



HYPOTHESIS RELATING CARBON ISOTOPE STRATIGRAPHY, ORBITAL PRECESSION, AND SEDIMENT ACCUMULATION DURING THE PALEOCENE-EOCENE THERMAL MAXIMUM, NORTHERN, SOUTHERN, AND WESTERN BIGHORN BASIN, WYOMING

GINGERICH Philip D.¹ and WOOD Aaron R.¹

1 – Department of Geological Sciences and Museum of Paleontology, The University of Michigan, Ann Arbor, Michigan 48109-1079 U.S.A. (gingeric@umich.edu)

Two high resolution carbon isotope records are available for $\delta^{13}\text{C}$ in dispersed organic carbon spanning the Paleocene-Eocene thermal maximum (PETM) at sites 150 km apart in the northern and southern Bighorn Basin. The first is at Polecat Bench or PCB (Magioncalda *et al.*, 2004), and the second is at Honeycombs-Castle Gardens or HCG (Yans *et al.*, submitted). The $\delta^{13}\text{C}$ records are similar at the two sites in that each shows three major peaks of decreasingly negative intensity in $\delta^{13}\text{C}$ — representing, by inference, decreasing peaks of greenhouse warming. Within the PETM, the transition from zone Wa-M (with *Meniscotherium*) to zone Wa-0 (with *Ectocion parvus*) takes place at or near the first and largest $\delta^{13}\text{C}$ peak in both sections. The isotope series leading to the first major peak appears to include a smaller peak, and this is visible too in the high-resolution $\delta^{13}\text{C}$ section from a third site (Cottonwood Creek-Meeteetse or CCM: Wood *et al.*, in prep.) on the west side of the Bighorn Basin. In addition, there appears to be a smaller peak between each of the three major peaks, making a total of six peaks or cycles for the whole PETM sequence. Clyde *et al.* (2001) found evidence interpreted to represent ca.100 kyr eccentricity cycles in a continental Eocene carbon isotope record in the Green River Basin, and the cycles we identify here in PETM sections from PCB, HCG, and CCM are similar in suggesting the presence of ca. 21 kyr precession cycles. If confirmed, six precession cycles imply a total duration for the PETM on the order of 126 kyr, with Wa-M representing approximately 42

kyr of this, and Wa-0 representing the remaining ca. 84 kyr. Wa-M is ca. 5 m thick at PCB, ca. 12 m thick at HCG, and ca. 15 m thick at CCM. The PETM section at PCB differs from the other two in lying downstream in the axis of the Bighorn Basin, and we attribute the relative thinness of the Wa-M part of the section at PCB, both relative to Wa-M elsewhere and relative to the succeeding Wa-0 section, to sediment starvation, which is likely to be related in turn to warmer, dryer climate characteristic of Wa-M time (Kraus and Riggins, 2002; Wing *et al.*, 2005).

References:

- Clyde, W. C., N. D. Sheldon, P. L. Koch, G. F. Gunnell, and W. S. Bartels. 2001. Linking the Wasatchian/Bridgerian boundary to the Cenozoic global climate optimum: new magnetostratigraphic and isotopic results from South Pass, Wyoming. *Palaeogeography, Palaeoclimatology, Palaeoecology*, 167: 175-199.
- Kraus, M. J. and S. Riggins. 2002. Effects of the PETM on continental weathering: analysis of alluvial paleosols, Bighorn Basin, Wyoming. *Geological Society of America, Abstracts with Programs*, http://gsa.confex.com/gsa/2002AM/finalprogram/abstract_38396.htm.
- Magioncalda, R., C. Dupuis, T. Smith, E. Steurbaut, and P. D. Gingerich. 2004. Paleocene-Eocene carbon isotope excursions in organic carbon and pedogenic carbonate: direct comparison in a continental stratigraphic section. *Geology*, 32: 553-556.
- Wing, S. L., G. J. Harrington, F. A. Smith, J. I. Bloch, D. M. Boyer, and K. H. Freeman. 2005. Transient floral change and rapid global warming at the Paleocene-Eocene boundary. *Science*, 310: 993-996.
- Yans, J., S. G. Strait, T. Smith, C. Dupuis, . . . Steurbaut, and P. D. Gingerich. 2006. High-resolution carbon isotope stratigraphy and mammalian faunal change at the Paleocene-Eocene boundary in the southern Bighorn Basin, Wyoming. Submitted.