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Revealing potential past collapses of the West Antarctic Ice Sheet - Upcoming drilling in the Amundsen Sea Embayment

Gerhard Kuhn (1), Karsten Gohl (1), Gabriele Uenzelmann-Neben (1), Torsten Bickert (2), Michael Schulz (2), Robert D. Larter (3), and Claus-Dieter Hillenbrand (3)

(1) Alfred Wegener Institute, Helmholtz Centre for Polar and Marine Research, Bremerhaven, Germany, (2) MARUM - Center for Marine Environmental Sciences, University of Bremen, Bremen, Germany, (3) British Antarctic Survey, Cambridge, United Kingdom

The West Antarctic Ice-Sheet (WAIS) is likely to have been subject to very dynamic changes during its history as most of its base is grounded below modern sea-level, making it particularly sensitive to climate changes. Its collapse would result in global sea-level rise of 3-5 m. The reconstruction and quantification of possible partial or full collapses of the WAIS in the past can provide important constraints for ice-sheet models, used for projecting its future behaviour and resulting sea-level rise. Large uncertainties exist regarding the chronology, extent, rates as well as spatial and temporal variability of past advances and retreats of the WAIS across the continental shelves. By using the seafloor drilling device MeBo during an RV Polarstern cruise scheduled for early 2015, a series of sediment cores will be drilled on the Amundsen Sea Embayment (ASE) shelf, where seismic data show glacially-derived sequences covered by only a thin veneer of postglacial deposits in some areas. From analyses of seismic data, we infer that interglacial sediments can be sampled which may have been deposited under seasonally open water conditions and thus contain datable microfossil-bearing material. A shallow basin near the Pine Island Glacier front will be one of the prime targets for the drilling. The near-horizontal seismic reflection horizons may represent a sequence of continuously deposited, mainly terrigenous material, including ice-rafted debris, meltwater deposits and hemipelagic sediments deposited rapidly during the Holocene or a series of unconformities caused by erosion resulting from grounding line oscillations through many glacial cycles. Subglacial bedforms imaged in multibeam bathymetric data indicate fast glacial flow over some shelf areas of the ASE, where seismic profiles show acoustic basement near the seafloor. It is unknown, whether fast ice-flow in these areas was facilitated by water-lubricated sliding over bedrock or presence of a thin layer of deformable till (perhaps less than a metre in thickness). The nature of this layer holds important clues for understanding the processes that operated beneath the margin of the ice-sheet, beneath ice-flows and on ridges between ice-streams during the Last Glacial Maximum. Grounding zone wedges (GZWs) are widely thought to be important in stabilising grounding line positions during ice-sheet retreat, but hypotheses about the processes and duration of their formation and their composition, are mainly based on conceptual models. Drill sites on and near GZWs are aimed to establish the nature of their sediments, their formation processes, their rates of growth and the palaeo-environmental conditions in their surroundings.