Geophysical Research Abstracts
Vol. 21, EGU2019-5028, 2019
EGU General Assembly 2019

Sr and Ar diffusion systematics in polygenetic white micas from Naxos

Igor M Villa (1,2), Johannes Glodny (3), Uwe Ring (4), Alasdair Skelton (4), and Alexandre Peillod (4)

(1) Università di Milano Bicocca, Dipartimento di Scienze dell'Ambiente e della Terra, Italy (igor@geo.unibe.ch), (2) Universität Bern, Institut für Geologie, 3012 Bern, Switzerland, (3) German Research Centre for Geosciences GFZ, Telegrafenberg, 14473 Potsdam, Germany, (4) Dept of Geological Sciences, Stockholm University, 10691 Stockholm, Sweden

The metamorphic history of Naxos includes an Eocene blueschist event, Oligocene greenschist retrogression, and a Miocene high-temperature overprint. Age attributions for these three events are inconsistent [1-3].
We report an approach to resolve the contradictions by combining electron microprobe (EPMA) characterization of the white mica (WM) generations with multichronometry. The WM samples analyzed by [2] consisted of "coarse" and "fine" sieve fractions (500-160 μm and 90-160 μm). Four samples of that suite were selected for further investigation; on three of them we obtained closely spaced EPMA analyses of WM crystal chemistry. EPMA demonstrates that all three WM samples are strongly heterogeneous, each consisting of at least three chemically distinct generations. This chemical disequilibrium explains [4] why Rb-Sr isochrons have MSWD >30 [2]. As in other polymetamorphic rocks [5], the two sieve sizes consist of different WM generations.
Both sieve fractions of each WM sample were analyzed by 39Ar-40Ar stepheating. All eight age spectra are hump-shaped, as expected [1]. The Cl/K vs age isotope correlation diagrams give linear arrays in the HT zone in central Naxos, proving that two WM generations predominate (one Cl-poor at ca. 38 Ma, one Cl-rich at 20-30 Ma). A lower grade sample (NA0710) from southern Naxos was less pervasively recrystallized, is older, and preserves $\geq$ 3 WM generations. The "fine" sieve fractions are always Cl-richer than the "coarse" ones. The Cl-Si-rich, younger phengitic WM is preferentially enriched in the fine fraction. In the high-grade central part of Naxos, Rb-Sr ages [2] coincide with K-Ar ages. Ar diffuses 4x10^4 times faster than Sr [6], therefore (i) K-Ar and Rb-Sr only can agree if both date mica crystallization, (ii) subsequent diffusive Ar loss from WM was negligible. Na0710 preserves one relict generation with a K-Ar age > 62 Ma (cfr. [3]), as anticipated from the high Ar retentivity of WM [7]. The high-MSWD Rb-Sr 36 Ma isochron age of Na0710 [2] is not reliable, as several non-cogenetic phases coexist in mutual disequilibrium.
The degassing rates of the fine and coarse WM fractions rule out "multidomain" diffusion (see the discussion of grainsize dependence of degassing in [8]). As no sample is monomineralic, each degassing is controlled by the mass balance of the unrelated rate constants of its constituent phases. Major element heterogeneity suggests that all HP phengite grains are intergrown with retrograde muscovite, at a scale <1 μm [5]. The HP event occurred around 38 Ma, relict mica survives in the low-grade zone.

[1] Wijbrans & McDougall, Contrib.Mineral.Petrol. 93 (1986) 187 - [2] Peillod et al., J.Metam.Geol. 35 (2017) 805 - [3] Cao et al., Tectonophysics 745 (2018) 66 - [4] Glodny et al., Contrib.Mineral.Petrol. 156 (2008) 27 - [5] Heri et al., Geol.Soc. London Spec.Pub. 378 (2014) 69 - [6] Bosse & Villa, Precamb.Res., in press - [7] Villa et al., J. Petrol. 55 (2014) 803 - [8] Chafe et al., Contrib.Mineral.Petrol. 167 (2014) 1010