Geophysical Research Abstracts, Vol. 9, 06808, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-06808

What controls the presence of HP-UHP continental rocks in convergent zones? Application to the Western Alps

P. Yamato, E. Burov, P. Agard, L. Le Pourhiet and L. Jolivet

Laboratoire de tectonique, Université Pierre et Marie Curie - Paris 6, CNRS, UMR 7072, 4 place Jussieu, F-75005 Paris, France

(philippe.yamato@lgs.jussieu.fr)

Occurrences of high pressure-ultra high pressure (HP-UHP) rocks at convergent plate boundaries (e.g., Alps, Himalayas, Norway…) imply important downward and upward vertical movements of material during burial and exhumation. The downward movements can be explained by the subduction of the continental lithosphere during the initial stages of continental convergence. Yet, the exhumation of deep rocks is much more difficult to explain, first because it is the lightest rocks of continental origin that exhibit the highest recorded pressures and second, because it appears that the HP-UHP exhumation is bimodal, with higher exhumation rates early in the exhumation process ($>$10 mm.yr^{-1}) and slower rates later, approximately once the material has reached crustal depths ($<$5 mm.yr^{-1}).

In this study, we try to understand the mechanisms that govern these phenomena. We focus our study on the Western Alps (e.g., UHP and HP rocks of Dora Maira and Gran Paradiso, respectively). This choice is stimulated by the abundance of the related structural and metamorphic data and by sufficient knowledge of the geodynamical context. We model continental subduction using numerical thermo-mechanical visco-elasto-plastic thermodynamically coupled models that reproduce a realistic thermo-rheological structure of the lithosphere and allow for precise tracing of the trajectories of the metamorphic facies. Comparison of the calculated P-T-t paths and exhumation rates with those inferred from petrology data allow us to (1) test the influence of various parameters such as the rheology of the continental crust, convergence and erosion rates and (2) constrain the mechanisms responsible for burial and exhumation

processes.

The results suggest that for UHP burial/exhumation in the Alpine context, the convergence rates have to be lower than <1.5 cm.yr^{-1}. Yet, the convergence rates do not appear to directly control the exhumation rates, as it would be in the case of simple accretion prism mechanisms. The first stage of exhumation is controlled by the buoyancy and viscous shear forces and requires a double-layered crustal structure with two ductile zones, from which the material can be exhumed. Erosion rates only control the slower second stage of exhumation and the related erosion coefficients are quite high (>1500 m^2.yr^{-1}). It is also noteworthy that we do not observe any important deviations from the lithostatic pressure in the exhumation zone.