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The Offshore New Harbor (ONH) Seismic Expedition: Revealing the Stratigraphic History in the Southern McMurdo Sound Region, Ross Sea, Antarctica from the Greenhouse to Icehouse Worlds

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In the austral spring 2008, the ANDRILL (ANtarctic geological DRILLing) Program's Offshore New Harbor Expedition successfully collected over 48 km of multi-channel seismic (MCS) data to investigate the stratigraphic and tectonic history of westernmost Southern McMurdo Sound during the Greenhouse World (Eocene) and the start of the Icehouse World (Oligocene). This survey represents an important step for identifying future drilling targets for ANDRILL, which is a multinational program, with the aim to recover stratigraphic intervals for interpreting Antarctica's climate and glacial history over the past 50 million years. The goal of the Offshore New Harbor Project is to recover proximal archives from two widely recognized but unresolved time intervals regarding Antarctica's history: 1) the mid-Paleogene cryospheric development on Antarctica; and 2) the abrupt climate shift across the Eocene/Oligocene transition.

The ONH seismic survey used methods successfully employed by previous ANDRILL's surveys in Southern McMurdo Sound (2005) and in Mackay Sea Valley (2007), which included deploying a Generator Injector (GI) airgun through holes drilled through the ice and a 1.5 km long streamer that used 60 gimbled geophones to measure the returning reflected seismic energy. Processing of the seismic data was successfully able to remove the bottom water multiple, permitting deeper seismic reflectors to be identified for the first time in this area.

Since one of the two seismic lines crossed close to the previously drilled CIROS-1, correlation was possible between the seismic reflectors and the entire stratigraphic section at CIROS-1, which has been dated as old as Late Eocene ($\sim$37 Ma). Additionally, seismic and gravity data indicated that a thick sedimentary wedge of up to 5 km lie immediately east of CIROS-1. With the Devonian Beacon Sandstone Formation having been observed to be no thicker than 2 km on land, an additional 3 km of Cenozoic sediments may lie below and down dip of CIROS-1. The Oligocene strata are characterized by a clinoformal geometry, with reflectors down lapping onto the two prominent reflectors that correspond to the Eocene / Oligocene Boundary and the "mid" Oligocene hiatus recognized in the CIROS-1 borehole. These new data support the idea that substantial Eocene and Oligocene strata can be recovered by drilling east of the location of the CIROS-1 borehole. The upper units imaged below the base of CIROS-1 represent the potential for future drilling objectives for the ANDRILL Program.

Additionally, reflectors that contained trough-like shapes were interpreted as representing incised valleys, which were most likely cut by ice streams. These valleys provide prima facie documentation of when the ice sheet extended beyond the present-day coastline. These reflectors were correlated to CIROS-1 as well as the ANDRILL AND-2A borehole, providing ages on the timing of major ice stream advances of the East Antarctic Ice Sheet in the western Ross Sea area.