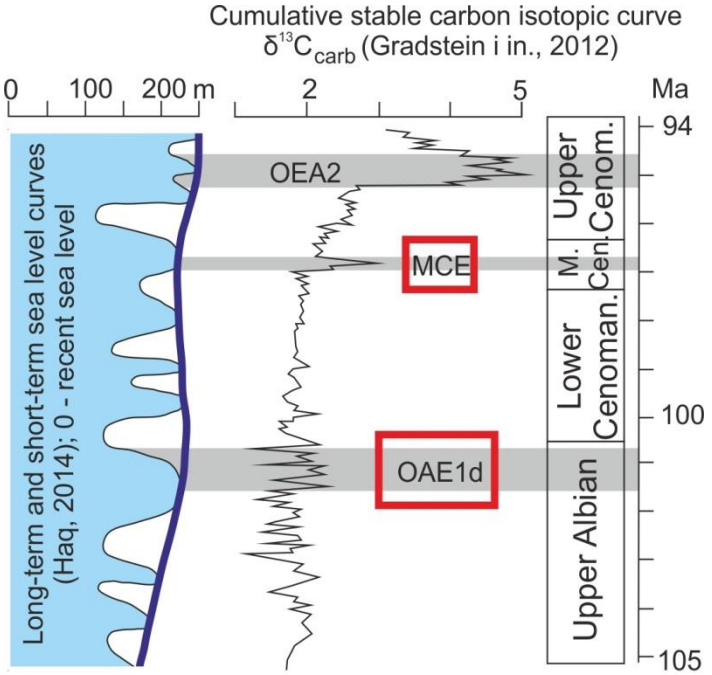
Response of benthic foraminifera to mid-Cretaceous oceanic anoxic events (OAE1d and MCE) in deep-water environments of the Western Tethys

- *description for the general public*

Mid-Cretaceous (113-94 Ma) was a period of an exceptional geologic history of the Earth in terms of repeated episodes of the high temperatures seawater, associated with a high sea level, approx. 150-250 m higher than today (see figure below). At that time, the sedimentation of a large amounts of organic matter (particulate and land derived) occurred in the deeper parts of the oceans. A low oxygen content in bottom water, associated with poor deep-water circulation favored accumulation of organic matter. Several events (so-called oceanic anoxic events – OAEs) with such conditions was characteristic of mid-Cretaceous times.

Oxygen depletion is also widespread in the recent world oceans. Persistent low oxygen is evident mainly in midwater oxygen minimum zones (OMZs), ranging from shelf to upper bathyal zones (depth 200–1000 m), and defined as regions where oxygen concentrations are below 0.5mll^{-1}. Such conditions have large effects on benthic assemblages including calcareous and agglutinated benthic foraminifers, the protozoans with small tests (ca. 0.5 mm). Where oxygen concentration is lowest, the benthic foraminifers exhibit depressed densities, low diversity and high dominance in the OMZs, however, most of them are completely not tolerant for oxygen depletion (O_2 below 0.2 mll^{-1}). Their adaptation to such condition includes small, thin tests, change in the nutrition and change in lifestyle. Permanent oxygen depletion as well as they expand and contract over geological time may influenced genetic diversity and play a key role in the evolution of benthic foraminifers.



Such OMZ conditions related to long-termed greenhouse and eutrophication periods occurred during mid-Cretaceous times. Their impact on the evolution of foraminiferal benthos living in the deep zones of the oceans is the main goal of the research, proposed in this project. The second goal is to describe the features of the seafloor environments that were intercepted by OMZs during the late Albian (OAE1d) and middle Cenomanian (MCE) (see figure on the left). Their duration was different, but both occurred in the periods of very high temperatures and a high sea level.

The analyses will be carried out based on the study of deep-water sediments occurring in the Carpathians; this area represented the NW part of the Western Tethys at that time. The samples will be taken from the rocks occurring in the Silesian and Skole nappes of the Outer Carpathians and from the Pieniny Klippen Belt, representing the deep-water successions with sediments deposited near calcium compensation depth. A reference to the time scale will be a key for the interpretation of the changes in benthic foraminiferal assemblages during the OAE1d and MCE. This will be based on the correlation of the local $\delta^{13}C$ curves with curves from the so-called stratotype areas. A further step of the research represents the various analyses, based on the same samples, taken with the highest possible resolution, leading to identify the environmental conditions in marine basins using the palaeontological tools (analyses of microfacies and biomarkers) and geochemical tools (analyses of geochemical indices). They should give an answer to the question about changes in oxygenation of bottom water, productivity of surface waters, content and origin of terrigenous particles and organic matter, which could highly influenced changes in the populations of benthic foraminifers. Concluding, this research project fall within the framework of a global nature, related to understanding the consequences of oxygen depletion in marine ecosystems, caused by global warming and eutrophication of the ocean.