Geophysical and geological signatures of submarine canyons off Cape Darnley, Antarctica

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The Antarctica continental slope off Cape Darnley is known as a major pathway of colder, less saline, and denser bottom water, which is produced in the Cape Darnley polynya and known as the Cape Darnley Bottom Water (CDBW). The mooring observations showed that significant signals of CDBW occurs at the center of the Wild Canyon (Ohshima et al., 2013). Intensive erosion and material transports from shallow regions to deep ocean can be expected here, but the relationship between submarine canyons and bottom water is still debated. Here we present new observations from large networks of submarine canyons off Cape Darnley. We conducted underway geophysical mapping, multichannel reflection seismic survey, bottom rock samplings and bottom sediment coring in this region during the R/V Hakuho-maru KH-19-1 and KH-20-1 cruises. Underway geophysical mapping was widely conducted in the area 60 ×90 miles. Multibeam bathymetry, sub-bottom profiler, total and vector magnetic fields, and gravity data were acquired. New bathymetric map compiled with previous survey data (e.g., Japanese Antarctic Research Expedition 51–55) clearly reveals that a large channel network of submarine canyons exists in the pathway of the CDBW. Sub-bottom and multichannel seismic reflection profile clearly show sub-seafloor structure of submarine canyons and surrounding sedimentary layers. Based on collected rocks, cored sediments, and deep-sea camera observations, it is shown that seafloor surface is covered with angular clast and sand in the shallower part of the channel. Furthermore, it is observed that sandy silt with current ripple morphology is deposited in the deeper part of the channel. These results imply that a main stream of the CDBW strongly contribute to erosion, transportation, and sedimentation at the submarine canyons, shaping the seafloor off Cape Darnley continental slope. This finding provides new insight into the ice-ocean-seafloor connection and indicates the distribution of the Cape Darnley Bottom Water, which is potentially linked to material transports from continent and/or continental margin into the deep ocean.

Keywords: East Antarctica, Submarine canyon, Cape Darnley Bottom Water, Marine geology and geophysics

