Alpine orogenic evolution from subduction to collisional thermal overprint: $^{40}Ar/^{39}Ar$ age constraints from the Valaisan domain

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The area investigated, located at and adjacent to the north-eastern edge of the Lepontine dome, occupies a key location in the Central Alps: metasedimentary units derived from the Valaisan and adjacent distal European domains record subduction-related HP/LT metamorphism in the north-east (Engadine window and wider Grisons area) while the same units are affected by collision-related Barrow-type amphibolite facies metamorphism within the NE rim of the Lepontine dome (Lukmanier/P. Molare). The timing of (a) earlier high-pressure metamorphism (42-40 Ma), (b) subsequent decompression and greenschist facies overprint (36-29 Ma) and (c) later Barrow-type overprint (18-16 Ma) was studied by $^{40}Ar/^{39}Ar$ dating of biotite and several white mica generations that are well characterized in terms of mineral chemistry, texture and associated mineral assemblages.

Phengites, texturally associated with Fe-Mg carpholite, yield apparent ages of 42-40 Ma, interpreted to date HP/LT conditions at 350-400 °C and 1.2-1.4 GPa (D1; Safien phase). The age constraints for mineral reactions occurring during or immediately after decompression were obtained on white mica intimately associated with chlorite found within pseudomorphs after carpholite. They reveal two age populations: an earlier one clusters at 36-33 Ma, a later one at 32-29 Ma, respectively. We relate the older retrograde stage to substantial decompression during which carpholite was destabilized by a reaction producing white mica, chlorite and quartz during D2 nappe stacking (Ferrera phase). The younger population is interpreted as related to greenschist facies metamorphic overprint at the end of decompression. Additionally, the white mica data also reveal a coherent apparent age cluster at ~ 25 Ma whose significance is not yet clear. Biotite that only occurs in the SW part of the study area and that clearly grew during collision-related amphibolite facies metamorphism within the Lepontine dome, only post-dated by the formation of the northern steep belt, dates a late and distinct pervasive Barrovian overprint for which the ages cluster around 18-16 Ma.

These isotopic data reveal a significant time gap in the order of some 20 Ma between the subduction-related HP/LT event (42-40 Ma) and the peak of the later collision-related MP/MT Barrovian overprint that immediately predates the 18-16 Ma age interval. This supports the notion of a polymetamorphic evolution associated with a bimodal P-T path. Amphibolite facies Barrow-type overprint in the Lepontine dome represents a distinct heating pulse that post-dates isothermal decompression as well as a greenschist facies overprint after the early high-pressure stage. We propose that the accretion of vast amounts of European continental crust led to the formation of the present-day Lepontine dome via high radiogenic heat production. Such heat transfer is interpreted to be entirely conductive and therefore rather slow, leading to surprisingly young and essentially post-kinematic amphibolite facies metamorphism in the north-eastern Lepontine.