History of the equatorial Pacific thermocline during the early to middle Miocene

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The evolution of the equatorial thermocline is essential in understanding climate changes in the tropical Pacific. Multispecies analyses of planktic foraminifera provide a way to examine temperature distribution thus equatorial thermocline. Although the secular development of the thermocline can date back up to the late Miocene, the early to middle Miocene interval has been rarely examined. In addition, causal relationships with dynamic Antarctic ice sheet and closing low latitude gateways remain unclear. Here we investigate vertical thermal gradient at Integrated Ocean Drilling Program Site U1337 in the eastern equatorial Pacific (EEP) throughout the early to middle Miocene. The gradient increased (surface water warmed) over the Miocene Climatic Optimum (16.9 to 14.7 Ma), whereas it decreased (surface water cooled) across the East Antarctic Ice Sheet Expansion (EAIE: ~13.9 Ma). Comparison of the EEP record with the western equatorial Pacific (WEP) counterpart (Corfield and Cartlidge, 1993) suggested that changes in sea surface temperature were relatively stable in the WEP than in the EEP through the early to middle Miocene (18.8 to 11.9 Ma). We further estimated thermocline depth and tilt from the two diagonal gradients between the EEP and the WEP records: shoaling of thermocline from 16.7 to 15.7 Ma and weakened thermocline tilt between 16.5 and 13.8 Ma. Closures of low latitude gateways (the Indonesian Throughflow and the Central American Seaway) (~17 to 15 Ma) might trigger thermocline shoaling, and the reduced Antarctic ice sheet volume (16.4~13.9 Ma) would affect thermocline tilt. Thermocline depth from 18.8 to 11.9 Ma was likely much deeper compared to the Pliocene to modern condition.

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