Exploring sedimentary response to Eocene-era tectonic and climate changes in southeast Indian Ocean

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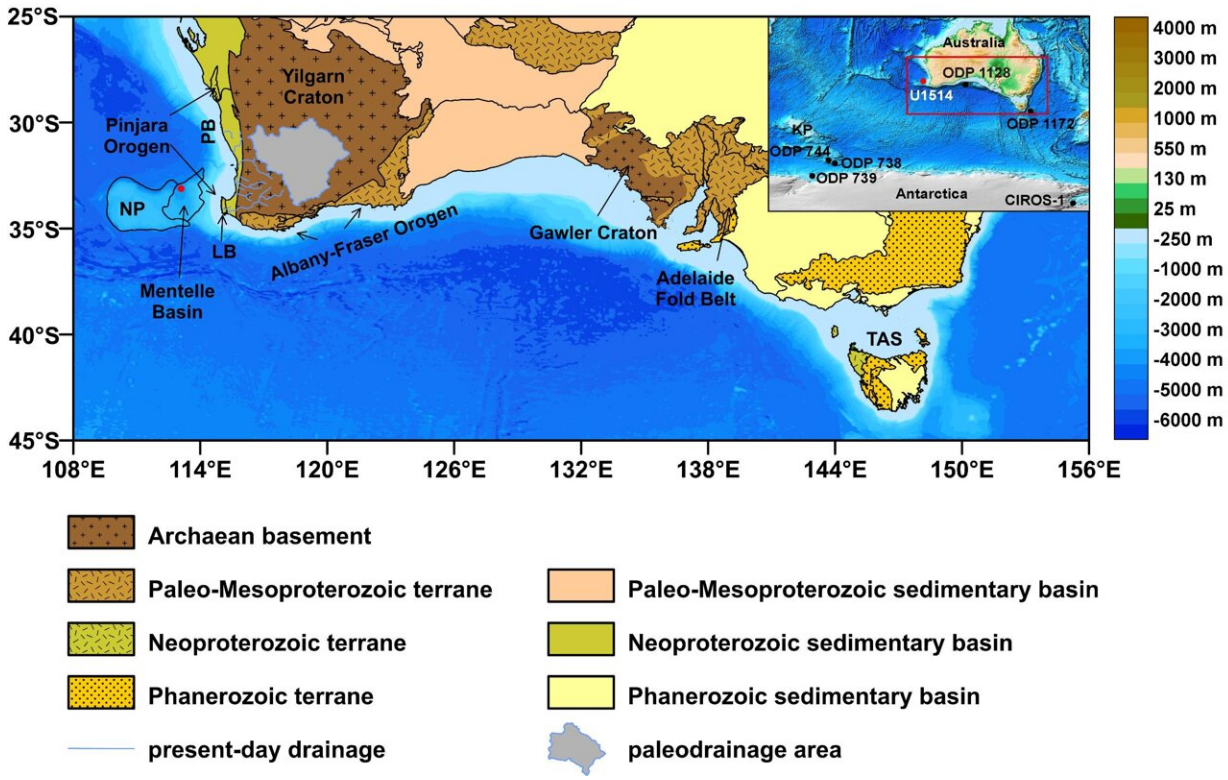

Map showing the modern locations of IODP Site U1514 (red dot) and the main geological regions of South Australia. Credit: IOCAS

A research team led by Prof. Chang Fengming from the Institute of Oceanology of the Chinese Academy of Sciences (IOCAS), for the first

time, reported the tectonic and climatic controls on sediment transport to the southeast Indian Ocean during the Eocene.

The study was published in *Global and Planetary Change* on Sept. 28.

The Eocene, a critical period in Earth's climate history, encompassed profound climatic and oceanographic reorganization from the greenhouse conditions of the early Eocene to the icehouse state of the early Oligocene. This interval was also a period of extensive global plate reorganization, including the onset of fast separation between Australia and Antarctica at ~43 million years ago (Ma), which finally allowed the generation of the Southern Ocean.

However, there are few records available from the climate- and tectonic-sensitive mid-high southern latitudes that span this entire interval of time.

In this study, the researchers reconstructed the source-to-sink processes in the mid-high southern latitudes during 52–34 Ma by multi-proxy investigation of grain size, clay minerals, major and trace element concentrations, and Sr-Nd isotopic compositions of sediments from International Ocean Discovery Program (IODP) Site U1514 in the Mentelle Basin.

"Siliciclastic sediments at the study site were predominantly originated from distal southwestern Australian continent between 52 and 43 Ma, and influenced by volcanic input from the Naturaliste Plateau during 43–38 Ma, the sediment provenance was then transferred to proximal continental sources between 37 and 34 Ma," said Wang Wei, first author of the study.

In addition, the researchers found that the onset of fast separation between Australia and Antarctica at ~43 Ma not only caused an

increased supply of volcanic materials from the Naturaliste Plateau between 43 and 38 Ma, but also released significant quantities of CO_2 to the atmosphere that induced a ~5 Myr-long warming period in southwest Australia. The latter resulted in enhanced chemical weathering on the western Australian continent. This interval was a significant warming reversal that interrupted the long-term global cooling throughout the middle to late Eocene.

Furthermore, rapid terrigenous input associated with stronger physical erosion occurred during 38–37 Ma. Tectonic processes related to the sudden acceleration in seafloor spreading in the Tasman Sea during this period led to the abrupt sea level drop along southwest Australian coast, and therefore, resulted in enhanced erosion of the exposed shelf sediments.

Subsequently (37–34 Ma), the regional uplift in southwestern Australia and coeval climate cooling resulted in the diversion and inactivation of large drainage systems, thus blocking the transportation of sediment from distant regions, and contributions of sediments from proximal sources became more important.

"We reconstructed the source-to-sink processes in the Mentelle Basin during the Eocene and their links to climatic and tectonic changes in the mid-high southern latitudes for the first time, which will help to better understand the relationship between climate-tectonic and environmental changes in warmhouse conditions," said Prof. Xu Zhaokai, the corresponding author of the study.

More information: Wei Wang et al, Tectonic and climatic controls on sediment transport to the Southeast Indian Ocean during the Eocene: New insights from IODP Site U1514, *Global and Planetary Change* (2022). DOI: 10.1016/j.gloplacha.2022.103956

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