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Heat transfer through the nappes of the Lepontine Dome

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The heat transfer through the nappes of the Lepontine Dome (Central Alps, Ticino, Switzerland) produced metamorphic amphibolite-facies isogrades that locally dissect the tectonic contacts. This large-scale observation, suggesting a thermal amphibolite-facies event after thrusting and nappe formation, is however at odd with the extremely pervasive mineral and stretching lineation (NW-SE directed) that attests non-coaxial deformation during shearing at similar metamorphic conditions.

To solve this apparent paradox we performed 2D thermo-kinematic simulations in which we investigated the relationships between nappe geometry and the geometries of isogrades. The numerical simulations are based on the finite difference method. We evaluate the relative importance of velocity, thermal diffusion and advection, and geometry of the thrust sheets, on the geometrical relation between tectonic contacts and isogrades. We calculate the thermal evolution and peak temperatures in order to compare the numerical results with field and petrological data collected along the Simano and Cima Lunga nappes.

In the field, the alternation of lithotypes is parallel to the nappe boundaries and constant over their whole length (order of kms). Passing from the Simano to the Cima-Lunga nappe, the transition between the nappes is marked by a progressive change in the texture of gneisses, in which the porphyroblasts become more stretched from the bottom to the top, and by the change in the constituent lithotypes. In the studied area, the Simano nappe is formed mainly by metagranitoids and by minor paragneisses. The Cima Lunga nappe is made of metasediments, mainly quartz-rich gneisses intercalated with amphibolite-gneisses, peridotitic lenses and local calcschists and/or marbles. Finally, the widespread paragneisses forming both the nappes frequently contain garnets of different sizes and internal microstructure. Published and own petrological data of these garnet-bearing rocks will be used to restrict the physical parameters of the numerical results.

We intend to test multiple geological scenarios related to different sources of heat production, such as: internal heat sources (radiogenic heating); additional heat flux at the bottom of the nappes, such in the case of a magmatic underplating, slab break-off, lower crust delamination; and in situ-produced heat due to shear heating mechanisms at the tectonic boundary between the nappes (thrust surface).