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A new restoration of the NFP20-East cross section and possible tectonic overpressure in the Penninic Adula Nappe (Central Alps)

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The Adula Nappe in the eastern Central Alps is one of the four units in the Alps from which ultrahigh-pressure rocks have been reported. Several very different models for its tectonic history have been published but none of these models is fully satisfactory. In the models of Schmid et al. (1996) and Engi et al. (2001), the main mechanism of exhumation is assumed to be extrusion. The extrusion models require top-to-the-hinterland, i.e. top-to-the-south faulting in the hanging wall of the exhuming nappe for which there is no evidence. Froitzheim et al. (2003) proposed a scenario with two different subduction zones, an internal one in which the South Penninic and Briançonnais domains were subducted, and an external one in which the North Penninc domain and the European margin, including the Adula nappe, were subducted. In this model, the exhumation of the Adula nappe results from the subduction of the overlying sub-Briançonnais and sub-South-Penninic mantle in the internal subduction zone. The Adula nappe would then have been exhumed from below into a top-to-the-north shear zone also affecting the overriding Briançonnais units. The main shortcoming of this model is that otherwise there is little evidence for two Alpine subduction zones.
All the models cited above are based on the conversion of peak pressures obtained from geobarometry to depth by assuming lithostatic pressures. This results in a much greater burial depth of the Adula Nappe with respect to the surrounding units which poses major problems when trying to reconcile maximum burial depths of the Penninic nappes with their structural record.
We performed a new restoration of the NFP20-East cross section (Schmid et al. 1996) without applying a lithostatic pressure-to-depth conversion but a purely geometrical restoration of deformation events in the Penninic nappe stack. The major constraints on these reconstructions are given by strain estimates for the major deformation phases in the units overlying the Adula Nappe (Mayerat Demarne 1994) and zircon fission track ages (Flisch 1986) indicating that the Austroalpine units have not been more than 10 km below surface after the Palaeocene. The maximum pressures of eclogites from the Adula nappe reported in the literature are about 1.8 times as high as the lithostatic pressures derived from our cross section restoration. Given that tectonic overpressure in an orogen may be as high as lithostatic pressure (Petrini and Podladchikov 2000), the results of our cross section restoration suggest that the exceptionally high pressures recorded by the Adula Nappe may not be due to exceptionally deep burial but, at least partly, to tectonic overpressure.

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