Using the average value of the velocity gradient across the margin and an average ice column temperature of -13.13°C (from surface and assumed bed temperatures at Downstream B), and assuming no other stresses, the shear stress was calculated to be 1.6 bar. Warmer temperatures (due to strain heating), additional stresses, or other factors such as fabric enhancement would all tend to lower the value of shear stress. We feel that the shear stress is probably not lower than 1 bar.

Our detailed measurements of velocity, strain, and surface topography have allowed us to calculate the balance of forces in this region. Across the profile at Downstream B, the average basal shear stress is 0, while over the entire apron area, the average basal shesr stress is only 0.005 bar (Bindschadler et al. in preparation). These small shear stresses underneath grounded ice are probably achieved by the widespread occurrence of pressurized subglacial water. For local areas of floating ice the creep thinning rates would exceed those of a floating ice shelf due to the excess ice thickness above sea level.

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References

Bentley, C.R. 1984. The Ross Ice Shelf Geophysical and Glaciological Survey (RIGGS): Introduction and summary of measurements performed, *Antarctic Research Series*, 42, 1–20.

Bindschadler, R.A., D.R. MacAyeal, and S.N. Stephenson. In press. *Ice Stream—Ice Shelf Interaction in West Antarctica.* (Proceedings of Workshop on the Stability of the West Antarctic Ice Sheet, Utrecht.) The Netherlands: Reidel Press.

Bindschadler, R.A., S.N. Stephenson, D.R. MacAyeal, and S. Shabtaie. In preparation. Ice dynamics at the mouth of Ice Stream B, Antarctica. In *Journal of Geophysical Research.* (Special issue: Chapman Conference on Fast Glacier Flow.)

Drewry, D. 1983. *Antarctica: Glaciological and geophysical folio.* Cambridge: Scott Polar Research Institute, University of Cambridge.

Shabtaie, S. and C.R. Bentley. In preparation. West Antarctic ice streams draining into Ross Ice Shelf; Configuration and mass balance. In *Journal of Geophysical Research.* (Special issue: Chapman Conference on Fast Glacier Flow.)

Swithinbank, C.W.M. 1958. *Morphology of the ice shelves of Western Dronning Maud Land, Norwegian-British-Swedish Antarctic Expedition, Scientific Results,* (Vol. 5, Glaciology).

Paleoclimatic ice core program at Siple Station

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An ice-core drilling program was successfully conducted at Siple Station (75°55'S 84°15'W, 1,054 meters above sea level) during the 1985–1986 austral summer. The overall objective is to obtain a high temporal resolution 500-year record of microparticle concentrations, oxygen isotopes, conductivity, accumulation, and chemistry for integration with other paleoclimatic histories for the last 500 years. Emphasis upon the last 500 years stems from recent analyses of two ice cores from the Quelccaya Ice Cap (southern Peru) in which the latest Neoglacial event (popularly known as the "Little Ice Age") is distinctly recorded within the microparticle, oxygen isotope, and accumulation records (Thompson et al. 1986).

The drill site was 1.5 kilometers upwind from the station (figure 1). Summer (November to January) is the only season with persistent winds: 68 percent of the 3-hourly observations were from azimuths of 100° to 225°, and 20 percent were from 110° to 150° during the period from January 1982 through December 1984. Five years of daily observations (from December 1978 to July 1982) yield an average wind speed of 5.7 meters per second (11.1 knots) with a maximum of 33.4 meters per second (65 knots). During the 1985–1986 field season (3 December 1985 to 8 January 1986) average working conditions were approximately -20°C with 18 knot winds. The prevailing winds were 150° from true north.

The first core, 302 meters deep, should provide a record to about A.D. 1440. The quality of the core is excellent to 200 meters after which the core is consistently wafered. Although wafered, core recovery was very good, and quality is adequate for microparticle concentrations, oxygen-18 isotopes, conductivity, and chemistry measurements. Figure 2 illustrates the microparticle (diameters greater than 0.63 micrometer) concentrations in a 1-meter section of the 302-meter core. The concentrations are among the lowest measured and partially reflect the diluting effect of the high accumulation (approximately 0.55 meter per year ice equivalent, Stauffer and Schwander 1984). The second core (located 1 meter from the first) is 132 meters long, should contain a record to about A.D. 1770 and is of excellent quality with nearly complete core recovery.

A complimentary program designed to assist in the interpretation of the deeper cores included hand augering nine 20-meter cores and sampling and stratigraphic mapping of walls in three pits. Samples were collected from three walls of the 2.8-meter deep central pit (pit 1) located 0.44 kilometer upwind from the drill trench (figure 1). Walls A and C (each 1-meter wide) were positioned parallel to the prevailing wind, with wall B (4-meters wide) perpendicular to the prevailing wind. Samples were collected for microparticle concentrations, conductivity, oxygen-18 isotopes, and chemistry. In addition, one profile was collected for Beta-radioactivity measurements, and one density profile was measured. Three cores (20-meters) each containing approximately 20 years were drilled behind wall B with each core associated with a specific vertical profile of pit samples. Pits 2 and 3 (figure 1), consisting of two 1-meter perpendicular walls (B and C), were each 2.2 meters deep. In each pit two complete vertical profiles of samples were collected for microparticle concentrations, oxygen-18 isotopes, conductivity, and chemistry, and two cores were drilled, one behind each wall. Additionally, one density profile was measured in each pit.

The pit and shallow core data contribute to the determination of the limit to which annual information can be extracted from

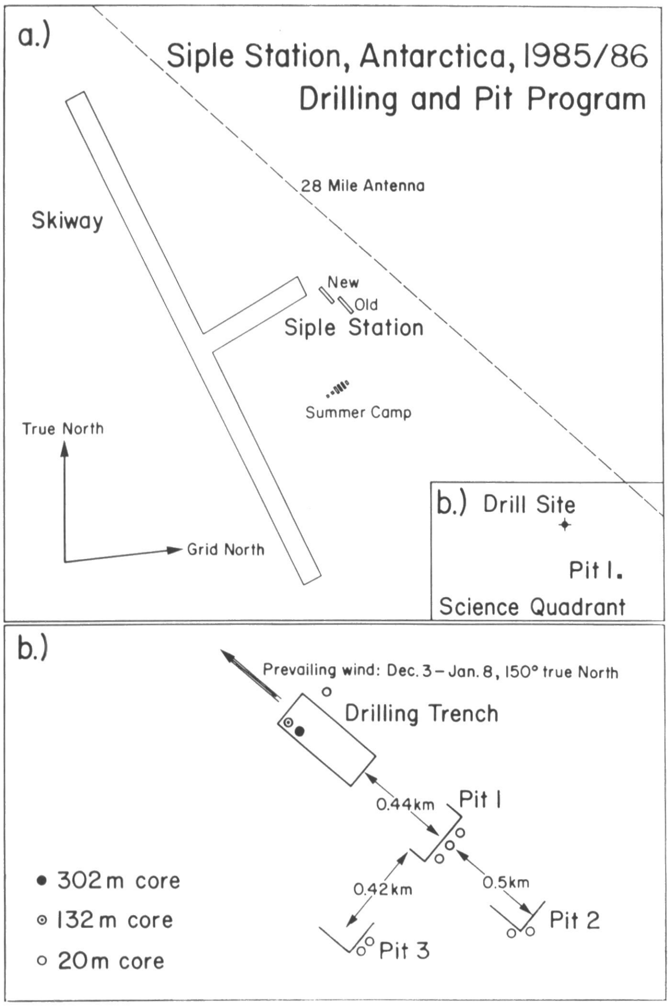

Figure 1. Location of the science quadrant, the two intermediate depth cores, nine shallow cores, and three pits with respect to the station and prevailing wind. ("m" denotes "meter.")

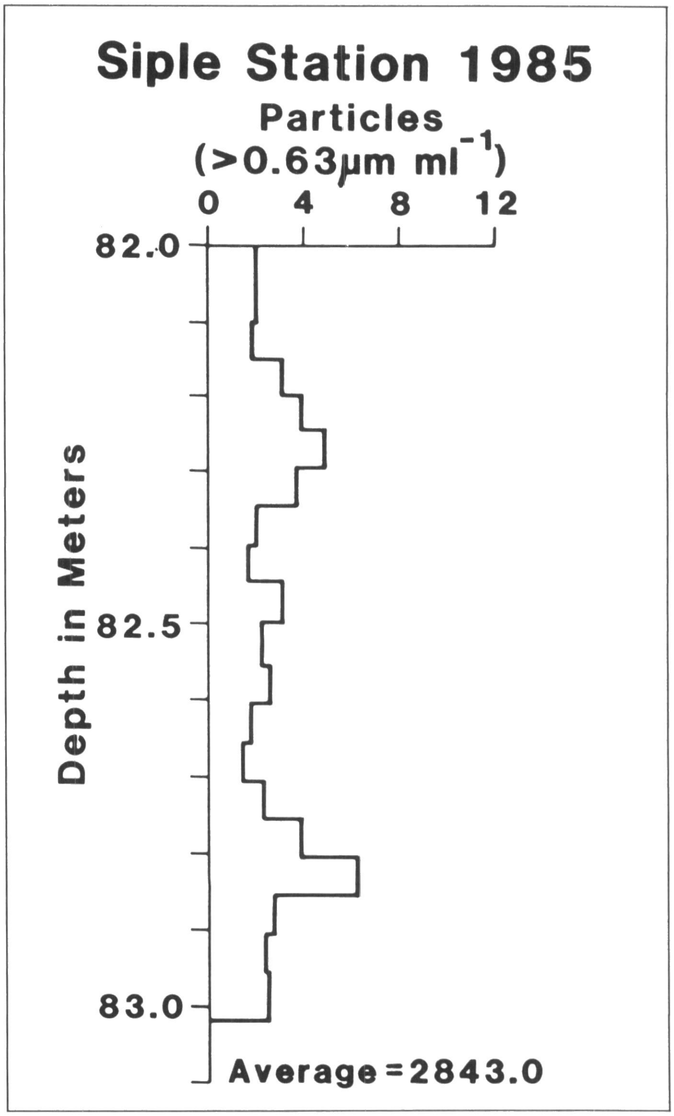

Figure 2. The microparticle concentrations (diameters greater than 0.63 micrometer) per milliliter sample are illustrated for a 1-meter section of the 302-meter core. The average of 2843 particles per milliliter is only for this meter.("μ ml^{-1}" denotes "micrometers per milliliter.")

the deeper cores and the characteristics of the individual annual signals (microparticle concentrations, oxygen-18 isotopes, conductivity, and chemistry) used for both dating and paleoclimatic reconstruction. Previous ice core analyses from South Pole Station (Mosley-Thompson and Thompson 1982; Mosley-Thompson et al. 1985) illustrate the effect of low accumulation upon the stratigraphic continuity of the preserved record. At Siple Station the high accumulation should ensure good temporal resolution, an uninterrupted stratigraphic record, and preservation of the annual oxygen-18 isotope signal. Alternatively, the intensity and frequency of drifting may alter the annual signal by mixing and scouring. The microparticle concentrations, oxygen-18 isotopes, conductivity, and accumulation time series from these cores will be compared (Mosley-Thompson and Thompson 1982) with other records with special emphasis upon histories from South Pole Station and the Quelccaya Ice Cap [Thompson et al. 1984(a), (b), 1985, 1986].

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References

Mosley-Thompson, E., and L.G. Thompson. 1982. Nine countries of microparticle deposition at the South Pole. *Quaternary Research*, 17(1), 1–13.

Mosley-Thompson, E., P.D. Kruss, L.G. Thompson, M. Pourchet, and P. Grootes. 1985. Snow stratigraphic record at South Pole: Potential for paleoclimatic reconstruction. *Annals of Glaciology*, 7, 26–33.

Stauffer, B., and J. Schwander. 1984. Core processing and first analysis of ice cores from Siple and South Pole Stations. *Antarctic Journal of the U.S.*, 19(5), 59–60.

Thompson, L.G., E. Mosley-Thompson, P. Grootes, and M. Pourchet. 1984(a). Tropical glaciers: Potential for paleoclimatic reconstruction. *Journal of Geophysical Research*, 89(D3), 4638–4646.

Thompson, L.G., E. Mosley-Thompson, and Benjamin Morales Arnao. 1984(b). Major El Niño/Southern Oscillation events recorded in stratigraphy of the tropical Quelccaya Ice Cap. *Science*, 226(4670), 50–52.

Thompson, L.G., E. Mosley-Thompson, J.F. Bolzan, and B.R. Koci. 1985. A 1500 year record of tropical precipitation recorded in ice cores from the Quelccaya Ice Cap, Peru. *Science*, 229(4717), 971–973.

Thompson, L.G., E. Mosley-Thompson, W. Dansgaard, and P.M. Grootes. 1986. The "Little Ice Age" as recorded in the stratigraphy of the tropical Quelccaya Ice Cap. *Science*. 234(4774), 361–364.

PICO drilling activities at Siple Station and on the Siple Coast during 1985–1986

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Polar Ice Coring Office (PICO) drilling activities this season focused on three projects in support of investigations by Ohio State University and the University of Wisconsin at Madison. A 4-week field season produced a record amount of core and number of shot holes drilled.

Two cores were collected at Siple Station for Ellen Mosley-Thompson, Ohio State University's Institute of Polar Studies, (Mosley-Thompson, Mountain, and Paskievitch, *Antarctic Journal*, this issue). The drill site was located 1.5 kilometers upwind from the station (133 degrees from true north) with drilling, logging, and packaging done in a covered trench (21 meters long by 2.7 meters deep by 3.6 meters wide) due to inclement weather. The first core was recovered to a depth of 302 meters, with excellent quality core to 200 meters, and wafered but usable core to 302 meters. Improved core quality was directly attributable to new asymmetrical double-angle bits. These cutters mounted on a drill head with increased inner diameter produced 10 percent greater volume of core than earlier bit configurations. Drilling proceeded at 30 meters per day. A second core was drilled 1.5 meters from the first, with excellent quality core recovered to 136 meters depth.

Both core drilling and hot-water drilling of shot holes were conducted on the Siple Coast in support of the University of Wisconsin at Madison. Ninety-six shot holes to 15-meters depth were drilled using the PICO hot-water drill mounted on a sled towed behind a Tucker SnowCat. The University of Wisconsin at Madison geophysicists (Bentley et al.*Antarctic Journal*, this issue) laid out a flagged grid of 96 points at 360-meter spacing in 12-kilometer lines along Ian Whillan's (Ohio State University) surface strain grid (Whillans, *Antarctic Journal*, this issue). Each day PICO drillers would traverse from the station to the grid area for drilling. After problems with pumps and heater ignition transformers on the first 2 days limited hole production to five holes, producing during the final 3 days of drilling was 25, 36, and 30 holes per day.

A 102-meter core was collected at Ridge B-C for the University of Wisconsin at Madison (Alley, *Antarctic Journal*, this issue) to replace core drilled at Upstream B during 1984–1985 but melted in transit from Antarctica to the United States. This project was support by Twin Otter aircraft from Upstream B.

Once in the field, drilling proceeded smoothly. Four of the 8 weeks of the field season were spent in transit, waiting for aircraft or weather.

The PICO field team included Bruce Koci, John Litwak, and Kent Swanson core drilling at Siple Station; Bill Boller and Randall Cerveny hot water drilling at Upstream B; and Bruce Koci and Bill Boller core drilling at Ridge B-C.

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References

Alley, R.B., and C.R. Bentley. 1986. Further firn studies on the Siple Coast of West Antarctica. *Antarctic Journal of the U.S.*, 21(5).

Bentley, C.R., D.D. Blankenship, D.G. Schultz, S.T. Rooney, and S. Anandakrishnan. 1986. Geophysical program at Upstream B Camp, Siple Coast. *Antarctic Journal of the U.S.*, 21(5).

Mosley-Thompson, E., K.R. Mountain, and J.F. Paskievitch. 1986. Paleoclimatic ice core program at Siple Station. *Antarctic Journal of the U.S.*, 21(5).

Whillans, I.M. Dynamics and mass balance of ice stream B. *Antarctic Journal of the U.S.*, 21(5).