Arctic hydrology during the Paleocene-Eocene thermal maximum: recent updates and revelations

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The Paleocene-Eocene thermal maximum (PETM) was an interval of extreme global warming associated with a >3‰ negative carbon isotope excursion (CIE) in marine carbonates, as well as a severe shoaling of the ocean calcite compensation depth; indicative of a massive input of ^{13}C-depleted carbon. Evidence from the high northern latitudes, including paleoecological reconstructions from coal distributions, terrestrial paleobotanical records, dinocyst assemblages, and hydrogen isotopic compositions of *n*-C17 point to a very moist Arctic region and a low salinity Arctic ocean during this time. During the PETM Arctic Ocean sea-surface temperatures increased by ~5˚C and evidence points to an increase in runoff and ocean freshening that led to water column anoxia. Hydrogen isotopes of higher plant *n*-alkanes recovered from the central Arctic Ocean show a large positive excursion at the onset of the $d^{13}C$ excursion that recovers to approximately pre-PETM D/H values well before the end of the warming event. D-enrichment was interpreted as a large-scale change in moisture transport. Decreased meridional temperature gradients would have reduced the frequency of rainout events, decreased isotopic distillation during vapor transport, enhanced poleward moisture transport, and led to D-enriched precipitation in the high latitudes. Subsequent studies suggest substantial global warming preceded the CIE associated with the PETM, and thus provides a mechanism for early changes in the hydrologic system. We continue investigating the hydrogen isotopic character of *n*-alkanes during the PETM, as well as the subsequent hyperthermal ETM2. Data from 3 additional PETM sites (Lodo, Contessa Road, Forada) show D/H excursions just before or near the onset of the event and thus support hemispheric changes in the hydrological system. However, both D-enrichment and D-depletion occurred, suggesting a heterogeneous hydrological response to early warming. Limited data for the Arctic ETM2 indicates a positive shift in D/H values prior to the CIE, similar to changes associated with the PETM. We suggest that the available data point to substantial changes in the hydrologic system during the early stages of global warming that include hemispheric effects, as well as more regional expressions of the water cycle driven by large-scale oceanographic changes.