

Carbon Isotope Constraints on Paleo AMOC: Depth vs Strength

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Carbon isotopes ($\delta^{13}\text{C}$ and $\delta^{14}\text{C}$) have been used to infer paleo AMOC. Here we explore the AMOC during the Last Glacial Maximum (LGM, 20 ka before the present) due to the relative abundance of sediment data from that period. Specifically, we use carbon isotopes, both stable carbon-13 and the unstable carbon-14 (radiocarbon), measured on fossil benthic foraminifera shells from ocean sediments, combined with a series of model simulations that include process-based cycling of those isotopes. The model simulations were designed to cover the two-dimensional AMOC depth vs AMOC strength phase space in order to explore the constraints provided by the sediment data on those two AMOC properties. We find that carbon isotopes provide good constraints on AMOC depth, which was shallower during the LGM, whereas constraints on AMOC strength are weak, which leaves a large range of possible overturning rates similarly consistent with the data. We discuss implications and possible research strategies to overcome this difficulty.