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Anatomy of an ancient subduction interface at 40 km depth: Insights from P-T-t-d data, and geodynamic implications (Dent Blanche, Western Alps)

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An exhumed metamorphic suture zone over 40 km long is exposed in the Dent Blanche Region of the Western Alps belt, along the Swiss-Italian border. In this region, the metasediment-bearing ophiolitic remnants of the Liguro-Piemontese ocean (Tsaté complex) are overthrusted by a continental, km-sized complex (Dent Blanche Tectonic System: DBTS) of Austro-Alpine affinity. The DBTS represents a strongly deformed composite terrane with independent tectonic slices of continental and oceanic origin. In order to better understand the nature and the geodynamic meaning of the shear zone at the base of the DBTS (Dent Blanche Thrust, DBT) we re-evaluated the pressure-temperature-time-deformation (P-T-t-d) history of these two units using modern thermobarometric tools, Rb/Sr deformation ages and field relationships.

Our results show that the Tsaté complex is formed by a stack of km-thick calcschists-bearing tectonic slices, having experienced variable maximum burial temperatures of between 360°C and 490°C at depths of ca. 25-40 km, between 41 Ma and 37 Ma. The Arolla gneissic mylonites constituting the base of the DBTS experienced a continuous record of protracted high-pressure (12-14 kbar), top-to-NW D1 deformation at 450-500°C between 43 and 55 Ma. Some of these primary, peak metamorphic fabrics have been sheared (top-to-SE D2) and backfolded during exhumation and collisional overprint (20 km depth, 35-40 Ma) leading to the regional greenschist facies retrogression particularly prominent within Tsaté metasediments. The final juxtaposition of the DBTS with the Tsaté complex occurred between 350 and 500°C during this later, exhumation-related D2 event.

Although some exhumation-related deformation partially reworked D1 primary features, we emphasize that the DBT can be viewed as a remnant of the Alpine early Eocene blueschist-facies subduction interface region. The DBT therefore constitutes the deeper equivalent of some shallower portions of the Alpine subduction interface exposed 200 km eastwards in eastern Switzerland (e.g. Bachmann et al., 2009). Our results shed light on deep (25-45 km) subduction zone structures and dynamics and are therefore of major interest for geophysical studies imaging the plate interface region in active subduction zones.