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Astronomically tuned Plio–Pleistocene benthic $\delta^{18}O$ record from South China Sea and Atlantic–Pacific comparison

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Abstract

Based on benthic foraminiferal $\delta^{18}O$ from ODP Site 1143, a 5-Myr astronomical timescale for the West Pacific Plio–Pleistocene was established using an automatic orbital tuning method. The tuned Brunhes/Matuyama paleomagnetic polarity reversal age agrees well with the previously published age of 0.78 Ma. The tuned ages for several planktonic foraminifer bio-events also agree well with published dates, and new ages for some other bio-events in the South China Sea were also estimated. The benthic $\delta^{18}O$ from Site 1143 is highly coherent with the Earth's orbit (ETP) both at the obliquity and precession bands for the last 5 Myr, and at the eccentricity band for the last 2 Myr. In general, the 41-kyr cycle was dominant through the Plio–Pleistocene although the 23-kyr cycle was also very strong. The 100-kyr cycle became dominant only during the last 1 Myr. A comparison of the benthic $\delta^{18}O$ between the Atlantic (ODP 659) and the East and West Pacific (846 and 1143) reveals that the Atlantic–Pacific benthic oxygen isotope difference ratio ($\Delta\delta^{18}O_{Atl-Pac}$) displays an increasing trend in three time intervals: 3.6–2.7 Ma, 2.7–2.1 Ma and 1.5–0.25 Ma. Each of the intervals begins with a rapid negative shift in $\Delta\delta^{18}O_{Atl-Pac}$, followed by a long period with an increasing trend, corresponding to the growth of the Northern Hemisphere ice sheet. This means that all three intervals of ice sheet growth in the Northern Hemisphere were accompanied at the beginning by a rapid relative warming of deep water in the Atlantic as compared to that of the Pacific, followed by its gradual relative cooling. This general trend, superimposed on the frequent fluctuations with glacial cycles, should yield insights into the processes leading to the boreal glaciation. Cross-spectral analyses of the $\Delta\delta^{18}O_{Atl-Pac}$ with the Earth's orbit suggests that after the initiation of Northern Hemisphere glaciation at about 2.5 Ma, obliquity rather than precession had become the dominant force controlling the vertical structure or thermohaline circulation in the paleo-ocean.

Keywords: stable isotopes; astronomical time scale; South China Sea; Pliocene; Pleistocene; Atlantic Ocean; Pacific Ocean

1. Introduction

The last 5 Myr of paleoceanographic history is crucial to our understanding of the Earth's climate system. The final closure of the Panama Isthmus and the Indonesian seaway, further uplift of the Tibetan Plateau and the onset of major ice

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