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Shifted westerlies caused low CO_2 during cold glacial periods

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Transitions in atmospheric CO_2 between low-CO_2 glacial periods and high-CO_2 interglacials are usually attributed to changes in the biogeochemistry of the ocean. We propose a new mechanism for determining the partition of CO_2 between the atmosphere and ocean. This mechanism depends on the position of the mid-latitude westerlies in relation to the Antarctic Circumpolar Current (ACC) in the Southern Hemisphere. Poleward-shifted westerlies that are aligned with the ACC (like today and during previous interglacials) should enhance the divergence around Antarctica and flush organically cycled CO_2 out of the deep ocean and into the atmosphere. Westerlies that are shifted equatorward of the ACC during glacial periods weaken the divergence around Antarctica allowing CO_2 to accumulate in the deep ocean. We will present results from an atmosphere-coupled MOM4 simulation of the changes in the ocean's circulation and chemistry associated with changes in the strength and position of the westerlies.

4.63.25

Stable carbon and oxygen isotope records in a Palau sclerosponge

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The calcium carbonate in sclerosponge skeletons appears to incorporate stable carbon (δ13C) and oxygen isotopes (δ18O) in isotopic equilibrium with seawater dissolved inorganic carbon (DI-13C) and seawater oxygen isotopes, respectively, thus faithfully archiving the isotopic composition of seawater over time at a given site. Here, a high-resolution (0.1 mm) δ13C and δ18O record for a 7.7 cm long Acanthocheatetes wellsi sclerosponge collected in 2001 from Palau (7oN, 134oW) in the northwestern region of the Western Pacific Warm Pool (WPWP) is presented. Radiocarbon and stable isotope analyses reveal that the sclerosponge is 52 years old with an average annual growth rate of 1.48 mm/year. Thus our sampling rate yields an average of almost 15 samples/year. Distinct horizontal skeletal features appear to be annual. The sclerosponge δ13C record shows a significant Seuss Effect with a decrease of 0.2 ‰/decade for the period of 1970-1990, which is equivalent to the instrumentally measured decrease in the tropical Pacific DI-13C for the same time period. Thus, Palauan sclerosponge δ13C seems to accurately record seawater DI-13C variability. The detrended sclerosponge δ18O record is inversely correlated with the Southern Oscillation Index and Trade Wind Index anomalies on interannual timescales indicating that the WPWP is cooler/saltier (warmer/fresher) during El Nino (La Nina). This is consistent with model and available instrumental data for the WPWP. These results show that sclerosponge δ13C and δ18O records may be valuable tools for reconstructing DI-13C and ENSO variability, respectively, on century or longer timescales. This research represents the first sub-annually resolved, multi-decadal long paleoceanographic record for the northwestern equatorial Pacific region of the WPWP.