Biotic change in the Bighorn Basin, Wyoming, before, during, and after the Paleocene-Eocene Thermal Maximum (PETM): Consistent with orbital forcing?

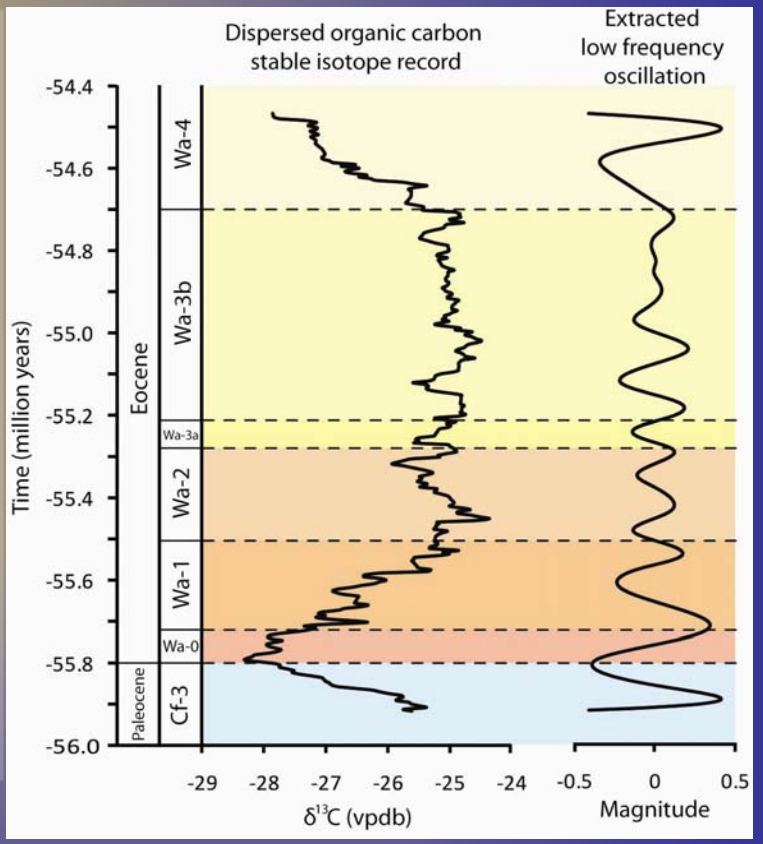
Philip D. Gingerich and Aaron R. Wood

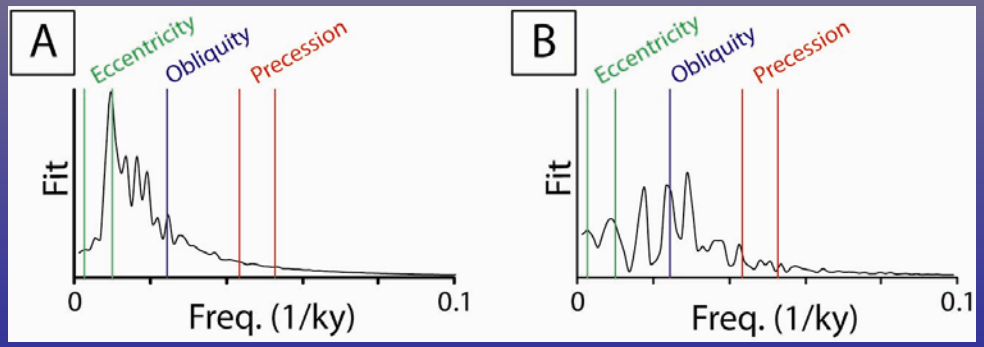
UNIVERSITY OF MICHIGAN

Early Eocene global warming events and concurrent biotic turnover preserved in ocean sediment are linked to changes in insolation on orbital timescales. We analyzed stable isotopes in dispersed organic carbon (DOC) through the lower Eocene of the Bighorn Basin, Wyoming, to determine whether climate and faunal change occur on orbital timescales in the terrestrial record. Coincidence of DOC isotope cycles with orbital periodicities and faunal boundaries would provide strong evidence for orbital forcing in the terrestrial realm.

Heterogeneity in depositional rates can cause patterns of orbital forcing to appear non-linear, preventing detection by conventional spectral analysis. Thus we decomposed the DOC isotope record into oscillatory patterns, regardless of linearity, and compared various periodicities for goodness of fit.

Lower frequency patterns are consistent with eccentricity periodicity (100 ky). However, faunal boundaries do not coincide consistently with maxima, minima, or zero-crossings in these lower frequencies. Higher frequency patterns exhibit additional peaks outside of known orbital periodicities. We are currently studying whether sedimentological factors explain the short periodicities, and whether morphological time series of individual taxa coincide with the eccentricity-scale periodicities.





Above: Comparison of faunal boundaries, DOC stable isotope record, and extracted low frequency oscillation.

Left: A, power spectrum for extracted oscillation above. B, power spectrum for representative high frequency oscillation.