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The evolution of the Leeuwin Current and its Undercurrent during the Middle Pleistocene Transition – Insights from multiproxy productivity records.

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The Middle Pleistocene Transition (MPT, 1.2 - 0.9 Ma) represents a fundamental reorganization in the Earth's climate state and portrays an increase in glacial- interglacial variability. The increased amplitude of glacial-interglacial (G-IG) cycles coincides with a shift from 41-kyr obliquity-driven G-IG cycles to the characteristic quasi-100-kyr cycles during the so called 900-kyr-event. Several hypotheses exist to explain the inception of this new climate mode but the exact causes of the MPT remain ambiguous. The MPT is especially intriguing because the shift in global climate response to astronomical forcing occurred in absence of any significant change in the orbital parameters that control Earth's insolation. Recent studies showed that heightened glacio-eustatic sea-level changes during the MPT had a significant impact on the Indonesian Throughflow (ITF) by restricting its flow path through the Indonesian Archipelago. These changes in turn affected the strength and mode of the Leeuwin current (LC) along the west coast of Australia. Today, the LC is an anomalous poleward-flowing eastern boundary current that carries warm, low-salinity water southward along the coast of Western Australia. Below the LC, the Leeuwin Undercurrent (LUC) exists as a northward flowing counter current transporting cool nutrient-rich Subantarctic Mode Waters (SAMW) sourced from the Flinders Current flowing westward along the south Australian shelf break and the Great Australian Bight. Understanding LC and LUC dynamics during the MPT consequently offers important insights into Pleistocene Indian Ocean and ITF dynamics and their effect on the global thermohaline circulation at large, particularly since the inception of the "modern" LC was proposed $\sim$1 Ma ago.
Here, we present a new sub-tropical productivity record for the critical time interval between 1.2 and 0.6 Ma from International Ocean Discovery Program (IODP) Site U1460 (27°22.5'S, 112°55.4'E; Expedition 356 "Indonesian Throughflow"). We constructed a multi-proxy dataset of total organic carbon (TOC) and sulfur, carbonate content, calcareous nannofossil assemblage counts and alkenone mass accumulation rates to determine the effect of the inception of the modern-day LC during the MPT on the oceanographic conditions along the west coast of Australia. Our data suggest that increased glacial-interglacial sea level changes during the MPT significantly affected LC und LUC conditions by altering ITF strength, but also the geometry of the west Australian shelf break. Surface water productivity records (calcareous nannofossil assemblages and alkenone concentrations) further suggest that productivity at Site U1460 dramatically increased during the 900-kyr-event. This increase may be directly related to increased upwelling of SAMW as a result of a weakened LC and strengthened LUC. During interglacials, a stronger, more turbulent LC may have served to produce stronger Leeuwin Current eddies, which are a key feature of the modern-day LC and have a major effect on the productivity along the west coast of Australia. Our data thus suggests that the inception of Pleistocene LC and LUC dynamics are directly related to the oceanographic and glacio-eustatic changes that occurred during the MPT.