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Rheological inheritance vs. disruptive tectonics: on the lithological incoherence of the High Pressure (HP) Cima Lunga Unit (Central Alps)

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The wavelength and size of nappes and related shear zones are governed by physical processes such as folding and faulting and by material properties. In most of the cases, theoretical and numerical studies of such processes perform with an idealized and simplified initial situation within an orogenic wedge. However, field studies sometimes document complex structural nappes and nappe piles that do not fit the results of these physical models. When this happens, the complexity is attributed either (i) to inherited magmatic, sedimentary and structural features that cause heterogeneous rheological conditions, (ii) to poly-phase and/or poly-orogenic structural evolution or (iii) to different geodynamic scenarios that involve mélanges within subduction channels.
We present here the field study of the eclogitic Cima Lunga Unit as an example of a locally lithologically incoherent unit whose complexity has been interpreted in the different ways listed above. Our new and published geological, structural, petrological and geochronological data are placed in the context of the nappes pile of the Central Alps, from bottom to top: the Leventina, Simano, Adula/Cima-Lunga and Maggia units. The Cima Lunga Unit comprises paragneisses, orthogneisses, sheets of marble and calcschist and lenses of mafic and ultramafic rocks that locally have an incoherent character. It differs lithologically from the other gneissic units in the higher frequency of ultramafic bodies and eclogites. This sheet-like unit crops out almost horizontal and is internally deformed. Deformation decreases downward in the Simano unit over ca. 1 km. This strain gradient is recognizable with a top to bottom opening of folds (from isoclinal to close folds). The upper boundary with the Maggia unit follows a folded surface at the base of a granodioritic gneissic body. Along this shear zone, syn- to post-mylonitic leucosomes attest partial melting during deformation. The HP metamorphism is limited to minor volumes of mafic and ultramafic rocks with P conditions peaking at around 2.5 GPa and 750°C. Published geochronological ages date this metamorphism at ca. 40 Ma. In the Cima Lunga unit, the later Barrovian metamorphism dated at ca. 33 Ma shows PT conditions of ∼650°C and 0.7 GPa and is associated with incipient partial melting dated until ca. 22 Ma close to the Insubric line to the South. All these geological data will be used to validate or discriminate the still debated scenarios listed above. Results from different disciplines come to opposing conclusions. However, based on our map and geological observation we tend to favor the hypothesis of an inherited pre-alpine, maybe pre-Variscan, sedimentary basin containing serpentinitic blocks which was reworked, deformed and metamorphosed during the Alpine orogenic cycle. In this scenario, the Cima Lunga unit is not the equivalent of the Adula nappe to the East.