Climate
of the Past
Discussions

Interactive comment on "Frequency, magnitude and character of hyperthermal events at the onset of the Early Eocene Climatic Optimum" *by* V. Lauretano et al.

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Received and published: 9 June 2015

Lauretano et al. present a valuable update to the previous assessments by Stap et al. (2010) and Kirtland Turner et al. (2014) of coupled carbon cycle and climate variations in the lead-up to the Early Eocene Climate Optimum, as revealed in the carbon and oxygen isotopic compositions of benthic foraminifera. The analyses are of high quality and the interpretations sound. They show that the d13C and d18O variations at eccentricity time scales are in sync and follow similar trajectories, implying similar drivers of change. Slightly steeper slopes for the second of one-two punches (ETM2-H2 and I1-I2) are interpreted to imply that a heavier carbon source contributed to the follow-up

events.

My only broad suggestion is to make more of the data at hand; rather than simply reporting the correlations, interpret them more deeply and quantitatively. I'll expand upon this as I progress through the manuscript, but it seems to me that the slope is telling us about the source, given what we understand about climate sensitivity. And it seems like a lack of lag between d13C and d18O tells us about reservoir sizes and pacings.

p. 1797 line 21 and elsewhere: ..ly modifiers don't take hyphens

p. 1799 line 3-5: Site 1263 suffered some dissolution and developed a clay layer during the PETM, so it didn't remain well above the lysocline throughout the Paleogene.

p. 1803 line 26: Need to be clear what the Oligocene-Miocene mechanisms were; expand this sentence.

p. 1804 line 14: It should be quite straightforward to take this constancy of slope a step further, to predict the temperature response (simply multiply d18O by the 4.38 slope of eq. 1) per Pg of C added for a given source (following, for example, Panchuk et al. , Geology 2008, v. 36, p. 315-318). A source of about -60 per mil (methane) requires about 550 Pg per permil change (Panchuk et al., 2008) whereas a source at -22 permil requires about 1700 Pg per permil. So one can estimate the warming inferred by a slope of 0.5 or 0.6 to be about 2.2oC per (either 550 Pg or 1700 Pg) carbon emitted. You can further use the airborne fractions revealed in the Panchuk et al. paper to calculate a climate sensitivity, and see if that's reasonable presuming either a methane or organic matter source for the CO2.

p. 1805 line 6: The difference in slope is so small (0.5 vs. 0.6) compared to the lever between -60 and -25 per mil, that I don't think you can say much about the need for a heavier source. Maybe a better way to put this, and consistent with the comment above, I think the paper would benefit from some quantification based on these slopes

and the sort of back of the envelope approach I describe.

p. 1806, line 3: I don't know what the authors mean by "scaled biotic response." Perhaps they could state this more clearly.

p. 1806, line 16: The ocean doesn't necessarily get colder with depth, it gets denser. So the authors can't make the conclusion here that the shallower water is saltier (and hence higher d18O). Site 1263 waters could be colder but fresher than site 1262 waters, or saltier but warmer; you can't use the relative depths to differentiate those two possibilities for why the forams at 1263 have heavier isotopic values.

p. 1807, line 3: Organic carbon isn't being released into the ocean-atmosphere system; CO_2 generated from the oxidation of organic matter might be. . . be more precise with the language.

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