

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

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The simulations have been re-run and re-plotted to fix various problems. The full set of revised figures and animations are posted on http://geosci.uchicago.edu/~archer/spongebob_passive/ and the results summarized here.

The biggest change was to correct a sign error in the ocean temperature changes, which made the oceans colder during high sea level rather than warmer, leading to the enhancement of hydrate inventory during the "warm" high-sea level stand 50 million years ago (Figure 1, a replot of Figure 16 in the manuscript). Although this result was met with considerable enthusiasm from the reviewer, now alas it has gone away. In the new results, the inventory grows in toward the end of the simulation, rather than

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peaking and declining as before. However, the model is still in general slightly more sensitive to reasonable changes in POC deposition than it is to temperature. When the competing impacts of temperature and POC deposition through time are set against each other, though, they cancel, and the hydrate inventory grows through time, similarly to the time-invariant model scenario called T0 (dashed line in the figure).

The simulations also now span 200 Myr rather than 140, and the bottom boundary condition to the lithosphere has been changed to 1600 K instead of 1600 degrees C. The runs are subjected to a stronger geothermal heat flux of 70 instead of 50 mW/m², and we are working on sensitivity studies for this parameter. Also a no-SO₄ case was added.

These changes have led to subtle changes in the model hydrate inventory, as reflected in Figure 2, a revision of the summary figure 17 in the manuscript.

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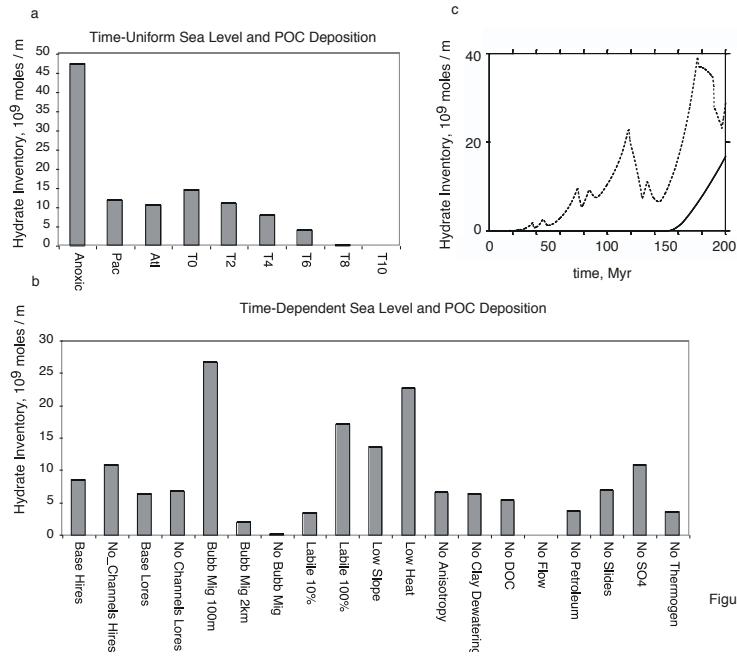


Figure 16

Fig. 1.

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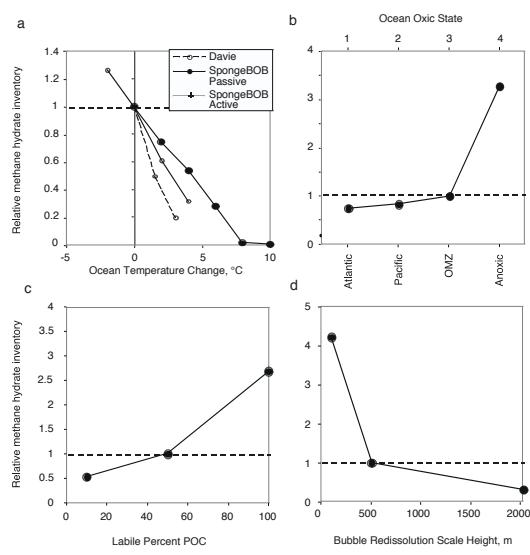


Figure 17

Fig. 2.

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