Surface exposure ages from the LGM trimline in the Ohio Range, Horlick Mountains

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Reconstructions of the West Antarctic Ice Sheet (WAIS) during the last glacial maximum (LGM) and ice sheet models of deglaciation require knowledge of past ice elevations. However, data from the interior is sparse (Steig et al., 2001). Mountains that project through the ice sheet serve as dipsticks that gauge past ice elevations that are recorded by glacial deposits and erosional features preserved on their slopes (Ackert et al, 1999; Stone et al. 2003). The Ohio Range, located at the southern end of the Transantarctic Mountains (85°S, 114°W), and near the WAIS ice divide is ideally situated to record past ice elevations in this interior sector of the WAIS (Figure 1).

The Ohio Range forms an east-west trending escarpment rising 500 m above the adjacent surface (~1550m) of the WAIS. During the 2004-2005 field season we mapped trim lines and sampled glacial erratics at Discovery Ridge, Darling Ridge and several nunataks along the escarpment (Figure 2). At Discovery Ridge, granite erratics first reported by (Mercer, 1963), occur on a bedrock bench at an elevation of 1725 m. The lack of erratics on the sedimentary rocks comprising the slopes above the terrace suggests that the ice level was not significantly higher. A trim line, determined from the lowest elevation of delicate weathering features occurs at 1765 m on Discovery Ridge and at 1750 m on the adjacent Treves Butte provides a maximum ice elevation at this location. Along ridge Darling Ridge, fresh-looking erratics occur at elevations up to 1705 m. Cavernous weathering with delicate features are preserved on the cliff about 20m above. A transition from smoothed to deeply weathered rock is evident at a similar elevation on the adjacent ridgeline near the northern end of Darling ridge. This trim line indicates a maximum WAIS elevation of ~1725 m at Darling Ridge. Assuming that the trim lines at both locations are the same age, these observations are used to reconstruct a WAIS surface 150 - 200 m higher than the present ice surface. However, the age of the trim line is not certain; it may correspond to the last ice expansion (LGM) or an earlier event.

The age of the most recent high stand of the WAIS at the Ohio Range is constrained by cosmogenic ^{3}He and ^{10}Be exposure ages of glacial erratics near the trim line. The combination of weathered bedrock surfaces and minimal erosion by cold-based ice means prior exposure of erratics is likely. Cosmogenic ^{3}He was measured in 44 erratics in order to screen the samples for prior exposure prior to selecting samples for ^{10}Be. Although helium is known to diffuse out of quartz, at Antarctic temperatures, diffusion is slow enough that significant ^{3}He is retained (Brook et al., 1993). Sample preparation for ^{3}He is significantly faster, requiring no wet chemistry and the isotopic measurements are made using conventional mass spectrometry rather than AMS. Consequently, sample through-put is higher and more samples can be run at less cost. Although we collected

only angular granite erratics with little evidence of weathering for exposure dating, we found prior exposure to be pervasive with only seven ^{3}He ages less than 20 ka. We take the youngest ^{10}Be exposure ages as the best estimate of the age of ice surface lowering from the elevation of the samples. The ^{3}He and ^{10}Be exposure ages of the youngest sample from Discovery Ridge (1725 m) are indistinguishable with a mean of 10.3 ± 0.6 ka. At Darling Ridge (1705m) the ^{10}Be age (12.5± 0.9ka), is slightly older than the ^{3}He age (9.3 ±0.3 ka). These samples indicate that ice elevations remained within 20 m of the trimline until ~12.5 ka at Darling Ridge and that Discovery Ridge bench remained ice covered until ~ 10 ka.

These ages are similar to the beginning of ice lowering at Mt Waesche, near a Dome of the WAIS in Marie Byrd Land that also began ~10 ka (Ackert et al., 1999). These results indicate that maximum WAIS elevations were ~1750 m at the Ohio Range and that ice elevations remained within 20 m of the trimline until 10 ka. These results place the first constraints on interior ice elevations near the WAIS divide during the last glaciation. As such they provide benchmarks for ice sheet models that attempt to capture the dynamics of the WAIS.

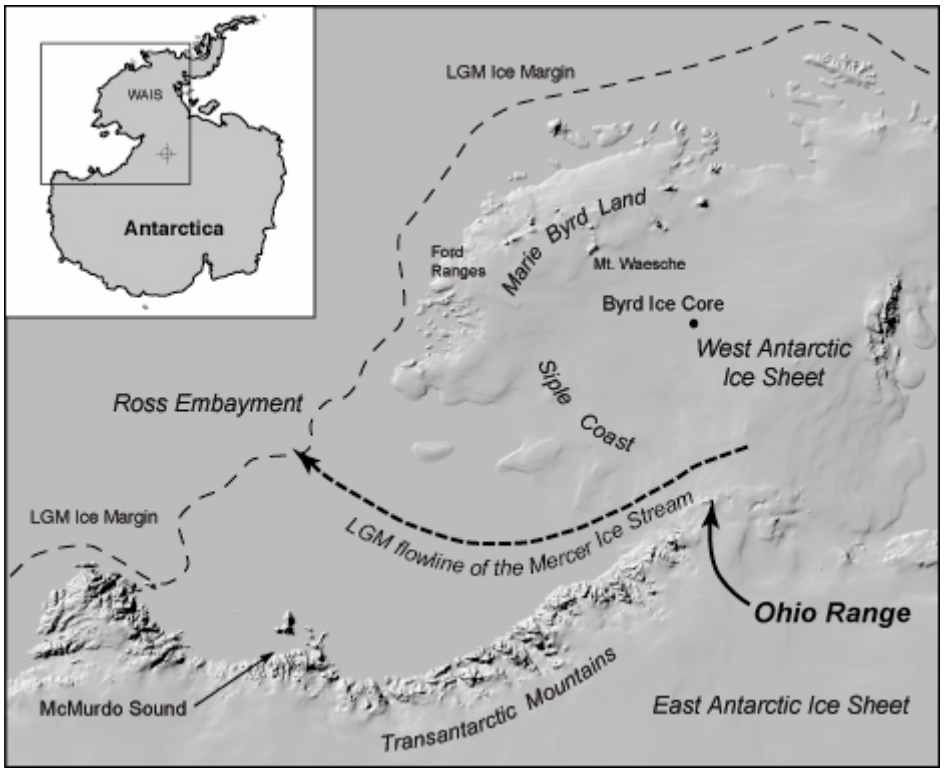

Figure 1. Radarsat image of the WAIS. Near the onset area of the Mercer Ice Stream and the WAIS divide, the Ohio Range is ideally situated to record past ice sheet elevations in this key region of the WAIS.

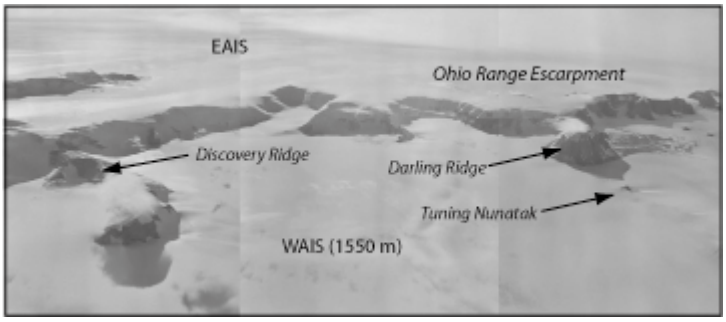

Figure 2. Oblique view of the Ohio Range Escarpment looking toward the south showing localities discussed in the text. The trimline is at the elevation of the arrows on Discovery Ridge and Darling Ridge. Because relatively little ice flows over the escarpment from the EAIS, ice elevations at the base of the escarpment are determined by the WAIS.

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