Biogeosciences Discuss., 8, C4032–C4035, 2011
www.biogeosciences-discuss.net/8/C4032/2011/

Biogeosciences
Discussions

Interactive comment on "Latitudinal differences in the amplitude of the OAE-2 carbon isotopic excursion: $p\mathrm{CO}_2$ and paleoproductivity" *by* E. C. van Bentum et al.

E. C. van Bentum et al.

bentum@geo.uu.nl

Received and published: 31 October 2011

Reaction to C2283–C2285 Anonymous Referee 1

Anonymous Referee 1:" One point that the authors must consider is the role of continental weathering as an additional factor in lowering the CO_2 content of the atmosphere. Frijia and Parente (2008) present Sr-isotope evidence for a pulse of enhanced weathering during OAE 2; Blättler et al.(2011) present Ca-isotope evidence. The conclusions of these papers need to be carefully considered."

The process of weathering as such was already incorporated in figure 9, which we will refer to more extensively. We will also address the importance of weathering briefly in

the introduction and by adding the following text at page 6206 line 18.

'Using marine strontium isotope ratios Frija and Parente (2008) demonstrated that the increased temperatures at the onset of OAE-2 resulted in enhanced weathering. Although Frija and Parente explain part of the strong positive strontium isotopes shift with increased ocean stratification, a recent study using stable Ca isotopes and modeling (Blättler et al., 2011) demonstrated that a three-fold increase in weathering rates at the onset of OAE-2 would explain the total magnitude of the Sr isotope shift. The increased weathering would result in the enhanced drawdown of carbon (Walker et al., 1981), acting as a negative feedback (Fig. 9). At the same time enhanced weathering would increase nutrient input into the ocean, which probably resulted in a more efficient carbon pump.'

Anonymous Referee 1:" It would also be useful to look at all sites with a view to comparing stratigraphic variation in TOC calibrated against the carbon-isotope curve. TOC values might well reflect productivity – how do TOC patterns compare with productivity changes suggested on the basis of other criteria? Page 6205:Line 12: the TOC record at Tarfaya increases over the C/T OAE interval (Tsikos et al., 2004),more in line with an increase in productivity over this interval."

The productivity estimates in table 1 are based on TOC values from the 4 sites. We will mention this in the Table caption and add the average TOC values to the table. OM accumulation rates at the different sites are discussed in Forster et al. 2008, which we will refer to for a more comprehensive discussion of differences in organic carbon mass accumulations rates for the different sites. In general TOC and the productivity pattern reconstructed using the δ^{13}C values agree, the exception is Tarfaya, where the TOC values increase over the C/T OAE interval (Tsikos et al., 2004). Still, TOC is not a direct proxy for productivity, since TOC is also effected by changes in preservation. We will mention this at Page 6205: Line 12.

Anonymous Referee 1:" The authors should also look at the recent paper of Jarvis et *al. in Paleoceanography (2011) for additional information on the Plenus Cold Event, based on a comparison of the carbonate and organic-carbon isotope profiles across the C/T OAE."*

The Jarvis et al. (2011) paper gives a very nice overview of the Plenus cold event and will be referred to at page 6194 line 11. We will also incorporate their observation that the elevated global sea level during the early Turonian could have decreased continental weathering rates, which could explain why oceanic nutrient supplies ceased and bioproductivity decreased, resulting in an increase in pCO_2 post OAE-2.

Anonymous Referee 1:" Page 6193: Line 17: need citation for terrestrial isotopic record of C/T OAE (papers by Hasegawa)"

We will add citation: (Hasegawa, 1997)

Anonymous Referee 1:" Page 6206: Line 14: osmium is generally concentrated in black shales and – as far as I am aware – is not necessarily related to volcanic/magmatic activity. Osmium-isotope ratios, on the other hand, may well be significant in this context."

At Page 6206 Line 14 we will add: 'Turgeon and Creaser (2008) show that the two observed pulses in Os concentrations coincide with low Os isotope values. This, together with the similar Os pattern in two different sections, implies that the raised Os concentrations are probably due to enhanced volcanic activity.'

All linguistic suggestions and suggested references will be incorporated.

We will change Page 6207 Line 19 to: 'The carbonate rich layer found at 425 mcd has been interpreted as an ash layer (Hetzel et al., 2009)'

References: Blättler, C. L., Jenkyns, H. C., Reynard, L. M., and Henderson, G. M.: Significant increases in global weathering during Oceanic Anoxic Events 1a and 2 indicated by calcium isotopes, Earth and Planetary Science Letters, 309, 77-88, 10.1016/j.epsl.2011.06.029, 2011. Frijia, G., and Parente, M.: Strontium iso-

tope stratigraphy in the upper Cenomanian shallow-water carbonates of the southern Apennines: Short-term perturbations of marine 87Sr/86Sr during the oceanic anoxic event 2, Palaeogeography, Palaeoclimatology, Palaeoecology, 261, 15-29, 10.1016/j.palaeo.2008.01.003, 2008. Hasegawa, T.: Cenomanian-Turonian carbon isotope events recorded in terrestrial organic matter from northern Japan, Palaeogeography Palaeoclimatology Palaeoecology, 130, 251-273, 1997. Hetzel, A., Böttcher, M. E., Wortmann, U. G., and Brumsack, H. J.: Paleo-redox conditions during OAE 2 reflected in Demerara Rise sediment geochemistry (ODP Leg 207), Palaeogeography Palaeoclimatology Palaeoecology, 273, 302–328, 10.1016/j.palaeo.2008.11.005, 2009. Jarvis, I., Lignum, J. S., Gröcke, D. R., Jenkyns, H. C., and Pearce, M. A.: Black shale deposition, atmospheric CO2 drawdown, and cooling during the Cenomanian-Turonian Oceanic Anoxic Event, Paleoceanography, 26, PA3201, 10.1029/2010pa002081, 2011. Tsikos, H., Jenkyns, H. C., Walsworth-Bell, B., Petrizzo, M. R., Forster, A., Kolonic, S., Erba, E., Premoli Silva, I., Baas, M., Wagner, T., and Sinninghe Damsté, J. S.: Carbon-isotope stratigraphy recorded by the Cenomanian-Turonian Oceanic Anoxic Event: Correlation and implications based on three key localities, Journal of the Geological Society, 161, 711–719, 2004. Turgeon, S. C., and Creaser, R. A.: Cretaceous oceanic anoxic event 2 triggered by a massive magmatic episode, Nature, 454, 323-326, 2008. Walker, J. C. G., Hays, P. B., and Kasting, J. F.: A negative feedbackmechanism for the long-term stabilization of the Earth's surface temperature. , J. Geophys. Res. , 9776–9782, 1981.

Interactive comment on Biogeosciences Discuss., 8, 6191, 2011.