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Dating metamorphic processes: combining phase equilibria and multichronometer geochronology

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We compare multichronometric data on well-preserved equilibrium assemblages so as to assess the systematic of dating metamorphism. By documenting PT-conditions using multi-equilibrium thermobarometry (TWQ: Berman, 1988), chemical equilibrium in the major element mineral phases is tested. Samples with precise PT-estimates are then dated by Ar-Ar and, where possible, by other chronometers, such as monazite and other REE-minerals, which may be applied to date mineral growth.

This study focuses on the transition between greenschist and epidote amphibolite facies, with samples taken from the Northern Steep Belt of the Central Alps. Mesozoic metasediments in this area present a large variety of rock types, all of which experienced but one orogenic cycle. Aluminous metasediments and metamarls have proven most useful as their mineral assemblages involve numerous equilibria, which constrain the PT-data well. Many geochronological data have been obtained over the past 50 years in that area. Although problems of inheritance limit the interpretability of many of these, some of the classic K-Ar ages for micas and the U-Th-Pb for monazite may be usefully compared with the new mica ages (Ar-Ar).

We present results from: **(A) Alpe Devero**, W of Val Antigorio (Italy): The assemblage Grt-Bt-Ms-Pl-Qz equilibrated at 10 ± 1 kb, 615 ± 50 ˚C. The Ar-Ar (isochemical) age on muscovite is 15.4 ± 0.2 Ma; two different biotite fractions yield ages of 13.8 ± 0.4 (250-500μm) and 12.1 ± 0.3 Ma (125-250 μm). **(B) Val Piora** (Ticino, Switzerland): The assemblage Grt-St-Bt-Ms-Pg-Pl-Qz equilibrated at 7.5 ± 0.5 kb, 550 ± 20 ˚C. The Ar-Ar age on intergrown muscovite and paragonite is 18.9 ± 0.7 Ma and on biotite 17.5 ± 0.8 Ma.

TWQ shows that biotite underwent no late recrystallization. In the zones studied, bi-

otite ages are always younger than muscovite. In terms of “closure temperature”, closure to Ar diffusion is constraining to occur at temperature lower than TWQ equilibration ($550 \pm 20^{\circ}$C). This is supported by biotite (A), with two size fractions yielding different ages, and by biotite-muscovite age differences. Regarding muscovite, geological interpretation must await monazite data. New monazite in the more aluminous metasediments forms, starting at much lower metamorphic grade (Janots et al., 2006).

Berman, R. (1988): J. Petrology. 29, 445-522.

Janots, E., Engi, M. and Berger, A. (2006): this meeting.