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Antarctica's Cenozoic Ice and Climate History: New Science and New Challenges of Drilling in Antarctic Waters

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Scientific drilling continues to advance knowledge of Antarctica's role in the climate system and the evolution of its ice sheets. Since 1972, seven DSDP, ODP, and IODP expeditions to Antarctic waters have documented cooling of Antarctic climate since the early Eocene; inception of large-scale glaciation at the start of the Oligocene; ice-sheet expansion and relative stabilization in the middle Miocene; fluctuations of the ice margins in the Pliocene; and high-resolution details of Holocene climate. Geological drilling by land- and ice-based projects such as ANDRILL has provided shoreward evidence of ice and climate behaviour complementary to the ship-based drilling. The scientific significance of the sediment cores collected on these expeditions has grown as the problem of global warming has become more apparent, and the cores continue to be analysed with the development of new techniques, such as biomarker temperature estimates and geochemical sediment provenance. However, these existing sedimentary records do not cover all of the Cenozoic and the core locations are geographically restricted.

Antarctic marine sediments hold further records of ice sheet dynamics and warm climates of the past that form analogues for high-CO₂ greenhouse scenarios of the next centuries. Several proposals to collect these records are in the IODP review system, for regions where the ice sheets are sensitive to warming and for time periods when the ice response to warm climates is not well known. A workshop is being held at IODP in College Station, Texas, in May 2016 to: (1) Produce an integrated overview of how IODP drilling can advance understanding of Antarctic ice sheet retreat (and hence sea level rise) under warm climates; (2) Examine existing sediment cores that revealed Antarctica's past marine glaciological history; and (3) Establish best practices for assessing ice and weather to conduct safe drilling operations in Antarctic waters.

Here we review the highlights and outcomes of this workshop, and look to the future of scientific drilling around Antarctica.

