylite) adjacent to the still active detachment fault. The U–Pb SHRIMP measurements of the ages of zircon rims, and the 40Ar/39Ar age spectrum from potassium feldspar, taken together, indicate multiple episodes of magmatic mineral growth at temperatures at or near the solidus. This observation is consistent with the tectonic position of the Naxos granodiorite at the core of an Aegean core complex which was subject to extreme extension while the granite was fluxed by pulses of hot fluids that plumed upwards through the mantle and overlying crust, from the subducting Hellenic slab.