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Multiproxy paleoceanography from Broken Ridge pinpoints the onset of Tasman Leakage at 6.6 Ma

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Inter-basinal heat and water exchange play a prominent role in driving global climate change on astronomical timescales, as part of the global thermohaline circulation. Tasman Leakage connects the Pacific and Indian Oceans at an intermediate water depth, south of Australia. Therewith, Tasman Leakage advects heat toward the Indian Ocean, and ultimately toward the Agulhas system. Hence, Tasman Leakage constitutes a non-negligible part of the present-day thermohaline circulation. The onset of Tasman Leakage likely occurred sometime in the Late Miocene (Christensen et al., 2021), but precise geochronology for the establishment of this inter-basinal connection is still lacking. Moreover, Tasman Leakage sensitivity to astronomical forcing remains to be constrained in detail. To understand Tasman Leakage on astronomical timescales, we present a new Miocene-to-recent multi-proxy dataset from Ocean Drilling Program (ODP) Sites 752 and 754, cored on Broken Ridge (30°53.475'S), southeastern Indian Ocean.

The dataset consists of new X-ray Fluorescence (XRF) core scans that provide element contents for 18 different elements, along with benthic carbon and oxygen stable isotopic records at 4 cm resolution. The XRF-derived Ca/Fe record is paced by 405-kyr eccentricity between 22 Ma and 13 Ma (early-middle Miocene), but then becomes more sensitive to obliquity and precession forcing. The new high-resolution benthic $\delta^{13}C$ record confirms the onset of Tasman Leakage in the Late Miocene, more specifically at 6.6 Ma. This is when the Broken Ridge benthic $\delta^{13}C$ signature no longer reflects an Antarctic Intermediate Water signal. The benthic $\delta^{18}O$ record shows a strong ~110-kyr eccentricity imprint, indicating that Tasman Leakage might be most sensitive to this astronomical parameter. We conclude that the Neogene nannofossil oozes, preserved on Broken Ridge, constitute an excellent paleoceanographic archive that allows us to fingerprint Tasman Leakage sensitivity to astronomical forcing.