Basal Reflectivity and Bed Conditions Along the US-ITASE Traverse, Taylor Dome to South Pole

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In 2006-2008 we recorded low-frequency ground-based radar data along the 1700 km US-ITASE traverse from Taylor Dome to South Pole. Recording one (stacked) trace every 3.5 m produced over 464,000 samples of the power returned from the bed, enabling a detailed study of changes in basal reflectivity along the traverse. Internal stratigraphy was also well depicted by the radar throughout the traverse, often to within meters of the bed at over 2.5 kilometers depth. Bed echo power values were corrected for geometric spreading losses and dielectric attenuation in order to derive values of basal reflectivity. Three methods were used to develop a model of dielectric attenuation. A first-order calculation based on the average decrease of basal echo power with depth for the entire data set gave a value of 8.6 db/km for depth-averaged one-way attenuation. A refinement of this technique based on the fall-off in power returned from internal reflectors at all depths was used to compute measurements of attenuation as a function of distance along the traverse. The values from this method were in general agreement with the above, yielding slightly lower attenuation in the colder ice toward South Pole and slightly higher values near Taylor Dome. The trend in these results is in accord with simple calculations based on the measured temperature profiles at these two locations. Values of attenuation near Taylor Dome are also confirmed by comparing the decrease in received power from single versus double reflections from the bed recorded there.

Using these measured values for dielectric attenuation, we mapped basal reflectivity along the length of the traverse (figure below). Our results show several areas of high reflectivity which are likely zones of localized basal melt, as well as other larger-scale regions where the bed is more highly reflective, indicating thawed conditions. Based on bed topography, some of the kilometer-scale bright features are likely to be subglacial lakes, including one within 25 km of South Pole Station. In contrast, the traverse passed over at least three areas where subglacial lakes have been indicated by changes in surface elevation seen in satellite imagery that do *not* today show high reflectivity. Larger-scale areas of thawed bed, including one near the north margin of the Byrd catchment, appear to have dynamic significance and are associated with areas of higher ice flow speed as shown by correspondence with InSAR and balance velocities.

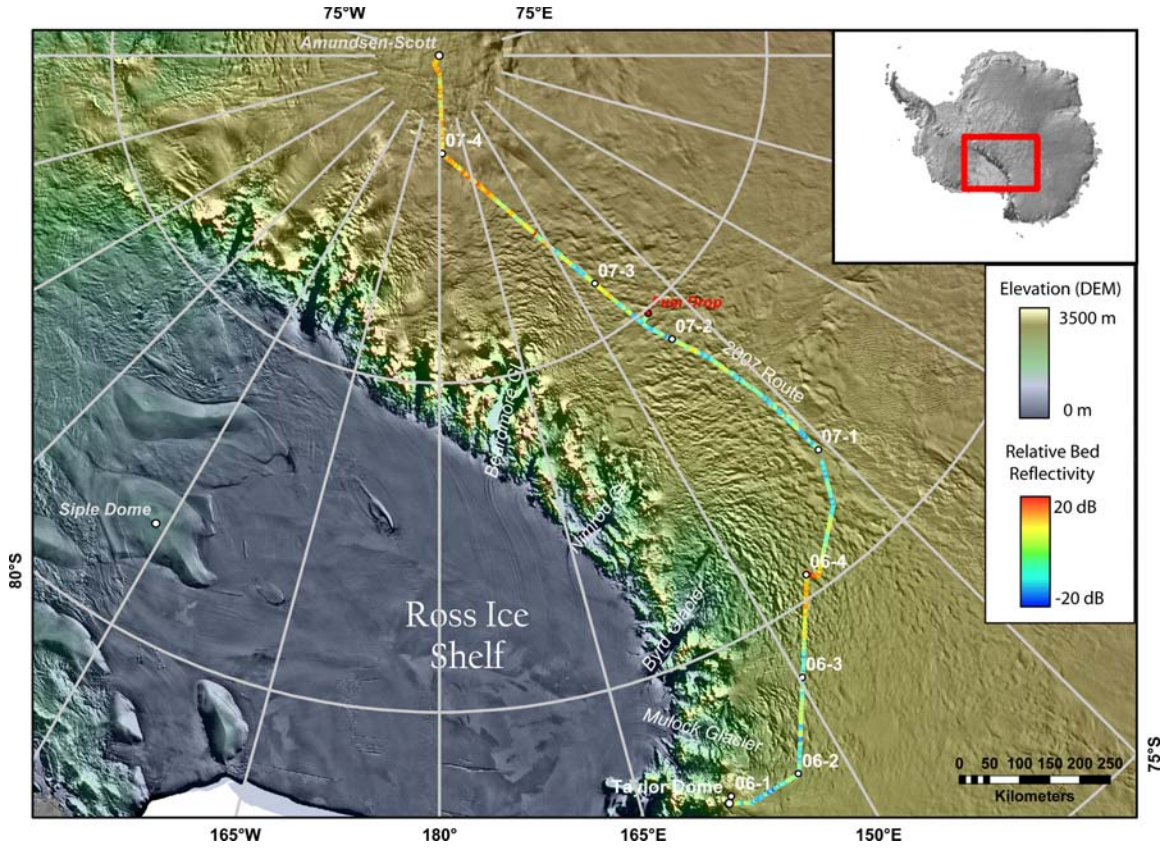

Figure 1. US-ITASE traverse, Taylor Dome to South Pole showing values of basal reflectivity, dB scale. Warmer colors correspond to areas with thawed bed conditions including small subglacial lakes and regions of enhanced flow.