Subsidence and uplift analysis of the Polish part of Outer Carpathian basins — backstripping of reconstructed profiles of the basin-fill

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The Outer Carpathian flysch belt sequences in Poland are divided into several tectonic and facial units related to primal sub-basins, of which the Late Jurassic, Cretaceous to Early Neogene tectonic evolution was a subject of the research. The units analysed here are: Skole, Silesian, Subsilesian, Dukla, Fore-Dukla and Magura. These are derived by Neogene inversion and thrusting from the basins in which were deposited, recently constituting tectonically complex fold-and-thrust belt.

Using outcrop and borehole data there were synthetic 1-D sections of the basin-fill reconstructed for individual zones of sub-basins. For these sections input data (thicknesses, absolute ages, bathymetry, lithological parameters) were quantitatively balanced and backstripping procedure was run in order to calculate tectonic component of the basement vertical movements. The control on thickness, lithology and stratigraphy of individual formations is good. Bathymetry is a key factor controlling tectonic subsidence pattern for the Early Cretaceous–Early Oligocene time span. Control on bathymetry is poor (error bars of up to several hundreds metres) and was estimated using lithofacial, ichnofacial, faunistic and sedimentological indicators. The result of the calculations are tectonic subsidence curves representing tectonic history of the basin/sub-basins, as well as deposition rates (corrected for decompaction), interpreted here as a record of source areas tectonic activity. Subsidence pattern similarities over all the basins suggest that geotectonic processes of regional scale controlled subsidence and uplift of sub-basins. The Magura basin individualizes, although it is partly a result of narrower stratigraphic interval represented by flysch successions of this unit. There is also more uncertainties in palaeobathymetric estimations for the Magura Basin.

For the Tithonian to Early Cretaceous (Silesian unit) rapid subsidence is recorded (coeval with relatively high sedimentation rates), followed by decreasing subsidence as well as decreasing sedimentation rates during upper part of the Early Cretaceous. Since the Turonian–Coniacian until Maastrichtian–Paleocene an uplift of several hundreds metres over the Skole, Subsilesian, Silesian, Dukla and Fore-Dukla sub-basins is recorded. This effect observed on tectonic subsidence curves is a result of shallowing of sedimentary environment, which was not compensated by sedimentation. The uplift is associated with increasing rate of deposition (~50–100 m/My), which, due to very high sea level at this time, allows to suggest tectonic nature of the source areas uplift. For the Magura Basin the Late Cretaceous uplift is uncertain. During the Paleocene subsidence was re-established (in Magura Basins increased in rate) and lasted until the Middle–Late Eocene; deposition rates decreased for this time span. Since the Late Eocene rapid uplift of a big magnitude (~2000 m?) started, which lasted until Early Oligocene. The uplift is recorded by drastic sedimentary environment shallowing, not compensated by limited sedimentation. There is some discrepancy in the beginning and end of this event, suggesting migration of the uplift process to the north and north–east in time (on the scale of single My). The uplift was followed by minor subsidence, being the last tectonic event in the basin, accompanied by drastically increasing deposition rates, which reached approx. 200–300 m/My for Late Oligocene–Early Miocene (max. ~800 m/My).