Precessionally Paced Foraminifera-bound Nitrogen Isotope Variations in the Solomon Sea Influenced by Eastern Equatorial Pacific Upwelling Intensity

*Haojia Abby Ren[1], Wei-Ning Fang[1], Yi-Chi Chen[1], Kuo-Yen Wei[1], Chuan-Chou Shen[1]

1. National Taiwan University

The surface water in the Western Equatorial Pacific (WEP), although is depleted with nitrate and other major nutrients, bears isotopic signature of partial nitrate assimilation in the nutrient-rich Eastern Equatorial Pacific (EEP). Driven by the easterlies, Equatorial Under Current upwells to the surface of the EEP, where biological uptake only partially consumes nitrate and leaves the remaining nitrate enriched in its nitrogen isotopic composition. Through multiple cycles of uptake and remineralization, the elevated nitrogen isotopic composition is recorded by organic matter and is spread out to regions away from the EEP, partly causing the WEP thermocline nitrate $\delta^{15}N$ to be much more elevated than the global mean. We then expect the $\delta^{15}N$ in the WEP to be sensitive to the expansion and shrinking of the EEP high nutrient region during past climatic cycles.

This study reports foraminifera-bound $\delta^{15}N$ (FB-$\delta^{15}N$) of two planktonic species –*Globigerinoides sacculifer* and *Globigerinoides ruber* –from a sediment core in the Solomon Sea over the last 158 ka. The FB-$\delta^{15}N$ values, similar between the two species, fall between 7‰ to 13‰. The core-top FB-$\delta^{15}N$ (9.2‰) is approximately equal to the modern subsurface nitrate $\delta^{15}N$ (9.4‰), the dominate nitrate source to the Solomon Sea surface. The FB-$\delta^{15}N$ values are significantly elevated during periods with high local summer/fall insolation with a strong precessional pacing. While without a clear glacial/interglacial difference, at both terminations, the FB-$\delta^{15}N$ hits lowest values (~8.3‰) before an abrupt increase.

The lack of clear glacial/interglacial change, yet a strong precessional pacing in the Solomon Sea FB-$\delta^{15}N$ record, implies a low latitude control and an insignificant influence from oxygen minimum zones in the eastern tropical Pacific. Supported by modern hydrologic data and modeling exercises, we argue that the variations in our FB-$\delta^{15}N$ record reflects changes in the EEP surface nutrient status, such that expansions of the high nitrate pool cause the observed high FB-$\delta^{15}N$ values. Together with reconstruction in the EEP paleoproductivity, our record strongly indicates enhanced EEP upwelling during periods with local insolation maximum, consistent with previous modelling studies showing a strong precessional control on ENSO evolution.

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