

The Eocene-Oligocene Transition (EOT) at ~34 Ma marked a climatic shift from greenhouse to icehouse conditions, towards long-lasting lower global temperatures and a continental ice sheet in the Antarctic. The relative importance of ocean gateways, pCO₂, and ice growth as drivers of this transition are not fully understood. We report on sedimentological and inorganic geochemical results across the EOT at Ocean Drilling Program (ODP) Site 696 in the Weddell Sea, within the Antarctic limb of the Atlantic circulation. The geochemical composition of detrital, authigenic and biogenic marine sediment components, and sortable silt proxies demonstrate the impact of ice growth on high latitude water masses. Sortable silt grain size and Zr/Rb ratios attest to a period of vigorous circulation at ~36.2-35.8 Ma, coincident with a known warm interval in the Southern Ocean. Across the EOT, detrital provenance suggests that regional ice growth in the western Weddell Sea was stepwise, first expanding in the Antarctic Peninsula, followed by parts of West Antarctica. In conjunction with regional ice growth, high uranium enrichment factors (U EF) in sediments spanning the EOT interval indicate anoxic conditions in the sediment with evidence of carbonate dissolution. Following glacial expansion and sea-ice formation at ~33.6 Ma, a return to oxic conditions and carbonate preservation is observed with excess barium and phosphorous indicative of an increase in productivity, and potentially carbon export. Our results highlight the important connections between ice growth and the changing properties of high-latitude water masses at the EOT with impacts on the global ocean circulation.