

Subglacial Morphology and Glacial Evolution of the Palmer Deep Outlet System, Antarctic Peninsula

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Abstract

The Palmer Deep is an erosional, inner-shelf trough located at the convergence of ice flow from three distinct accumulation centers. It served as a funnel for ice flow out across the continental shelf of the Antarctic Peninsula. Swath mapping of 1440 km² of seafloor in and adjacent to the Palmer Deep basin defines a large paleo-ice stream that flowed 230 km across the Antarctic Peninsula continental shelf during the Last Glacial Maximum (MIS-2). The unique perspective and detail of the Palmer Deep physiography allow us to recognize several phases of erosion and deposition in the outlet basin. These events are uniquely constrained by two ODP drill cores (sites 1099 and 1098) that together recovered over 150 m of latest Pleistocene and Holocene sediment. We divide this region of the continental shelf into three zones based upon mega- to meso-scale bathymetric features and emphasize that all three were part of one glacial outlet during the most recent period of glaciation. These zones include from inner shelf to outer shelf: the Palmer Deep basin, the Palmer Deep Outlet Sill and the Hugo Island Trough. Specific seafloor features associated with these zones include: relict terraces, sub-glacial lake deltas, channels and levees, debris slopes, spindle and p-shaped bed forms, mega-scale glacial lineations, morainal banks, and bank breach points. The origin of many of these features can be linked to the development of a sub-glacial lake basin within the Palmer Deep during or prior to MIS-2, its subsequent drainage, and recession of the Palmer Deep ice stream system. It is significant to note that this sub-glacial lake system is reconstructed at the head of a major paleo-ice stream.