Stable SST in the Indo-Pacific warm pool during the Pliocene-Pleistocene climate transition

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The early Pliocene is the most recent time in Earth history when greenhouse gas concentrations were similar to today and average global temperature was warmer. This warm period came to an end with the onset of significant northern hemisphere glaciation. Yet as the high latitudes shifted toward cooler conditions with higher ice volume, sea surface temperatures (SST) in the Indo-Pacific warm pool (IPWP) appear to have remained stable. The stability of IPWP SST is critical to addressing the role of CO_2 in the Pliocene-Pleistocene climate transition. Climate models predict ~1˚C temperature rise in the IPWP when CO_2 concentrations increases by 100ppm (to ~400ppm), and a ~2˚C warming if CO_2 is doubled. If the IPWP was no more than 1˚C warmer in the early Pliocene compared to today, then CO_2 was unlikely to be higher than ~400ppm.

We present a *G. sacculifer* Mg/Ca record in the Indian Ocean (ODP site 758: 5º23'N, 90º21'E, 2925 m water depth), which shows little variation through the last 5 Ma, agreeing with a previous Mg/Ca record in the western equatorial Pacific. IPWP SST stability has been called into question because the SST records may be biased by secular changes in Mg/Ca of seawater (Mg/Ca_{sw}). However, Mg/Ca_{sw} is not well constrained; estimates of Mg/Ca_{sw} at 3-5 Ma range from 0.5-3 mol/mol lower than today. Adjusting Mg/Ca SST estimates at ODP site 847 in the eastern equatorial Pacific leads to early Pliocene SST estimates that largely disagree with $U^{K'}_{37}$ SST estimates. Adjusting Mg/Ca bottom water temperatures at ODP site 607 leads to unrealistic bottom water temperatures and $\delta^{18}O$ of seawater estimates that are implausible because they imply isotopically heavier seawater (higher ice volume) in the early Pliocene compared to today. Therefore, changes in Mg/Ca_{sw} were likely modest and had a minimal affect on the Mg/Ca paleotemperature proxy on these time scales, and our stable Mg/Ca record reflects little change in SST in the IPWP through the last 5 Ma. Thus stable SST in the IPWP support pCO_2 of 400ppm or less during the early Pliocene.