Accumulation Patterns and Basal Conditions from Radar Observations Along the US-ITASE Traverse in East Antarctica

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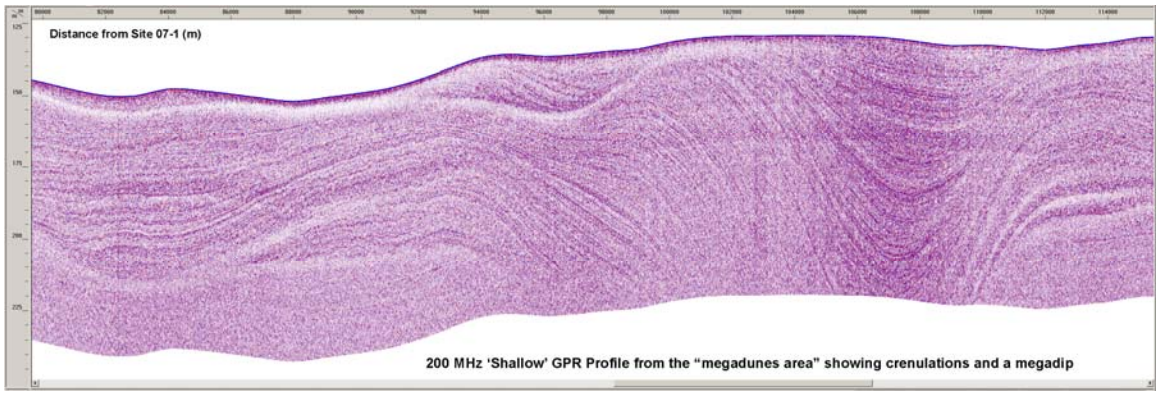
We present short-pulse radio echo reflection profiles recorded along a largely cross-flow transect during the 2006-08 US-ITASE traverse from Taylor Dome to South Pole. We used a 200-MHz system to focus on firn strata within the upper 100 meters and a 4-MHz system to focus on englacial strata, as well as the bed. Within the catchment area of Byrd Glacier, unusual cross-cutting englacial horizons suggest changing accumulation patterns possibly caused by long term wind shifts. Profiles recorded by both systems from south of the Byrd catchment area to Titan Dome are conspicuously characterized by buried megadunal type stratigraphy, consistent with the traverse being downflow from the apparent eastern edge of the modern megadunes region. The 200-MHz profiles reveal buried and partially buried foreset beds extending over 20 km in length, and in packets up to 50 m thick that are sandwiched between 4–8 m thick unstratified layers up to 35 km long. These beds are antidunal deposits, and the unstratified layers are glazed, zero accumulation zones of extreme, long term metamorphism. One packet projects to well over 100 m thick, and several intersect the surface so that they are active. The deeper, 4-MHz profiles show apparent foreset beds to 1000 m depth, up to 200 m thick and all with strata dipping to the south, consistent with near surface profiles. These impressive features, both near the surface and at depth, apparently show the concentrated way snow accumulates in the megadunes area. If these beds formed during high accumulation Holocene warming periods, then we need to understand how they could be interleaved with features characteristic of zero accumulation. The 4-MHz detection of deep foreset beds must be made possible by volcanic high conductivity layers, which suggests that these beds contain datable layers.

We have also plotted the power received from some 300,000 bed echoes versus ice thickness along the traverse. We use these data to estimate the average 4-MHz signal absorption rate within the ice, which allows us to calculate bed reflectivity and interpret basal properties. The results suggest many areas of thawed basal conditions, generally thought to be rare in East Antarctica. They also depict bed reflectivity at several candidate subglacial lake sites based on satellite imagery and reveal at least one possibly new subglacial lake.


Distance from Site 07-1 (m)
200 MHz 'Shallow' GPR Profile from the "megadunes area" showing crenulations and a megadip