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IODP Expedition 379: Late Miocene to Pleistocene shelf to rise processes in the Amundsen Sea, West Antarctica, from seismic correlation

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The West Antarctic Ice Sheet (WAIS) is thought to be highly sensitive to climatic and oceanographic changes. Modelling infers that the WAIS likely had a very dynamic history throughout the Neogene to the present. A complete collapse of the WAIS would result in a global sea level rise of 3.3 to 4.3 m, yet there is large uncertainty on predicting its future behavior and its contribution to sea level rise. Geological constraints on the past behavior of the WAIS are relatively sparse and mainly based on records from the Ross Sea sector. In particular, records of time intervals with climatic conditions similar to those expected for the near and distant future, such as the Pliocene, are needed. Deglaciation of the WAIS in the Amundsen Sea sector is hypothesized to have triggered WAIS collapses during past warm times. Drill records from the International Ocean Discovery Program (IODP) Expedition 379 provide continuous late Miocene to Pleistocene sediment sequences from a drift on the continental rise, allowing the assessment of sedimentation processes from cold and warm times. In particular Site U1532 recovered an expanded sequence of Pliocene lithofacies with an excellent paleomagnetic record allowing for very high-resolution, sub-orbital scale climate change studies of the previously sparsely sampled eastern Pacific sector of the West Antarctic margin. At both Sites U1532 and U1533, sediments characterized by high microfossil content and high abundance of ice-rafted debris alternate with laminated terrigenous muds and are interpreted to result from cyclic deposition under interglacial and glacial conditions, respectively. Deep-sea channels likely mark the pathways of terrigenous detritus that was transported downslope from the Amundsen Sea shelf via turbidity currents or other gravitational transport processes predominantly during glacial periods. The association of lithological facies predominantly reflects an interplay of these downslope and contouritic sediment transport

processes as well as phases of increased pelagic and hemipelagic sediment input. Correlation of the seismic stratigraphy at the drill sites on the rise with that of the continental shelf of the Amundsen Sea Embayment allowed us to identify massive prograding sequences that expanded the outer shelf seaward by about 80 km by frequent advances of grounded ice across the shelf mainly during Pliocene times. The preservation of buried grounding zone wedges visible in seismic profiles from the shelf is explained by (hemi)pelagic sedimentation during prolonged periods of ice retreat. This can be correlated with an extended warm middle Pliocene period chronologically constrained by the drill records. The contrast between sediments deposited under cold and warm climate conditions indicates that this WAIS sector was highly dynamic in the Pliocene.

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