Subduction-related high-pressure metamorphism in Valaisan and Ultra-Helvetic sedimentary units followed by a separate Barrow-type heating event in the northern Lepontine dome (Switzerland)

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Occurrences of Fe-Mg-carpholite, indicating HP/LT metamorphism under blueschist facies conditions, are widespread in meta-sediments derived from the Valaisan domain (so-called "Bündnerschiefer", Bousquet at al. 2002). However, such carpholite bearing rocks were so far only known from areas situated east of the Barrow-type Lepontine metamorphic dome (Grisons and Engadine window) and from the Petit St. Bernard area located southwest of this dome, respectively. No relics of such a blueschist facies event were found so far within the intervening part of the Valaisan units, traversing the northern part of the Lepontine dome. This study documents such relics of blueschist metamorphism within the northernmost Lepontine dome for the first time and investigates the question whether Barrow-type Lepontine metamorphism merely represents a later stage of a continuous PT-evolution, or alternatively, a later thermal event.

The working area, located around Olivone/TI in the NE part of the Lepontine dome, exhibits a remarkable field metamorphic gradient, ranging from carpholite bearing rocks in the east (Luzzone valley) to classical Barrow-type amphibolite facies overprint further west (i.e. Pizzo Molare). Within the working area pseudomorphs after carpholite were found to be widespread in meta-sediments derived from the Valais-Bündnerschiefer, as far south as Pizzo Molare, located far inside the amphibolite facies realm of the Lepontine dome. Moreover, pseudomorphs after carpholite also occur at the northernmost rim of the Lepontine dome, i.e. within parts of the Mesozoic sediments in Ultra-Helvetic facies, tectonically overlying the Gotthard-"massif" (Peidener Schuppenzone). This clearly points to the existence of a contiguous former subduction zone located at the transition between Valaisan and Helvetic paleogeographic domains ("Subpenninic units") while up to now only a middle greenschist facies metamorphic event was known for this transitional area. The new findings raise questions after the temporal and spatial relationships between the two metamorphic events.

Three deformation phases could be distinguished: D1, D2 and D3, related to regional phases. Relationships between metamorphism and deformation unambiguously show that the HP event predates D1 (or perhaps is syn-D1). Pseudomorphs after carpholite were then

refolded by D2, while the amphibolite facies minerals formed later and during a deformational lull between D2 and D3. Hence the Bündnerschiefer derived from the Valaisan domain of the eastern Lepontine dome and adjacent Ultrahelvetic sediments show a discontinuous two- stage tectono-metamorphic evolution: (1) A subduction event produced HP/LT metamorphism under blueschist facies conditions and also affected the northern parts of the present-day Lepontine dome, documenting the existence of one contiguous Valaisan suture between Western and Eastern Alps. (2) "Lepontine" (Barrovian) metamorphism occurred after isothermal or cooling decompression during syn-D1 nappe stacking. Hence the amphibolite facies minerals found in the northern parts of the Lepontine dome grew during a separate heating pulse.

We emphasise that this separate heating pulse is only documented for the northern part of the Lepontine dome. This contrasts with recent findings from the southern part of the Lepontine dome, where it is well documented that Barrow-type metamorphism represents the final stages of a continuous P-T-loop, reached at by isothermal decompression from an eclogitic stage (Keller at al. 2005, Nagel et al. 2002). The exact causes for this separate heating pulse that affected the northern part of the Lepontine dome are yet unknown. We speculate that processes such as radiogenic heat production by the accretion of continental material (Goffé et al. 2003) and/or slab break-off during the post-collisional stages of Alpine orogeny (von Blanckenburg & Davies 1995), may be responsible for this separate late-stage heating event.

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