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The evolution of the Antarctic Circumpolar Current in the Southwest Pacific sector of the Southern Ocean throughout the Cenozoic era

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The establishment and evolution of the Antarctic Circumpolar Current (ACC) throughout the Cenozoic remains poorly known, mainly because of the lack of continuous long-term records at strategic locations. Here we present new records from marine sediments collected by the Deep Sea Drilling Project (DSDP) Site 278, located in the Southwestern Pacific sector of the Southern Ocean (Southern Emerald Basin), spanning from the mid-Oligocene to the Pleistocene (ie. the$\sim$28-2 Ma). Our site is ideally situated to reconstruct changes in the ACC since the mid-Oligocene as it remained along the polar frontal zone as shown by paleolatitude reconstructions and microfossil assemblage data. To track its evolution, we combined (i) mean grain size of sortable silt (SS) data with (ii) primary productivity proxies including biogenic silica (BSi), calcium carbonate ($CaCO_3$) and organic matter, and (iii) neodymium isotope ratios (εNd) generated from fossil fish teeth and debris. Our results document a significant increase in SS, enhanced marine productivity and a decrease in εNd values towards present-day Circumpolar deep water εNd values, suggesting a progressive strengthening of the proto-ACC flow over the last 28 Ma. However, we find that the development of a modern-like, homogenous and deep-reaching current was fully established solely during the Pliocene-Pleistocene transition, concomitantly with the onset of the Northern Hemisphere glaciation.