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Response of Arctic climate and hydrology to the Toarcian Oceanic Anoxic Event

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The Toarcian Oceanic Anoxic Event (T-OAE), ca. -183 ma, is though to reflect one of the most dramatic environmental perturbations of the last 200 myr. Nevertheless, the scarcity of geochemical data from outside the western margin of the Tethys has led to much controversy concerning the mechanisms at the origin of both the T-OAE and associated environmental changes. In this study, we have generated new high-resolution geochemical data from the biostratigraphically well-constrained section of Anabar Bay (Northern Siberia), which preserves an expanded succession of sandstones, siltstones and clays of Pliensbachian and Toarcian age deposited at polar paleolatitudes. The carbon isotope composition of the sedimentary organic matter (OM) reveals a pronounced negative excursion (CIE) of ~ -4.5 permil spanning about 25 m of dark clays that closely correlates with that recorded by marine OM and carbonate fossil wood during the T-OAE in NW European sections. Macro and microscopic observations, as well as the nitrogen isotope compositions and C/N ratios, indicate that the OM is mainly composed of terrestrial material, thus confirming that the CIE reflects changes in the ocean-atmosphere C budget rather than local processes. The distribution of climate-sensitive sedimentary and palynofloral indicators along the section suggests that the T-OAE in the Arctic coincided with a dramatic change in polar climate from near freezing conditions (glendonites) in the latest Pliensbachian to increased warmth favorable to the development of thermophilous elements (pollen Classopollis) during the CIE. Furthermore, sedimentary data indicate that the onset and termination of the negative excursion were associated with rapid sea-level rise and fall, respectively, suggesting an intimate coupling between the C cycle perturbation and sea-level changes. The amount of total organic carbon (TOC) increases markedly (from $\sim$0.2 to $\sim$2 wt%) during the negative excursion, but appears relatively low compared to TOC values recorded during the T-OAE in most European sections (5-15 wt%). Nevertheless, calculation of mass accumulation rates indicates that the amount of organic carbon buried by unit of time in this locality exceeds that obtained in most European OM-rich sections, suggesting that increased runoff and terrestrial OM burial at high latitudes may have been important negative feedbacks to CO_2 input and global warming during the T-OAE.