Geophysical Research Abstracts
Vol. 21, EGU2019-13597, 2019
EGU General Assembly 2019

Vegetation responses during and after the Late Smithian Thermal Maximum

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The Late Smithian negative carbon isotope excursion is one of the most pronounced during the Mesozoic, but possibly also one of the least understood. It is linked with extreme global warming generally attributed to continued volcanism in the Siberian Traps large igneous province (Grasby et al., 2016), resulting in extreme temperatures in the equatorial upper ocean with deleterious effects on marine organisms, and widespread deforestation and dominance of herbaceous lycophytes on land (Sun et al., 2012). This Late Smithian Thermal Maximum (LSTM) is followed by a rapid cooling and a sharp shift to positive C-isotope values across the Smithian–Spathian boundary (SSB) globally (Song, 2014). A contemporaneous shift to gymnosperm dominated floras in the early Spathian has been attributed to a climate shift from more humid to drier conditions (Galfetti et al., 2007). Smithian–early Anisian strata in Peary Land, North Greenland were deposited in offshore to upper shoreface settings at ∼45°N on the northern margin of Pangaea. The succession is well constrained by palynology and ammonites, and shows a remarkable shift from spore-dominated assemblages in the Late Smithian to gymnosperm dominated ones in the early Spathian. The variations in spore/bisaccate pollen ratio occur in concert with shifts in [U+F064]13Corg. Chemostratigraphic correlation with other SSB sections with records of terrestrial floral change in Pakistan, Tibet and South China (Saito et al., 2013), suggests that the recovery of gymnosperms began earlier in the mid-latitudes of the southern hemisphere (Pakistan) than on the northern hemisphere. However, while on the southern hemisphere gymnosperms were rapidly replaced again by lycopsid-dominated floras already in the early Spathian, they continued to be dominant during the Spathian on the northern hemisphere. Here, we compare our Smithian-Spathian spore-pollen record from North Greenland with other contemporaneous records of floral change globally, and discuss the implications of this on the global climate development and environmental conditions from the LSTM to the Late Spathian.

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