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Local variations of metamorphic record from compositionally heterogeneous rocks: Inferences on exhumation processes of (U)HP-HT rocks (Cima di Gagnone, Adula-Cima Lunga unit)

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The record of metamorphic conditions may be highly heterogeneous in spatially close rocks with different composition and rheology. The Cima di Gagnone area (Central Alps) represents an example of ultrahigh–pressure and high–temperature ultramafic lenses enveloped within amphibolite–facies metasediments. Structural investigations demonstrate that the rheologically strong ultramafics and eclogites and weak metapelites experienced a common Alpine deformation history in a single tectonic unit, excluding their coupling within a tectonic mélange (Maino et al., 2021). New structural, microstructural and petrological analyses and thermodynamic modelling results on the metasediments, confirming that all rocks generally experienced medium pressure and medium temperature conditions of 1.0–1.2 GPa and 640–700 °C, followed by a retrograde stage around 0.6–0.8 GPa and 600–675 °C. However, significantly higher *P–T* conditions of 1.3–3.0 GPa and 750–850 °C are locally developed close to the rheological boundary depicted by the micaschists-peridotite contact (Corvò et al., 2021; Piccoli et al., 2021). Rock and mineral chemistry changes during growth of new mineral phases indicate a local melt/fluid interaction (i.e., metasomatism) between metasediments and ultramafics during the high temperature deformation. The local occurrence of (U)HP and HT conditions is demonstrated by the absence of significant melting in the unit, although around the peridotite lenses, metapelites show hydrated assemblage at T>800 °C were stable at variable P stage. U-Pb zircon and monazite dating indicate that local HP and HT conditions were accomplished at the early stage of Alpine exhumation (~36 Ma), while the rocks fa form the rheological boundaries records only pre–Alpine ages. Our results documented that, even though weak metasediments share the same structural evolution with the strong UM, large differences in the local metamorphic conditions (ΔP up to 2 GPa; ΔT up to 160 °C) are recorded in relation to the distance from the UM lenses. Fluid–assisted metasomatism is further documented as being strongly localized at the interface between ultramafic lenses and the metapelitic host throughout all part of the metamorphic evolution, including the HP–HT stage.

Therefore, in the Cima di Gagnone type–locality, the interplay between metapelites and ultramafic exerts a crucial first–order control to allow assemblage equilibrium during HT metamorphism and amphibolite–facies retrogression. These new findings exclude that the different metamorphic record may be attributed only to differential preservation during the retrograde path. Our new *P–T–t–D* paths highlight the crucial role of the rheological boundaries in modify the P-T metamorphic records without varying lithostatic pressure and thus depth conditions.

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