Last Glacial Maximum carbonate system reconstructions and glacial water mass constraints

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Estimates of the past ocean state often rely on sparsely sampled observations, and from this, attempts are made to quantify changes in Earth history. The ocean carbonate system represents: a newly developing proxy database, an underused oceanic water mass tracer, and a quantitative link to the ocean-atmosphere carbon cycle. We present global carbonate system maps consistent with sea floor observations and Atlantic mass circulation solutions utilizing current B/Ca-[CO_3^{2-}] and other carbonate parameters to constrain an ocean model with 4° resolution. The addition of carbonate fields to a global model allows for quantitative analysis of changes to ocean storage, a crucial control for glacial-interglacial variation.

Although the quantity of published B/Ca derived carbonate data is low, they add an independent constraint to the interface between water emanating from the Northern (North Atlantic Deep Water) and Southern (Antarctic Bottom and Intermediate waters) sources. We find that the North Atlantic Deep Water - Antarctic Bottom Water interface is below 2500m, and significantly different from some previous estimations. This both suggests that atmospheric CO_2 change can be driven by relatively minor changes to ocean circulation, and that more traditional proxy records of circulation may need to be reinterpreted in a multiproxy setting.

We utilize 3D visualization from the Woods Hole Oceanographic Institution, Physical Oceanography MiniCave to view these complex datasets and provide new insights into the structure of LGM ocean structure.