Using Multiple Paleosol Proxies to Interpret Paleoclimate Change: The Paleocene-Eocene Thermal Maximum in Wyoming

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ABSTRACT

The Paleocene-Eocene Thermal Maximum (PETM) was a transient episode of global warming that occurred at the Paleocene/Eocene boundary. The event is marked by a sharp decline in carbon isotope values that is globally recognized from marine and continental sections. The negative isotope excursion has been attributed to the release of methane hydrates from oceanic sediments. Although studies concur that temperatures rose during the PETM, changes in precipitation are not well understood.

In the Bighorn Basin of Wyoming, multiple proxies from alluvial paleosols were used to interpret changes in precipitation across the PETM interval. Because paleosols are vertically stacked, they provide a continuous and highly resolved record of paleoclimate, including precipitation. The key features are: (1) carbonate accumulations, (2) yellow-brown (ferruginous) nodules, (3) morphologies of different kinds of paleosols, and (4) soil weathering indices and associated estimates of mean annual precipitation (MAP). The paleosols show a significant but transient decrease in precipitation at the onset of the PETM but a gradual return to pre-PETM levels by the end of the interval. The paleosols also show additional, although less dramatic, wet/dry cycles within the PETM interval that may correspond to precessional cycles that have been identified in the marine record of the PETM.

This study counters interpretations of increased precipitation for Wyoming at this time and shows the importance of detailed case studies of continental strata to test climatic generalizations and models that have been developed for PETM precipitation patterns.

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