

Upper ocean temperatures over the last glacial in the low-to-mid latitude Western Pacific based on a systematic multiproxy approach

*Sze Ling Ho¹, Yuan-Pin Chang², Min-Te Chen³, Jeroen Groeneveld⁴, Kuo-Fang Huang⁵, Pei-Ting Lee¹, Shih-Yun Lin¹, Maria Makarova¹, Nele Meckler⁶, Mahyar Mohtadi⁷, Ren Yi Ooi¹, Chuan-Chou Shen⁸, Liang-Jian Shiau^{3,9}, Raul Tapia¹, Masanobu Yamamoto¹⁰

1. Institute of Oceanography, National Taiwan University, Taipei, Taiwan, 2. Department of Oceanography, National Sun Yat-sen University, Kaohsiung, Taiwan., 3. Institute of Applied Geosciences, National Taiwan Ocean University, Keelung, Taiwan., 4. Department of Geosciences, Hamburg University, Germany. , 5. Institute of Earth Sciences, Academia Sinica, Taipei, Taiwan., 6. Bjerknes Centre for Climate Research and Department of Earth Science, University of Bergen, Norway., 7. MARUM-Center for Marine Environmental Sciences, University of Bremen, Germany. , 8. High-Precision Mass Spectrometry and Environment Change Laboratory (HISPEC), Department of Geosciences, National Taiwan University, Taipei, Taiwan., 9. Exploration and Development Research Institute, CPC Corporation, Miaoli, Taiwan., 10. Faculty of Environmental Earth Science, Hokkaido University, Sapporo, Japan.

Upper ocean (0-200 m) temperature reflects large-scale ocean circulation and the atmosphere-ocean heat exchange. It is therefore a useful metric in characterizing paleoclimate, including the roles played by the East Asian Monsoon and the Indo-Pacific Warm Pool in driving climate change in the low-to-mid latitude Western Pacific. Biomarker- and calcite-based geochemical proxies are widely used to reconstruct past ocean temperature, but may yield discrepant estimates due to chemical and ecological differences of the proxy carriers. Deriving temperature estimates from multiple proxies for the same site may shed light on proxy systematics and improve the robustness of ocean temperature reconstruction, yet there are few multiproxy temperature records spanning the upper water column in the aforementioned region. Therefore, we aim to fill in the gap by using a network of sediment cores from the South China Sea, Indo-Pacific Warm Pool and Okinawa Trough. We compile and generate for each site paleotemperature records of the sea surface and thermocline, inferred from proxies based on vastly different proxy carriers, namely planktic foraminifera-based Mg/Ca and clumped isotopes, haptophyte-based $U^{K'}_{37}$, and archaea-based TEX₈₆. Preliminary results show that the sea surface glacial cooling estimates inferred from clumped isotopes are stronger than the Mg/Ca-derived estimates, despite both proxies being based on the same proxy carriers. At several sites, the temporal patterns of planktic foraminifera Mg/Ca records differ for the mixed layer and thermocline, as the thermocline warms while the surface ocean cools during the last glacial. Thermocline glacial warming, however, is not replicated by TEX₈₆ which is increasingly interpreted as shallow subsurface or thermocline temperature signal. Despite consistent glacial-interglacial patterns, the magnitude of change in TEX₈₆ temperature records differ substantially across sites, in contrast to that suggested by $U^{K'}_{37}$ and Mg/Ca of mixed layer-dwelling planktic foraminifera. We discuss possible causes leading to the abovementioned proxy discrepancies. We envisage that such a systematic multiproxy approach will refine our understanding of past changes in the oceans surrounding East Asia as well as proxy interpretation in general.

Keywords: $U^{K'}_{37}$, Mg/Ca, TEX₈₆, Clumped isotopes, South China Sea, Okinawa Trough