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The effect of thermal resetting and recrystallisation on white mica 40Ar/39Ar ages during retrograde metamorphism on Syros, Greece

Bertram Uunk, Jan Wijbrans, and Fraukje Brouwer
Deep Earth and Planetary Science cluster, De Boelelaan 1085, 1081HV Amsterdam, The Netherlands (bertr@muunk.nl)

White mica 40Ar/39Ar dating is a proven powerful tool for constraining timing of metamorphism, deformation and exhumation. However, in high-pressure metamorphic rocks, dating often results in wide age ranges which are not in agreement with constraints from other isotopic systems, indicating that geological and chemical processes complicate straightforward 40Ar/39Ar dating. In this research project, white mica ages from rocks of the Cycladic Blueschist Unit on Syros, Greece with contrasting rheology and strain mechanisms are compared, in order to better understand the role of deformation, recrystallization and fluid flow on 40Ar/39Ar ages of white mica during retrograde metamorphism.

Resulting ages vary along different sections on the island, inconsistent with other isotopic constraints on eclogite-blueschist metamorphism (55-50 Ma) and greenschist overprinting (41-30 Ma). Two end-member models are possible: 1) Results represent continuous crystallization of white mica while moving from blueschist to greenschist conditions in the metamorphic P-T loop, or 2) white mica equilibrated in eclogite-blueschist conditions and their diffusion systematics were progressively perturbed during greenschist overprinting.
The single grain fusion analyses yielded contrasting age distributions, which indicate contrasts in degree of re-equilibration during retrograde metamorphism. Step wise heating of larger grain populations resulted in flat plateau shapes, providing no evidence for partial resetting. Electron microprobe measurements of Si per formula unit, as a proxy for pressure during crystallisation, do not explain age variation within sections or on the island scale.

The previously unreported north-south age trend and age ranges per sample, as shown only in the 40Ar/39Ar system of the metapelitic and marble lithologies, contains key information that will allow us to test between different scenarios for age formation. Excess argon infiltration at this stage seems to have been of minor importance. Our new approach should lead to a better understanding of the interplay of these processes during and after HP metamorphism.