Biogeosciences Discuss., 9, C802–C805, 2012
www.biogeosciences-discuss.net/9/C802/2012/

Biogeosciences Discussions

Interactive comment on "A two-dimensional model of the passive coastal margin deep sedimentary carbon and methane cycles" *by* D. E. Archer et al.

D. E. Archer et al.

d-archer@uchicago.edu

Received and published: 24 April 2012

I neglected to mention in my summary of the revised model results that I also adjusted the rate constant for DIC uptake via reaction with igneous rocks (chemical weathering). The uptake rate constant is given by

10ˆ(-A + 0.062*T)

in units of per year with T in C. The original runs used a value of -9.0 for A, and in the new runs that value has been adjusted to -6.3 . The goal was to optimize the fit with the Sivan data. The correspondence between model and data is much better than before (from the new Figure 13 of the manuscript reprinted in Fig 1 below), but of course the model misses the fine structure near the sediment surface, because of its 200-meter grid spacing, and because it seems to take a lot of fiddling to explain the detailed gradients of biological activity tracers such as SO4, methane, and DIC, as David Burdidge and Klaus Wallmann are finding in their much more detailed models than this one. Certainly there is knowledge to be gained by attacking this problem with the model resolution that it requires, but that's beyond what I can do for this paper.

There isn't a DIC mass balance problem either, because since the uptake rate constant for DIC by weathering is a tunable parameter, all that it would mean, if the DIC concentration in reality is a bit higher than the model is producing, is that I have that rate constant set too fast. If CO2 uptake is disabled in the model (Figure 13c) the model DIC is 10 times higher than observed, so there is lots of room to dial it up and down. What is the point of having a model with a tunable parameter, the reader may wonder. The point is to derive what rate constant would be required to simulate the data given the proposed mechanism, perhaps to compare it with theoretical considerations, and ultimately providing information such as overall CO2 uptake rates. Again, there is more work to be done, but for this study we can conclude that the CO2 uptake seems required in the model to explain the data.

Carbon isotopes provide a firmer constraint on the carbon cycle, because they are not strongly affected by chemical CO2 uptake or by loss of CH4. The model captures the ultimate deep del 13 C value, which was achieved by tuning the balance between CH4 and CO2 production from organic matter. Again, the model misses the fine structure near the sediment surface, a light spike presumably produced by respiration without methanogenesis, at least in part due to low resolution. The revised figure 14 from the manuscript is pasted into Figure 2.

A final note: I've cleaned up the animations, should have done that years ago. They look much nicer and will be more useful, posted at http://geosci.uchicago.edu/~archer/spongebob_passive/ .

Interactive comment on Biogeosciences Discuss., 9, 2921, 2012.

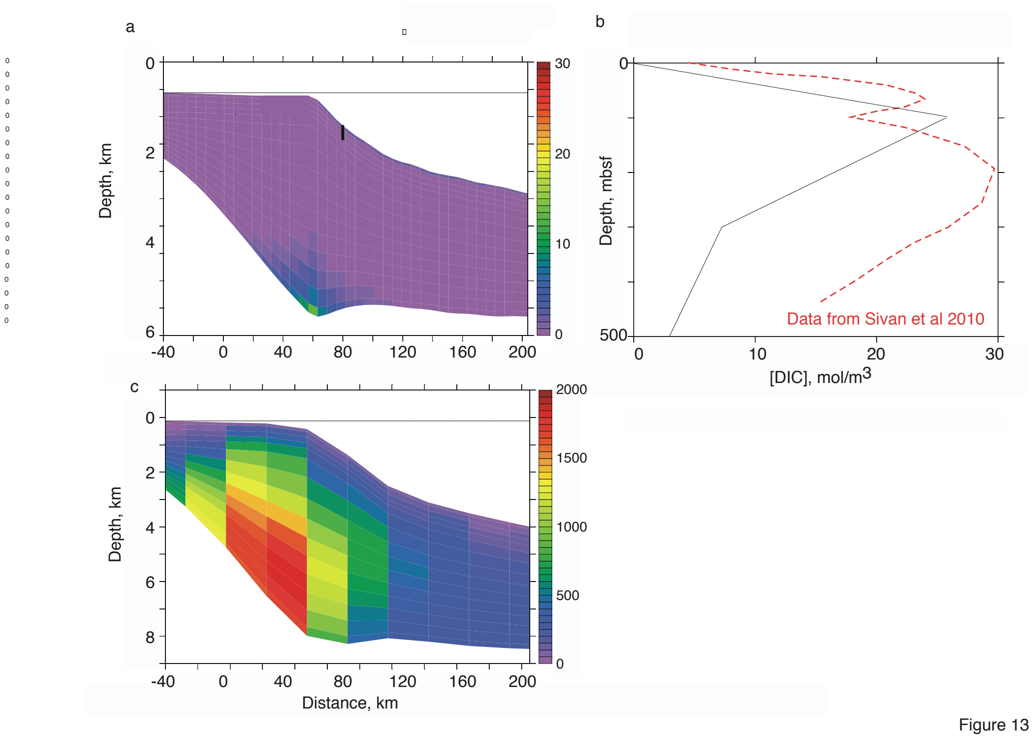

Fig. 1. revised Figure 13 from the discussion manuscript

BGD

9, C802–C805, 2012

Interactive Comment

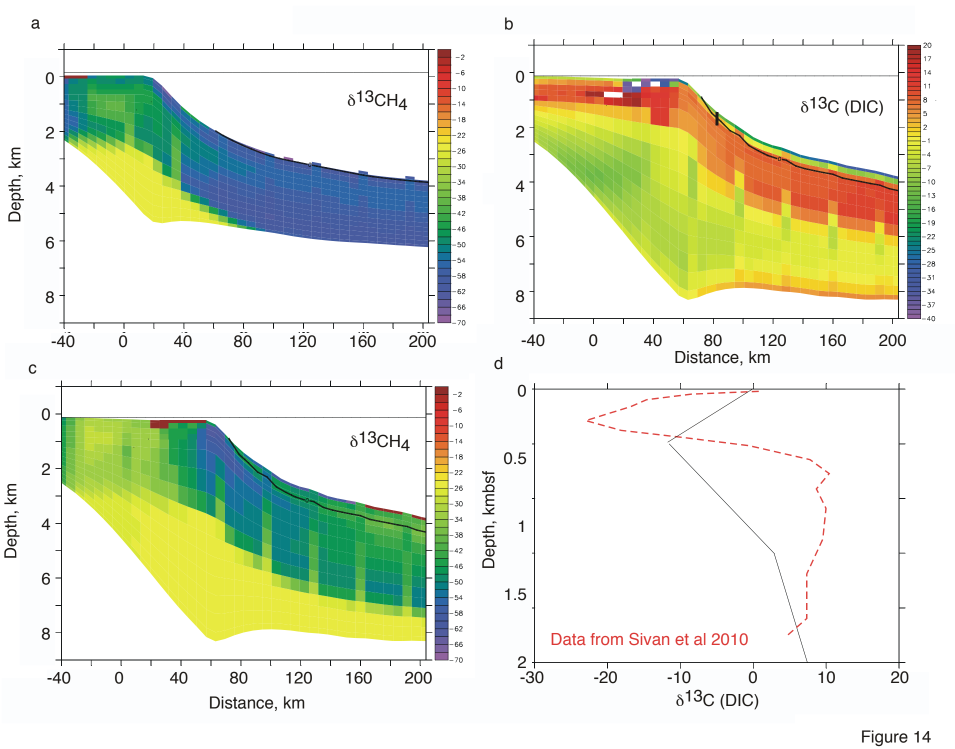

Fig. 2. revised Figure 14 from the discussion manuscript

Full Screen / Esc

Printer-friendly Version

Interactive Discussion

Discussion Paper