Some mechanical aspects of collision and extension in the Eastern Alps: the Cretaceous event

E. WILLINGSHOFER

Faculty of Earth Sciences, Vrije Universiteit, Amsterdam, wile@geo.vu.nl

The Austroalpine unit represents at present the highest tectonic element of the Eastern Alps and contains abundant evidence for a continent-continent collisional event of Cretaceous age. Among others, the restored distribution of sedimentary facies within the Northern Calcareous Alps and the metamorphic signature of Cretaceous tectonics argue for a collision-related model to explain the observations.

The Cretaceous evolution of the Austroalpine unit is discussed on the basis of published P-T-t and structural data and numerical model predictions. The latter one provides valuable information on the possible mechanical evolution of collision zones within well defined boundary conditions. Keeping in mind that the geologic record points to continuous convergence during the Cretaceous, the Austroalpine unit seems to have experienced a three-phase tectonic evolution.

The first phase is characterized by crustal thickening that started within cover sequences (Northern Calcareous Alps) of the Austroalpine unit upon closure of the south to southeasterly-located Meliata Ocean as early as Mid Jurassic. Subsequent propagation of the deformation toward the west to northwest successively led to the incorporation of basement units in the subduction-collision process. Maximum pressure (P) and temperature (T) conditions have been estimated to be in the order of 1.8–2.0 GPa and 600–700 °C, respectively. The high-pressure metamorphism took place at ca. 100–95 My. During the major compressional phase, the thermal structure of the lithosphere is controlled by the subduction process such that the isotherms are dragged downward according to the imposed tectonic movement. As a consequence Austroalpine basement (Middle Austroalpine Unit) is emplaced underneath a strong mantle wedge of the overriding plate. The important implication of such a configuration would be that it prevents the already formed eclogites from strictly moving vertically toward shallower crustal levels. Isothermal exhumation of the eclogites could, therefore, have occurred for example by buoyancy driven reverse flow parallel to the subduction zone. During that second phase (ca. 95–90 My)ductile structures like thick shear zones (Plattengneis) or normal faults emphasize vertical shortening of the thickened crust. Major vertical movements related to the isothermal exhumation of the eclogites and the formation of metamorphic domes enforced advective heat transfer upward what results in weakening of the orogenic system.

During this stage of orogeny gravitational forces apparently have been released by ductile flow within lower structural levels. The third phase that covers approximately the time span from 90 My until the end of the Cretaceous is characterized by cooling of the basement and renewed accretion of material (Lower Austroalpine Unit) to the system. This phase coincides with detachment faulting along Upper–Middle Austroalpine interfaces and the formation of sedimentary basins on internal parts of the orogen commencing at ca. 86 My. According to analogue modelling, detachment-type deformation is promoted by the presence of low viscosity layers in the crust. Such a configuration most likely existed during the Late Cretaceous as indicated by the prevalence of extended low-strength regions in the center of the orogen.

The role of rheology in collisional orogenic settings: TRANSALP – a numerical and analogue approach

E. WILLINGSHOFER & S. CLOETINGH

Faculty of Earth Sciences, Vrije Universiteit, Amsterdam, wile@geo.vu.nl, cloeting@geo.vu.nl

We like to introduce a new ALW-project that aims to explore the role of rheology during Cenozoic continent-continent collision in the Eastern Alps. It forms an integral part of the international TRANSALP research programme studying the structure of the lithosphere across the Eastern