CHEMENDA-TYPE EXHUMATION DURING NON-STEADY STATE SUBDUCTION: MODEL AND LATE CRETACEOUS EVOLUTION OF EASTERN ALPS

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The Chemenda model (CHEMENDA et al., 1995, EPSL, 132: 225–232) predicts exhumation of previously subducted continental crust metamorphosed at UHP/HP metamorphic conditions mainly driven by (1) buoyancy of subducted material, and (2) associated surface erosion of the subducted wedge. Thrust surfaces in the footwall and a major normal fault in the hangingwall confine, therefore, the uplifting UHP/HP metamorphic wedge. Clastic material mainly derived from the surface of the uplifting subducted wedge fills a flexural sedimentary basin located on top of the lower plate in front of the UHP/HP wedge. A cross-section through an orogen exposes, therefore, the following units: (1) the non-subducted lower plate rocks with a collapse basin at the top, (2) the exhumed, previously subducted wedge with a nappe stack, which is dominated by cover rocks at the leading edge front and exhumed metamorphic, mostly polymetamorphic basement rocks, all metamorphosed at HP/UHP conditions at the rear front – all units were accreted from the footwall plate – and (3) the upper plate with collapse-type basins at top only in the case when extension-induced subsidence exceeds uplift. This is not the case in a setting of steady-state subduction, but in the non-steady state case when retreat of the subduction zone triggers extension in the upper plate unit.

The Austroalpine (AA) basement-cover nappe complex of the Eastern Alps likely represents a superb field example to test the non-steady state Chemenda model. The AA nappe complex received its final internal structure largely by middle–late Cretaceous tectonic processes as subduction of the Piemontais-Ligurian Ocean beneath the AA units started. The Lower AA and lower part of Middle AA basement-cover nappes represent the footwall of the UHP/HP wedge and were accreted to the exhuming UHP/HP wedge at ca. 80 Ma during a pronounced stage of thrusting. The Middle AA Eclogite-Gneiss units represent the exhuming UHP/HP wedge, which was subducted to depths corresponding to ca. 1.0 GPa in the north and max. ca. 3.0 GPa in southemmost exposures (JANAK et al., 2004, Tectonics, 23, TC5014) at ca. 95 - 90 Ma (THÖNI, 1999, Schweiz. Mineral. Petrogr. Mitt., 79, 209–230). Most pronounced exhumation of the HP/HP wedge occurred between 87 and 84 Ma, as cooling ages indicate. In the hangingwall, a series of ductile low-angle normal faults separates the UHP/HP wedge from uppermost Middle AA and Upper AA nappes representing the upper plate. Sinistral, transtensional, normal low-angle faults were most active between 87 - 84 Ma during formation of collapse basins (Gosau basins) on top of the upper plate, which we explain by disturbance of steady-state subduction by oceanward retreat of the subduction zone. The tectonic unroofing of the UHP/HP wedge continuously increased to and was most pronounced at the rear end of the wedge, so that more than 50 km of overburden was cut out.