Is the Rocca Canavese Thrust Sheet (Italian Western Alps) a subduction-related mélange? A multidisciplinary approach

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In the Sesia-Lanzo Zone (SLZ), the subunit Rocca Canavese Thrust Sheet (RCT) is characterized by a mixture of mantle- and crust-derived lithologies such as metapelites, metagranitoids, metabasics, and serpentinised lherzolite lenses, from meter to hundred-meter size. We use a multidisciplinary approach in order to evaluate whether this tectonic mixture can be interpreted as a former subduction-related mélange in the Austroalpine domain. In particular, we perform a structural and metamorphic analysis of metagabbros, Jd-bearing and Lws-bearing glaucophanites to estimate their P-T-t-d evolution during the Alpine convergence. We also compare the geologic results with the predictions of a numerical simulation of an ocean-continent subduction zone.

Metagabbros and Jd-bearing glaucophanites experienced a D1a metamorphic stage characterized by a pressure of 1.3-1.8 GPa and temperature of 450-550°C, in eclogite facies condition. On the other hand, Lws-bearing glaucophanites experienced a D1b metamorphic stage at a temperature <470° and pressure of ca. 1.2-1.5 GPa, in Lws-blueschist facies condition. The two tectono-metamorphic units (TMUs) were coupled together during the exhumation at D2 stage, under Ep-blueschist facies conditions. Successive evolution occurs at lower pressure, under greenschist facies conditions. D1a peak conditions are compatible with a thermal gradient between a cold and a warm subduction zone, while D1b peak is recorded in a thermal gradient compatible with a cold subduction. The coupling between the two TMUs occurred under a cold thermal gradient, suggesting a still active subduction.

We develop a 2D FEM simulation of an ocean-continent subduction zone in order to verify the tectonic evolution of the two TMUs and estimate the amount of mixing occurring in a subduction-related mélange. The predictions of the numerical model well reproduce the two peak conditions (D1a and D1b) as well as the successive coupling of the two TMUs under Ep-blueschist facies conditions. Interesting, the peak conditions lie along two different P/T gradients. Thus, the two different thermal gradients showed by the two peak conditions can represent two burial paths probably accomplished in different positions within the subduction channel. The amount of mixing estimated in the field well agrees with that predicted by the numerical simulation. According to our multidisciplinary analysis, RCT is a tectonic mixture of recycled crustal slices and hydrated mantle material formed within a subduction channel. The different origin and P-T-d-t paths of the blocks, the intense shearing experienced by all lithologies during their coupling and the abundance of serpentinites in the tectonic mixture agree with the interpretation of a subduction-related mélange for RCT.