Geophysical Research Abstracts
Vol. 16, EGU2014-171, 2014
EGU General Assembly 2014

Reconstructing the carbonate compensation depth from 0 to 100 Ma using ocean ion concentrations and bathymetry models

Joel Davis and Carolina Lithgow-Bertelloni
University College London, Earth Sciences, London, United Kingdom (joel.davis.09@ucl.ac.uk)

The oceans play an important part in regulating the carbon cycle and climate system, acting as a buffer between the carbon in the atmosphere and the deep earth. Of all dissolved inorganic carbon (DIC) in the ocean, only carbonate can exist in a solid state (mostly as calcite). In the near-surface ocean, calcite is supersaturated and thus precipitates. Deeper in the ocean, the solubility of calcite increases and all is entirely dissolved at the carbonate compensation depth (CCD), where the rate of falling carbonate equals the rate of dissolution.

The CCD today is around 4.5 km depth, though previous work that looked at the composition of sediments on the ocean floor has suggested that CCD was different in the past (e.g. Pälike et al., 2012; Sclater et al., 1977). These studies mostly show the CCD decreasing to shallower depths through the Cenozoic and the Mesozoic. The deepening of the CCD through time is consistent with the decrease in atmospheric CO_2 over time shown in the GEOCARB models (Berner, 1987; Berner and Kothavala, 2001; Berner, 2006); more carbon is being stored in the ocean as sediment.

We look at the evolution of the CCD since 100 Ma by focusing on changes in the volume of the ocean basins. We combine recent advancements in determining palaeobathymetry into the Mesozoic from reconstructed ages of the ocean floor (Müller et al., 2008) in conjunction with a geochemical model by Boudreau et al. (2010) for the average CCD today, applying it from 0 to 100 Ma. A history of global ocean ion concentrations produced by Tyrrell and Zeebe (2004) was used. Various assumptions about productivity rates, solubility constants and other conditions in the past oceans were necessary to make a first order working model.

The model was found to be very sensitive to even minor changes in the dissolved concentration of carbonate. In the reconstruction where the surface saturation state was decreased going back to 100 Ma, the CCD gradually deepens with time, consistent with other independent studies. Changes in CO_2 concentrations likely influenced this, which would have affected the amount of silicate weathering from continents (Misra and Froelich, 2012). We will show maps of the extent of the global carbonate cover for the last 100 my, which suggest that the amount of sedimentary carbon being subducted has increased with time, despite an overall decrease in volcanic activity since the Mesozoic.