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Deep Ocean Circulation Changes in the South Pacific During the Mid-Pleistocene Transition

EMILY SYMES[1], CHANDRANATH BASAK[2], JENNIFER L MIDDLETON[3], JESSE R FARMER[4], GISELA WINCKLER[3], ANNA P.S. CRUZ[5] AND EXPEDITION 383 SCIENCE PARTY[6]

[1]Department of Earth Sciences, University of Delaware, Newark, DE 19716, USA
[2]University of Delaware
[3]Columbia University
[4]University of Massachusetts Boston
[5]California State University
[6]International Ocean Drilling Program, Texas A&M University

Presenting Author: esymes@udel.edu

The Mid-Pleistocene Transition (MPT) between ~1.25 to 0.7 Ma marks a fundamental change in Earth's climate system when the glacial cyclicity changed from 41 to 100 kyr. This observed change occurred independently of changes in solar forcing suggesting internal feedbacks might have driven the transition. The South Pacific represents the largest fraction of the Southern Ocean and hence an important target region for studying the Earth's internal feedbacks, during the MPT. Here, we use cores from Site U1541 (54˚13'S, 125˚25'W, 3604 m) collected during the International Ocean Discovery Program (IODP) Expedition 383 to investigate the role of deep ocean circulation during the MPT and how it may be linked to global climate change drivers during this period.

We report authigenic Nd isotopes (expressed as e_{Nd}) time series from U1541 across the MPT. The e_{Nd} record is broadly interpreted as a mixing proportion of two end members, namely the unradiogenic Atlantic and radiogenic Pacific sourced waters. The modern-day dissolved e_{Nd} at this location is ~ -7, which is attained by most interglacials during this period. The glacials are represented by radiogenic e_{Nd} values that varied with time and an e_{Nd} ~ -6 is first observed at 1250 ka and subsequently at 900 and 650 ka indicating a dominance of Pacific-sourced water. A direct comparison of the U1541 e_{Nd} record with that of ODP Site 1123 $d^{18}O_{sw}$ (a proxy of ice volume or sea level change) off New Zealand shows a similar structure, suggesting a strong coupling between these records via global ice volume. It has been suggested that the ice volume increase at 900 ka originated in Antarctica. We compared Ice Rafted Debris (IRD) fluxes (an indicator of ice sheet growth or instabilities) from Site U1539 (56°09' S, 115°08'W, 4070 m) where prominent IRD peaks precede the first radiogenic excursion in e_{Nd} at 1250 ka and subsequently prior to other prominent e_{Nd} excursions. Therefore, Antarctic ice growth shows repeated systematic increase before observed changes in the e_{Nd} record, probably indicating a much more pronounced influence of Antarctic ice sheet growth on deep water circulation than what is currently recognized.