

Factors Regulating Post-LGM Retreat of the Pine Island and Marguerite Ice Streams

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Ongoing research focuses on the timing of ice sheet retreat from Pine Island Bay and Marguerite Bay and on those factors that regulated retreat. Among the controls on grounding line retreat are seafloor bathymetry and geology, ice sheet thickness and profile, sea-level rise, climate, subglacial meltwater undermining and incursion of warm deep water onto the shelf. Marguerite Bay shares a number of similarities to Pine Island Bay, but its ice stream has completely vanished. We have a much better record of glacial retreat from Marguerite Bay, in addition to better seismic, swath bathymetry and core coverage, so its retreat history is better constrained and, therefore, the factors that regulated ice stream retreat are better known. There is also a well established climate history for the Antarctic Peninsula region.

During the LGM, the Marguerite Ice Stream (MIS) extended to the shelf break (O’Cofaigh et al., 2005; Heroy and Anderson, 2008). Initial retreat (14 cal yrs BP) of the ice sheet from the landward sloping, relatively low relief continental shelf was influenced by sea-level rise with punctuated retreat at ~14,000 cal yrs BP associated an episode of rapid sea level rise (MWP 1a) (Heroy and Anderson, 2008). The grounding line was situated near the mouth of the bay at 12,000 cal yrs BP and remained there, pinned by islands and rugged bedrock topography, until ~10,000 cal yrs BP. Rapid retreat from the bay occurred just prior to ~10,000 cal yrs BP and the bay was virtually ice free by ~9,000 years BP. This rapid retreat of ice from the bay was associated with a period of climatic warming (Mid-Holocene Climate Optimum) that began at about this time on the western side of the peninsula (Allen et al., in press; Michalchuk et al., in press). Other factors that may have contributed to retreat of the ice stream from Marguerite Bay include incursion of warm deep water (Allen et al., in press) and undermining by subglacial meltwater (Anderson and Oakes-Fretwell, 2009). Ongoing research focuses on obtaining better age constraints on grounding line retreat and on constraining the timing of warm deep water incursion onto the shelf and into the bay and on the role of subglacial meltwater in controlling grounding line retreat.

Swath bathymetry data are still sparse on the outer shelf offshore of Pine Island Bay, so the extent of the LGM grounding line and paleo-ice stream is still poorly constrained. In addition, few radiocarbon dates have been acquired from the area so the timing of grounding line retreat is poorly established. What we do know is that the ice sheet was grounded within the bay during the LGM, that it retreated from by ~10,000 cal yrs BP (Lowe and Anderson, 2004a) and that there is a subglacial meltwater drainage system within the bay, very similar to the one that exists in Marguerite Bay (Lowe and Anderson, 2004b). An upcoming cruise aboard the Swedish Ice Breaker Oden (February 2010) is aimed at addressing several important questions regarding the glacial history of the region and the mechanisms that contributed to grounding line retreat.