MEETINGS

Improving Constraints on Paleo Ice Sheets in the Amundsen Sea Embayment

Amundsen Sea Embayment: Tectonic and Climatic Evolution; Granada, Spain, 9 September 2009

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Geoscientists working on the Amundsen Sea Embayment (ASE) of West Antarctica met at a workshop during the First Antarctic Climate Evolution Symposium to discuss recent advances from, and future priorities for, work in this region. The ASE is the most rapidly changing sector of the West Antarctic Ice Sheet (WAIS) and contains enough ice to raise sea level by 1.2 meters. Ice sheet modeling studies suggest that this sector of the WAIS is potentially unstable.

Considerable efforts have been made through several national Antarctic programs to acquire new data on the geological structure, subglacial topography, bathymetry, and glacial history of this remote region. These data are important for establishing boundary conditions for ice sheet modeling, for providing constraints on past ice sheet changes that can be used to test models, and for putting recent changes into a longer-term context.

Participants described recent research on the ASE. For instance, plate reconstructions and seismic measurements suggest multiple phases of extension since 90 million years ago. Aerogeophysical surveys have transformed knowledge of ASE subglacial topography and provide evidence of sedimentary basins and possible subglacial volcanic centers. In addition, continental shelf seismic survey results were presented that suggest deposition from fluctuating ice sheets, but without stratigraphic drilling, the age of these glacial cycles remains unknown.

Swath bathymetry data compilation has provided greatly improved maps of the continental shelf, slope, and rise. For instance, cross-shelf troughs show former ice stream paths during glacial periods. Workshop participants presented detailed swath bathymetry data that reveal bed forms generated beneath a more extensive ice sheet and provide insight into its past extent, dynamic behavior, and retreat pattern since the Last Glacial Maximum (LGM; about 20,000 years ago). Radiocarbon dates on sediment cores suggest rapid grounding line retreat across the shelf before 12,000 years ago, and then more gradual retreat until the ongoing dramatic acceleration.

Ice sheet surface elevation changes since the LGM have been investigated using cosmogenic isotopes to determine surface exposure ages on nunataks. New results were presented that contrast with the offshore record in that they indicate relatively slow change initially following the LGM, and then more rapid change over the past few thousand years.

Participants also noted that some continental rise sediment cores contain continuous records spanning the Quaternary (about 2.5 million years ago to the present) but do not reveal any clear indication of a collapse of the WAIS. However, collapse might not necessarily yield a prominent layer of ice-rafted debris close to the Antarctic margin.

Workshop participants agreed that priorities for future research are to (1) establish a deglacial history of each shelf trough through complete swath bathymetry coverage and targeted sediment coring, (2) develop proxies to recognize ice sheet collapse and Circumpolar Deep Water incursions and to estimate past surface water temperatures, (3) intensify and extend surface exposure age studies, (4) extend aerogeophysical surveys to adjacent areas, (5) obtain measurements of heat flow, and (6) extend seismic coverage to identify targets for stratigraphic drilling that will reveal long-term glacial history and its sensitivity to changing climate, sea level, and oceanography.

A longer version of this report, including a list of workshop participants, can be found in the electronic supplement to this *Eos* issue (http://www.agu.org/eos_elec).

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Understanding Antarctic Climate and Glacial History

First Antarctic Climate Evolution Symposium; Granada, Spain, 7–11 September 2009

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Antarctic Climate Evolution (ACE; http://www.ace.scar.org), a scientific research project of the Scientific Committee on Antarctic Research and a core International Polar Year project, held its first international symposium in Spain in September 2009. ACE's mission is to facilitate the study of Antarctic climate and glacial history through integration of numerical modeling with geophysical and geological data. Nearly 200 international scientists from the fields of climate, ocean, and ice modeling joined geologists, geophysicists, and geochemists for 5 days of intense interaction. Oral sessions were plenary and were limited to allow time for poster viewing, discussion, and workshops (http://www.acegranada2009.com/).

Thematic topics included paleoenvironmental reconstruction and climate/ice modeling; geophysical, geological, and geochemical data synthesis; Arctic-tropical-Antarctic climate linkages; Cenozoic (past 65 million years) Southern Ocean evolution and linkages with Antarctic climate; and Neogene (the past 23 million years) climate and ice sheet variability and implications for future sea level.

Paleoenvironmental sessions focused on discoveries from the Antarctic Geological Drilling (ANDRILL) and Shallow Drilling on the Antarctic Continental Margin (SHALDRIL) programs, but the Integrated Ocean Drilling Program (IODP), ice coring, and outcrop communities were also well represented. Recent advances in Antarctic climate and ice sheet modeling were presented with examples of global climate models, regional climate models, and ice sheet models applied to past, present, and future climate change. A session devoted to recent radio echo sounding surveys reported on ice sheet thickness, bed roughness, and distribution of subglacial sediment, all critical boundary conditions for ice sheet simulations. Improvements for ancient boundary conditions were also presented, including tectonic and paleotopographic reconstructions implying a larger subaerial Antarctic continent at the time of the first major glaciation in the earliest Oligocene (about 34 million years ago).

In addition, new proxy carbon dioxide (pCO_2) reconstructions for the past 70 million years combined with numerical climate modeling emphasized atmospheric CO_2, relative to other forcing mechanisms, as the fundamental driver of Antarctic climate and ice volume through the Cenozoic. Participants noted that knowledge of climate and ice sheet behavior before 3 million years ago (with elevated temperatures but perhaps only slightly elevated pCO_2) is relevant to predictions of future ice sheet stability and sea level change.