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Reappraisal of ODP Site 1172 does not support rapid deepening across Eocene-Oligocence boundary, but reveals plume volcanism influence on sedimentation prior to Antarctic Circumpolar Current onset

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The final separation of Australia and Antarctica in the mid-Eocene to Oligocene opened the Tasmanian Gateway, creating a progressively deeper connection between the Atlantic and Pacific and potentially removing the last barrier to the Antarctic Circumpolar Current (ACC). Early work suggested that the inception of the ACC played an important role in the continental-scale glaciation of Antarctica by thermally isolating it from 34 Ma onwards. More recent studies, by contrast, indicate an initial westward surface water flow across the incipient Tasmanian Gateway from about 50 Ma, with the onset of an eastward flowing ACC onset delayed until 30 Ma when the gateway had widened sufficiently northwards to fall under the influence of the westerly wind belt. Climate model simulations and plankton biogeography further suggest that surface circulation patterns in the southern Pacific prior to 34 Ma did not allow for significantly greater pole-wards heat transport. The thermal isolation hypothesis has consequently fallen out of favour, with reduced atmospheric CO_2 now considered a more likely driver of Southern Hemisphere glaciation.

The material recovered during ODP Leg 189 has been central to this evolving debate. ODP Site 1172, located on the East Tasman Plateau (ETP), has been particularly important to efforts to constrain the timing and climatic impact of the evolution of the Tasmanian Gateway. Initial work inferred rapid, major deepening of the ETP in the latest Eocene, however recent studies highlight a major discrepancy in the inferred Late Eocene water depth of the ETP, with sedimentary material from Site 1172 and the adjacent Cascade Seamount both interpreted to have been deposited in a shallow-marine setting even though these locations currently have about 1900 m relief between them and lack evidence of differential subsidence. This palaeodepth discrepancy has significant implications for inferring ETP subsidence rates and the timing and pace of Tasmanian Gateway deepening more generally.

Here we reassess the Site 1172 Eocene-Oligocene record. New sedimentological and petrographic observations show that previously described erosive surfaces and abrupt grain size variation at 35.5 to 30 Ma reflect deposition of reworked shallow-water material by turbidity currents sourced from mass wasting of the adjacent Cascade Seamount, not winnowing by bottom-currents associated with rapid deepening of the ETP. Furthermore, the stratigraphic distribution of volcanic ash, Ar-Ar dates constraining the evolution of the Cascade Seamount, and a reconstruction of the Balleny hotspot track indicate that markedly reduced sedimentation rates/hiatuses in the late Eocene are at least partially due to local thermal uplift associated with passage of the Balleny plume. We further suggest that the prominent shift from siliceous sediments to calcareous ooze recorded at most ODP Leg 189 sites is may reflect regional subsidence, but is primarily related to the globally recognised deepening (up to 1 km) of the carbonate compensation depth at the E/O boundary. Our reassessment does not support rapid deepening of the ETP related to opening of the Tasman Gateway at the E/O boundary.