



Early Eocene hyperthermals recorded in terrestrial sediments of the Canadian Arctic (Stenkul Fiord, Ellesmere Island): evidence from new carbon isotope data

Lutz Reinhardt (1), Andreas Lückge (1), Jennifer Galloway (2), Markus Sudermann (3), Christopher West (4), Martina Dolezych (5), Mark Schmitz (6), and Werner von Gosen (7)

(1) Bundesanstalt für Geowissenschaften und Rohstoffe, BGR, Hannover, Germany (lutz.reinhardt@bgr.de), (2) Geological Survey of Canada, Calgary, Canada, (3) Brandon University, Brandon, Canada, (4) University of Saskatchewan, Saskatoon, Canada, (5) Senckenberg Naturhistorische Sammlungen Dresden, Dresden, Germany, (6) Isotope Geology Laboratory, Boise State University, Boise, USA, (7) Friedrich-Alexander-Universität Erlangen-Nürnberg, Erlangen, Germany

The succession of largely fluvial clastic sediments with intercalated coals of the upper Paleocene/lower Eocene Margaret Formation exposed at Stenkul Fiord on southern Ellesmere Island provides one of the few terrestrial records of the early Eocene in high latitudes.

Recent field studies and mapping of the area southeast of Stenkul Fiord indicate that the clastic deposits consist of at least four sedimentary units separated by unconformities. A volcanic ash layer, identified within one coal seam and preserved as crandallite group minerals (Ca-bearing goyazite), was traced throughout the outcrop. Three samples from this ash layer provided U-Pb zircon ages (ID-TIMS) indicating that the volcanic ash-fall took place at 53.7 Ma.

To overcome limitations of a previous sampling resolution of carbon isotope measurements, new and more closely spaced samples were collected along a section including bulk coal, amber droplets, and plant remains from clastic intervals between coal seams. As stratigraphic tie-point, the dated volcanic ash layer permits the interpretation of the carbon isotope data with respect to early Eocene hyperthermals expressed as negative carbon isotope excursions (CIE's).

A few decimeters above the dated ash layer, a discrete negative CIE is interpreted as hyperthermal II (naming scheme of Cramer et al. 2003, astronomically tuned age of 53.665 Ma after Westerhold et al. 2017). Below this tie-point, separated by average carbon isotope values and a short negative excursion that possibly represents hyperthermal H2, the Eocene Thermal Maximum 2 (ETM-2 or H1) covers an interval of about 10 meters thickness. The sediments in this interval include the onset and body of the second largest CIE after the Paleocene-Eocene Thermal Maximum (PETM).

Below follows a ca. 20 m thick interval characterized again by less negative values with several negative excursions possibly reflecting the hyperthermals E to F.

An unconformity separates this division from the sediments at the base of the section that show the most negative carbon isotope values of the whole data set. These were measured in thick coal seams that are bounded by normal faults on each side forming a preserved block below the unconformity. Our data from this ca. 25 m thick succession are interpreted as expression of the PETM at Stenkul Fiord.

The integration of structural studies, U-Pb zircon ages, and carbon isotope records provides a new stratigraphic framework for further examination of the unique early Eocene flora and fauna preserved in this high-latitude outcrop (e.g., Sudermann et al., EGU2019-4519 on the palynology of Stenkul Fiord).

Cramer, B.S. et al. (2003) Orbital climate forcing of $\delta^{13}\text{C}$ excursions in the late Paleocene–early Eocene (chrons C24n–C25n). *Paleoceanography*, 18(4), 1097.

Westerhold, T. et al. (2017) Astronomical calibration of the Ypresian timescale: implications for seafloor spreading rates and the chaotic behavior of the solar system? *Climate of the Past*, 13: 1129-1152.