Geophysical Research Abstracts, Vol. 8, 03500, 2006
SRef-ID: 1607-7962/gra/EGU06-A-03500

Exhumation of the Dora Maira UHP unit : a special case ?

S. Duchêne, M. Ford

Centre de Recherches Pétrographiques et Géochimiques, CNRS, Vandoeuvre lès Nancy, France

The Dora Maira ultra-high pressure (UHP) unit is an end-member in the metamorphic evolution of the high-pressure tectonostratigraphic units of the alpine belt. The peak metamorphic pressure recorded by this unit is the highest ($c.$ 0.3 GPa), the age of metamorphism is the youngest (35 Ma), and the exhumation is the most rapid (at least 10 mm a^{-1} of vertical exhumation rate).

In order to discuss the subduction-exhumation history of the Dora Maira UHP unit, we have reconstructed its trajectory based on compiled Pressure-Temperature-time data, which have been integrated into a plate convergence model.

The subduction history of the UHP Dora Maira unit is compatible with plate convergence models if we interpret the Dora Maira massif as the distal limit of the European margin (Briançonnais domain). Between 50 Ma and 35 Ma, 195 km of north-south convergence is estimated to have occurred in the central and western Alps. If the edge of the Dora Maira UHP unit was just entering the subduction channel at 50 Ma, it is reasonable to estimate that it was subducted down to 100 km depth (assuming lithostatic pressure gradients) in 15 million years (50 to 35 Ma) in a subduction channel dipping at 36º toward the SE.

At 30 Ma Pressure-Temperature-time data indicate that the Dora Maira UHP unit had already been exhumed to within 10-20 km of the surface (assuming lithostatic pressure). To achieve this, the UHP unit must have moved horizontally 124 km between 35 and 30 Ma within the adopted subduction channel geometry. However, NW directed plate convergence for this period is estimated to have been only 25km. Moreover, the Dora Maira UHP unit was exhumed at a minimum rate of 10 mm a^{-1}, which is much higher than the estimated vertical component of the subduction rate (4 mm a^{-1}).

This inconsistency between measured displacement rates and plate motion velocity can be resolved in several ways. Firstly, the UHP in Dora Maira may be considered as partly due to tectonic overpressure. Assuming overpressure developed at a maximum depth of 50 km at 35 Ma, the horizontal displacement between 30 and 35 Ma is reduced to 55 km and the vertical component of the exhumation rate to a minimum of 4.4 mm a^{-1}, which is compatible with the most rapid estimates of plate motion over the period. Secondly, forces other than those generated by plate convergence may have enhanced lateral and vertical movements. Slab breakoff could explain the accelerated vertical movement, but not the lateral component. A higher buoyancy for Dora Maira continental rocks compared to other parts of the subduction complex could lead to more rapid vertical movement relative to surrounding material. Finally, as shown by the paleogeographic reconstructions, the Dora Maira UHP unit approached the transpressive western limit of the orogen at $c.$ 35 Ma. Constriction of the subduction channel in this transpressive zone may have accelerated extrusion of the UHP Dora Maira unit.