IODP Expedition 382 (Iceberg Alley) –Preliminary results on dust-climate couplings

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International Ocean Discovery Program (IODP) Expedition 382, Iceberg Alley and Subantarctic Ice and Ocean Dynamics, took place from March 20 to May 20, 2019 with RV JOIDES Resolution (Weber et al., 2019). The primary goal is to investigate the long-term history of Antarctica in order to better understand the dynamics of the Antarctic Ice Sheet (AIS), how the pace and magnitude of past ice-mass loss responded and contributed to global sea-level evolution. Another goal is to decipher how past changes in ocean bioproductivity and dust deposition in the Antarctic zone might have influenced atmospheric CO_2 variability. We drilled five sites with multiple holes east of the Drake Passage with a total core recovery of ~2.8 km.

Three sites were collected in the center of Iceberg Alley, between –57.4˚S and –59.4˚S in the southern Scotia Sea. We recovered continuously deposited late Neogene sediments covering at least the last 3.5 Ma. Preliminary biostratigraphic assessment indicates over 45 first and last occurrences of biosiliceous species that are pristinely preserved. Also, all known magnetic boundaries since the Late Neogene are clearly documented. Resulting sedimentation rates are ~20–10 cm/kyr for Sites U1536 and U1537, and ~40–20 cm/kyr for Site U1538. Accordingly, all sediment physical and optical properties determined onboard at 1–2 cm increments, translate into sample resolutions in the upper decadal to lower centennial band. Overall, we retrieved the first high-resolution and long-term, continuous climate and ice-sheet record in the Antarctic zone.

The sites from Iceberg Alley will be used to study the Plio-Pleistocene flux of icebergs through Iceberg Alley, the main pathway along which icebergs calved from the margin of the AIS travel as they move equatorward into the warmer waters of the Antarctic Circumpolar Current (ACC). In particular, the continuous and rather highly-resolved sediment record from Iceberg Alley should enable us to assess the magnitude of iceberg flux and dust climate couplings for key time periods of AIS evolution, e.g., the middle Miocene glacial intensification of the East Antarctic Ice Sheet, the mid-Pliocene warm period, the late Pliocene glacial expansion of the West Antarctic Ice Sheet, the mid-Pleistocene transition (MPT), “warm interglacials” and glacial terminations of the last 800 kyr. We will use the geochemical provenance of iceberg-rafted detritus (IBRD) and other glacially eroded material to determine regional sources of AIS mass loss. We will also address interhemispheric phasing of ice sheet growth and decay, study the distribution and history of land-based versus marine-based ice sheets around the continent over time, and explore the links between AIS variability and global sea level.

Comparing changes in dust proxy records between the Scotia Sea and Antarctic ice cores will also provide a detailed reconstruction of changes in the Southern Hemisphere westerlies on millennial and orbital timescales for the last 800 kyr. Extending the ocean dust record beyond that time is a critical goal and will help evaluating dust-climate couplings since the Pliocene, the potential role of dust in iron fertilization

and atmospheric CO_2 drawdown during glacials, and whether changes in dust input to Antarctica played a role across the MPT for subsequently slightly lowered glacial atmospheric pCO_2.

Reference

Weber, M.E., Raymo, M.E., Peck, V.L., Williams, T., and Expedition 382 Scientists, 2019. Expedition 382 Preliminary Report: Iceberg Alley and Subantarctic Ice and Ocean Dynamics. International Ocean Discovery Program, 1-40.

Keywords: Antarctica, paleoclimate, ice-sheet

