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West Antarctic archipelago covered by cool-temperate forests during early Oligocene glaciation

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The Eocene-Oligocene Transition (~34.4–33.7 Ma) marks a major step in the long-term evolution from the greenhouse climate of the Early Palaeogene to the icehouse regime of the Late Neogene and Quaternary. However, it remains uncertain which landmasses were covered by ice sheets during the Early Oligocene Glacial Maximum (~33.7–33.2 Ma), an interval of peak glaciation inferred from deep-sea benthic foraminifera oxygen isotope records that immediately follows the Eocene-Oligocene Transition. The scarcity of Late Eocene and Early Oligocene continental and shallow-marine records in both Arctic and Antarctic regions has prevented the reconstruction of environmental conditions and ice-sheet extent during the Early Oligocene, which is critical for assessing ice–ocean–atmosphere interactions during early stages of the Cenozoic icehouse. Here, we present the first Early Oligocene shallow-marine record from the Pacific margin of West Antarctica, recovered from the central Amundsen Sea Embayment shelf on RV *Polarstern* expedition PS104 at Site 21. Marine mudstones recovered at this site document the presence of a

vegetated archipelago at a palaeo-latitude of 73.5°S. Pollen assemblages and organic biomarker proxies indicate a cool-temperate *Nothofagus*-dominated forest situated within a productive marine archipelago. No evidence for marine terminating ice was detected in the cores from Site 21, thus indicating that the West Antarctic Ice Sheet was small or entirely absent during the Early Oligocene.

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