A FEW PRELIMINARY RESULTS FROM THE GLACIOGEOPHYSICAL SURVEY OF
THE INTERIOR ROSS EMBAYMENT (GSIRE)

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We report here on some of the results of our first two seasons work
along the Siple Coast. These results are all preliminary in nature and
could be modified substantially with further analysis. Furthermore, we
have selected from a much larger body of data only a few points that we
believe will be of interest to this workshop.

Extensive airborne radar measurements were made during the 1984-85
field season covering ice streams A, B and C, Crary Ice Rise, and the
grid northwestern corner of the Ross Ice Shelf. A sample profile across
Ice Stream A shows a pronounced subglacial trough. Surface features
showing in the radargram suggest the boundaries between the outflow,
within Ice Stream A, from Reedy Glacier, Horlick/Shimizu Ice Stream, and
the glaciers in between. These boundary zones can be traced downstream
across the Ross Ice Shelf to a point about grid north of Crary Ice Rise.

The ridge between ice streams A and B is relatively free of surface
"clutter" produced by crevassing. The grid northern boundary of Ice
Stream branch Bl (the grid northerly branch), marked by pronounced
surface crevassing, overlies nearly the bottom of a downslope into a
subglacial trough. The trough, however, is only half as wide as Ice
Stream Bl -- part of the ice stream lies over a relative high in the
subglacial topography. Between Ice Stream Bl and the UPB camp on Ice
Stream B2, there is an "island" with a complex surface and rough
subglacial bed. Ice Stream B2 is associated with a much less pronounced
subglacial trough. Similar characteristics for ice streams Bl and B2
persist downstream from where the two merge.

Profiles over Crary Ice Rise show the striking contrast between
clutter-free ice on the ice rise and strong clutter over the surrounding
ice shelf. The boundary between the two is abrupt in most places, but
not all. This characteristic difference shows clearly also over Ice Rise
A, indicating crevasse-free ice there. This strongly suggests that Ice
Rise A is a true ice rise, i.e. that the ice is not being driven across
it; such a conclusion is contradicted, however, by the apparent absence
of surface crevassing anywhere around its periphery.

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Short-pulse radar surveys have been carried out on the surface at camps UPB and UPC, the latter being on Ice Stream C. Abundant near-surface crevasses are seen around both camps, at an average depth of about 15 m at UPB and about 35 m at UPC. If we assume that the crevasses in Ice Stream C were at the surface when the ice stream shut down, we can estimate from the depth of burial that that event occurred about 250 years ago.

Near the UPB camp, an extensive seismic reflection survey has been carried out to examine in detail a double echo from the base of the ice. Our analyses to date have revealed that there is a layer immediately beneath the ice with a thickness of about 8 m in which the seismic wave velocities are very low. The P-wave velocity is less than 2000 m/sec. At present we can only cite an upper limit, but that is enough to indicate that the layer is unfrozen and poorly consolidated.

Shear-wave reflections recorded from both the top and the bottom of the layer show that the S-wave velocity is only 1/10 that of the P-waves, i.e. less than 200 m/sec. This extremely low velocity can be attributed only to a highly porous saturated medium. We believe that the layer must have such a low resistance to shear deformation that most of the relative motion between the ice and the bedrock takes place by shear within this soft layer, and not by sliding of the ice over the top of the layer. This result is similar, although on a much larger scale, to the subglacial deformation observed by Boulton (1979) beneath the margin of Breidamerkurjökull in Iceland. We follow Boulton further in suggesting that this easily-deformable layer is the cause of the low basal shear stresses observed on active ice streams. We suggest still further that the occurrence of a satisfactory subglacial layer is an important factor in determining the locations of ice streams. We also infer that the presence of a deforming subglacial layer implies the development of a delta at the junction between the ice streams and the ice shelf.

A final result of interest comes from a 100 m core from UPB. Bubbles become increasingly elongated horizontally with depth in the firn. At 86 m depth, some show an aspect ratio as great as 10 to 1. Presumably the elongation is along the direction of flow, although this cannot be confirmed because the orientation of the core in the horizontal plane is not known.

Figure 1. (Opposite page) Map of the Siple Coast area, with the Ross Ice Shelf to the lower right, the East Antarctic Ice Sheet to the upper right, and the West Antarctic inland ice to the left. Ice streams A, B (B1 and B2), and C are long bands between heavily patterned borders that denote marginal shear zones. UpB (UB) and UpC (UC) camps and Crary Ice Rise (C.I.R.) are also shown. Thin solid lines are the radar flight lines referred to in this report; dotted lines are earlier radar flight lines. Dashed lines denote tracers in the ice, and arrows are velocity vectors. (From: Shabtaie and Bentley, 1986).