DATA REPOSITORY TABLES

Table DR1  Table DR2  Table DR3

DETAILED METHODS

Compound-Specific Isotope Analysis

n-Alkane stable carbon isotope ratios were measured at Northwestern University (NU), Pennsylvania State University (PSU), and the University of Utah SIRFER laboratory. At NU, carbon isotope ratios were acquired using a ThermoFisher Trace GC Ultra coupled to a Thermo Delta V Plus isotope ratio mass spectrometer via a GCC III interface. The GC was fitted with a split/splitless injector operated in splitless mode with a fused silica column (Agilent J&W DB-5; 30 m long, 0.25 mm I.D., 0.25 μm film thickness). The column flow rate was 1.4 mL/min. The GC oven held for two minutes at a temperature of 80°C, increased at a rate of 5°C/min to 320°C, then held for six minutes. In the SIRFER laboratory, n-alkane δ13C ratios were measured on an HP 6890A GC coupled via a GCC III interface to a Finnigan Delta Plus XL isotope ratio mass spectrometer. The GC was fitted with a split/splitless injector operated in splitless mode using a fused silica column (Agilent J&W DB-1; 30 m long, 0.25 mm I.D., 0.25 μm film thickness). The column flow rate was 1.2 mL/min and the oven program began at a temperature of 80 °C (held for 4 min). Oven temperature then increased 6 °C/min to a maximum temperature of 320 °C with a final hold time of 12 min. At PSU, n-alkanes were separated on a Varian model 3400 GC with a split/splitless injector operated in splitless mode. A fused silica capillary column (Agilent J&W DB-5; 30 m long, 0.32 mm I.D., 0.25 μm film thickness) was used with helium as the carrier gas and a column flow rate of 2.0 mL/min. The oven program began at a temperature of 60 °C (held for 1 min), increased at a rate of 6 °C/min to 320 °C, which was held for 20 min. Following GC separation, n-alkanes were combusted over nickel and platinum wire with O2 in He (1%, v/v) at 1000 °C. CO2 was monitored using a Finnegan Mat 252 isotope ratio mass spectrometer.

Isotopic abundances were determined relative to a reference gas calibrated with Mix A (n-C16 to n-C30; Arndt Schimmelmann, Indiana University). Carbon isotope values of samples analyzed at NU and in the SIRFER laboratory were normalized to the Vienna Pee Dee belemnite (VPDB) scale using the Uncertainty Calculator (Polissar and D’Andrea, 2014) and are reported in standard delta notation. Standard errors of the mean for individual samples range from 0.1 to 0.2‰ (Uncertainty Calculator, Polissar and D’Andrea, 2014). Carbon isotope values of samples analyzed at PSU were calculated relative to co-injected standards (androstane, squalane, n-C38, n-C41) and are reported in delta notation relative to VPDB. The standard deviations of reference materials were ± 0.5‰.

REFERENCES CITED

Figure DR1. Fraction of allochthonous carbon required to explain the remaining $^{13}$C enrichment in paleosols after accounting for degradation using $\delta^{13}$C$_{TT}$ values calculated from $n$-C$_{27}$ alkane (blue), $n$-C$_{29}$ alkane (red), $n$-C$_{31}$ alkane (green), and average predicted $\delta^{13}$C$_{TT}$ values (black). Curves show 5-point moving averages.
Figure DR2. Modeling the relative contributions of soil organic matter degradation and allochthonous carbon input to paleosol $\delta^{13}$C$_{org}$ enrichment at CAB 10. (A) Average predicted $\delta^{13}$C$_{TT}$ smoothed curve (averaging pre-PETM, PETM, and post-PETM $\delta^{13}$C values) (solid gray) and the average predicted $\delta^{13}$C$_{TT+deg}$ curve when $\alpha = 0.998$, pre/post-PETM $F_{SOC} = 0.33$, and PETM $F_{SOC} = 0.16$ (dashed gray). (B) The fraction of allochthonous carbon needed to explain the remaining $^{13}$C enrichment. Gray shading indicates PETM interval.
Figure DR3. Modeling the relative contributions of soil organic matter degradation and allochthonous carbon input to paleosol $\delta^{13}C_{org}$ enrichment at Big Red Spit. (A) Average predicted $\delta^{13}C_{TT}$ smoothed curve (averaging pre-PETM, PETM, and post-PETM $\delta^{13}C$ values) (solid gray) and the average predicted $\delta^{13}C_{TT+deg}$ curve when $\alpha = 0.998$, pre/post-PETM $F_{SOC} = 0.38$, and PETM $F_{SOC} = 0.19$ (dashed gray). (B) The fraction of allochthonous carbon needed to explain the remaining $^{13}C$ enrichment. Allochthonous carbon estimate truncated at 31.1 m because of uncertainty in correlation between the Big Red Spit section and predicted curve. Gray shading indicates PETM interval.
Figure DR4. Modeling the relative contributions of soil organic matter degradation and allochthonous carbon input to paleosol $\delta^{13}$C$_{org}$ $^{13}$C enrichment at North Butte. (A) Average predicted $\delta^{13}$C$_{TT}$ smoothed curve (averaging pre-PETM, PETM, and post-PETM $\delta^{13}$C values) (solid gray) and the average predicted $\delta^{13}$C$_{TT+deg}$ curve when $\alpha = 0.998$, pre/post-PETM $F_{SOC} = 0.44$, and PETM $F_{SOC} = 0.22$ (dashed gray). (B) The fraction of allochthonous carbon needed to explain the remaining $^{13}$C enrichment. Gray shading indicates PETM interval.
Figure DR5. Stratigraphic distribution of shark teeth in the southeastern Bighorn Basin. Number of vertebrate fossil localities containing shark teeth (shaded) out of total number of fossil localities aligned with δ¹³C values for HW 16, CAB 10, Big Red Spit, and North Butte. Dashed lines represent lithologic correlations based on bed tracing (Baczynski et al., 2013). The lower dashed line marks the base of the onset geosol, the paleosol containing the stratigraphically lowest excursion δ¹³C values. The upper dashed line marks the base of the Big Red 1 geosol (BR1) geosol.