

# Deglaciation of the southern Ellsworth Mountains, Weddell Sea Sector of the West Antarctic Ice Sheet

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The stability of the marine West Antarctic Ice Sheet (WAIS) is the greatest source of uncertainty in predicting future sea level. Study of the deglaciation history of West Antarctica provides 'ground truth' for ice-sheet models, enabling more accurate predictions of the future behavior of the ice sheet.

While recent work has established a deglaciation chronology for the Ross Sea sector of the ice sheet since the last glacial maximum (e.g. Ackert et al., 1999; Hall and Denton, 1999; Conway et al., 1999; Stone et al., 2003), the Weddell Sea sector remains largely unconstrained. Marine geophysical data indicate that grounded ice extended to the shelf edge in the late Pleistocene (Bentley & Anderson, 1998), but the timing of this advance is poorly dated. Moraines and trimlines in the Ellsworth Mountains, at the head of the Weddell Sea, record ice levels up to 1900 m higher than the modern ice-sheet surface (Denton et al., 1992), but again, there is no age control. Nonetheless, most reconstructions use these data to infer the configuration, volume and flow patterns of the last glacial maximum (LGM) ice sheet (e.g. Bentley and Anderson, 1998; Denton and Hughes, 2002). We are measuring cosmogenic Be-10 in erratics from the Marble Hills, a nunatak in the southern Ellsworth Mountains, to date deglaciation and explore the possibility of obtaining constraints on LGM ice thickness in the Weddell Sea sector of West Antarctica.

The Marble Hills rise ~600 m above present-day glacier level in the southern Heritage Range, at the southern end of the Ellsworth Mts. Bedrock surfaces are ice-moulded to summit level, consistent with earlier mapping that placed this peak below the regional trimline (Denton et al., 1992), and striations on nearby peaks indicate northeasterly flow of overriding ice, roughly normal to the direction of present-day glaciers. Bedrock surfaces are littered with cobble- to boulder-sized erratics, which range from highly angular to rounded, and are mostly derived from metasedimentary rock types found elsewhere in the range. The majority of our samples are resistant, fine-grained quartzite of the Crashsite Group (Webers et al., 1992).

Out of 22 samples analyzed, we obtained only eight exposure ages younger than the LGM. These come from the four lowest sites (870-1250 m), and decrease systematically with decreasing altitude. Our youngest samples on bedrock have ages of 3500-3700 yr B.P.; samples from a blue ice area beneath the peak have ages less than 350 years. These data are consistent with deposition as LGM ice retreated from the peak. If so, LGM ice cover was at least 430 m thicker in the Marble Hills, and retreated gradually from some time prior to 10,600 yr B.P. through the late Holocene. The implied deglaciation history closely matches results from Marie Byrd Land (Stone et al., 2003). Five samples from these lower sites give scattered ages that: (i) exceed the age of the LGM, (ii) greatly exceed the Holocene ages obtained from nearby erratics, and (iii) do not form a single consistent trend with altitude, indicative of progressive deglaciation. For these reasons, we attribute the high Be-10 concentrations in these samples to recycling from older deposits exposed during earlier interglacial periods.

Samples from the two highest sites on the mountain have apparent ages which significantly exceed the age of the LGM, but cluster into two loose groups: Four samples from a bench at 1340 m give ages ranging from 41 +/- 3 to 67 +/- 5 kyr B.P. Four samples from the summit, at 1390 m, give much older ages ranging from 571 +/- 40 - 770 +/- 56 kyr B.P. Given the scatter in apparent ages among pre-exposed samples deposited at sites lower on the mountain, we consider it unlikely that these groupings arose through chance deposition of pre-exposed erratics during LGM glaciation. Two other interpretations are possible: (i) The old erratics were deposited at these sites during glacial episodes > 41 kyr and > 0.57 Myr ago, and have been exposed intermittently since. In this case, ice that overrode the peak during the LGM and earlier glaciations neither removed these erratics, nor deposited younger erratics at the summit. (ii) The old erratics were deposited by glaciations prior to the LGM; their survival, and the absence of younger erratics, indicate that ice did not reach these sites during the LGM. In this interpretation, the Marble Hills have not been overrun by ice since ca. 0.5 Myr B.P., and the glaciation responsible for sculpting ice-smoothed topography below the regional trimline occurred before this time. Unfortunately, although these interpretations have very different

implications for LGM and earlier glaciation of the Ellsworth Mts, we cannot verify or distinguish between them without additional fieldwork, sample collection and cosmogenic nuclide analyses.

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