

Upcoming IODP Expedition 379: Development and sensitivity of the West Antarctic Ice Sheet tested from drill records of the Amundsen Sea Embayment

Karsten Gohl¹, Julia Wellner², Adam Klaus³

¹*Alfred Wegener Institute Helmholtz-Centre for Polar and Marine Research, Bremerhaven, Germany*

²*Dept. of Earth and Atmospheric Sciences, University of Houston, Houston, TX, USA*

³*IODP, Texas A&M University, College Station, TX, USA*

The West Antarctic Ice Sheet (WAIS) is largely marine based and thus highly sensitive to both climatic and oceanographic changes. Therefore, the WAIS has likely had a very dynamic history over the last several million years. A complete collapse of the WAIS would result in a global sea level rise of 3.3–4.3 m, yet the world's scientific community is not able to predict its future behavior. Moreover, knowledge about past behavior of the WAIS is poor, in particular during geological times with climatic conditions similar to those expected for the near and distant future. Reconstructions and quantifications of partial or complete WAIS collapses in the past are urgently needed for constraining and testing ice sheet models that aim to predict future WAIS behavior and the potential contribution of the WAIS to global sea level rise. Large uncertainties exist regarding the chronology, extent, rates, and spatial and temporal variability of past advances and retreats of the WAIS across the continental shelves. These uncertainties largely result from the fundamental lack of data from drill cores recovered proximal to the WAIS. The continental shelf and rise of the Amundsen Sea are prime targets for drilling because the records are expected to yield archives of pure WAIS dynamics unaffected by other ice sheets and the WAIS sector draining into the Amundsen Sea Embayment (ASE) currently experiences the largest ice loss in Antarctica.

We plan a series of drill sites for the ASE shelf where seismic data reveal seaward-dipping sedimentary sequences that span from the preglacial depositional phase to the most recent glacial periods. Our strategy is to drill a transect from the oldest sequences close to the bedrock/basin boundary at the middle–inner shelf transition to the youngest sequences on the outer shelf in the eastern ASE. If the eastern ASE is inaccessible due to sea ice cover, a similar transect of sites can be drilled on the western ASE. The core transect will provide a detailed history of the glacial cycles in the Amundsen Sea region and allow comparison to the glacial history from the Ross Sea sector. In addition, deep-water sites on the continental rise of the Amundsen Sea are selected for recovering continuous records of glacially transported sediments and detailed archives of climatic and oceanographic changes throughout glacial–interglacial cycles. We will apply a broad suite of analytical techniques, including multiproxy analyses, to address our objectives of reconstructing the onset of glaciation in the greenhouse to icehouse transition, processes of dynamic ice sheet behavior during the Neogene and Quaternary, and ocean conditions associated with the glacial cycles.

The five principal objectives of IODP Expedition 379 are as follows:

1. To reconstruct the glacial history of West Antarctica from the Paleogene to recent times and the dynamic behavior of the WAIS during the Neogene and Quaternary, especially possible partial or full WAIS collapses, and the WAIS contribution to past sea level changes. Emphasis is placed in particular on studying the response of the WAIS at times when the pCO₂ in Earth's atmosphere exceeded 400 ppm and atmospheric and oceanic temperatures were higher than at present.
2. To correlate the WAIS-proximal records of ice sheet dynamics in the Amundsen Sea with global records of ice volume changes and proxy records for air and seawater temperatures.
3. To study the relationship between incursions of warm Circum-Polar Deep Water onto the continental shelf of the Amundsen Sea Embayment and the stability of marine-based ice sheet margins under warm water conditions.
4. To reconstruct the processes of major WAIS advances onto the middle and outer shelf that are likely to have occurred since the middle Miocene and compare their timing and processes to those of other Antarctic continental shelves.
5. To identify the timing of the first ice sheet expansion onto the continental shelf of the ASE and its possible relationship to the uplift of Marie Byrd Land.

IODP Expedition 379 will be conducted with the drill ship *JOIDES Resolution* from 18 January to 20 March 2019.