Spatial Variation of Basal Conditions on Kamb Ice Stream

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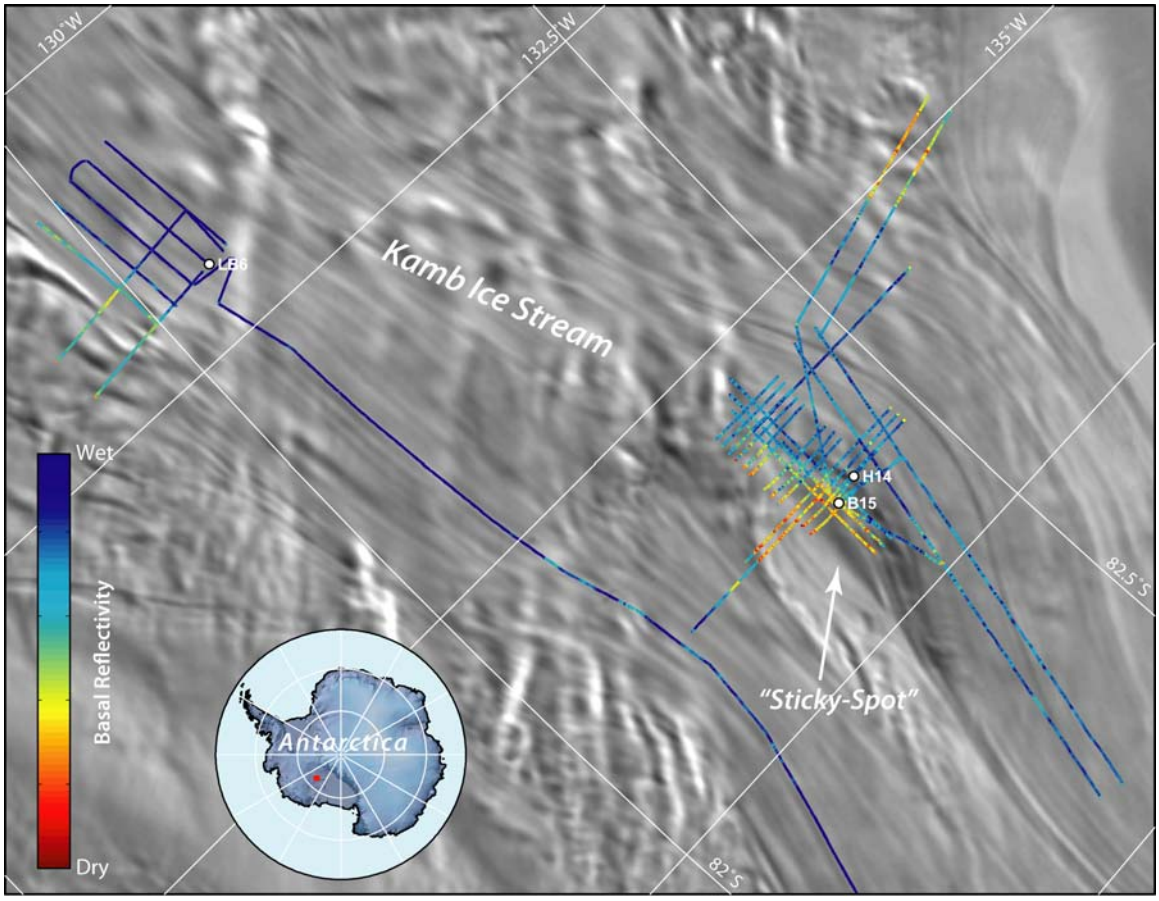
Radar profiles of bed echo intensity provide a way to survey conditions at the ice-bed interface and test for the presence or absence of water. However, extracting information about bed properties from bed echo intensities requires an estimate of the dielectric attenuation loss through the ice. A recent survey [MacGregor et al., 2007] found that the few reported values of depth-averaged attenuation rates in West Antarctica vary by a factor of 3, presumably due to spatial variations in the chemistry and temperature profiles of the ice. Thus, a single value for depth-averaged ice-sheet attenuation cannot be assumed, even over a relatively small region.

We measured attenuation rates at several locations on and near Kamb Ice Stream (KIS) by examining basal echo intensity values as a function of ice thickness from constant-offset radar data acquired in 2004-2006. Our values obtained for Siple Dome of 29 dB/km agree with previous measurements [Gades et al., 2000] and the recent calculations and model results of MacGregor et al. [2007]. On KIS, we measured attenuation values of 20 dB/km over the "sticky spot", where ice has become stagnant. This value is consistent with an attenuation model over the sticky spot calculated using borehole temperature data [Engelhardt, 2005] and chemistry data from the Siple Dome ice core. Our radar profiles in the main trunk region of KIS yield a slightly lower value of 15 dB/km, presumably because colder ice is still being advected from inland West Antarctica.

Using these values of attenuation, we calculated the basal radar reflectivity at the ice-bed interface in the regions of all our surveys (Figure). We found that most regions of the bed in the trunk of KIS have high basal reflectivities and that these values are similar to those obtained in locations where water was found in the Caltech boreholes [Engelhardt, 2005]. Areas of lower bed reflectivity are limited to the sticky spot, where a borehole found a dry bed, and along the margins of KIS. We use these results to hypothesize about the stagnation of KIS and the possibility of its reactivation.



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