Understanding Antarctic Melting History through Sea-level Highstand Deposit from Rameswaram Island, India

*Saikat Kumar Misra[1], Shoko Hirabayashi[2], Shradha Menon[1], Yusuke Yokoyama[2], Pankaj Khanna[1]

1. REEFS Lab, Department of Earth Sciences, Indian Institute of Technology Gandhinagar, Palaj, Gandhinagar, Gujarat-382355, India , 2. Atmosphere and Ocean Research Institute, The University of Tokyo, 5-1-5 Kashiwanoha, Kashiwa, Chiba 277-8564, Japan

Rameswaram Island, located between the Gulf of Mannar and Palk Bay along the southeastern margin of India, preserves in situ fossil coral reefs and lithified coastal sediments along the northern and eastern margins. These exposed reefs can provide valuable insights into Holocene relative sea-level (RSL). Radiocarbon dating of minimally altered *Porites* corals was performed at the Atmosphere and Ocean Research Institute (AORI), University of Tokyo (Yokoyama Laboratory), to establish the chronology of the exposed reefs. Elevations were measured using high-precision GNSS (Trimble DA-2 RTK) referenced to the WGS84 ellipsoid and corrected using the EGM2008 geoid model.
Four distinct stratigraphic units were identified above present sea level. The lowest level comprises microatolls with upper surfaces at 0.7 to 0.9 m. Overlying this unit are domal massive corals and branching coral-clast-rich, cemented carbonate layers with upper surface elevations near 1.7 m. A higher unit consists of massive microatolls of *Porites* coral characterised by depressed centres and elevated rims, occurring at 2.0 to 2.5 m elevation. Lithified fine-grained skeletal carbonate sediments locally engulf these upper microatolls. These upper microatolls are capped by an onlapping siliciclastic layer exhibiting trough cross-stratification, with uppermost elevations ranging from 2.7 to 2.9 m. Given the microtidal regime (<0.5 m tidal range), microatoll upper surfaces are interpreted to approximate former relative sea level within ±0.3 m vertical uncertainty. Radiocarbon ages indicate that the lower microatolls formed at ~7 ka BP, whereas the upper massive microatolls date to ~5 ka BP. These data suggest an approximately 2 m rise in relative sea level between 7 and 5 ka BP. The siliciclastic sediments prograde over these reefal surfaces after carbonate production stopped.
Relative sea-level change of any region reflects the combined effects of eustatic sea-level rise, glacial isostatic adjustment (GIA), and potential tectonic influences. A comparison of microatoll elevations and calibrated radiocarbon ages with GIA-modelled relative sea-level predictions by Yokoyama et al. (2019), based on the ANU ice model for this region, indicates a better fit with scenarios involving higher upper mantle viscosity and a two-stage Holocene melting history. These scenarios include continued melting of the Antarctic ice sheet until either ~4 ka BP or ~2 ka BP, rather than cessation at ~6 ka BP following the Last Glacial Maximum. The results highlight the sensitivity of far-field tropical RSL records to mantle rheology and late-Holocene meltwater contributions.

Reference: Yokoyama, Y., Hirabayashi, S., Goto, K., Okuno, J., Sproson, A. D., Haraguchi, T., Ratnayake, N., & Miyairi, Y. (2019). Holocene Indian Ocean sea level, Antarctic melting history and past tsunami deposits inferred using sea level reconstructions from the Sri Lankan, southeastern Indian and Maldivian coasts. *Quaternary Science Reviews, 206*, 150–161

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