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Understanding Tertiary metamorphic ages in the northern Central Alps

J. Allaz (1,2), E. Janots (1), M. Engi (1), A. Berger (1) and I.M. Villa (1,3)

(1) Institute of Geological Sciences, University of Bern, Switzerland, (2) (jallaz@geo.unibe.ch / Phone: +41-31-631-4738), (3) Università di Milano Bicocca, Italy

Despite numerous studies over a long time involving many geochronologists (e.g. Hunziker et al., 1992), metamorphic ages obtained for the northern Central Alps pose major problems of interpretation. Data may reflect inheritance from earlier metamorphic stages or effects of isotopic loss, in either case ages are not readily interpretable. Based on multichronometry using well-equilibrated metapelites and metamarls, we attempt a reinterpretation of the Pressure-Temperature-time (PTt) evolution during the Tertiary Barrovian metamorphism in the northern Central Alps.

The area of interest lies in the northern part of the Lepontine domain. Sampling has been restricted to Mesozoic metasediments showing well-equilibrated mineral assemblage and textures. Over the area studied, a metamorphic field gradient emerges from uppermost greenschist facies to middle amphibolite facies. We used TWQ (Berman, 1988) to calculate equilibrium PT-conditions and DOMINO (de Capitani and Brown, 1987) to compute the PT-evolution for suitable bulk-rock compositions. Conditions documented increase from North to South: 400 => 620˚C, 6 => 8-10 kbar.

In terms of U-Th-Pb dating, we used prograde allanite ($T_{formation}$ ca. 400˚C), which partially breaks down *in-situ* to monazite ($T_{formation}$ ca. 570˚C); this offers the possibility to date two distinct stages in one and the same sample. Th-Pb and U-Pb SHRIMP dates on allanite and monazite yield ages of 29.1-31.5 Ma and 18.0-19.1 Ma, respectively. Considering the maximum temperature recorded by the samples dated (ca. 580˚C), these ages are interpreted to reflect crystallisation conditions rather than later closure. Therefore, the difference of 13.5 Ma between the two ages is thought to represent the time elapsed during prograde heating from 400˚C to 570˚C.

Ar-dating of white mica in similar samples from this region yields 20 to 18 Ma, consistent with the monazite age. Thus these Ar-ages for white micas should pertain to the equilibrium conditions documented (520-570˚C, 6-8 kbar), and full Ar-retention is indicated upon cooling from this temperature. At higher T (e.g. Pizzo Molare and Alpe Devero, 580-620˚C), muscovite Ar-ages are 16.5 to 15 Ma, i.e. 2 to 4 Ma younger than monazite ages for that area. However, these monazite data are not for the same types of samples. In these cases, partial Ar-loss may have reset the mica ages. Biotite dated in many of the same samples always is found to be $>$1 Ma younger, confirming Ar-loss in tri-octahedral micas at these temperatures (500-600˚C).

Our results have important implications regarding the geodynamical evolution of the Central Alps. In the northern part, frontal units reached ca. 400˚C at 30 Ma (allanite ages) and metamorphic peak temperatures at 20-18 Ma (monazite and muscovite ages). The allanite and monazite ages indicate an average heating rate of 13˚/Ma (E. Janots et al., 2007). The regional distribution of ages shows that the thermal peak was diachronous from the southern to the northern part of the Central Alps, with ages of 30-27 Ma north of the Insubric line and 20-18 Ma at the northern margin of the Lepontine. There, zircon fission track data of 14-12 Ma indicate rapid cooling to 350˚C (Rahn et al., 2004). An average cooling rate of 37˚/Ma is determined from the monazite ages and the zircon fission track data.

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

C. de Capitani and T.H. Brown (1987): Geochim. Cosmochim. Acta 51, 2639-2652.

J.-C. Hunziker et al. (1992): Mem. Geol. Lausanne 13, 59 pp.

E. Janots et al. (2007): this session.

M. Rahn et al. (2004): Am. Min. 89, 473-484.