Radar Studies on Kamb Ice Stream

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During the past two Antarctic field seasons we acquired approximately 1600 km of ground-based ice-penetrating radar data on the lower trunk of Kamb Ice Stream (KIS) as part of a larger radar, GPS and modeling study with scientists at the University of California Santa Cruz examining the possibility of ice stream reactivation. We present here a summary of radar results from this work and some preliminary interpretations.

We have produced a map of detailed bed topography over the "sticky spot" where ice appears to have become grounded over a large bedrock bump. Archival data from the University of Wisconsin airborne radar profiles (Retzlaf et al., 1993) have enabled us to place this in a regional context. We are able to trace the evolution of folds in the radar internal stratigraphy in this region in both time and space by comparison with ground-based radar data we collected in the late 1980's (Jacobel et al., 1993). These studies depict changes in the horizontal strain rate as ice passes around the sticky spot.

We have also quantified variations in the amplitude of radar reflections from the ice-bed interface which appear to define different provenances of the ice stream. The weakest-reflecting ice-bed interface is found over the sticky spot where bore holes drilled by Cal Tech in 2000 showed a dry bed. A more highly reflective bed is located to either side of the sticky spot in regions of the trunk of KIS including one area where bore holes showed water at the ice-bed interface. The brightest bed, however, is located in the northern branch of the trunk, approximately 80 km upstream of the sticky spot, where ice velocities are still on the order of 120 m/a. Here radar reflected power is up to 1.5 times higher than elsewhere in the trunk despite the ice being 40% deeper. From this pattern of bed reflectivity we hypothesize that conditions allowing for rapid flow still exist under most areas of KIS and that sticky spots, like the one studied here, have played a key role in the ice stream shut down.

Two profiles crossing from this actively-flowing region of highly reflective bed into the northern margin of KIS (defined by strong velocity gradients) show continuous internal stratigraphy across the margin, indicating that substantial volumes of ice are still flowing across the margin into KIS in this area. The bright layer identified throughout West Antarctic (Jacobel and Welch, 2005) corresponding to 17.5 Ka based on ice core dating at Byrd is easily seen in these profiles.

A 210 km long longitudinal profile has also been acquired following a flow line from the area of bright bed to Siple Dome. We have traced dated internal stratigraphy from the ice core drilled at Siple Dome to the KIS north margin. Similarly, we have traced internal layers for the length of this profile, including the easily-identified bright layer

corresponding to 17.5 Ka . However we have not been able to convincingly tie layers in the ice stream to the dated Siple Dome stratigraphy because of the high shear that has taken place across this margin. Bed topography, brightness and internal layer characteristics will all provide constraints to models describing the evolution and possible future of ice flow in KIS.

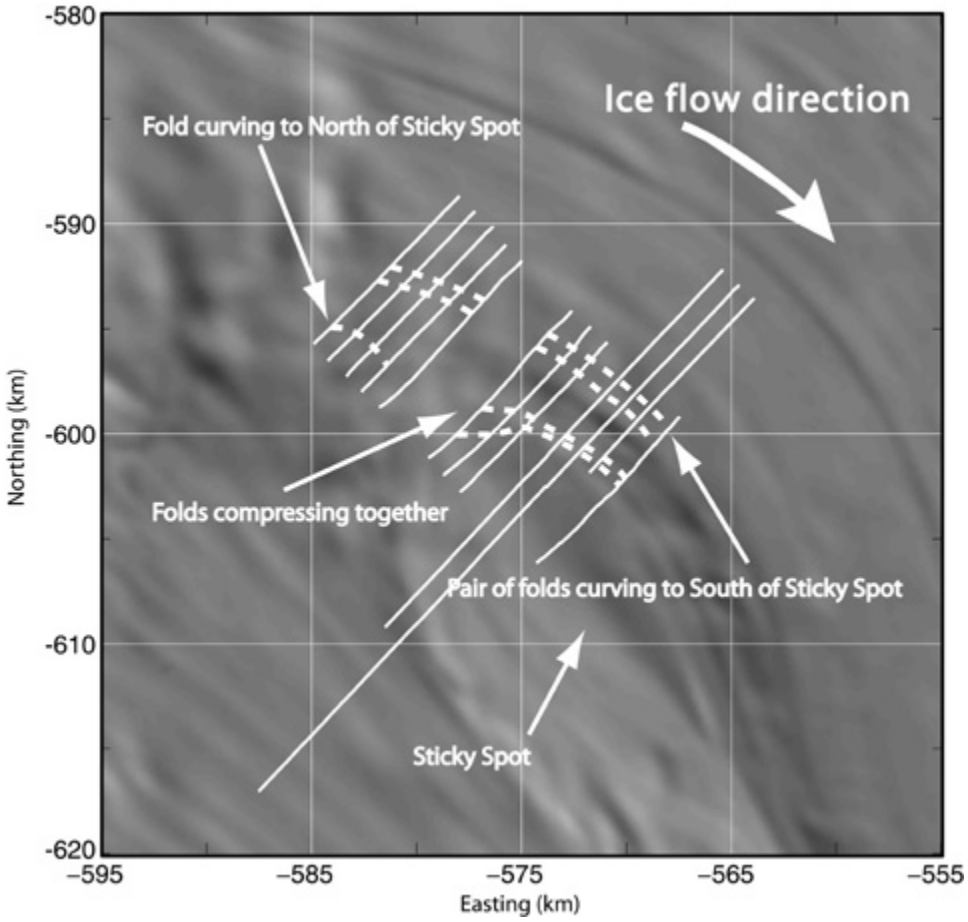

Figure: MODIS image of the KIS sticky spot showing the flow trajectories of several folds in the internal stratigraphy imaged by the radar as ice encounters the bedrock rise beneath the ss.