Geophysical Research Abstracts,
Vol. 11, EGU2009-1349, 2009
EGU General Assembly 2009

Anatomy and growth of a mountain belt: a look at the Alps from the earth's surface down into the mantle.

S.M Schmid

FU Berlin, Institut für Geologische Wissenschaften, Berlin, Germany (stefan.schmid@unibas.ch)

During the development of the tectonically complex Alpine arc several continental and oceanic plates were amalgamated. Analyses of crustal structures, derived from modern fieldwork, and geophysical deep sounding of the lithosphere-asthenosphere structure were combined into major transects through the Alps. Particularly high-resolution teleseismic tomography, together with the correlation of tectonic units along strike, revealed a far more complex 3D geometry of the Alpine orogen than hitherto believed.

In the Western Alps, the European Plate is seen to have been subducted beneath the Adriatic micro-plate. The generally SE directed subduction of the European continental lithosphere can be followed along strike and into the most complete transect across the Alps located at the transition between Western and Eastern Alps in Eastern Switzerland. Further eastwards, the subduction angle gradually becomes steeper and is finally vertical under the westernmost part of the Eastern Alps (western Tauern Window and Giudicarie lineament). Quite unexpectedly, some 50 km further to the east it is the continental lower lithosphere of the Adriatic plate that is seen to have been subducted to the NE beneath the European Plate although there is no fundamental change in the crustal architecture; the slab configuration is that of the Dinarides. It is argued that the easternmost Alps became part of the Dinaridic orogen during the last 20 Ma in the wake of a dramatic reorganization of the entire Alps-Carpathians-Dinarides system.

Major along-strike changes are also reflected in fundamental changes in the geometry and timing of nappe stacking. The West-Alpine nappe stack was severely overprinted by late stage (post-35 ma) west-directed indentation of the Adriatic micro-plate in a first stage, followed by even later incorporation of the Ligurian Alps and their continuation into the Northern Apennine into the growing Apenninic orogen during a second stage. The profile in Eastern Switzerland is characterized by an impressive amount of Cenozoic N-S-shortening that amounts to some 500km according to kinematic retrodeformations. Thrusting is asymmetric and top-N initially, but completely reworked into a bivergent orogen during Oligocene back thrusting and retro thrusting that pre-dominates during the Miocene. A very thick pile of Austroalpine nappes characterizes the easternmost Alps, floating on European crust. This nappe stack formed during 2 subsequent orogenies, a Cretaceous one that is followed by a Cenozoic one, the two being separated by an extensional phase related to the formation of the Gosau basins. The Cretaceous cycle is related to the closure of a branch of Neotethys, namely the Meliata branch in the east, triggering intra-continental subduction in the Eastern Alps. This event affected the Austroalpine nappe stack only. The Cenozoic cycle, on the other hand, led to the closing of the Alpine Tethys, parts of which are preserved within the Penninic nappe stack; the former Cretaceous orogen now forms the upper plate. However, presently this entire Alpine nappe stack is found in an upper plate position with respect to the eastern part of the Southern Alps where foreland-directed thrusting, linked to that within the external Dinarides, is still active. Hence Cretaceous and Cenozoic Alpine nappe stacking were followed by a third episode, when the easternmost Alps became part of the Dinaridic orogen, within which they presently occupy an upper-plate position.