

The Eocene Thermal Maximum 2 (ETM-2) in a terrestrial section of the High Arctic: identification by U-Pb zircon ages of volcanic ashes and carbon isotope records of coal and amber (Stenkul Fiord, Ellesmere Island, Canada)

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The Stenkul Fiord section on southern Ellesmere Island reveals largely fluvial clastic sediments with intercalated coal seams of the Margaret Formation of Late Paleocene/Early Eocene age according to palynology and vertebrate remains.

Field studies in recent years and interpretative mapping of a high-resolution satellite image of the area southeast of Stenkul Fiord revealed that the clastic deposits consist of at least four sedimentary units (Units 1 to 4) separated by unconformities. Several centimeter-thin volcanic ash layers, recognized within coal layers and preserved as crandallite group minerals (Ca-bearing goyazite), suggest an intense volcanic ash fall activity.

Based on new U-Pb zircon ages (ID-TIMS) of three ash layers, the volcanic ash fall took place at 53.7 Ma in the Early Eocene, i.e. within the Eocene Thermal Maximum 2 (ETM-2) hyperthermal. The ETM-2 is bracketed further by discrete negative excursions of carbon isotope records of both bulk coal and amber droplets collected from individual coal layers of the section. The identification of the ETM-2 hyperthermal provides a stratigraphic tie-point in the terrestrial Margaret Formation sediments enabling assignment of the lowermost sedimentary Unit 1 to the Late Paleocene-earliest Eocene, Unit 2 to the Early Eocene, whereas Unit 3 and 4 might be Early to Middle Eocene in age. Thus the timing of syn-sedimentary movements of the Eurekan deformation causal for the observed unconformities in the section can be studied and the positions of further hyperthermals like the PETM or the ETM-3 in the section can be identified in the future.

The integration of structural studies, new U-Pb zircon ages, and different 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.