Tectonics and glacial-marine sedimentation in Pine Island Bay: Survey plan of an upcoming RV Polarstern cruise

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Pine Island Bay forms the third-largest outflow area for the West Antarctic ice-shield. The main ice streams from the WAIS into Pine Island Bay flow through the Pine Island and Thwaites Glacier systems, through which most of the glacial-marine sediments onto the shelf of Pine Island Bay and across the continental slope into the deep sea have been transported. This drainage pattern probably owes its existence to the an assumed crustal boundary between the Thurston Island/Ellsworth Land blocks and the Marie Byrd Land block. The Pine Island Bay represents an ideal working area in which the hypotheses of a total melt-down of the WAIS during the Quaternary can be tested. With the exception of a few single-channel seismic profiles and bathymetric tracks, a dense and systematically sampled grid of geophysical and geological data does not exist in Pine Island Bay at this stage. Dense and detailed surveys of the glacial-marine sedimentary sequences over large areas from the shelf and slope of Pine Island Bay and its adjacent continental rise would allow reconstructions of the onset of large-scale glaciation in West Antarctica, the long-term dynamics of the WAIS and the reaction of WAIS dynamics to the global glacial-interglacial cycles of the Late Quaternary.

A geoscientific cruise with RV Polarstern to the Amundsen Sea embayment is scheduled for February to April 2006 in cooperation between AWI, the British Antarctic Survey (BAS) and the New Zealand Institute of Geological & Nuclear Sciences (GNS). The main objectives are:

" Recording of the youngest sedimentary sequences since the Oligocene across the shelf, slope and the continental rise, using high-resolution reflection seismics, sub-bottom profiler and swath-bathymetry in order to derive a sedimentation model

" Sampling of sediment cores to determine sedimentological and physical parameters of the youngest deposits and to reconstruct depositional and erosional events in space and time.

" Mapping of the acoustic basement and its structure with seismic reflection methods to obtain tectonic geometries to understand sediment transport and depositional processes.

" Identification of the tectonic boundaries between suspected crustal blocks, in particular of those between the Thurston Island and Marie Byrd Land blocks. It is suspected that the glacier troughs and Pine Island Bay developed along such a tectonic boundary.

Helicopter-magnetic, gravimetric and deep crustal seismic surveys will provide the necessary data base for a tectonic model.

" During and after separation from the Chatham Rise and Campbell Plateau (New Zealand), the continental margin of Marie Byrd Land developed as a passive margin, probably accompanied by intensive volcanism. The question is whether this volcanism occurred mainly during the rifting process or during post-rift phases, or whether it developed in relation to the West Antarctic rift system. Heli-magnetic mapping and deep crustal seismic profiling of the continental margin of Marie Byrd Land as well as petrological sampling and geochemical analyses of volcanic rocks from seamounts (e.g. Marie Byrd Seamounts) and parts of exposed mainland will provide data to develop models of the magmatic evolution.