Radar Wave Speed and Attenuation Studies Using Constant Midpoint Profiles on Kamb Ice Stream

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Studies of radar wave speed and attenuation as a function of depth were carried out on Kamb Ice Stream this past field season as part of a two-year program of radar and GPS studies examining the possibility of ice stream reactivation. Two constant midpoint profiles were completed in which the radar transmitter and receiver were separated in 20 meter increments starting from 100 meters and extending to 1200 meters. The locations of these two profiles were in areas characteristic of both high and low bed reflectivity, one of them over rough bed topography on the "sticky spot" and the other at the south margin of the sticky spot where Cal Tech bore hole 00-01 located a layer of liquid water at the bed in 2000.

The semblance analysis from both profiles shows coherent returns from a number of prominent internal reflectors (figure). By differencing average two-way travel times from these reflectors we have produced a radar wave velocity versus depth curve that can be used to test theoretical models based on ice density and temperature. As expected it shows higher velocity from near-surface layers and decreasing toward the bed.

We have also carried out an analysis of the reflected power as a function of antenna separation giving us information about radar wave attenuation with propagation distance in the ice. These data complement results from our profile measurements where attenuation varies with ice thickness.

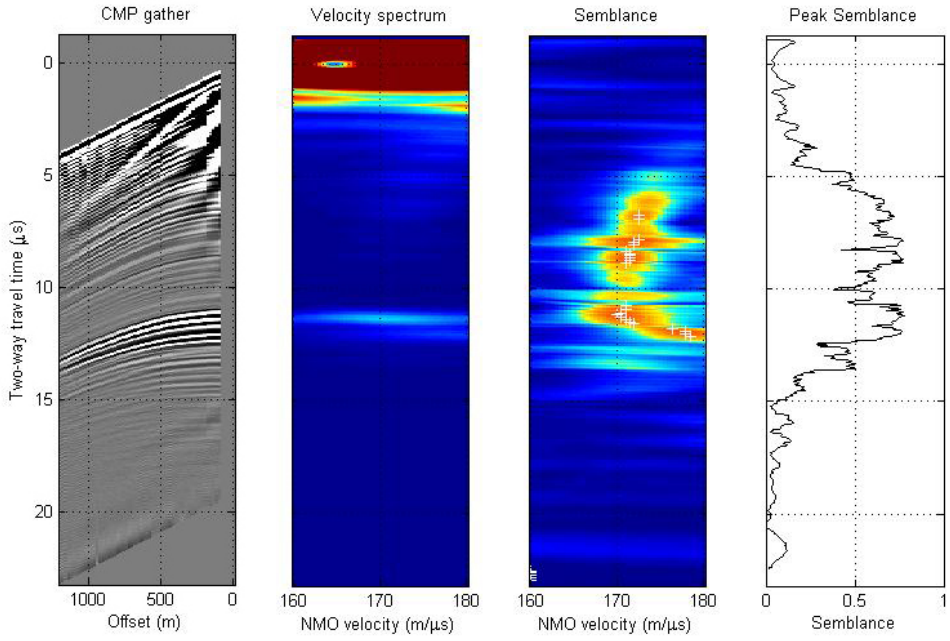

Figure Caption:
Semblence analysis for constant midpoint profile on Kamb Ice Stream centered on the “sticky spot.” Panel at the left shows hyperbolic returns from individual internal layers imaged at increasing transmitter – receiver separation. Second panel gives information about the return amplitude as a function of depth. Third panel shows decreasing average two-way velocity with depth. The first phase of the bed echo at approximately 11 microseconds has an average value just above 170 m/usec. Panel at the right indicates the relative strength of the semblance for each reflector. Note that the higher apparent velocities below the first bed echo are from returns off to the side of the profile in this area of bumpy bed topography and are not treated correctly by this analysis.