Surface ocean and climate change before, during and after the K-Pg boundary

Using biomarkers and marine palynology on a unique sediment core to reconstruct the effect of volcanism and meteorite impact on ocean conditions

Department: Earth Sciences
Research group: Marine Palynology and Paleoceanography
Supervisor: Peter K. Bijl
Email address: p.k.bijl@uu.nl

Project description

The K-Pg boundary (66 Ma) represents arguably the most dramatic disruption of climate and ecology in Earth's history. Long-term volcanic outgassing from Deccan Trap volcanism (India) and associated climate change in the Late Cretaceous (94-66 Ma) may have preconditioned the ecosystem for strong disruption during the meteorite impact that marks the K-Pg boundary. The meteorite impact had long-lasting effects on ecosystems, in terms of biomass and trophic complexity, with consequences for the carbon cycle. The oceanographic consequences are not well understood, and this limits the understanding of the climate changes associated with both Deccan volcanism and meteorite impact.

Research on the K-Pg boundary is strongly limited by the availability of sedimentary archives. Moreover, few studies show the longer-term leadup to the impact event. Recently, with International Ocean Discovery Program Expedition 392, a unique new sedimentary succession has been recovered from the Transkei Basin south of South Africa. This represents the marine succession that is closest to the Deccan Volcanism to date (southern India was close to South Africa at that time). Site U1581 contains a 400+meters well-dated marine organic-rich mudstone, that enables us to study the long-term leadup to the K-Pg boundary as well as high-resolution ocean reconstruction of the aftermath of the meteorite impact.

The Bright Mind is given the unique opportunity to study this new material. They will generate the first high-resolution biomarker (TEX_{86})-based ocean temperature data on this record. Previous student projects already resulted in a low-resolution pilot dataset demonstrating that the proxy works well in these sediments. The work of the student will further be used to investigate alkenones in these samples, in a collaborative parallel project at Harvard University (Pearson Lab). Student will also process samples for palynology, to reconstruct ocean conditions from dinoflagellate cyst assemblages. Shipboard analyses show the extreme diversity and exceptional preservation of the dinocysts, allowing a detailed insight in ocean change as a result of volcanism and meteorite impact.

Job requirements

Student must have affinity for working in the lab, attention for detail, and affinity with micropaleontology and microscope work. Student must have followed the Masters course Organic Geochemistry and preferably also Reconstructing Extreme Climate Transitions. If needed, training will be offered for the sample processing, and for post-processing analysis of dinocysts and biomarkers.