Subsidence versus exhumation: Vertical movements in the Alpine-Carpathian-Pannonian region during the Late Cretaceous

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Vertical movements within orogenic belts with respect to a reference level (e.g. surface, sealevel) are documented by P-T-t and/or T-t paths, which give informations on the exhumation and cooling path of rocks as well as subsidence curves, which portray the evolution of sedimentary basins quantitatively. Contemporaneous exhumation of metamorphic domes and subsidence within adjacent basins is a characteristic feature, observed all over the Alpine-Carpathian mountain belt during the Late Cretaceous. Subsidence curves (own calculations and compiled from literature) and cooling age data (compiled) are presented from the Alpine-Carpathian-Pannonian region in order to document spatial and temporal variations of Late Cretaceous vertical movements.

The formation of synorogenic Late Cretaceous "Gosau" basins, all over the Alpine-Carpathian-Pannonian area, is a key feature for that time and gives hints for the operating subsurface processes and the geodynamic evolution of the whole mountain belt(s). The characteristic features of Gosau basins are: (1) Gosau sequences post-date Mid-Early Late Cretaceous thick-skinned thrust imbrications. (2) A combination of strike-slip and normal faults, typical for transtensional settings, plays an important role during initial basin formation. (3) The subsidence pattern commonly indicate a two step subsidence history with a moderate initial subsidence (Uppermost Turonian- Campanian) followed by a distinct subsidence pulse during the Campanian to Early Maastrichtian. (4) The sedimentary record displays an evolution from an alluvial to lacustrine/shallow marine to deep marine depositional environment. Accordingly, coarse-grained clastics, shallow water limestones, locally coal bearing marls, sandstones, turbiditic sequences and shales are observed. The major facies change from shallow to deep water is associated with the Campanian to Maastrichtian subsidence pulse.

Isotopic studies clearly show, that post-metamorphic exhumation and cooling of basement series occurs contemporaneous with basin subsidence and started first in the E-Carpathians and Apuseni Mountains during the Aptian to Albian, whereas younger cooling ages (ca. Cenomanian onward) are known from the Eastern Alps and Western Carpathians. Additionally, structural investigations revealed ductile to semi-ductile extensional structures, which are related to the tectonic unroofing of previously thickened crust. Rapid exhumation of metamorphic domes results in thermally and subsequently mechanically unstable conditions with large lateral and vertical gradients. Lithospheric strength is reduced in these thermally active regions and subsequent collapse of the mechanically very weak crust, which can not support large stresses provides a plausible trigger for Gosau basin formation in internal positions of the orogen.