An overview on IGCP 609: Climate-environmental deteriorations during greenhouse phases: Causes and consequences of short-term Cretaceous sea-level changes

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Sea level constitutes a crucial geographic boundary for humans, and sea-level fluctuations drive major shifts in the landscape. UNESCO-IUGS IGCP project 609 (http://www.univie.ac.at/igcp609/index.html) uses the Cretaceous climate and sea-level history as 'laboratory' to investigate the Earth under different climate conditions to infer causes and consequences of eustatic climate and sea-level changes, and to model scenarios for climate extremes and the shift between climate modes. Identifying different processes and factors controlling climate and sea-level changes (e.g. HAY, 2017) during the Cretaceous is essential to better evaluate global climate models and near future predictions.

The Cretaceous yields increasing evidence for significant (20–110 m amplitude) short-term eustatic sea-level fluctuations that follow long-term Milankovitch cycles (4th-order – mainly 405 ka, and 3rd-ordee – mainly 1–2.4 Ma), and, thus, imply globally synchronous forcing (WENDLER et al., 2014, 2016; SAMES et al., 2016). Provided chronological linking, these cyclic climate – and corresponding sea- and lake-level – fluctuations play an important role for Cretaceous high-resolution marine chronostratigraphy with substantial potential for marine to non-marine stratigraphic and palaeoenvironmental correlations.

Though glacio-eustasy is considered to be the main process controlling short term eustatic sea-level fluctuations the presence of large continental ice shields is highly unlikely for the warm greenhouse to hothouse conditions during the mid-Cretaceous. Alternatively, aquifer-eustasy may have played a significant role during these times, by storing water as groundwater (and in lakes) on the continents. Lake-level changes (non-marine sequences) may provide information on significant groundwater-table changes and corresponding continent-ocean water distribution imbalances that should lie within the longer Milankovitch band, but out-of-phase with sea-level change (WAGREICH et al., 2014).

Processes and feedback for sea-level change are highly complex, resulting from various combinations of climate and solid-Earth mechanisms leading to changes in either ocean water volume or capacity of ocean basins. Operative timescales of processes, their water volume equivalents and the corresponding orders of magnitude in eustatic sea-level change remain controversial. Ongoing progress in Cretaceous climate change and integrated stratigraphy, as well as progress in our understanding of solid-Earth processes and their different effects on both regional and global sea-level fluctuations, has led to changing ideas concerning Cretaceous climate and sea-level change.

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