The response of N₂ fixation to deglacial changes in shelf nitrogen loss along the western Pacific margin

HAO JIA ABBY REN¹, ERWEN YANG¹, YUAN-PIN CHANG², MIN-TE CHEN³ AND DANIEL M. SIGMAN⁴

¹National Taiwan University
²National Sun Yat-sen University
³Institute of Earth Sciences, National Taiwan Ocean University
⁴Princeton University

Presenting Author: abbyren@ntu.edu.tw

The tropical and subtropical western Pacific is bounded by broad and shallow continental shelves, where marine fixed nitrogen is removed by benthic denitrification. Past changes in sea level may drive significant changes in the rate of benthic denitrification, implying a strong compensation by marine N₂ fixation to stabilize the balance of marine N inventory in ocean margin regions and the global ocean. A published record using the foraminifera-bound d₁⁵N (FB-d₁⁵N) in the South China Sea suggests that losses of N in the margins are compensated by N₂ fixation on glacial/interglacial time scales. However, the South China Sea might represent a special case, being particularly strongly influenced by the extensive marginal shelves that surround it. Here, we present two new foraminifera-bound d₁⁵N records from the Western Pacific, including the Okinawa Trough at the eastern boundary of the East China Sea and in Kuroshio Current of the open North Pacific Subtropical Gyre. The d₁⁵N changes in the Okinawa Trough shows a glacial-to-interglacial d₁⁵N decline that closely resembles the d₁⁵N decline in the South China Sea. This similarity argues that N₂ fixation throughout the region responded to a sea level-paced deglacial increase N loss along the tropical east Asian margin. In contrast, FB-d₁⁵N from the North Pacific Subtropical Gyre is consistently low and largely invariant over the last 30,000 years, suggesting that N₂ fixation activity has remained relatively constant within the gyre. Taken together, these records suggest that the east Asian shelf sedimentary denitrification changes elicit a N₂ fixation in the near-margin waters that fully compensates for the shelf N loss. As a result, no excess P (N deficit) is available to be mixed laterally into the surface waters of the Kuroshio Current or the North Pacific Subtropical Gyre that it bounds. Such strong local compensation of N₂ fixation for denitrification-driven N loss implies that the western North Pacific’s N:P ratio will be stable over time.