Low-grade tectono-metamorphic overprint in the Carboniferous Badstub Formation as Alpine convergence record in the shallow crust of the Drauzug-Gurktal Nappe System, Upper Austroalpine basement nappes

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Within the Carboniferous of Nötsch, the Badstub Formation is a clastic sequence in the topmost Drauzug-Gurktal Nappe System of the Upper Austroalpine basement nappes exposed few kilometres north of the Gailtal line (e.g., Piller, 2014), an eastern segment of the Periadriatic Fault System (Carinthia, Austria). This sequence consists of conglomerate, breccia, sandstone and siltstone, and fossil-rich carbonatic schists that form a south-dipping monoclinal stratigraphy. The prevalent clastic rock type is metabasite. Although these Palaeozoic sequences preserve pristine sedimentary features clearly detectable at a first glance and are even famous for the outstanding fossil records, multi-scale structural analysis disclosed a syn-metamorphic foliation in fine-grained rocks, sets of mineralised faults, veins, and corona textures. Vein fillings and coronas within intra-clast space contain equilibrium mineral assemblages characterised by prehnite, pumpellyite, chlorite, phengitic mica, winchite, and riebeckite. Thermodynamic modelling based on mineral assemblages and chlorite geothermometry constrain metamorphic conditions at 260 - 310°C and 0.25 - 0.50 GPa that are consistent with a temperature / depth ratio of about 20°C km^{-1}. This ratio falls in the maximum term of the range of the pressure and temperature estimates of the Eo-Alpine metamorphic peak in the Upper Austroalpine basement nappes (e.g., Janák et al., 2015; Schulz, 2017). Therefore, we set a 2D thermomechanical model that simulates a generic ocean-continent convergence and that shows the fitting of this thermal state at different time steps in the upper and lower continental plate either during oceanic subduction or continental collision. Without any radiometric age constraint, we envisage that the tectono-metamorphic record of the Badstub Formation was recorded during the Alpine times by ablation of upper continental plate operated by the subducting oceanic plate or in the passive margin of lower continental plate because of collision. Anyhow, during the Alpine convergence, the Badstub rocks were buried from the shallow crust at depths between 13 and 18 km and eventually stacked into the orogenic wedge at the Adria margin. During the downward and upward path, the Badstub rocks were translated as a coherent poorly strained block according to the scarce possibility of mylonite development in a low-grade metamorphic environment, as predicted by numerical modelling (Regorda et al., 2021). This is the first quantitative constraint on metamorphism for these Carboniferous rocks and is consistent with the Upper Austroalpine basement nappes being a tectonic system that recorded the Alpine convergence under eclogite to prehnite-pumpellyite facies conditions.

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