P-T-t estimates in low-grade metamorphic terrains, a key to reconstruct the geodynamic evolution of the Alpine continental subduction (Briançonnais zone, Western Alps)

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The study of the geodynamic evolution involving continental subduction and exhumation processes requires knowledge of detailed Pressure-Temperature-time paths as recorded in different units across mountain belts. Such P-T-t estimates can be obtained from well equilibrated high-grade metamorphic rocks; usually several methods are available. By contrast, in low-grade metapelites P-T-t estimation using such an approach is challenging, especially if no index minerals occur. Metapelites at greenschist facies metamorphic conditions show a poor spectrum of metamorphic minerals, such as quartz, chlorite and K-white mica; commonly detrital metamorphic relics inherited from a prior metamorphic history remain. Therefore, to acquire reliable P-T estimates a multi-method approach is required, involving qualitative and quantitative Raman study of Carbonaceous Material (RSCM), chemical analysis from standardized X-ray maps and multi-equilibrium inverse thermodynamic modelling of chlorite and white mica. This thermobarometry study may be coupled with $^{40}Ar/^{39}Ar$ dating on newly crystallized phengite in order to constrain the age of crystallization.

In the French Western Alps, the Briançonnais zone is a remnant of the continental subduction wedge. Several studies conducted over the last ten years have aimed at constraining the P-T-t conditions and evolution of the internal parts of the continental wedge (e.g. the Vanoise and Ambin massifs) during the Alpine orogeny. By contrast, the metamorphic evolution of the external part of the Briançonnais Zone, (i.e. the Briançonnais cover and the Briançonnais Zone houillère) remains largely unconstrained. The present study focused on these units; P-T and P-T-t paths were estimated using a multi-method approach advertised above. Examples will be shown, notably for a sandstone sample in the Briançonnais Zone houillère. The study allows distinguishing Hercynian peak metamorphic conditions of 371 ± 26°C and 3.5 ± 1.4 kbar (recorded by detrital minerals) and Alpine peak metamorphic conditions of 275 ± 23°C and 5.9 ± 1.7 kbar. Another sample, taken further south, from the Plan-de-Phasy unit, allows to estimate phengite crystallization conditions at 270 ± 50°C and 8.1 ± 2 kbar at an age of 45.9 ± 1.1 Ma. According to these and previous results in more internal parts of the Briançonnais zone, an adjusted geodynamic model is proposed for the evolution of the Alpine continental subduction. The results are consistent with a diachronous evolution of the Briançonnais zone involved in the Alpine continental subduction.