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ACCUMULATION RATES IN SOUTH AND CENTRAL GREENLAND

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Abstract: This is the second of two papers summarizing the glaciological observations made on the southern and central parts of the Greenland Ice Sheet during two field campaigns conducted during the 1980s by scientists at The Ohio State University's Byrd Polar Research Center. Three large clusters of survey stations, as well as a strain grid leading to the Dye-3 borehole, were deployed and surveyed in 1980, and resurveyed the next summer (1981). In 1987 and 1989, similar surveys were conducted in the Summit region as part of the GISP2 site selection. The primary objectives of these field campaigns were to measure absolute surface velocities and to obtain 20–30 year average accumulation rates from shallow firn cores. At a number of the survey sites, shallow cores were retrieved to determine accumulation rates and firn temperatures were measured in some of the boreholes. Each core was sampled for density and gross beta-radioactivity. The latter reveals specific stratigraphic horizons associated with nuclear fallout from atmospheric testing of thermonuclear devices in the 1950s and early 1960s. Measurements of oxygen isotopic ratios allowed identification of the seasonal cycles preserved in the firn that provide annual markers distinguishing individual accumulation years. While most of the final results, such as surface velocities and accumulation rates, have been published previously in various reports and papers, the raw data and basic details of the observations are not easily accessible. The purpose of this review is to present these data, including data hitherto unpublished in a single place, and to evaluate and review their quality for those who have used or plan to use these observations. The report augments these observations by comparison with more recent measurements. Together with the data on surface velocity and ice-sheet geometry presented in the first part, these glaciological data sets represent one of the first large-scale surveys conducted on the Greenland Ice Sheet and, as such, provide an invaluable benchmark for change detection.

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INTRODUCTION

Teams from The Ohio State University's (OSU) Byrd Polar Research Center (BPRC) launched two extensive field efforts in the 1980s to measure ice velocity and surface deformation on the Greenland Ice Sheet. Over the course of two field seasons in 1980 and 1981, a glaciological survey was conducted along a transect across the south dome of the Greenland Ice Sheet (Fig. 1). This project was part of GISP, a joint research program involving scientists and engineers from the United States, Denmark, and Switzerland. Surface deformation was measured at three clusters using Doppler (TRANSIT) satellite receivers. Along a strain grid consisting of three rows of poles extending ~20 km upstream from the Dye-3 deep borehole deformation was measured using electronic distance measurements. Shallow cores were retrieved at a number of sites to determine longer-term average accumulation by identifying high levels of beta-radioactivity associated with atmospheric nuclear tests conducted in the 1950s and 1960s (Crozaz et al., 1966). After core recovery, firn temperatures were measured in the boreholes. Airborne and ground-based radar sounding provided ice thickness data. Other data collected include visible stratigraphy, oxygen-isotope profiles, firn density and grain size, and gravity measurements.

In 1987, a 150 km × 150 km survey grid was established by OSU researchers as part of the GISP2 site-selection program in the Summit region of central Greenland (Fig. 1). At nine sites, shallow cores were retrieved to depths of ~17 m to assess spatial and interannual variability of the annual net accumulation rate in this region (Bolzan and Strobel, 1994). The positions of 21 sites were determined from TRANSIT satellite tracking and these stations were revisited in the summer of 1989 to obtain displacements and hence ice velocities (Bolzan, 1994). In addition to the ground-based survey, the basal and surface topography were determined by airborne radar sounding was conducted using the 60 MHz ice radar from the Technical University of Denmark (Hodge et al., 1990).

This report, published in two parts, presents a summary of glaciological observations made on the Greenland Ice Sheet during the 1980/1981 and 1987/1989 OSU field campaigns. The present paper is the second part of this report and focuses on accumulation rates and firn temperatures. The first part, published in *Polar Geography*, Vol. 24, No. 4 (Van der Veen et al., 2000) discusses ice sheet geometry (surface and bed elevations, depth of internal layers), surface velocity, and strain rates. Other data, including visible stratigraphy, grain size, and gravity measurements, will be discussed in future contributions.

All data presented in this report were obtained by personnel from The Ohio State University's Byrd Polar Research Center under the leadership of Dr. Ian Whillans (1980–1981) and Dr. John Bolzan (1987–1989), with the exception of the stable isotopic measurements. Oxygen isotopic ratios, $\delta^{18}O$, were measured by Dr. H. Clausen (1980–1981) and Drs. W. Dansgaard and N. Gundestrup (1987–1989), all at the Geophysical Isotope Laboratory in Copenhagen, Denmark.

ACCUMULATION SITES

A number of shallow-depth (<21 m) firn cores were collected in association with the OSU survey programs to determine accumulation rates. In the southern clusters,

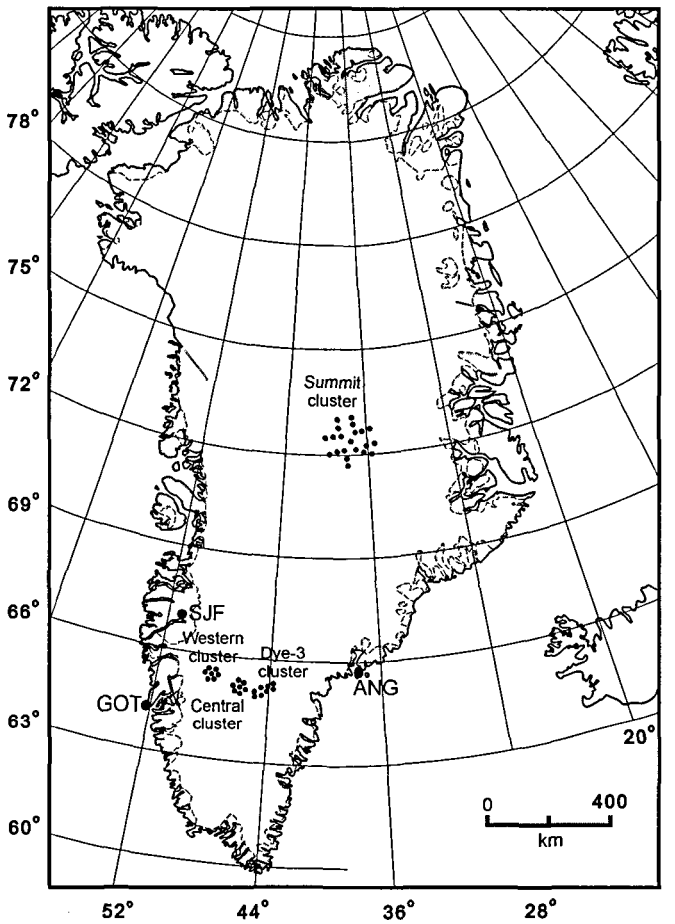


Fig. 1. Location of strain clusters in south and central Greenland.

eight cores were collected in 1980, and nine cores in 1981. Nine cores were drilled in the Summit cluster in 1987. All coring sites are at satellite tracking stations with the exception of two cores drilled in 1981. Core L2 is located about 2.5 km west of station 1002 (near trail marker 12.18) and core L5 is about halfway between stations 1001 and 1005 (near trail marker 15.12; Fig. 2). Coordinates of the ice core sites are given in Table 1.

The same procedure for collecting cores was used at the southern clusters and the Summit array. After excavating a 2 × 2 × 2 m snowpit, drilling proceeded from the floor of the pit. For the 1980/1981 cores, a conventional Sipre auger with a 1 m long drill barrel was used. In 1987, a light-weight hand auger with a 2 m long barrel fabricated by the Polar Ice Coring Office was used. The pit wall was sampled every 10 cm for stable oxygen-isotope, $\delta^{18}O$, and gross β-activity measurements. In 1987, two pits were dug at each site, one for drilling and the second for sampling. Densities of the upper 2 m were obtained by sampling pit walls using a 500 ml sampling tube.

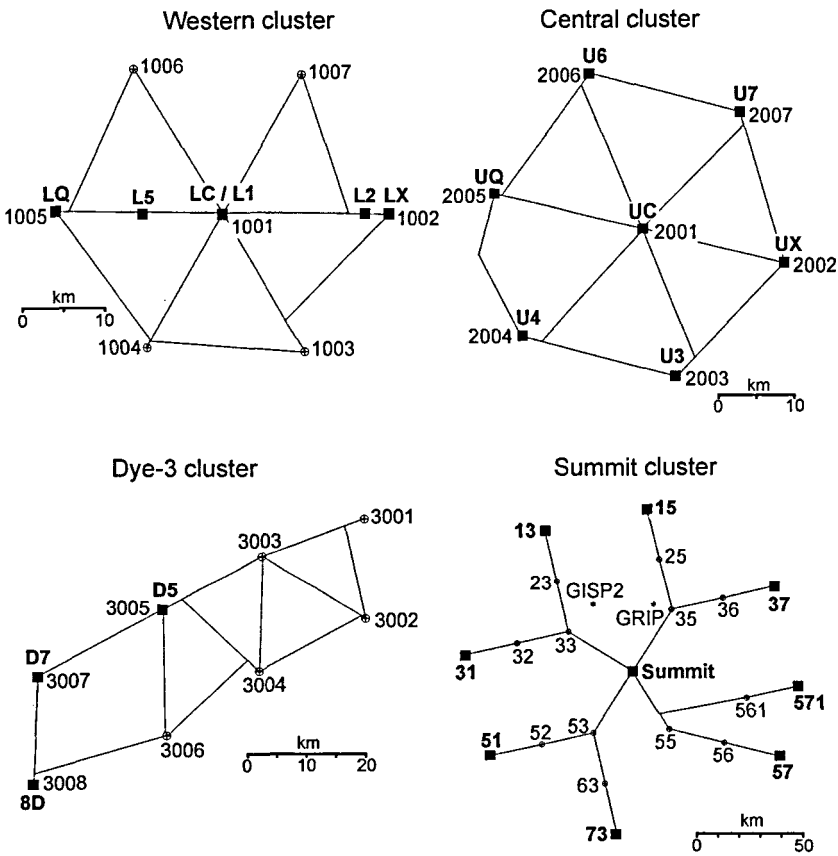


Fig. 2. Arrangement of survey sites in the clusters. Accumulation sites are indicated in bold.

At the drill site, each core was divided into ~10 cm sections that were sealed in plastic bags and returned to OSU-BPRC for further analyses. Typically, core recovery is less than 100% and is often greater for cores drilled with a hand auger. Material can be lost at any break in the core, as the sections may rotate differentially within the barrel and grind away firn into very fine chips. In the upper 5 to 10 meters, friable hoar layers create zones of weakness where breaks frequently occur within a drill run. At this interface between sections, depth hoar is particularly prone to being ground into fine chips. Additionally, some fraction of the core can be lost if the core break at the end of the drill run is not flush with the bottom of the borehole. When the drill is again lowered into the hole to continue drilling, any protruding core left from the previous run may be re-drilled and either damaged or ground away. Whillans and Bolzan (1988) developed an algorithm to estimate the contribution of core loss and to determine the true depth of the samples retrieved. For the 1987 Summit cores, however, core loss amounted to only a few percent of the total core recovered so that this correction had only a small effect on the results (Bolzan and Strobel, 1994). For the 1980 and 1981 cores, drill logs could not be located and information on core loss is not available. Thus, it is not clear whether any corrections were made.

TABLE 1

Coordinates of Survey Sites Shown in Figure 2 Where Shallow Firn Cores Were Retrieved for Determining Accumulation Rate

Station	Latitude			Longitude			Year recovered
LC (1001)	65	23	15.484	-47	40	22.752	1980
LQ (1005)	65	23	25.301	-48	6	34.918	1980
L1 (1001)	65	23	15.835	-47	40	25.330	1981
L2 (12.18)							1981
L5 (15.12)							1981
UC (2001)	65	6	29.389	-45	41	11.713	1980
UX (2002)	65	4	2.070	-45	17	13.356	1980
UQ (2005)	65	8	56.704	-46	6	12.275	1980
U3 (2003)	64	55	58.368	-45	35	48.426	1981
U4 (2004)	64	58	53.438	-46	1	35.562	1981
U6 (2006)	65	17	34.807	-45	50	2.975	1981
U7 (2007)	65	14	48.711	-45	24	32.379	1981
D5 (3005)	65	7	7.281	-44	11	51.928	1980
D7 (3007)	65	0	50.911	-44	38	35.579	1980
8D (3008)	64	50	59.285	-44	39	11.655	1981
Summit	72	17	38.205	-37	55	18.567	1987
13	72	53	11.069	-39	9	24.598	1987
15	72	58	52.589	-37	42	16.185	1987
31	72	20	54.954	-40	12	49.622	1987
37	72	38	27.092	-35	56	41.996	1987
51	71	55	35.813	-39	50	7.307	1987
57	71	55	13.813	-35	57	35.535	1987
571	72	12	43.350	-35	40	5.875	1987
73	71	36	7.879	-38	8	7.879	1987

Tabulated data on the eight cores drilled in 1980 are not available, and for these cores results presented here are restricted to the figures and firn load data given in Bow (1982). For the nine cores drilled in 1981, as well as for the nine Summit cores, all available data are presented in Tables and Figures.

FIRN DENSITY

Depending on field personnel, more or fewer of the core sections recovered during the 1980 and 1981 field seasons were measured in the field for density. Measurements of the radius and mass of core segments were also made in the cold laboratory at BPRC. Whillans et al. (1987) considered density values measured in the lab to be less accurate because of concern about sintering and shrinkage of samples during

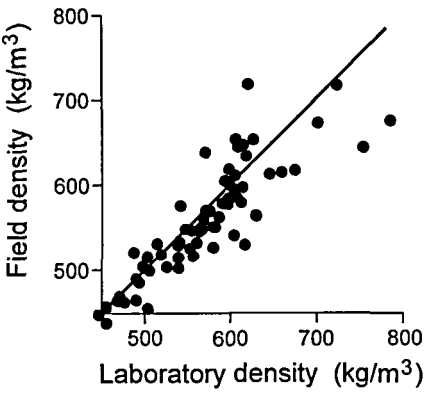


Fig. 3. Comparison of densities determined in the field and in the laboratory. The line represents no-bias. From: Whillans et al. (1987).

shipment. However, comparison between densities measured in the field and in the laboratory shows no clear bias (Fig. 3). Because the laboratory measurements are more complete, these are presented here and used in computing accumulation rates.

Depth-density profiles are shown in Figures 4–6 and, for the 1981 and 1987 cores also tabulated in the Appendix (Tables A1 and A2, respectively). Some of the profiles measured in the laboratory are problematic, with firn densities significantly greater than the density of solid ice (in particular L1 and L5 in Fig. 5). The reasons for these errors are not clear, but as a result, the calculated load at depth is significantly greater than at other sites (Fig. 7). The load at any depth equals the weight of material above and thus represents the depth-integrated density. For the 1980 cores, loads at meter intervals below the surface are given in Bow (1982) and tabulated here in Table 2. Loads for the 1981 and 1987 cores are calculated from density data. For comparison with the 1980 results, loads in Tables 3 and 4 are also given at meter intervals, although the more closely spaced density data and loads at ~10 cm intervals are used in our revised calculations of accumulation rate, as discussed below. For all cores, load as a function of depth below the surface is shown in Figure 7. Omitting the anomalous L1 and L5 loads, as well as values for the U3 core, where densities appear to be too small, a best fit to the load data for 11 cores from the three southern clusters gives

$$L = 425.82 \cdot D + 6.99 \cdot D^2,$$

where L represents the load in kg/m^3 and D the depth in m below the surface. The correlation coefficient of this regression is $R^2 = 0.988$.

GROSS BETA-RADIOACTIVITY

Atmospheric testing of thermonuclear weapons in the 1950s and early 1960s resulted in increased atmospheric levels of ^{90}Sr and ^{137}Cs and subsequently in elevated β-radioactivity levels in the snow deposited at that time. The first such tests, in 1952 and 1953, produced a twofold increase in β-activity in Greenland snow

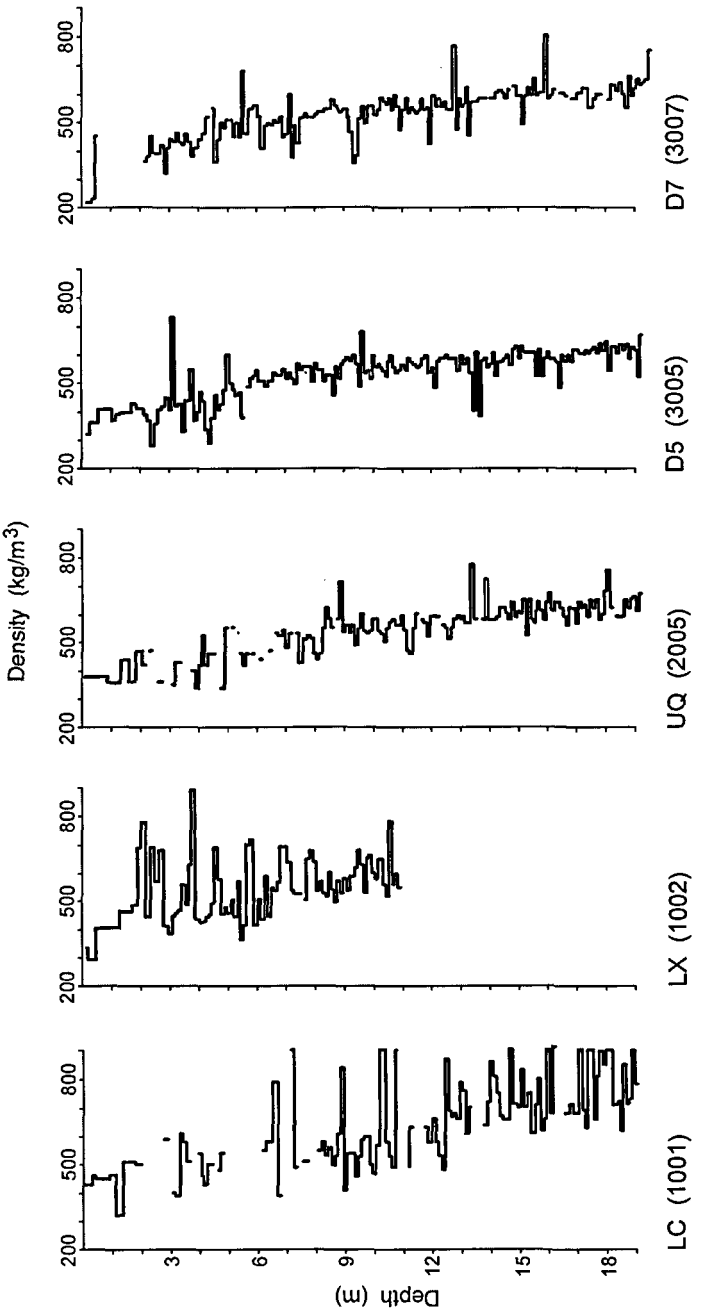


Fig. 4. Depth-density profiles for the 1980 cores. From Bow (1982).

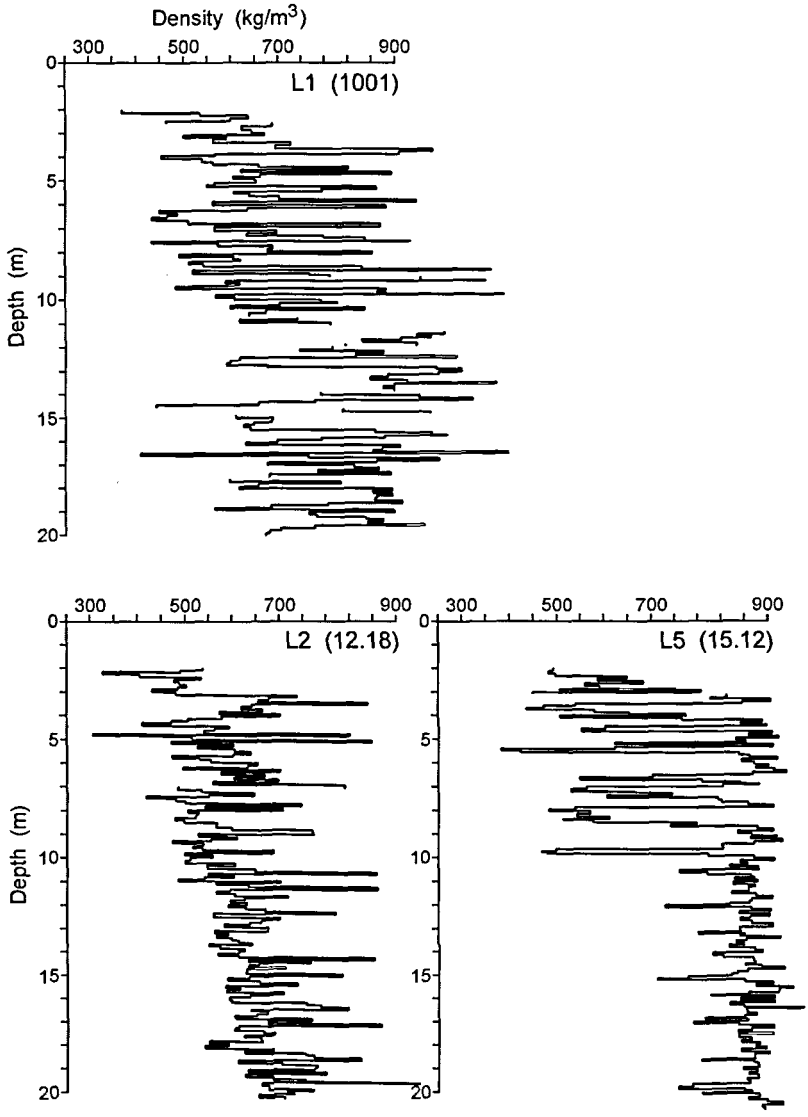


Fig. 5. Depth-density profiles for the 1981 cores. From Whillans et al. (1987). Continues on facing page.

deposited in late 1953 compared to the natural background level. In early 1954, the Castle series of tests resulted in a fivefold to tenfold increase above the pre-testing background in snow deposited during the second half of 1954. In 1959, a testing moratorium was enacted, and the firn layer deposited in 1960 shows a clear minimum in β-activity. Resumption of Soviet tests in 1961 and 1963 produced very high levels of activity in the 1963 layer, which is perhaps the best stratigraphic horizon to use for determining accumulation rate, as it is readily identified without additional information on stratigraphy (Crozaz et al., 1966; Bolzan and Strobel, 1994).

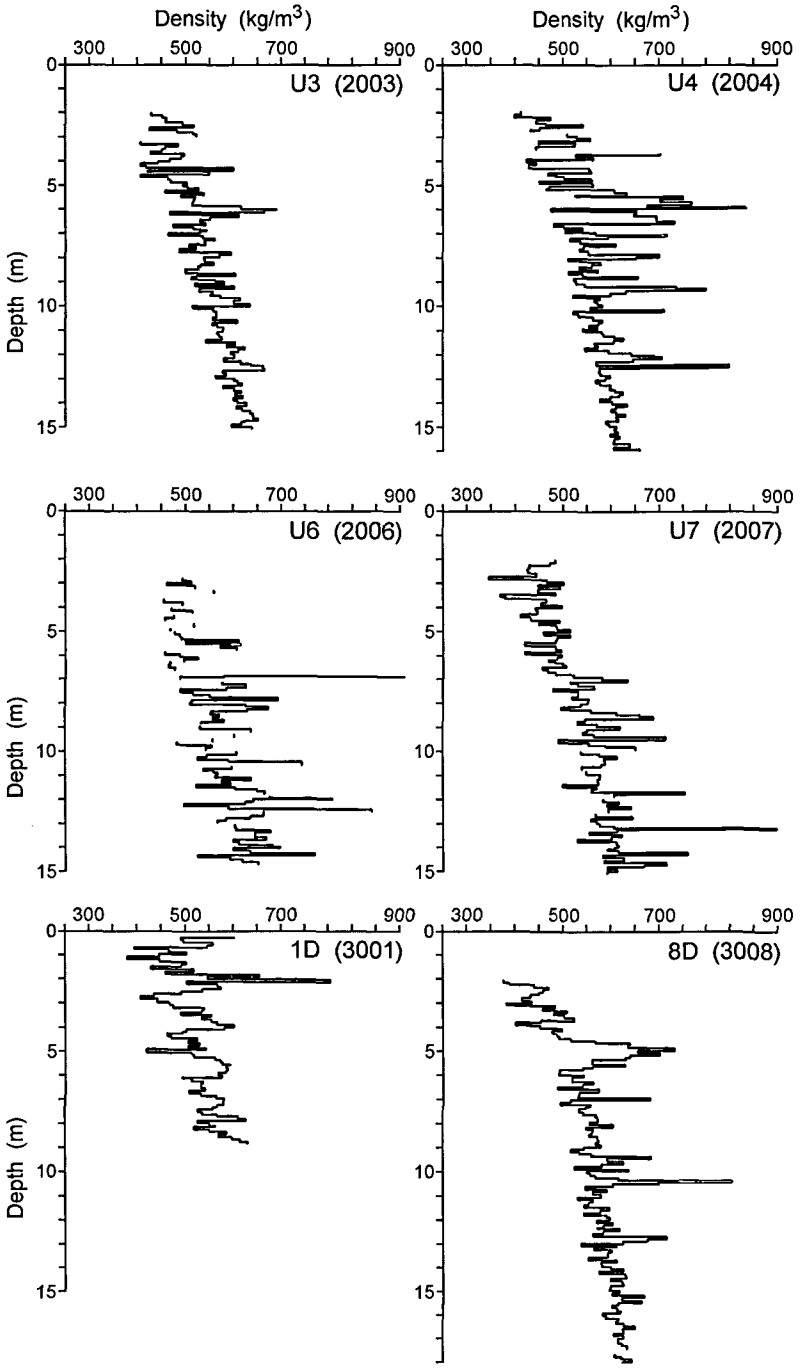


Fig. 5. Continued.

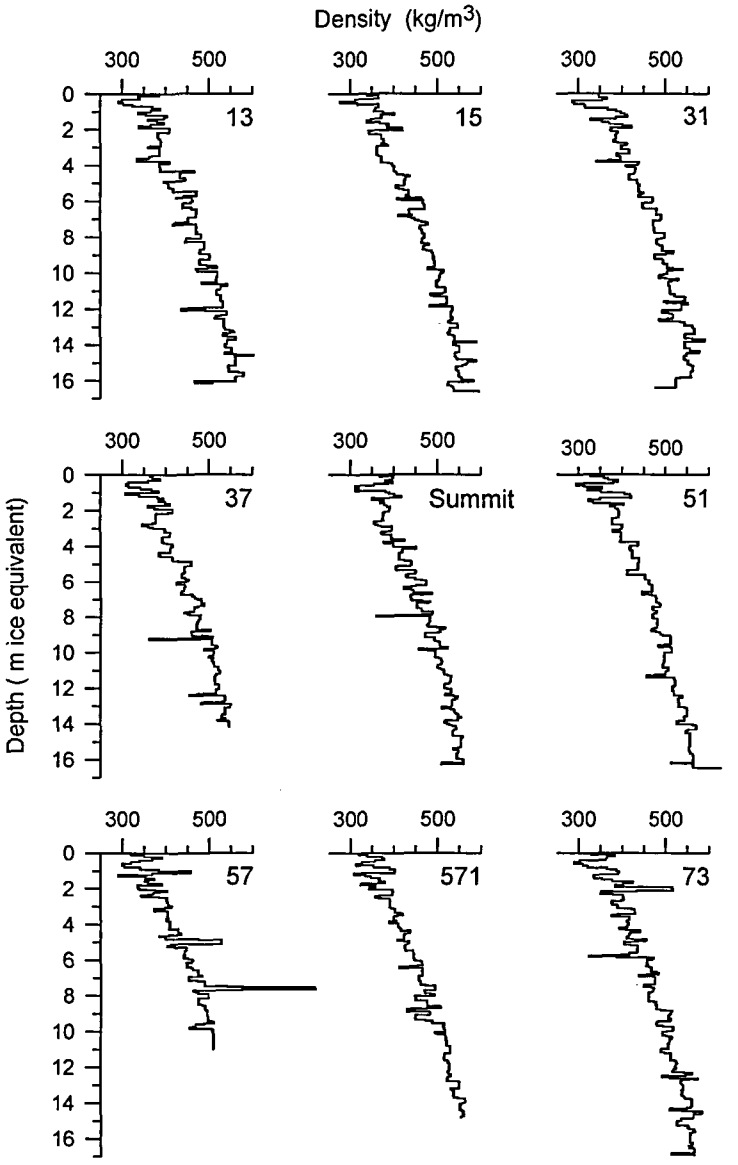


Fig. 6. Depth-density profiles for the 1987 Summit cores.

Beta-radioactivity on the 1980 and 1981 cores was measured by students under the supervision of Dr. Whillans using the equipment in his laboratory. The samples used for density measurements were acidified to achieve the required pH for filtering and to inhibit adherence of salts to the container walls. Samples were melted and then pumped through ion-exchange filters (Whatman type SA-2) that were then air dried. Part of the residual water was then sent to the University of Copenhagen for measurement of stable isotope ratios. The filters were counted using a Canberra model 2200 gas flow proportional counter that includes a sealed guard counter that is encased in a

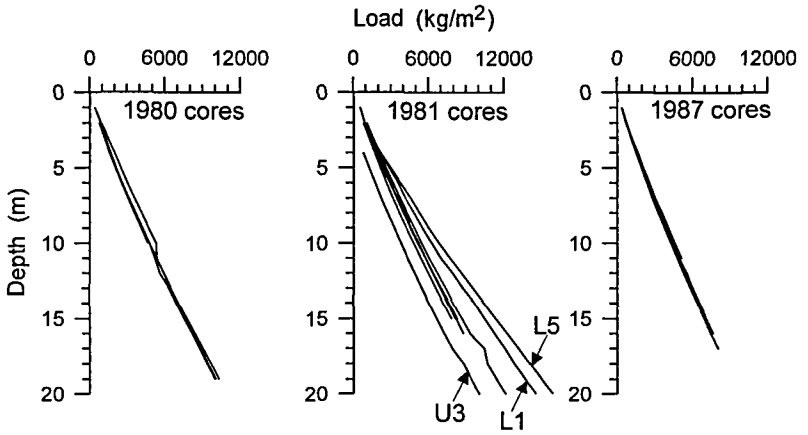


Fig. 7. Load as a function of depth for the 1980, 1981, and Summit cores.

TABLE 2

Load (in kg/m^2) at Depth below the Surface Derived from Density Measurements on the 1980 Cores

Depth (m)	LX (1002)	UQ (2005)	D5 (3005)	D7 (3007)
1			371	
2	876	799	816	745
3	1444	1216	1240	1140
4	1976	1623	1667	1572
5	2486	2072	2100	2051
6	3003	2544	2585	2558
7	3561	3068	3112	3059
8	4138	3563	3660	3564
9	4687	4181	4202	4118
10	5307	4753	4773	4620
11		5334	5340	5190
12		5895	5912	5576
13		6476	6487	6343
14		7105	7033	6924
15		7734	7625	7521
16		8378	8217	8161
17		9008	8805	8756
18		9668	9421	9343
19		10296	10035	9980

Source: From Bow, 1982.

TABLE 3

Load (in kg/m^2) at Depth below the Surface Derived from Density Measurements on the 1981 Cores[a]

Depth (m)	L1 (1001)	L2 (12.18)	L5 (15.12)	U3 (2003)	U4 (2004)	U6 (2006)	U7 (2007)	1D (3001)	8D (3008)
1								519	
2	883	818	850	766	784	793	782	1043	834
3	1464	1277	1447	1239	1238	1387	1224	1538	1262
4	2147	1951	2123	1713	1747	1894	1680	2080	1737
5	2810	2506	2939	2187	2237	2387	2139	2576	2321
6	3523	3084	3734	2713	2886	2910	2616	3144	2883
7	4135	3728	4579	3256	3483	3416	3118	3689	3431
8	4843	4301	5297	3791	4062	3986	3659	4257	3992
9	5514	4887	6022	4329	4618	4566	4240		4552
10	6260	5447	6838	4907	5220	5144	4827		5137
11	6978	6048	7721	5468	5785	5745	5399		5747
12	7930	6702	8639	6055	6373	6380	5992		6319
13	8748	7363	9538	6659	7007	7021	6589		6938
14	9698	7966	10438	7264	7604	7662	7203		7533
15	10468	8664	11338	7892	8208	8294	7840		8151
16	11253	9309	12258		8820				8776
17	12086	10444	13159						9412
18	12845	10687	14069						10048
19	13718	11424	14987						
20	14521	12147	15872						

[a]As discussed in the text, values for cores L1 and L5 are unrealistically large, while the load for the U3 core appears to be too small.

lead-brick box. A typical background rate is about 0.7 counts per minute (cpm). For the 1987 samples, part of the beta-activity was counted by Dr. Bolzan using a Tennelec model 1000 counter. During the one-year period over which the 1987 samples were measured, the average background activity was about 0.65 cpm for the Canberra, and 0.45 cpm for the Tennelec. Because both counters were located well above ground (on the second floor), and may have been susceptible to important short-term fluctuations in background activity, measurements of background activity were taken before and after counting all samples (between 150 and 200) from a given core (Bolzan and Strobel, 1994). For the earlier samples, it is not entirely clear whether such background measurements were taken regularly. However, the large peaks in β-radioactivity corresponding to the atmospheric tests are sufficiently obvious in most cases to be readily identified, regardless of possible fluctuations in the background activity.

TABLE 4

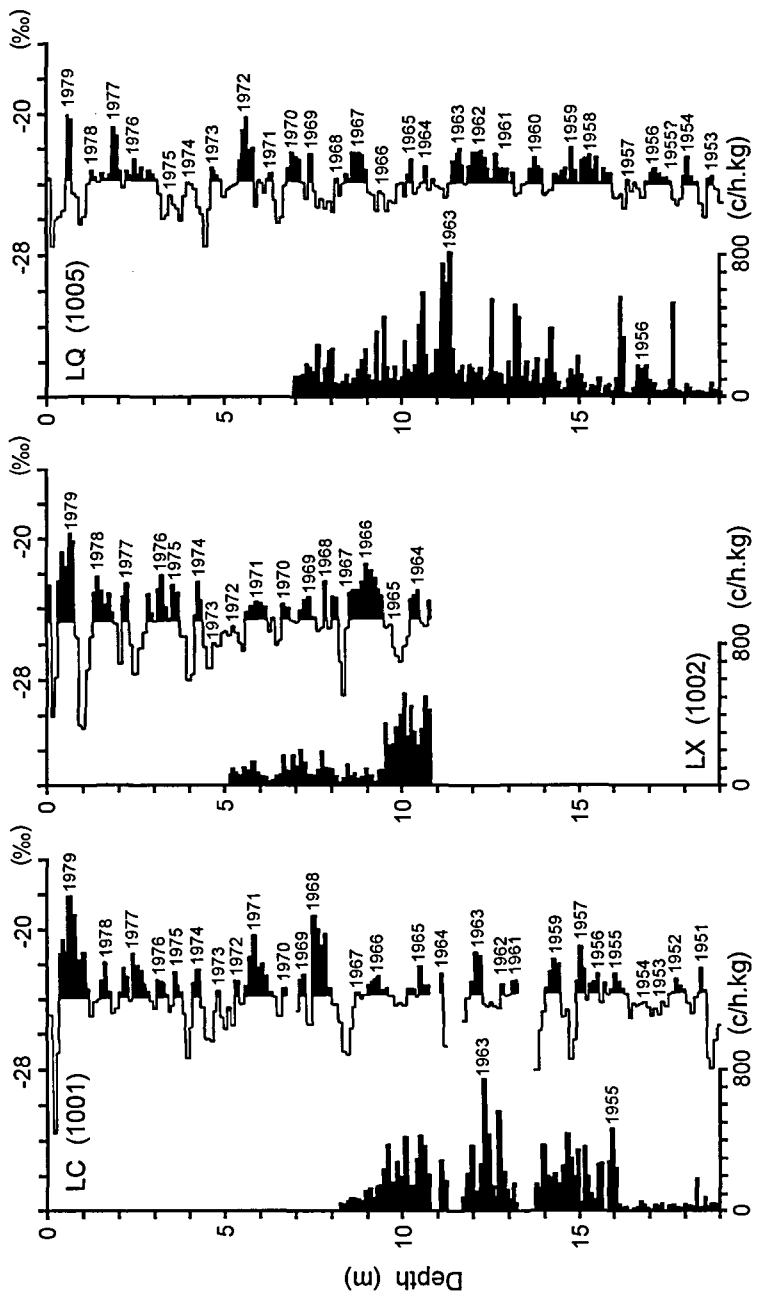
Load (in kg/m^2) at Depth below the Surface Derived from Density Measurements on the 1987 Summit Cores

Depth (m)	13	15	31	37	Summit	51	57	571	73
1	336	342	330	344	359	349	331	343	334
2	706	712	716	717	743	725	697	702	712
3	1107	1084	1105	1105	1123	1118	1140	1089	1125
4	1515	1452	1537	1555	1553	1529	1641	1498	1534
5	1967	1981	2004	1967	2018	1959	2067	1918	1954
6	2429	2460	2465	2474	2452	2393	2575	2354	2373
7	2906	2911	2934	2943	2904	2858	3035	2809	2835
8	3372	3376	3420	3413	3423	3337	3593	3281	3303
9	3846	3848	3913	3906	3957	3814	4101	3824	3779
10	4336	4341	4410	4397	4448	4345	4592	4309	4281
11	4854	4846	4915	4907	4967	4817	5121	4852	4783
12	5472	5359	5560	5425	5489	5323		5374	5294
13	5901	5893	5962	5943	6023	5849		5920	5827
14	6442	6429	6523	6479	6557	6390		6465	6370
15	6995	6980	7073		7100	6946			6924
16	7557	7529	7659		7669	7503			7472
17									8064

Measured profiles of β-radioactivity are shown in Figures 8–10, and are given in counts per hour per kilogram (c/h.kg). A careful calibration of the counters was not made because interest was in relative values. According to manufacturer's specifications and comparison of values measured on samples from Dome C, Antarctica, with values reported by Petit et al. (1982) and Palais et al. (1982) suggest an efficiency of about 30% for the Canberra counter. This would imply that the actual activity in disintegrations per hour per kilogram is about three times larger than the values plotted (Whillans et al., 1987). For ease of comparing stratigraphic horizons determined from β-activity and those obtained from oxygen isotope profiles, the latter are also shown in Figures 8–10.

OXYGEN ISOTOPIC RATIOS

Measurements of oxygen isotopic ratios, $\delta^{18}O$, were made at the Geophysical Isotope Laboratory at the University of Copenhagen. The ratio between the concentrations of heavy and light oxygen isotopes ($^{18}O/^{16}O$) in firn samples is commonly expressed using the δ scale, which represents the relative difference between the ratio in the sample and that ratio in Standard Mean Ocean Water. The oxygen isotope concentrations are measured using mass spectrometric techniques with an overall



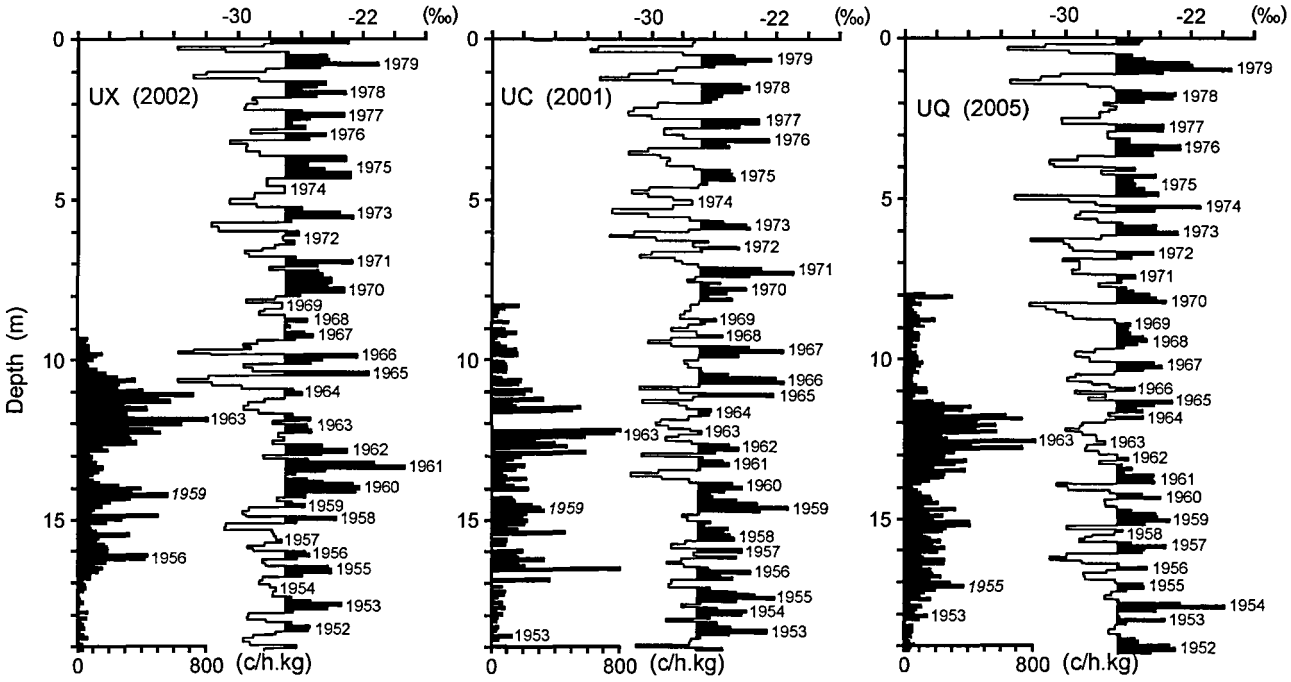


Fig. 8. Gross beta-activity and oxygen isotope profiles for the 1980 cores. Horizons used for calculating accumulation rate are indicated on the beta profiles. Where different, years in italics indicate horizons used by Whillans et al. (1987) to determine accumulation rate. From Bow (1982). Figure continues on following page.

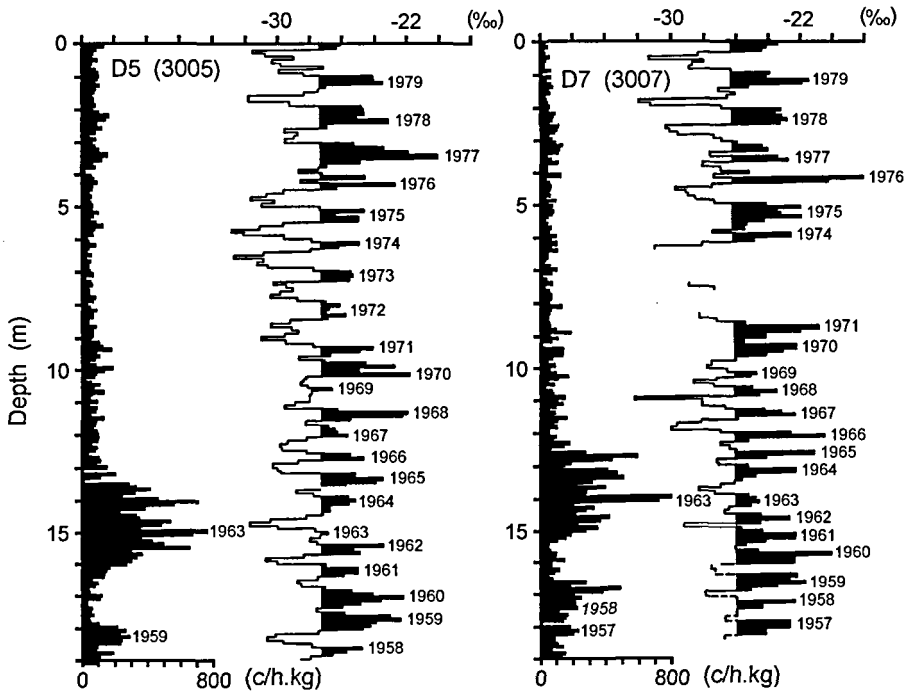


Fig. 8. Continued.

reproducibility of ±0.12 ‰ (Dansgaard et al., 1973). In cold regions, such as Greenland and Antarctica, the primary factor that determines the ratio is the difference between the condensation temperature at a given location, and the condensation temperature at the first stage of the precipitation process, that is, when the water evaporated from the oceans. Neither of these temperatures are generally known, but are often assumed to be a measure of the actual temperatures. If, in addition, the temperature at the early stages of condensation remains more or less constant, $\delta^{18}O$ can be considered an indicator of the air temperature at the time of deposition (Dansgaard et al., 1973). Throughout the year, $\delta^{18}O$ varies with peaks (least negative values) identifying summer layers, and troughs (most negative values) representing snow deposited during the winter. This seasonal cycle is preserved in glacier firn (albeit progressively smoothed by isotopic diffusion; Whillans and Grootes, 1985) and thus provides annual markers that distinguish individual accumulation years (Dansgaard et al., 1973; Bolzan and Strobel, 1994).

The $\delta^{18}O$ profiles shown in Figures 8–10 reveal the cyclical pattern associated with summer warmth and winter cold. However, in the 1980 and 1981 cores there is ambiguity in the identification of specific years. This is particularly true for the 1981 cores (Fig. 9) (e.g., L1 and L5), where few peaks are present at depths greater than five or so meters below the surface. This lack of clear seasonality may have been caused by meltwater percolation and refreezing, as suggested by the anomalous density profiles at L1 and L5. Thus, the 1980 and 1981 cores should be used only to estimate the long-term (~20 yr) average accumulation rate. In contrast, the quality of the

isotope signal in the Summit cores is excellent (Figure 10) and clearly shows individual summer peaks and winter troughs that can be used to estimate annual accumulation values. For the 1981 and 1987 cores, $\delta^{18}O$ values at depth are tabulated in Tables A3 and A4.

While the seasonal cycle in $\delta^{18}O$ is well preserved in the 1987 cores, there are ambiguities in identifying some of the annual summer peaks, as indicated by the arrows in Figure 10. In core 57, according to the years assigned by Bolzan and Strobel (1994), the greatest beta-value corresponds to 1964, rather than to 1963 as expected. It may be that 1971 should be assigned to the small plateau marked by the arrow and that subsequent peaks are one year older than proposed by Bolzan and Strobel (1994), so that the deepest layer corresponds to 1963. This appears to be supported by the record for core 571, in which 1971 does not have a pronounced peak in $\delta^{18}O$. For the four sites (13, 15, 37, and 73) shown in the second panel of Figure 10, there is some inconsistency between the beta- and oxygen-isotope stratigraphy, in that there are too many or too few peaks or features that could be identified as annual markers between the 1986 and 1963 layers. These differences are discussed more fully in Bolzan and Strobel (1994). At site 73, accumulation rate is high and Bolzan and Strobel (1994) elect not to assign years to the three features indicated by arrows because these peaks are based on two or three samples only, whereas other peaks in the profile are better defined. By ignoring these features, the depth of the 1963 layer corresponds to the pronounced peak in the beta-profile. Similarly, in core 13, the two narrow peaks in 1962–1963 and 1966–1967 are ignored by Bolzan and Strobel (1994). In core 37, the $\delta^{18}O$ profile appears to be missing a peak between 1986 and 1963. Bolzan and Strobel (1994) assigned 1982 to a single-sample peak just above the 1981 summer horizon. Alternatively, 1972 could have been assigned to the single-sample peak between 1971 and 1972. However, Bolzan and Strobel (1994) argued that a high accumulation in 1971–1972 is also seen at sites 57 and 13, while no anomalous high accumulation is seen at any sites in 1982–1983, thus suggesting the shallower peak should be assigned to 1982. Finally, for core 15, the beta-profile does not include the 1963 peak, but does show the sharp rise in beta-radioactivity at 6 m depth. If this rise corresponds to the Castle series tests (1954), then the $\delta^{18}O$ profile is missing one peak. Bolzan and Strrobel (1994) attribute this missing peak to core loss at ~2 m depth, which could account for a five-sample peak in the isotope profile. Because summer peaks above this depth are unambiguous, Bolzan and Strobel assigned 1976 to the missing peak.

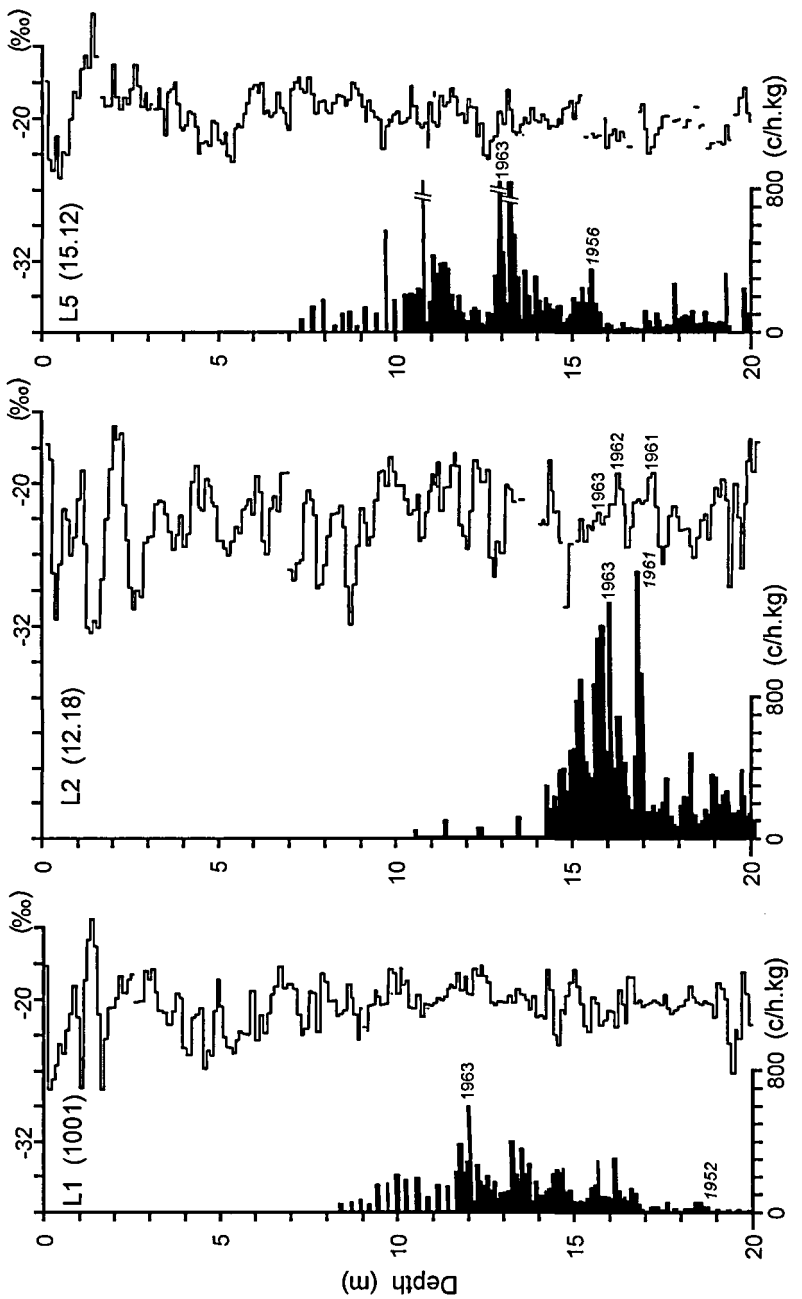
ACCUMULATION RATES

Southern Clusters

Accumulation rates for the southern clusters were first published in Whillans et al. (1987). Here "revised estimates" for the long-term average accumulation rates are presented, based on our reanalysis of the data discussed in the previous sections.

As noted, the β-radioactivity profile can be used to date the shallow firn cores. For the 1980 cores shown in Figure 8, Bow (1982) used the following layer identifiers in the β-activity profile:

1955: Castle test causing first "major' increase in activity;
1959: last major peak before 1960 moratorium;



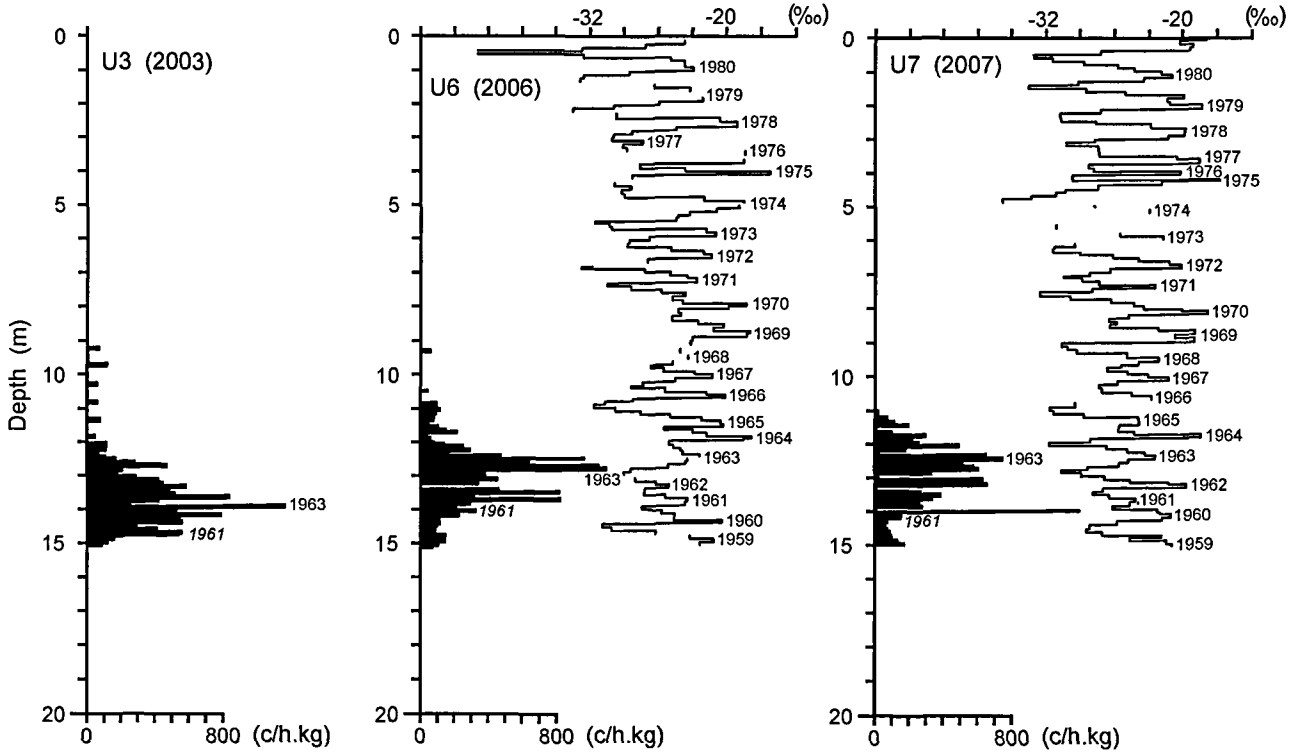


Fig. 9. Gross beta-activity and oxygen isotope profiles for the 1981 cores. Horizons used for calculating accumulation rate are indicated on the beta profiles. Where different, years in italics indicate horizons used by Whillans et al. (1987) to determine accumulation rate. From Whillans et al. (1987). Figure continues on the following page.

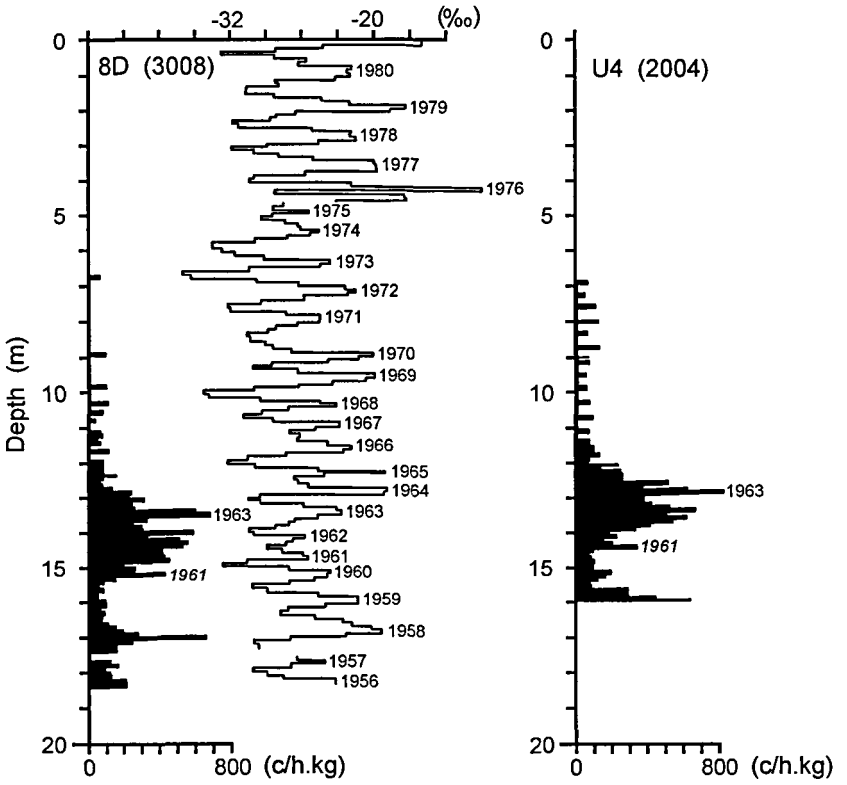


Fig. 9. Continued.

1960: moratorium minimum, not well defined in regions of high meltwater percolation;

1963: absolute maximum resulting from deposition of debris from high yield tests in 1960 and 1961.

After identifying these years in the profiles, seasonal variations in $\delta^{18}O$ were used to interpolate between layers and to resolve ambiguities in identifying peaks in β-radioactivity. Core LX (1002) is ambiguous, as it is not evident whether the record extends back to the 1963 maximum, and therefore this record is not considered in further discussion.

Dating of the 1981 cores is more problematic, and here only the 1963 horizon is used to estimate revised values for the long-term accumulation rate, as this horizon is clearly evident in all β-radioactivity profiles. Whillans et al. (1987) used deeper strata (indicated by italic numbers in the β-profiles), but some of these layers may be questioned due to lack of clear seasonality in the oxygen isotope record that would allow deeper extrapolation from the 1963 horizon.

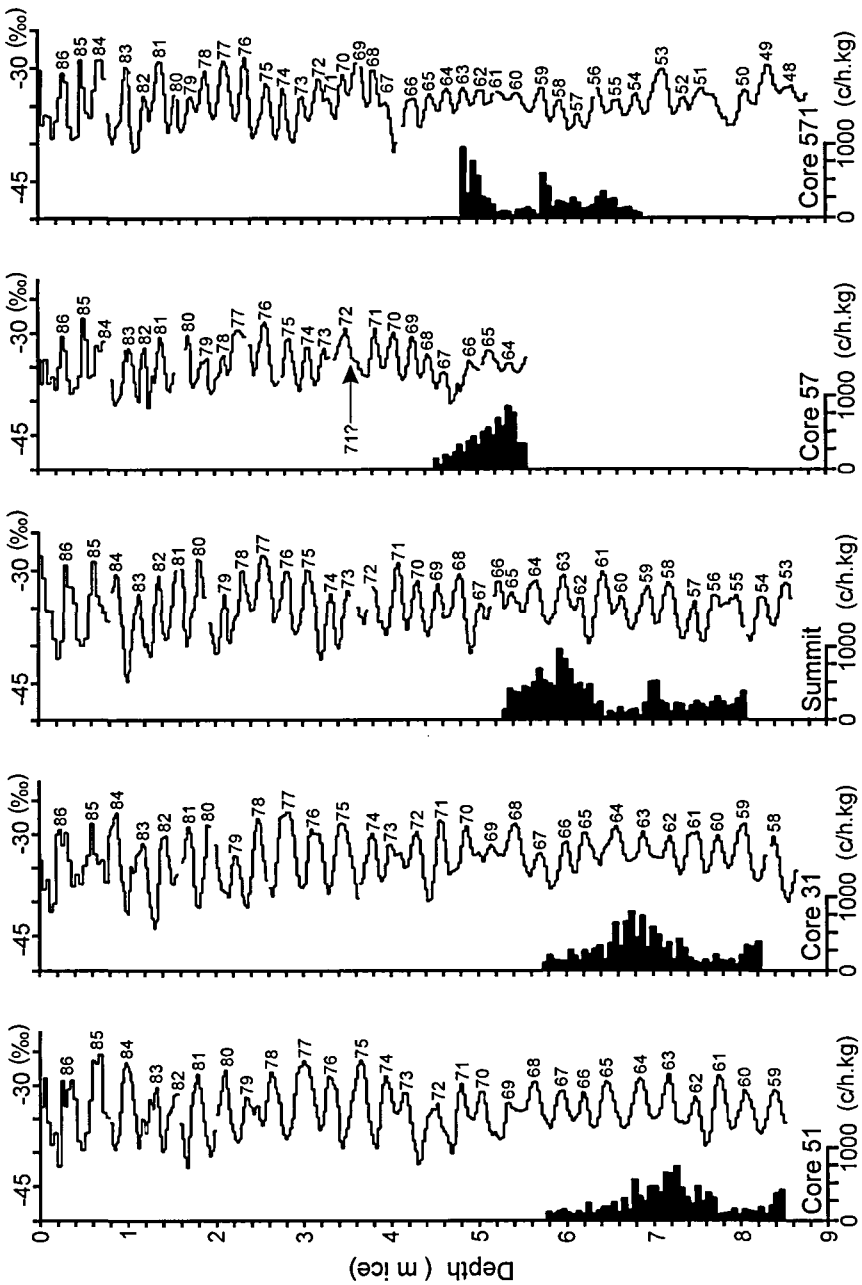
Revised accumulation rates are given in Table 5. Several accumulation values obtained here, italicized in Table 5, are questionable, namely those calculated using the measured density profiles for cores L1 and L5 in which densities exceed that of

pure ice and thus are unrealistic (Fig. 5). As a result, using these densities results in the calculation of significantly overestimated loads and thus accumulation. A comparison with the earlier values reported by Whillans et al. (1987) is given in Table 6. In this table, values in the last column represent the average of the revised accumulation rates derived from the β-horizon and oxygen isotope stratum given in Table 5. The large differences between revised accumulation rates at sites LC, L1, and L5 calculated here and earlier estimates given in Whillans et al. (1987) (Table 6) result from their use of the large load at depth. As for site LQ, the accumulation value of Whillans et al. (1987) is large as a result of using a large load at depth. No density profile could be found for this site and it is not clear how the large load was calculated.

Summit Cluster

Average accumulation rates for the 1987 Summit cores are given in Table 7. For comparison, accumulation rates determined by Clausen et al. (1988) at nine sites south of the Summit cluster are also given. Values in cm ice equivalent per year given in Bolzan and Strobel (1994) and Clausen et al. (1988) were converted to cm of water equivalent per year using an ice density of 917 kg/m^3. Within measurement uncertainty, there appears to be no significant change between the more recent Summit averages and the earlier values from Clausen et al. (1988) (Bolzan and Strobel, 1994). Figure 11 shows the contour map of accumulation rate derived from these accumulation values. This pattern is discussed in more detail by Bolzan and Strobel (1994) but, in short, the spatial gradient is relatively uniform and persistent in the northwest to southeast direction, as inferred earlier by Mock (1967) based on trend surface analysis. There appears to be little or no influence of surface topography on the accumulation pattern. The northwest to southeast trend in contours suggests that accumulation in this region derives from a moisture source to the southwest of the central Greenland Ice Sheet (Bolzan and Strobel, 1994). The average oxygen isotope ratio becomes progressively depleted along the southwest to the northeast direction (Bolzan and Strobel, 1994, Fig. 6) as was to be expected for moisture transport to the northeast. Because there is no source for additional moisture once an air mass reaches the interior of the ice sheet, the remaining water vapor should become progressively more depleted of heavier oxygen isotopes (yielding more negative values of $\delta^{18}O$) as the air mass travels further inland and precipitation continues (Bolzan and Strobel, 1994).

Because the seasonal cycle in oxygen isotope ratio is well preserved in the nine Summit cores (Fig. 10) annual net accumulation values can be obtained from the ice or water equivalent depth between subsequent summer peaks or winter troughs (note, however, that some ambiguities remain, as discussed above). Annual time series are shown in Figures 12 (based on summer to summer peaks) and Figure 13 (based on winter to winter troughs) and values are given in Tables 8 and 9. The largest source of uncertainty in annual accumulation derives from the uncertainty in the timing of the isotopic peak or trough. Theoretically, the summer peak corresponds to the summer peak in air temperatures. The warmest temperatures generally occur in June and July (Stearns and Weidner, 1991), but similar warm temperatures may also occur in August. Assuming that the most positive values of the oxygen isotope ratio are associated with the warmest air temperatures, then summer peaks correspond to snow deposited between June and August. If the occurrence of temperature maxima can be



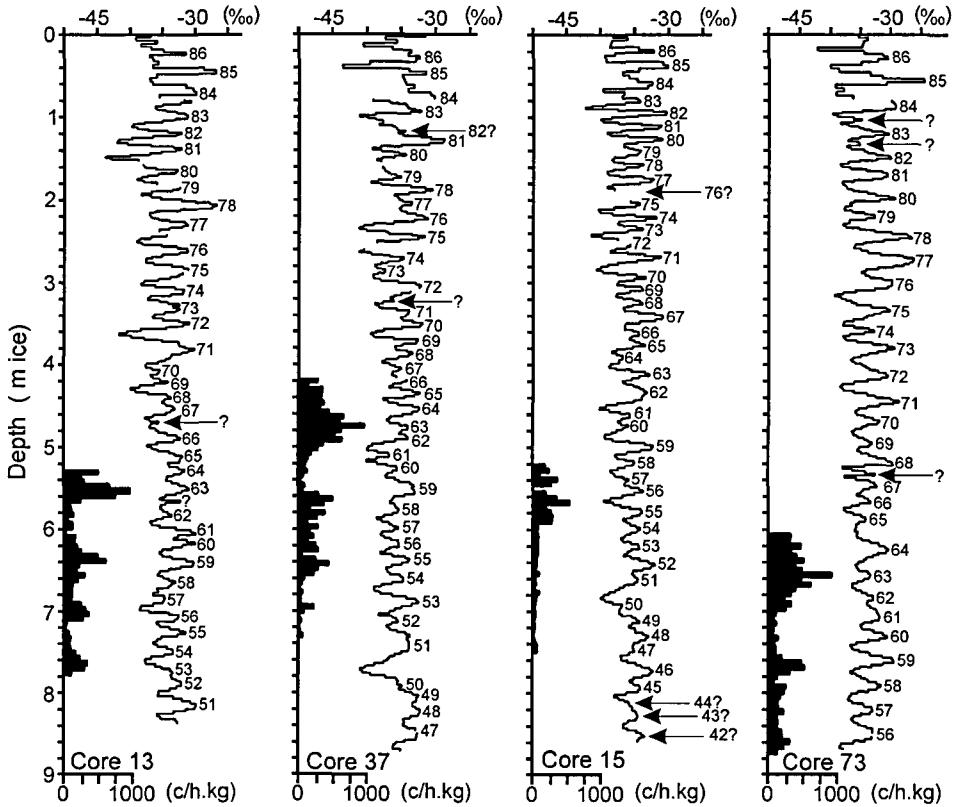


Fig. 10. Gross beta-activity and oxygen isotope profiles for the 1987 Summit cores. Note that the depth is in meters of ice equivalent. From Bolzan and Strobel (1994). Reproduced from the *Journal of Glaciology* with permission from the International Glaciological Society.

TABLE 5

Revised Average Accumulation Rate (in cm of water equivalent per year) Calculated for the 1980 and 1981 cores[a]

		Core	Year	Depth	Load measured	Accum.	Load regression	Accum.
				Western Cluster				
		LC (1001)	*1980*					
Stratum 1	β		1963	12.28	8172[b]	48.1	6283	37.0
	^{18}O		1963	12.24	8139[b]	47.9	6259	36.8
Stratum 2	β		1955	16.00	11253[b]	45.0	8603	34.4
	^{18}O		1955	16.12	11329[b]	45.3	8681	34.7
		LQ (1005)	*1980*					
Stratum 1	β		1963	11.25			5675	33.4
	^{18}O		1963	11.58			5868	34.5
Stratum 2	β		1956	16.76			9100	37.9
	^{18}O		1956	17.12			9339	38.9
		L1 (1001)	*1981*					
Stratum 1	β		1963	12.05	7973	44.3	6146	34.1
	^{18}O							
		L2 (12.18)	*1981*					
Stratum 1	β		1963	16.13	9404	52.2	8687	48.3
	^{18}O		1963	16.23	9483	52.7	8752	48.6
		L5 (15.12)	*1981*					
Stratum 1	β		1963	13.04	9572	53.2	6741	37.5
	^{18}O							
				Central Cluster				
		UC (2001)	*1980*					
Stratum 1	β		1963	12.24			6259	36.8
	^{18}O		1963	12.27			6277	36.9
Stratum 2	β		1953	18.73			10428	38.6
	^{18}O		1953	18.49			10263	38.0
		UX (2002)	*1980*					
Stratum 1	β		1963	11.82			6010	35.4
	^{18}O		1963	11.88			6045	35.6
Stratum 2	β		1956	16.10			8668	36.1
	^{18}O		1956	16.12			8681	36.2

(*table continues*)

TABLE 5 (Continued)

		Core	Year	Depth	Load measured	Accum.	Load regression	Accum.
		U3 (2003)	*1981*					
Stratum 1	β		1963	14.00	7264	40.4	7332	40.7
	^{18}O							
		U4 (2004)	*1981*					
stratum 1	β		1963	12.97	6989	38.8	6699	37.2
	^{18}O							
		UQ (2005)	*1980*					
Stratum 1	β		1963	12.51	6191	36.4	6421	37.8
	^{18}O		1963	12.59	6238	36.7	6469	38.1
Stratum 2	β		1953	17.94	9628	35.7	9889	36.6
	^{18}O		1953	18.12	9743	36.1	10010	37.1
		U6 (2006)	*1981*					
Stratum 1	β		1963	12.59	6771	37.6	6469	35.9
	^{18}O		1963	12.40	6635	36.9	6355	35.3
		U7 (2007)	*1981*					
Stratum 1	β		1963	12.56	6333	35.2	6451	35.8
	^{18}O		1963	12.45	6270	34.8	6385	35.5
				Dye-3 Cluster				
		D5 (3005)	*1980*					
Stratum 1	β		1963	14.89	7560	44.5	7890	46.4
	^{18}O		1963	15.00	7625	44.9	7960	46.8
Stratum 2	β		1959	18.26	9581	45.6	10106	48.1
	^{18}O		1959	17.73	9255	44.1	9747	46.4
		D7 (3007)	*1980*					
Stratum 1	β		1963	14.00	6924	40.7	7331	43.1
	^{18}O		1963	14.16	7020	41.3	7431	43.7
Stratum 2	β		1957	18.08	9394	40.8	9984	43.4
	^{18}O		1957	17.94	9308	40.5	9889	43.0
		8D (3008)	*1981*					
Stratum 1	β		1963	13.44	7199	40.0	6986	38.8
	^{18}O		1963	13.44	7199	40.0	6986	38.8

[a]For the 1980 cores, measured ice load (in kg/m^2) at depth (in m below the surface) was calculated from the measurements given in Table 2 and interpolated to stratigraphic horizons; for the 1981 cores, the measured load was calculated from integrated densities given in Table A1. The last column gives the accumulation rate calculated using the linear regression for load at depth. Accumulation values in italics are suspect because of the measured density profile, as explained in the text.
[b]Using densities measured in core L1.

TABLE 6

Comparison between Accumulation Rates (in cm of water equivalent per year) Reported by Whillans et al. (1987) and Revised Values Given in Table 5[a]

Core	Year	Stratum	Depth	Load lab	Accum. W87	Load field	Accum. W87	Accum. revised
LC (1001)	1980	1955	16.1	11329	45.3			34.6[b]
LQ (1005)	1980	1956	16.9	13107	54.6			38.4[b]
L1 (1001)	1981	1952	18.8	13556	46.7	12640	43.6	34.1
L2 (12.18)	1981	1961	17.0	10062	50.3	9010	45.1	48.5
L5 (15.12)	1981	1956	15.8	12093	48.4	12620	50.5	37.5
UC (2001)	1980	1959	14.8	7932	37.8			38.3[b]
UX (2002)	1980	1959	14.7	7681	36.6			36.1[b]
U3 (2003)	1981	1961	14.8	7769	38.8	7622	38.1	40.7
U4 (2004)	1981	1961	14.5	7893	39.5	7033	35.2	37.2
UQ (2005)	1980	1955	17.1	9074	36.3			36.9[b]
U6 (2006)	1981	1961	14.1	7712	38.6	6980	34.9	35.6
U7 (2007)	1981	1961	14.3	7384	36.9	7386	36.9	35.7
D5 (3005)	1980	1959	18.5	9728	46.3			47.3[b]
D7 (3007)	1980	1958	17.4	8991	40.9			43.2[b]
8D (3008)	1981	1961	15.1	8225	41.1	7747	38.7	38.8

[a]Revised values are given in the last column and represent the average of the accumulation rate estimated from the ß- and oxygen isotope horizons given in Table 5. Values from Whillans et al. (1987) in italics are suspect as explained in the text.
[b]Value for deepest stratum.

described by a Gaussian probability distribution, the corresponding standard deviation of the timing of each stratigraphic horizon is approximately one month. Thus, because annual values are determined as the depth difference between two consecutive peaks or troughs, the standard deviation of the length of accumulation years is 1.4 months. For an average accumulation rate of 25 cm water equivalent per year, the standard deviation from measurement error is then 3 cm water equivalent per year (Van der Veen and Bolzan, 1999).

The time series of annual accumulation rate do not show a persistent trend over the interval 1964–1987 common to the nine cores (Bolzan and Strobel, 1994). Van der Veen and Bolzan (1999) analyzed these time series to separate the effects of spatial noise and interannual fluctuations in snowfall on the variability observed in the annual time series. That study concluded that for the Summit region, spatial noise and interannual fluctuations are equally important, with standard deviations of ~25 cm water equivalent per year.

Comparison with Recent Accumulation Studies

Bales et al. (2001) present the most recent map of Greenland accumulation, based on some 288 point measurements of accumulation rates, including values reported in

TABLE 7

Annual Accumulation Rate (in cm water equivalent per year) for the 1987 Summit Cores[a] and for the Nine Sites South of the Summit Cluster[b]

Site	Accumulation	Uncertainty	Period
13	21.1	1.7	1959-1987
15	16.3	1.2	1959-1987
31	26.2	1.0	1959-1987
37	18.1	0.6	1959-1987
Summit	22.7	0.9	1959-1987
51	27.4	1.1	1959-1987
57	21.4	1.2	1964-1987
571	18.5	0.8	1959-1987
73	24.9	0.9	1959-1987
A	28.2		1943-1973
B	30.0		1943-1973
C	31.2		1943-1973
D	33.5		1943-1973
E	20.6		1943-1973
F	21.7		1943-1973
G	23.0		1943-1973
H	25.4		1943-1973
Crete	27.3		1943-1973

[a]From Bolzan and Strobel (1994).
[b]Shown in Figure 11 (from Clausen et al., 1988).

Whillans et al. (1987) and Bolzan and Strobel (1994). These measurements are distributed irregularly over the ice sheet and to construct a map of accumulation distribution Bales et al. (2001) applied kriging to interpolate values to a regular grid. This procedure remains faithful to the data in a least-squares sense so that predicted values obtained by reinterpolating grid values back to measurement sites need not be the same as the original measurements. A comparison between measured and predicted accumulation rates is shown in Figure 14 (left panel) and Table 10. For the Summit cluster, differences between measurements and values predicted from kriging are small. For the three southern clusters, differences are greater, with core LQ (station 1005) an apparent outlier if the values given in Whillans et al. (1987) are used. Using the revised accumulation values obtained in this study removes this outlier, but otherwise does not significantly reduce the differences. For the Central cluster, the average difference is ~2 cm water equivalent per year with measured values consistently lower than those predicted from kriging, except for core U3 (station 2003). For the Western cluster, revised values derived here are significantly lower than predicted by Bales et al. (2001) while the values reported by Whillans et al.

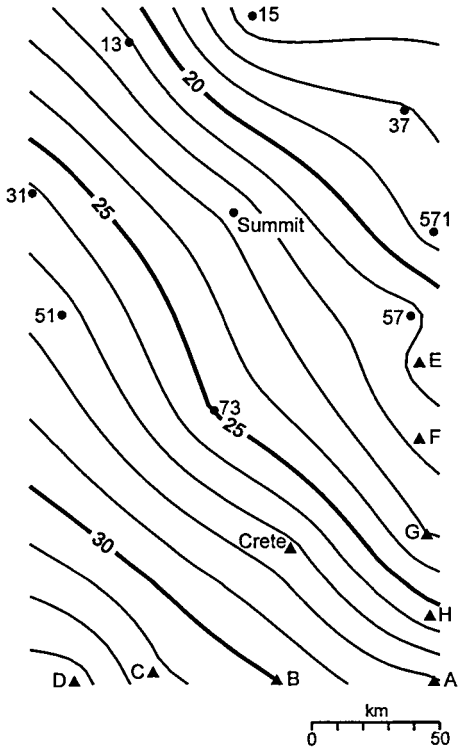


Fig. 11. Contours of constant accumulation rate (interval: 1 cm of water equivalent per year) in the Summit region obtained from gridding using the average accumulation rates given in Table 7.

(1987) are significantly higher than predicted. The likely reason for this is that the higher values from Whillans et al. (1987) were used in the compilation of the map, which thus may overestimate accumulation in this region. For the Dye-3 cluster, accumulation at site 3005 (core D5) is significantly greater than predicted. There are no independent determinations of accumulation rates near the southern clusters that can be used to evaluate whether the revised values obtained here are more realistic than those reported in Whillans et al. (1987).

In the kriging procedure, grid values are estimated from surrounding measurements, with greater weight given to measurements close to the grid point. Thus, a systematic bias in the measurements may be difficult to detect using a comparison as given above. Another possibility for evaluating the data is to compare these to the large-scale trend surface in accumulation rate. Van der Veen et al. (2001) applied multivariate regression methods to the same 288 accumulation measurements to evaluate the important factors that describe the current distribution of accumulation. Predictor values considered in the regressions are geographical coordinates (latitude and longitude) and three independent factors or principal components describing the geometry of the ice sheet. While the geometry of the ice sheet can be characterized by elevation of the surface, and surface slopes in the north and east directions, these variables are not independent. Therefore, Van der Veen et al. (2001) calculated three mutually orthogonal principal components to eliminate correlations among these three predictor

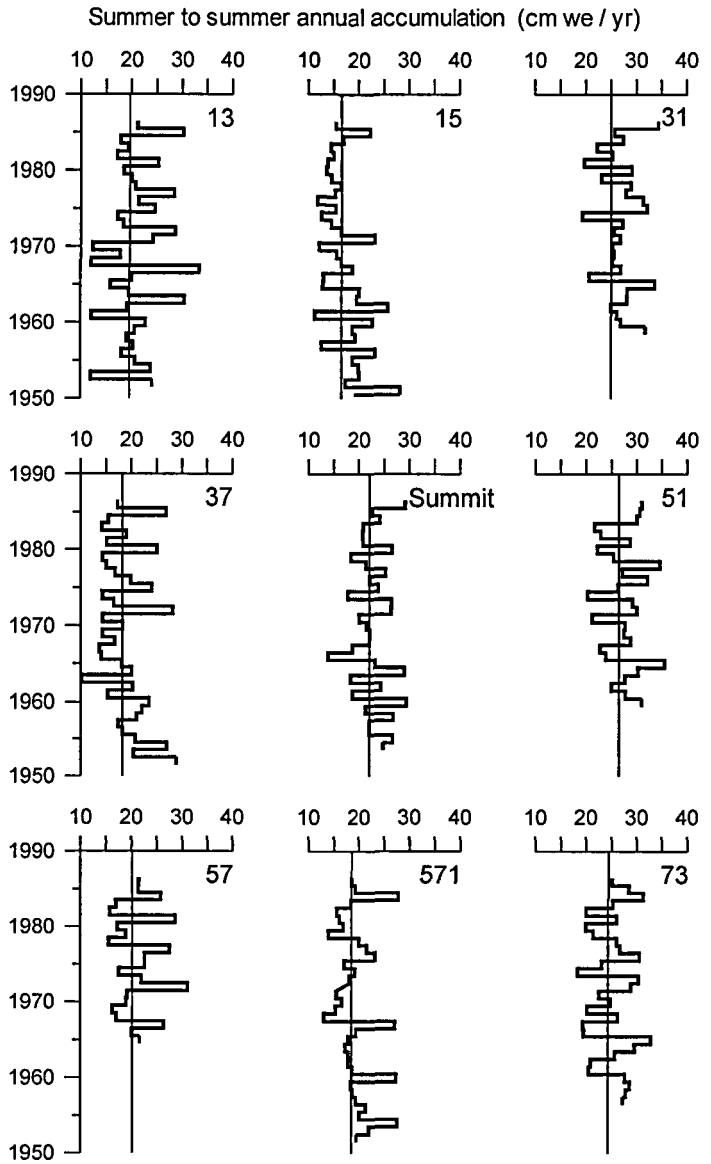


Fig. 12. Annual values of accumulation rate for the nine Summit cores determined from the thickness between successive summer peaks in oxygen isotope values.

variables. The results indicate that 80% of the variance in the data is explained by the regression model. That is, most of the spatial distribution of accumulation can be explained by the large-scale atmospheric circulation over the ice sheet and orographic forcing near the margins where surface slopes are large. It should be noted that, while the study of Van der Veen et al. (2001) also included accumulation values from Whillans et al. (1987), these values have only a small effect on the derived trend surface because all data points are given equal weight in multivariate regression. Thus,

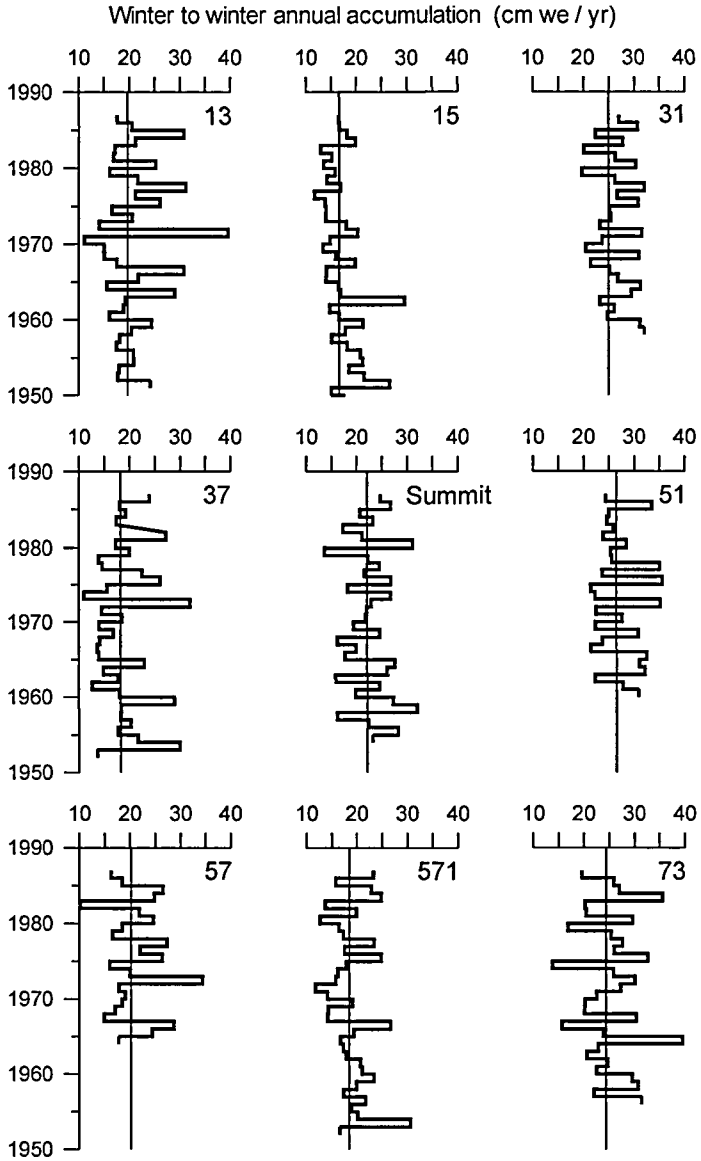


Fig. 13. Annual values of accumulation rate for the nine Summit cores determined from the thickness between successive winter troughs in oxygen isotope values.

comparison of the cluster accumulation rates with the trend surface may provide a less biased test than comparison with accumulation predicted by Bales et al. (2001).

The right panel in Figure 14 shows the comparison between measured accumulation rates and values predicted from the trend surface analysis. For the Summit cluster, the differences between measurements and values predicted from the statistical model are greater than differences between measurements and predictions from kriging. This was to be expected, because the trend surface describes the large-scale

TABLE 8

Annual Values of Accumulation Rate (in cm of water equivalent per year) for the Nine Summit Cores[a]

Year	13	15	31	37	Summit	51	57	571	73
1986	21.1	15.5	34.4	17.3	29.2	31.0	21.5	18.6	25.1
1985	30.2	22.2	25.7	26.8	22.7	30.6	21.4	19.4	28.4
1984	17.9	16.9	27.3	15.5	24.1	30.0	25.9	27.9	31.2
1983	19.3	14.5	22.2	14.2	20.9	21.6	17.0	18.4	25.3
1982	17.2	15.0	25.2	19.0	20.7	22.8	15.8	15.7	20.1
1981	25.3	13.8	19.7	15.1	20.8	28.7	28.7	16.1	26.1
1980	18.5	13.6	29.1	25.0	26.5	22.2	17.3	16.9	20.0
1979	20.0	14.5	23.0	14.3	18.4	25.4	19.0	14.0	21.5
1978	20.8	16.5	28.9	15.0	21.4	34.6	15.6	20.0	26.1
1977	28.4	15.3	27.9	16.8	25.3	27.1	27.6	21.6	26.7
1976	21.4	11.8	31.3	19.9	22.1	32.1	22.7	23.3	30.5
1975	24.6	15.4	32.1	24.0	23.8	26.3	22.7	17.1	23.2
1974	17.3	12.6	19.3	14.3	17.7	20.3	17.6	19.3	18.4
1973	18.4	14.5	27.2	16.5	26.4	29.1	22.0	18.1	30.4
1972	28.6	16.5	25.5	28.1	26.4	30.0	31.1	9.1	28.9
1971	24.2	23.1	26.7	14.4	20.1	21.2	19.3	15.5	22.6
1970	12.4	12.1	25.2	18.3	21.6	27.6	19.0	16.6	24.9
1969	17.7	15.5	25.4	14.3	22.1	27.4	16.3	15.4	20.3
1968	12.1	16.4	25.1	16.7	22.1	28.7	17.1	13.1	26.3
1967	33.3	18.6	26.7	13.7	18.6	22.8	26.4	27.1	19.4
1966	20.1	12.9	20.6	14.1	13.8	23.9	20.2	19.5	19.6
1965	15.9	12.8	33.5	18.1	23.2	35.5	21.6	17.9	32.8
1964	19.5	20.1	28.0	20.1	29.0	30.2		17.3	29.6
1963	30.5	19.6	28.0	10.2	18.4	27.6		17.9	25.7
1962	19.2	25.8	24.8	20.2	24.3	25.0		17.9	20.9
1961	12.2	11.3	25.9	15.3	18.7	27.7		18.6	20.5
1960	22.8	22.7	26.8	23.5	29.4	30.9		27.4	27.6
1959	20.7	18.7	31.7	22.1	21.4			18.4	28.6
1958	19.1	19.3		21.0	26.8			18.7	27.9
1957	20.3	12.6		17.4	22.1			19.5	27.3
1956	18.0	23.2		18.2	22.1			21.4	
1955	20.7	18.7		20.8	26.7			20.1	
1954	23.8	20.0		27.0	24.8			27.6	

(*table continues*)

TABLE 8 (Continued)

Year	13	15	31	37	Summit	51	57	571	73
1953	12.0	20.1		20.4				22.1	
1952	24.1	17.3		28.8				19.5	
1951		28.2							
1950		19.1							
1949		16.4							
1948		13.5							
1947		25.5							
1946		18.8							
Average	20.8	17.3	26.7	18.8	22.8	27.4	21.2	19.1	25.2
St. dev.	5.2	4.1	3.8	4.6	3.6	4.0	4.4	4.1	4.1

[a]Determined from the thickness between successive summer peaks in oxygen isotope values. Accumulation for year 1985 refers to the accumulation year from the summer of 1984 to the summer of 1985.

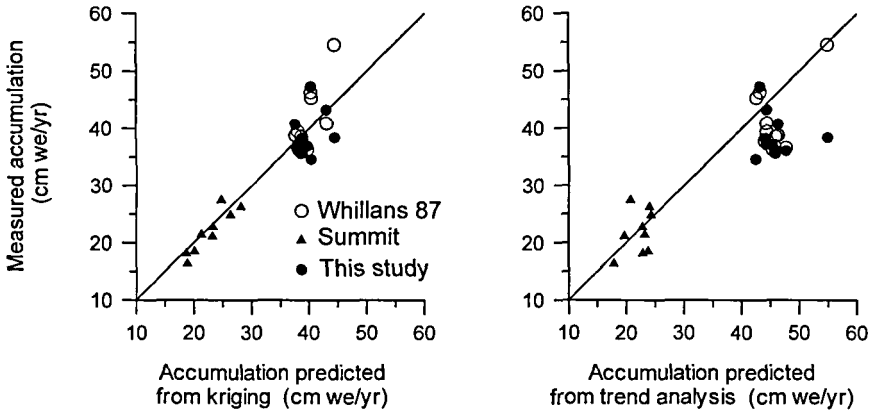


Fig. 14. Comparison between measured accumulation rates and values predicted by kriging (panel on the left) and predicted by trend surface analysis (right panel). Measured values are from Whillans et al. (1987) and Bolzan and Strobel (1994), and those obtained in this study. Predictions from kriging are based on the map compiled by Bales et al. (2001), whereas predictions from trend analysis are based on the multivariate regression analysis of Van der Veen et al. (2001).

distribution of accumulation, and does not include local variations associated with local topography or other effects, whereas kriging remains more faithful to such local variations. However, there is no systematic bias between the Summit measurements and predictions from trend analysis. For the southern clusters, on the other hand, a bias is obvious from Figure 14, with measurements consistently lower than predicted by the trend surface. This may indicate that significant core loss occurred during the 1980 and 1981 drilling. Whillans et al. (1987) did not report on the core quality retrieved, nor did they mention whether any corrections were made to account for core loss. Considering that the correction procedure of Whillans and Bolzan (1988) was

TABLE 9

Annual Accumulation Rate (in cm of water equivalent per year) for the Nine Summit Cores[a]

Year	13	15	31	37	Summit	51	57	571	73
1986	17.6	16.4	27.0	23.9	24.7	24.4	16.3	23.3	19.6
1985	20.4	16.6	30.6	18.1	26.7	33.5	18.5	15.8	25.9
1984	30.7	18.1	22.4	19.2	20.7	25.0	26.5	22.9	27.0
1983	21.2	19.8	27.7	17.4	23.2	24.6	24.8	24.8	35.5
1982	17.2	12.9	20.0	9.5	17.3	25.8	10.2	13.7	20.2
1981	16.9	15.1	26.2	27.2	21.1	23.9	21.8	19.9	20.4
1980	25.2	13.5	30.3	17.3	31.1	28.4	24.6	12.7	29.6
1979	16.1	15.7	19.6	19.9	13.6	25.4	18.5	16.4	16.9
1978	21.6	14.1	26.1	13.9	22.3	25.6	16.6	17.3	25.4
1977	31.2	16.8	32.0	14.6	24.5	35.0	27.3	23.4	27.6
1976	21.2	11.7	26.7	22.5	21.6	23.7	22.0	17.6	26.0
1975	26.0	13.8	30.8	26.0	26.8	35.6	26.4	24.8	32.6
1974	16.5	13.9	25.1	15.6	18.3	21.4	16.0	18.0	13.8
1973	20.5	13.9	25.4	11.0	26.7	22.3	20.0	16.2	25.8
1972	14.1	18.0	23.3	31.9	22.9	35.2	34.4	15.8	30.0
1971	39.6	20.3	31.5	14.5	22.0	22.5	17.8	11.7	27.2
1970	11.1	14.8	23.7	18.6	21.8	27.6	19.1	14.1	22.5
1969	15.0	13.4	20.5	14.0	19.4	22.3	18.5	19.1	20.3
1968	15.1	15.9	30.9	16.8	24.6	30.8	17.0	14.3	20.1
1967	17.5	19.8	21.4	14.1	16.2	23.7	15.0	14.2	30.3
1966	30.8	14.0	25.2	13.6	19.9	21.4	28.7	26.7	15.7
1965	21.7	14.0	26.8	13.9	17.8	32.4	24.4	19.4	23.8
1964	15.6	16.5	31.2	22.9	27.6	31.0	17.8	16.7	39.5
1963	29.0	16.8	29.4	14.9	26.1	32.1		17.3	22.8
1962	19.3	29.5	23.3	17.7	15.8	22.2		17.9	20.6
1961	18.8	14.7	26.1	12.7	24.5	27.7		20.7	24.7
1960	16.0	16.5	24.8	18.1	19.8	30.8		21.1	22.6
1959	24.4	21.3	31.1	28.8	27.2			23.4	29.5
1958	20.4	17.8	32.0	18.3	31.9			20.0	30.7
1957	18.1	15.1		18.2	16.1			17.4	22.0
1956	17.5	18.2		20.2	22.3			21.7	31.4
1955	20.8	20.8		17.7	28.2			19.0	
1954	20.8	21.3		21.6	23.2			20.2	

(*table continues*)

TABLE 9 (Continued)

Year	13	15	31	37	Summit	51	57	571	73
1953	18.0	18.6		29.9				30.6	
1952	17.7	21.6		13.6				16.6	
1951	24.1	26.5							
1950		15.0							
1949		17.8							
1948		21.7							
1947		11.2							
1946		28.0							
1945		16.1							
Average	20.8	17.3	26.6	18.5	22.6	27.2	21.0	19.0	25.2
St. dev.	5.8	4.1	3.8	5.4	4.4	4.6	5.5	4.2	5.8

[a]Determined from the thickness between successive winter troughs in oxygen isotope values. Years refer to calendar years.

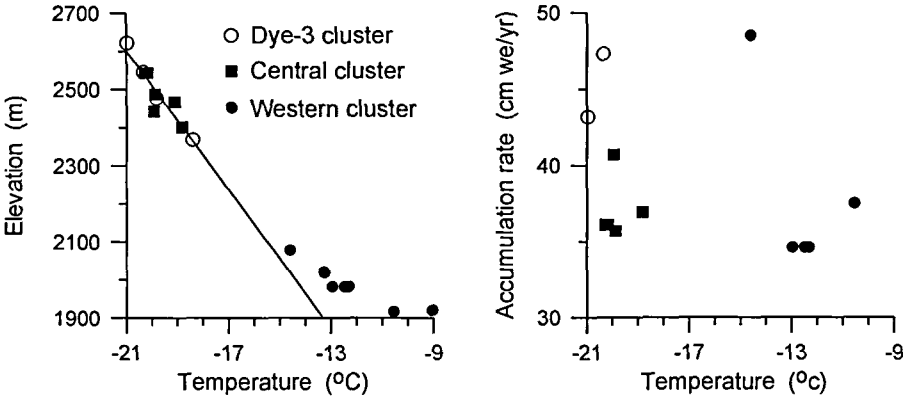


Fig. 15. Relation between firn temperature and elevation (left panel) and long-term accumulation rate (right panel) in the southern clusters. The sloped line in the left panel corresponds to a lapse rate of 1°C per 100 m.

not developed until several years after accumulation rates for the southern clusters were calculated, it appears unlikely that such corrections were made. A core loss of about 10% would bring the inferred accumulation values close to the values predicted from multivariate regression.

FIRN TEMPERATURE

At selected sites in the southern clusters, firn temperature was measured by thermistor, mostly in hot-point drilled boreholes, after hole equilibration (~8 days or longer; Whillans et al., 1987). Repeatability of the measurements was about 0.01°C, but local variation was at least 0.1°C, evident from temperatures obtained at different

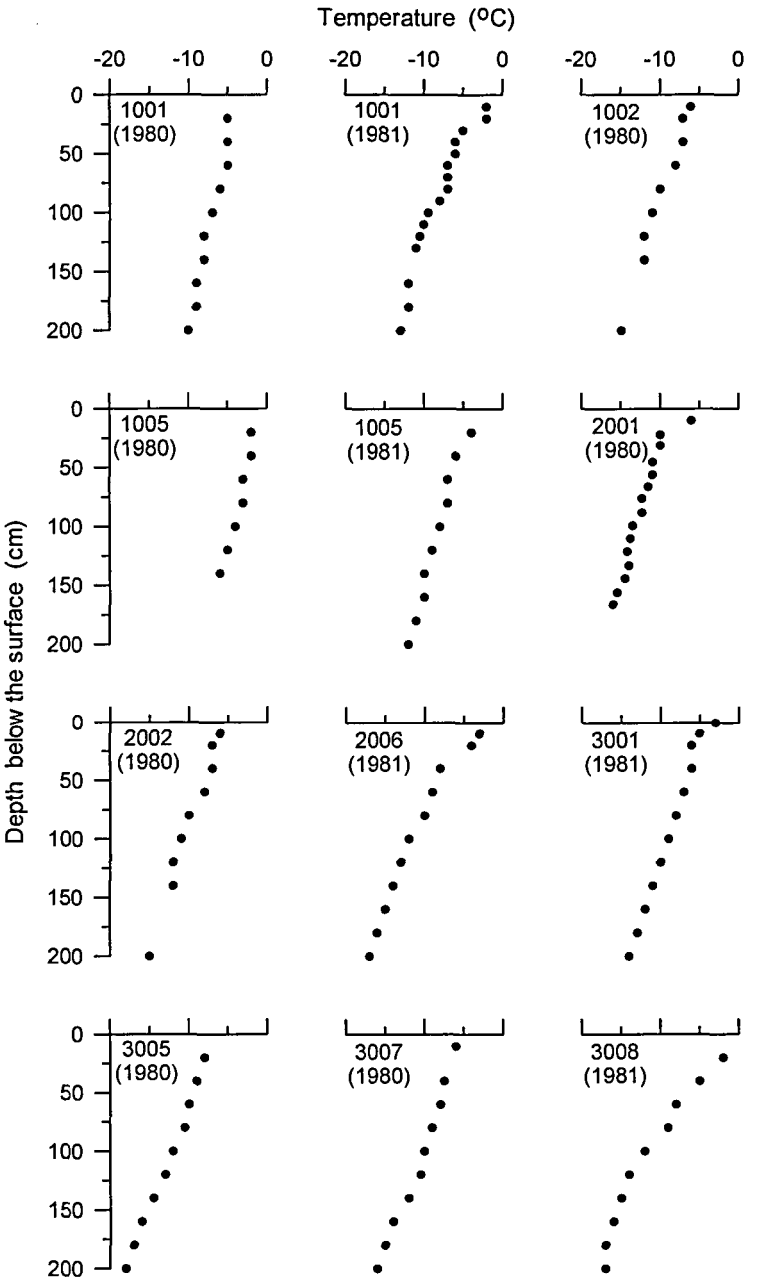


Fig. 16. Near-surface firn temperature profiles measured in snow pits in the southern clusters.

depths in the same borehole, or in neighboring holes. The hot-point holes have a diameter of 2–3 cm, depending on the drill used, and the wall of the hole is sealed with refrozen melt. Temperatures measured in these holes are more reliable than those measured in hand-augered holes because of air movement along the hole or into or out

TABLE 10

Comparison between Measured and Predicted Accumulation Rates (in cm water equivalent per year)[a]

Station	Value used in prediction	This study	Predicted from kriging	Predicted from trend analysis
1001	45.3	34.6	40.4	42.5
1005	54.6	38.4	44.4	54.9
2001	37.8	38.3	38.7	44.0
2002	36.6	36.1	38.1	47.7
2003	38.8	40.7	37.6	46.3
2004	39.5	37.2	38.0	44.3
2005	36.3	36.9	39.7	45.4
2006	38.6	35.6	38.6	45.9
2007	36.9	35.7	38.9	45.7
3005	46.3	47.3	40.3	43.1
3007	40.9	43.2	43.0	44.3
13	21.1		23.2	19.7
15	16.3		18.9	17.9
31	26.2		28.1	24.0
37	18.1		18.7	22.9
Summit	22.7		23.3	22.8
51	27.4		24.7	20.7
57	21.4		21.3	23.2
571	18.5		20.1	23.8
73	24.8		26.3	24.3

[a]Values in the second column are from Whillans et al. (1987) and Bolzan and Strobel (1994), while values in the third column correspond to the revised values obtained in this study. Predictions from kriging are based on the map compiled by Bales et al. (2001) while predictions from trend analysis are based on the multivariate regression analysis of Van der Veen et al. (2001).

of the firn as well as the fact that convection in the hole is less of a problem in the narrower hot-point holes (Whillans et al., 1987). Temperatures are given in Table 11. An asterisk next to the depth indicates measurements in a hand-augered hole. The depth of the hole at station 3001 was not measured but was almost certainly 9 m according to Whillans et al. (1987). Note that Whillans et al. (1987) reported two temperature measurements for station 2002, with one reaching a depth of 45.5 meters and supposedly hand-augered. Whether or not this was the case or whether a hotpoint drill was used to reach this depth, or whether the reported depth is wrong, cannot be determined from the available records. In any case, there was no core recovered to this depth.

TABLE 11

Firn Temperatures Measured at Selected Sites of the Southern Clusters[a]

Station	Depth (m)	Temperature (°C)	Elevation (m)	Accum (cm we/yr)
		Western Cluster		
1001	11	-12.95	1983	34.6
	15	-12.48		
	24	-12.31		
12.08	27.8	-13.26	2020	
12.18	19*	-14.60	2078	48.5
15.13	16	-10.55	1917	37.5
15.16	21*	-9.04	1920	
		Central Cluster		
2002	45.5	-20.29	2543	36.1
	17	-20.17		
2003	14*	-19.93	2443	40.7
14.17	17.3	-19.11	2467	
2005	16.5	-18.82	2401	36.9
2007	17	-19.87	2487	35.7
		Dye-3 Cluster		
3001	9	-18.408	2369	
3003	18	-19.818	2477	
3005	17	-20.353	2546	47.3
3007	17	-20.977	2622	43.2

[a]Temperatures were measured in hot-point drilled boreholes except at stations 12.18, 15.16, and 2003, where measurements were taken in the hand-augered hole.
Source: From Whillans et al., 1987.

The plot of temperature versus elevation (Figure 15, left panel) suggests a lapse rate of about 1°C per 100 m at elevations greater than 2200 m. At lower elevations in the Western cluster, firn temperatures are significantly warmer than predicted by this lapse rate, possibly because of warming of the firn at depth by percolating meltwater (Whillans et al., 1987). There is no clear correlation between firn temperature and average accumulation rate (Fig. 15, right panel).

In addition to temperatures at depth, near-surface temperature profiles were measured in the snow pits from the floor of which the firn cores were drilled. It is not known what instrument was used and what the precision of these measurements is, nor is the exact date of the observations known. The dates given in Table 12 correspond to the dates of occupancy of the camp at each cluster. Whereas the deeper temperatures are a good indicator of the annual-mean air temperature, the near-surface

TABLE 12

Near-Surface Firn Temperatures Measured in Snow Pits in the Southern Clusters

Western Cluster					
Site:	1001	1001	1002	1005	1005
Date:	June 19 - 27 1980	June 10 - 27 1981	June 19 - 27 1980	June 19 - 27 1980	June 10 - 27 1981
Depth (cm)	T (°C)	T (°C)	T (°C)	T (°C)	T (°C)
10		-2	-6		
20	-5	-2	-7	-2	-4
30		-5			
40	-5	-6	-7	-2	-6
50		-6			
60	-5	-7	-8	-3	-7
70		-7			
80	-6	-7	-10	-3	-7
90		-8			
100	-7	-9.5	-11	-4	-8
110		-10			
120	-8	-10.5	-12	-5	-9
130		-11			
140	-8		-12	-6	-10
160	-9	-12			-10
180	-9	-12			-11
200	-10	-13	-15		-12

Central Cluster				
Site:	2001		2002	2006
Date:	July 3 - 13 1980		July 3 - 13 1980	July 2 - 20 1981
Depth (cm)	T (°C)	Depth (cm)	T (°C)	T (°C)
10	-6	10	-6	-3
22	-10	20	-7	-4
31	-10	40	-7	-8
45	-11	60	-8	-9
56	-11	80	-10	-10
66	-11.5	100	-11	-12
76	-12.3	120	-12	-13
88	-12.3	140	-12	-14
99	-13.5	160		-15
110	-13.8	180		-16
121	-14.2	200	-15	-17

(table continues)

TABLE 12 (Continued)

Central Cluster				
Site:	2001		2002	2006
Date:	July 3 - 13		July 3 - 13	July 2 - 20
	1980		1980	1981
Depth (cm)	T (°C)	Depth (cm)	T (°C)	T (°C)
133	-14			
144	-14.5			
156	-15.5			
166	-16			

Dye-3 Cluster				
Site:	3001	3005	3007	3008
Date:	July 22 - Aug 3	July 15 - Aug 4	July 15 - Aug 4	July 22 - Aug 3
	1981	1980	1980	1981
Depth (cm)	T (°C)	T (°C)	T (°C)	T (°C)
0	-3			
10	-5		-6	
20	-6	-8		-2
40	-6	-9	-7.5	-5
60	-7	-10	-8	-8
80	-8	-10.5	-9	-9
100	-9	-12	-10	-12
120	-10	-13	-10.5	-14
140	-11	-14.5	-12	-15
160	-12	-16	-14	-16
180	-13	-17	-15	-17
200	-14	-18	-16	-17

profiles shown in Figure 16 reflect seasonal variations resulting from the annual cycles in insolation and air temperature.

CONCLUDING REMARKS

Often, only derived final results from glaciological investigations are presented without full disclosure of the raw data. While this does not necessarily lessen the value of these results, it does prevent other researchers from reevaluating the original data. The revised accumulation values for the southern clusters presented here illustrate the need for access to actual measurements, in this case, density and oxygen-isotope profiles. For the southern clusters, we have reevaluated these profiles and derived "revised accumulation rates" that in many cases are quite different from those reported by Whillans et al. (1987). Now that we have presented all the available raw data, reevaluated them, and calculated revised accumulation rates, other researchers should be able to use the results with greater confidence. Those who have relied upon

the original accumulation data may wish to reevaluate their results in light of the revised information presented in this report.

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TABLE A1

Density (kg/m^3) at Depth (m) below the Surface Measured on Samples from the 1981 Cores[a]

L1 (1001)		L2 (12.18)		L5 (15.12)		U3 (2003)		U4 (2004)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
2.10	372	1.99	539	2.11	493	2.12	430	2.10	413	2.08	463	2.12	485	0.09	604	2.09	376
2.21	536	2.09	492	2.22	484	2.21	452	2.21	399	2.17	758	2.22	474	0.19	655	2.16	388
2.35	636	2.20	328	2.32	498	2.32	461	2.31	474	2.86	496	2.37	432	0.29	491	2.26	439
2.45	600	2.30	407	2.41	650	2.41	459	2.45	445	2.96	514	2.48	428	0.40	496	2.35	468
2.53	464	2.39	536	2.51	588	2.53	493	2.53	465	3.06	464	2.55	429	0.51	558	2.46	458
2.68	688	2.50	479	2.61	685	2.62	516	2.63	543	3.16	522	2.69	446	0.61	546	2.56	449
2.83	624	2.60	490	2.71	562	2.72	427	2.73	452	3.36	561	2.82	347	0.69	395	2.63	433
2.94	644	2.70	505	2.83	593	2.82	483	2.81	433	3.76	458	2.92	467	0.80	465	2.72	431
3.03	672	2.80	487	2.86	754	2.89	516	3.01	510	3.89	496	3.02	503	0.89	503	2.83	414
3.14	500	2.91	435	2.89	507	3.00	523	3.09	530	4.09	473	3.10	450	1.00	446	2.93	434
3.21	592	3.02	483	3.00	809	3.32	409	3.19	558	4.17	516	3.21	495	1.09	381	3.01	383
3.35	564	3.10	740	3.05	451	3.41	485	3.29	451	4.41	478	3.35	450	1.20	447	3.09	483
3.48	728	3.21	681	3.23	864	3.52	459	3.41	527	4.51	460	3.45	485	1.30	502	3.20	457
3.62	696	3.30	658	3.28	829	3.62	452	3.53	445	4.74	519	3.53	371	1.38	492	3.29	507
3.72	1032	3.40	893	3.39	958	3.72	430	3.77	706	4.93	471	3.62	381	1.50	430	3.40	480
3.83	960	3.50	644	3.48	897	3.82	497	3.87	529	5.09	480	3.76	466	1.61	518	3.49	502
3.91	568	3.61	622	3.57	542	3.93	491	3.97	565	5.20	490	3.87	456	1.71	459	3.62	523
4.04	456	3.72	667	3.67	473	4.03	468	4.08	425	5.30	494	3.97	499	1.80	657	3.71	453
4.17	540	3.81	577	3.74	438	4.10	445	4.18	445	5.35	613	4.08	445	1.89	547	3.82	402
4.28	564	3.91	705	3.84	582	4.21	409	4.33	429	5.45	503	4.23	448	2.01	806	3.92	452
4.39	660	4.03	581	3.90	656	4.29	420	4.43	556	5.50	618	4.27	431	2.11	504	4.02	498
4.51	852	4.12	509	3.97	776	4.40	600	4.52	560	5.60	575	4.37	413	2.22	568	4.14	477
4.61	624	4.23	474	4.06	508	4.45	423	4.61	469	5.69	609	4.51	435	2.32	576	4.24	487

4.70	944	4.34	414	4.16	767	4.57	549	4.66	485	5.90	460	4.58	494	2.42	536	4.36	492
4.80	664	4.42	596	4.27	938	4.67	409	4.76	503	6.01	490	4.68	452	2.52	492	4.46	517
4.90	608	4.52	566	4.36	892	4.79	464	4.86	561	6.10	529	4.78	486	2.64	436	4.53	568
4.97	652	4.63	544	4.42	948	4.90	470	4.96	452	6.20	499	4.88	489	2.74	408	4.58	641
5.06	656	4.71	854	4.53	603	5.00	502	5.07	564	6.34	471	4.98	516	2.88	444	4.71	637
5.15	568	4.77	310	4.63	553	5.07	494	5.17	471	6.44	467	5.02	460	2.97	468	4.82	735
5.22	552	4.89	518	4.74	959	5.15	504	5.21	465	6.55	480	5.11	462	3.08	476	4.91	658
5.34	912	4.97	900	4.82	910	5.24	527	5.32	608	6.78	961	5.20	516	3.18	540	5.01	705
5.44	796	5.07	474	4.91	972	5.33	459	5.45	633	6.84	583	5.32	489	3.28	536	5.10	641
5.52	608	5.17	605	5.02	883	5.40	538	5.50	526	6.95	492	5.43	485	3.38	492	5.20	632
5.61	640	5.27	530	5.10	903	5.52	491	5.61	752	7.15	580	5.54	423	3.44	556	5.29	561
5.75	704	5.39	607	5.17	624	5.62	519	5.73	704	7.28	629	5.64	485	3.55	536	5.39	562
5.85	996	5.49	641	5.28	961	5.73	517	5.84	770	7.37	589	5.70	486	3.66	556	5.46	631
5.98	564	5.59	605	5.38	623	5.86	514	5.94	677	7.48	493	5.79	498	3.76	568	5.54	564
6.11	932	5.69	477	5.46	383	5.99	615	5.99	883	7.58	519	5.89	423	3.86	604	5.63	543
6.21	636	5.75	534	5.53	424	6.02	691	6.09	474	7.68	554	5.99	499	3.96	584	5.74	494
6.33	452	5.86	558	5.64	889	6.13	665	6.20	653	7.80	697	6.10	489	4.06	504	5.85	492
6.43	488	5.96	657	5.73	911	6.23	468	6.30	648	7.90	517	6.18	471	4.15	496	5.92	544
6.52	468	6.06	636	5.82	971	6.32	611	6.39	695	7.98	513	6.25	484	4.27	464	6.02	520
6.63	436	6.16	501	5.93	895	6.44	551	6.53	696	8.05	629	6.35	501	4.36	472	6.12	520
6.75	512	6.26	706	6.04	922	6.55	530	6.62	733	8.17	677	6.43	508	4.46	526	6.24	564
6.89	920	6.36	581	6.11	953	6.66	541	6.72	480	8.26	632	6.53	459	4.55	508	6.33	542
7.05	568	6.47	673	6.21	926	6.76	474	6.79	501	8.40	557	6.63	469	4.65	532	6.43	490
7.16	700	6.56	608	6.29	965	6.84	516	6.88	540	8.50	575	6.73	485	4.75	508	6.57	576
7.27	636	6.66	703	6.37	990	6.89	543	6.98	504	8.61	561	6.84	524	4.81	545	6.67	535
7.35	800	6.77	565	6.48	919	7.00	530	7.08	568	8.71	585	6.95	583	4.93	422	6.78	533
7.48	888	6.88	846	6.57	704	7.10	465	7.13	717	8.76	538	7.05	635	5.02	516	6.87	684
7.51	984	7.02	491	6.66	551	7.20	536	7.23	594	8.99	535	7.12	518	5.12	520	6.97	517
7.58	436	7.12	540	6.77	811	7.27	559	7.34	514	9.11	641	7.22	533	5.21	565	7.08	496

(table continues)

TABLE A1 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U3 (2003)		U4 (2004)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
7.69	576	7.23	650	6.84	892	7.37	539	7.44	535	9.32	606	7.34	567	5.31	576	7.15	559
7.82	692	7.33	555	6.88	933	7.47	541	7.54	609	9.53	561	7.43	481	5.40	580	7.23	549
7.92	681	7.40	424	6.96	856	7.57	507	7.65	542	9.68	487	7.53	534	5.47	596	7.38	536
8.03	904	7.50	485	7.06	565	7.66	521	7.76	534	9.77	559	7.64	534	5.56	588	7.48	545
8.14	494	7.60	506	7.17	532	7.77	487	7.89	553	9.88	547	7.75	521	5.65	592	7.58	571
8.25	609	7.70	752	7.23	670	7.87	595	8.00	701	10.07	611	7.85	554	5.75	588	7.69	575
8.34	623	7.79	547	7.33	745	7.97	571	8.06	652	10.18	549	7.95	553	5.85	572	7.78	576
8.45	515	7.89	713	7.43	607	8.08	539	8.13	511	10.28	531	8.05	539	5.95	580	7.89	559
8.56	545	7.98	512	7.53	844	8.18	541	8.21	536	10.35	595	8.10	516	5.99	496	7.99	609
8.67	881	8.08	533	7.63	852	8.28	559	8.30	579	10.49	749	8.21	499	6.10	516	8.09	552
8.73	1155	8.22	528	7.75	908	8.37	532	8.41	560	10.65	601	8.30	560	6.20	540	8.19	566
8.85	522	8.32	485	7.85	962	8.50	527	8.52	534	10.74	543	8.41	612	6.29	536	8.29	564
8.92	770	8.41	504	7.95	540	8.66	500	8.62	573	10.82	563	8.48	660	6.40	536	8.39	558
8.97	814	8.50	573	8.02	483	8.75	604	8.71	512	10.92	572	8.58	688	6.52	544	8.54	575
9.08	1007	8.61	572	8.13	572	8.81	524	8.80	541	11.03	567	8.68	548	6.61	512	8.64	578
9.15	1144	8.71	605	8.25	544	8.91	513	8.88	655	11.13	641	8.79	532	6.72	536	8.74	572
9.25	592	8.81	778	8.35	612	8.99	562	8.99	522	11.23	581	8.88	572	6.82	568	8.83	583
9.35	621	8.91	780	8.39	514	9.10	580	9.11	526	11.33	599	9.02	619	6.96	584	8.94	547
9.39	564	9.01	535	8.48	578	9.18	820	9.22	544	11.43	528	9.12	553	7.07	584	9.03	520
9.49	486	9.10	616	8.56	798	9.28	601	9.30	736	11.51	609	9.22	544	7.17	572	9.11	538
9.60	933	9.20	562	8.66	743	9.38	529	9.37	798	11.60	655	9.32	567	7.27	564	9.22	563
9.70	915	9.30	481	8.77	929	9.48	557	9.47	630	11.70	671	6.46	715	7.37	532	9.30	689
9.73	1182	9.41	546	8.87	963	9.55	552	9.58	598	11.87	682	9.57	494	7.48	540	9.43	597
9.84	572	9.48	524	8.97	887	9.65	572	9.66	520	11.93	814	9.68	556	7.55	572	9.55	630
9.94	611	9.58	544	9.07	917	9.76	613	9.74	576	12.04	647	9.74	591	7.64	616	9.65	585
10.06	794	9.70	696	9.11	970	9.90	600	9.84	564	12.14	630	9.85	652	7.74	632	9.76	528

10.10	829	9.81	508	9.21	915	10.00	633	9.95	571	12.22	503	10.03	540	7.84	532	9.81	641
10.19	706	9.91	566	9.31	981	10.10	515	10.05	581	12.33	595	10.13	578	7.95	556	9.92	554
10.29	601	10.01	519	9.42	922	10.21	557	10.18	556	12.40	896	10.23	614	7.99	568	10.02	561
10.38	887	10.15	509	9.52	853	10.33	563	10.25	709	12.54	669	10.33	587	8.10	524	10.12	572
10.50	677	10.27	613	9.62	856	10.45	564	10.35	520	12.63	669	10.48	590	8.19	556	10.21	620
10.62	641	10.39	555	9.72	499	10.56	556	10.46	530	12.72	641	10.58	582	8.29	592	10.27	860
10.80	744	10.50	655	9.76	470	10.66	607	10.57	561	12.83	590	10.68	542	8.43	576	10.36	706
10.91	622	10.57	916	9.83	481	10.76	556	10.68	580	12.91	572	10.90	551	8.51	604	10.47	609
10.98	816	10.64	557	9.93	824	10.86	566	10.78	572	13.11	609	11.00	579	8.61	620	10.59	551
11.38	1058	10.74	610	10.03	922	10.96	579	10.88	553	13.22	611	11.10	579	8.70	636	10.69	596
11.46	1000	10.83	549	10.13	965	11.06	578	10.97	570	13.31	684	11.20	574			10.80	567
11.54	1030	10.91	493	10.24	893	11.16	566	11.06	539	13.41	651	11.32	576			10.93	584
11.64	965	10.97	711	10.34	907	11.26	570	11.16	579	13.51	651	11.43	503			11.02	535
11.74	883	11.04	574	10.39	870	11.39	576	11.25	583	13.63	675	11.52	572			11.13	567
11.86	998	11.13	641	10.51	931	11.49	543	11.34	605	13.73	606	11.64	562			11.23	558
12.05	819	11.25	919	10.61	762	11.60	603	11.43	624	13.84	618	11.74	755			11.34	549
12.11	749	11.34	603	10.72	821	11.69	586	11.54	605	13.93	689	11.84	609			11.47	602
12.21	927	11.45	575	10.83	914	11.77	623	11.64	565	13.98	704	12.05	586			11.57	583
12.32	869	11.54	613	10.85	921	11.88	610	11.74	572	14.08	606	12.16	618			11.67	549
12.38	1083	11.58	727	10.95	880	11.99	594	11.84	545	14.20	641	12.25	595			11.76	596
12.49	622	11.70	634	11.05	928	12.14	602	11.94	595	14.28	778	12.35	643			11.88	603
12.59	602	11.80	605	11.15	877	12.27	580	12.05	641	14.37	532	12.45	597			11.99	576
12.71	595	11.89	639	11.25	923	12.38	615	12.10	689	14.47	599	12.67	570			12.09	609
12.79	681	11.99	601	11.35	910	12.45	636	12.20	705	14.57	625	12.77	646			12.19	590
12.86	1041	12.07	637	11.45	910	12.56	663	12.31	645	14.67	659	12.85	561			12.24	577
12.98	1094	12.21	679	11.54	874	12.65	666	12.44	568	14.83	609	12.96	572			12.34	623
13.09	1046	12.28	831	11.64	926	12.76	578	12.56	846	14.93	602	13.07	579			12.44	590
13.21	938	12.44	571	11.74	960	12.88	585	12.67	575	15.01	644	13.16	608			12.54	569
13.32	901	12.55	711	11.85	917	12.98	564	12.77	574			13.21	947			12.67	724

(table continues)

TABLE A1 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U3 (2003)		U4 (2004)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
13.43	979	12.64	671	11.95	912	13.08	601	12.86	577			13.31	615			12.76	684
13.49	1167	12.74	646	12.00	870	13.18	608	12.97	597			13.41	558			12.86	632
13.58	951	12.86	593	12.11	732	13.28	617	13.07	587			13.50	625			12.96	545
13.69	929	13.00	686	12.21	916	13.39	579	13.16	566			13.61	604			13.02	618
13.78	951	13.10	573	12.29	957	13.49	601	13.27	576			13.72	533			13.12	570
13.97	796	13.20	601	12.40	891	13.59	616	13.35	598			13.84	614			13.22	608
14.09	1005	13.30	578	12.50	955	13.70	604	13.46	596			13.94	618			13.31	600
14.19	1118	13.40	609	12.58	914	13.80	619	13.57	607			14.04	610			13.44	600
14.28	784	13.51	624	12.69	893	13.90	599	13.66	623			14.09	595			13.55	560
14.39	663	13.60	651	12.80	917	14.00	608	13.75	615			14.18	618			13.64	618
14.49	448	13.68	562	12.92	962	14.12	626	13.86	597			14.27	761			13.74	586
14.69	844	13.78	584	12.94	948	14.22	606	13.95	576			14.38	586			13.83	588
14.73	1030	13.87	636	13.04	892	14.32	618	14.06	601			14.51	629			13.93	606
14.95	615	13.96	624	13.14	892	14.44	634	14.16	631			14.61	589			14.03	633
15.03	693	14.06	581	13.22	803	14.54	640	14.27	609			14.71	717			14.12	582
15.13	691	14.12	623	13.32	900	14.64	641	14.38	599			14.78	671			14.22	636
15.24	652	14.22	913	13.35	891	14.74	651	14.47	609			14.88	595			14.31	639
15.34	631	14.31	643	13.44	976	14.80	623	14.57	627			14.97	615			14.42	606
15.46	645	14.36	778	13.54	904	14.90	616	14.67	609			15.05	595			14.53	630
15.57	911	14.44	666	13.63	883	15.00	596	14.78	613							14.62	633
15.67	1032	14.54	645	13.73	899	15.09	638	14.88	588							14.72	607
15.71	1064	14.60	723	13.83	868			14.99	594							14.82	605
15.80	932	14.69	641	13.94	922			15.09	609							14.91	625
15.91	798	14.80	640	14.03	938			15.20	605							15.02	610
16.01	704	14.91	846	14.13	833			15.30	612							15.11	677
16.12	636	15.01	646	14.24	855			15.41	597							15.25	630

16.21	964	15.12	601	14.32	919	15.51	616	15.35	672
16.32	927	15.21	669	14.42	920	15.62	605	15.44	622
16.40	908	15.32	750	14.52	923	15.72	603	15.56	610
16.45	1315	15.42	598	14.57	902	15.77	636	15.69	620
16.56	416	15.50	927	14.64	938	15.86	636	15.79	628
16.66	770	15.61	600	14.72	985	15.97	604	15.88	592
16.78	1048	15.71	720	14.84	907	16.00	657	16.01	598
16.87	915	15.81	649	14.93	886			16.11	625
16.96	684	15.93	606	15.03	873			16.21	621
17.08	868	16.04	611	15.11	781			16.32	637
17.17	920	16.13	771	15.16	715			16.43	660
17.27	792	16.23	802	15.26	901			16.53	635
17.37	944	16.34	860	15.36	961			16.63	637
17.49	688	16.39	652	15.46	926			16.73	616
17.67	604	16.51	687	15.52	1003			16.84	636
17.77	840	16.60	664	15.62	976			16.93	625
17.88	664	16.71	619	15.72	974			17.03	625
17.98	624	16.82	782	15.83	910			17.13	633
18.07	948	16.92	688	15.85	829			17.27	643
18.18	908	17.02	931	15.95	966			17.60	618
18.29	948	17.12	626	16.06	893			17.69	632
18.37	916	17.22	618	16.15	966			17.82	653
18.49	912	17.31	680	16.25	871			17.92	635
18.60	968	17.41	703	16.35	900			18.03	639
18.70	812	17.49	638	16.39	1026			18.12	629
18.80	692	17.59	673	16.49	906			18.26	641
18.87	572	17.69	676	16.59	907				
18.97	952	17.81	565	16.69	927				

(table continues)

TABLE A1 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U3 (2003)		U4 (2004)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
19.08	772	17.89	605	16.78	902												
19.19	788	17.99	556	16.84	817												
19.28	892	18.09	701	16.94	908												
19.38	928	18.19	640	17.01	793												
19.49	896	18.27	770	17.12	888												
19.56	1016	18.38	789	17.24	964												
19.67	784	18.48	889	17.33	917												
19.78	712	18.59	627	17.44	888												
19.88	688	18.68	720	17.49	962												
19.97	680	18.79	797	17.63	889												
		18.87	792	17.74	916												
		18.97	648	17.85	895												
		19.06	816	17.93	934												
		19.18	643	18.03	926												
		19.28	702	18.13	948												
		19.37	772	18.24	896												
		19.41	1016	18.33	954												
		19.51	679	18.44	923												
		19.62	694	18.54	924												
		19.71	694	18.60	811												
		19.77	790	18.70	922												
		19.85	734	18.80	931												
		19.92	747	18.90	933												

20.03	672	18.99	900
20.12	727	19.09	929
		19.20	912
		19.30	932
		19.36	932
		19.46	908
		19.58	914
		19.70	792
		19.80	762
		19.88	903
		19.95	918
		20.01	812
		20.16	933
		20.26	910
		20.36	949
		20.47	982
		20.58	939
		20.70	944

[a]The core sample extends from the corresponding depth to the next deeper depth.

TABLE A2

Density (kg/m^3) at Depth (m) below the Surface Measured on Samples from the 1987 Summit Cores[a]

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
0.00	321.30	0.00	351.59	0.00	310.28	0.00	310.28	0.00	347.92	0.00	387.40	0.00	279.07	0.00	279.07	0.00	311.20
0.10	385.56	0.10	339.66	0.10	347.00	0.10	364.45	0.10	367.20	0.10	326.81	0.10	320.38	0.10	320.38	0.10	329.56
0.20	337.82	0.20	365.36	0.20	347.00	0.20	369.95	0.20	400.25	0.20	358.02	0.20	349.76	0.20	337.82	0.20	382.81
0.30	340.58	0.30	365.36	0.30	366.28	0.30	387.40	0.30	396.58	0.30	368.12	0.30	391.07	0.30	373.63	0.30	365.36
0.40	300.19	0.40	312.12	0.40	355.27	0.40	359.86	0.40	380.05	0.40	391.07	0.40	369.04	0.40	378.22	0.40	362.61
0.50	292.84	0.50	276.32	0.50	286.42	0.50	314.87	0.50	398.41	0.50	380.05	0.50	339.66	0.50	357.10	0.50	302.94
0.60	302.94	0.60	317.63	0.60	290.09	0.60	309.37	0.60	355.27	0.60	294.68	0.60	320.38	0.60	326.81	0.60	290.09
0.70	324.05	0.70	366.28	0.70	313.96	0.70	314.87	0.70	312.12	0.70	313.04	0.70	300.19	0.70	313.04	0.70	310.28
0.80	369.95	0.80	366.28	0.80	315.79	0.80	342.41	0.80	320.38	0.80	354.35	0.80	304.78	0.80	353.43	0.80	321.30
0.90	388.31	0.90	358.94	0.90	367.20	0.90	368.12	0.90	312.12	0.90	320.38	0.90	341.50	0.90	390.15	0.90	364.45
1.00	367.20	1.00	355.27	1.00	387.40	1.00	383.72	1.00	381.89	1.00	351.59	1.00	383.72	1.00	403.00	1.00	386.48
1.10	337.82	1.10	376.38	1.10	397.49	1.10	308.45	1.10	390.15	1.10	405.76	1.10	457.16	1.10	402.08	1.10	392.90
1.20	355.27	1.20	403.00	1.20	406.67	1.20	338.74	1.20	402.08	1.20	418.61	1.20	369.04	1.20	308.45	1.20	390.15
1.30	403.92	1.30	369.95	1.30	412.18	1.30	381.89	1.30	417.69	1.30	421.36	1.30	291.01	1.30	334.15	1.30	334.15
1.40	397.49	1.40	373.63	1.40	386.48	1.40	395.66	1.40	350.68	1.40	349.76	1.40	353.43	1.40	347.92	1.40	335.99
1.50	360.77	1.50	348.84	1.50	328.64	1.50	383.72	1.50	378.22	1.50	323.14	1.50	373.63	1.50	369.04	1.50	353.43
1.60	381.89	1.60	338.74	1.60	354.35	1.60	399.33	1.60	369.04	1.60	333.23	1.60	351.59	1.60	366.28	1.60	377.30
1.70	397.49	1.70	369.04	1.70	369.95	1.70	410.35	1.70	379.13	1.70	403.92	1.70	359.86	1.70	380.05	1.70	425.03
1.80	366.28	1.80	389.23	1.80	400.25	1.80	359.86	1.80	384.64	1.80	372.71	1.80	391.07	1.80	324.97	1.80	403.00
1.90	338.74	1.90	384.64	1.90	421.36	1.90	374.54	1.90	392.90	1.90	384.64	1.90	335.07	1.90	358.94	1.90	383.72
2.00	409.43	2.00	420.44	2.00	372.71	2.00	416.77	2.00	391.07	2.00	391.07	2.00	337.82	2.00	344.76	2.00	515.92

2.05	409.43	2.05	420.44	2.05	372.71	2.05	416.77	2.05	389.23	2.05	392.90	2.05	339.66	2.04	343.33	2.05	517.75
2.10	409.43	2.10	343.33	2.10	374.54	2.10	416.77	2.10	380.05	2.10	391.07	2.10	376.38	2.10	396.58	2.10	517.75
2.15	408.93	2.15	343.33	2.15	389.23	2.15	405.96	2.15	376.38	2.15	391.07	2.15	403.92	2.14	396.58	2.15	433.30
2.20	381.89	2.20	343.33	2.20	390.57	2.19	378.22	2.20	376.38	2.20	391.07	2.20	385.56	2.19	398.41	2.20	352.51
2.26	383.72	2.25	343.33	2.26	387.40	2.24	378.22	2.25	378.22	2.25	392.90	2.25	372.71	2.24	396.58	2.25	352.51
2.31	381.89	2.30	359.86	2.31	385.56	2.30	378.22	2.30	376.38	2.30	391.07	2.30	370.87	2.30	396.58	2.30	350.68
2.36	383.72	2.35	370.87	2.36	383.72	2.35	378.22	2.35	376.38	2.35	391.07	2.35	359.86	2.35	396.58	2.35	378.22
2.41	381.89	2.40	370.87	2.41	385.56	2.40	378.22	2.40	376.38	2.40	391.07	2.40	343.33	2.40	367.20	2.40	402.08
2.46	383.72	2.45	370.87	2.46	385.56	2.44	378.22	2.45	374.54	2.45	385.56	2.45	345.17	2.44	359.86	2.45	402.08
2.50	385.56	2.50	370.87	2.50	385.56	2.50	378.22	2.50	374.54	2.50	376.38	2.50	385.56	2.49	358.02	2.50	402.08
2.56	389.23	2.55	370.87	2.56	385.56	2.54	378.22	2.55	376.38	2.55	376.38	2.55	403.92	2.54	365.37	2.55	403.92
2.60	387.40	2.60	376.38	2.60	380.05	2.60	378.22	2.60	370.87	2.60	376.38	2.60	402.08	2.59	391.07	2.60	402.08
2.66	389.23	2.65	376.38	2.66	380.05	2.64	378.22	2.65	354.35	2.65	376.38	2.65	402.08	2.64	391.07	2.65	402.08
2.70	389.23	2.70	378.22	2.70	380.05	2.70	378.22	2.70	354.35	2.70	376.38	2.70	403.92	2.69	392.90	2.70	396.58
2.76	387.40	2.75	376.38	2.76	389.23	2.74	370.87	2.75	354.35	2.75	376.38	2.75	402.08	2.74	391.07	2.75	374.54
2.80	389.23	2.80	374.54	2.80	409.43	2.80	347.00	2.80	358.02	2.80	376.38	2.80	405.76	2.79	391.07	2.80	376.38
2.86	389.23	2.85	370.87	2.86	411.26	2.84	347.00	2.85	363.53	2.85	399.84	2.85	405.76	2.84	391.07	2.85	374.54
2.90	389.23	2.90	383.72	2.90	407.59	2.90	359.86	2.90	370.87	2.90	397.80	2.90	405.76	2.89	392.91	2.90	376.38
2.96	365.36	2.95	387.40	2.96	396.58	2.94	362.19	2.95	394.74	2.94	400.25	2.95	407.59	2.94	391.07	2.95	387.40
3.00	359.86	3.00	361.69	3.00	398.41	3.00	372.21	3.00	394.74	2.99	398.41	3.00	414.94	2.99	391.07	3.00	389.23
3.06	385.56	3.05	361.69	3.06	396.58	3.06	398.41	3.05	394.74	3.04	398.41	3.05	413.10	3.04	391.07	3.05	387.40
3.10	385.56	3.10	359.86	3.10	396.58	3.10	396.58	3.10	394.74	3.09	393.72	3.10	398.41	3.09	392.90	3.10	389.23
3.16	385.56	3.15	361.69	3.16	414.93	3.16	398.41	3.15	394.74	3.14	377.40	3.15	374.54	3.14	400.25	3.15	420.44
3.20	385.56	3.20	359.86	3.20	416.77	3.20	396.57	3.20	381.89	3.18	378.22	3.20	376.38	3.19	402.08	3.20	427.79
3.26	385.56	3.25	361.69	3.26	414.93	3.26	409.43	3.25	370.87	3.23	378.22	3.25	374.54	3.24	402.08	3.25	427.79
3.30	385.56	3.30	359.86	3.30	416.77	3.30	409.43	3.30	370.87	3.28	396.57	3.30	405.76	3.29	402.08	3.30	427.79
3.36	385.56	3.35	361.69	3.36	416.77	3.36	409.43	3.35	374.55	3.33	396.58	3.35	403.92	3.34	401.88	3.35	427.79

(*table continues*)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
3.40	385.56	3.40	359.85	3.40	387.40	3.40	409.43	3.40	392.90	3.38	396.58	3.40	405.76	3.38	416.16	3.40	429.62
3.46	385.56	3.45	361.69	3.46	389.23	3.46	408.00	3.45	394.74	3.43	396.58	3.45	405.75	3.43	418.61	3.45	389.23
3.50	367.20	3.50	365.37	3.50	387.40	3.50	392.24	3.50	392.90	3.48	394.74	3.50	403.92	3.48	420.44	3.50	376.38
3.56	361.69	3.55	370.87	3.56	394.74	3.56	391.07	3.55	394.74	3.53	396.58	3.55	405.76	3.53	407.59	3.55	374.55
3.60	361.69	3.60	372.71	3.60	396.58	3.60	391.07	3.60	392.90	3.58	396.58	3.60	405.59	3.58	400.25	3.60	416.16
3.66	334.15	3.65	370.87	3.66	396.58	3.66	392.90	3.65	398.41	3.63	396.57	3.66	405.59	3.63	398.41	3.64	416.77
3.70	334.15	3.70	372.71	3.70	396.58	3.70	391.07	3.70	424.12	3.68	396.58	3.71	400.25	3.68	400.25	3.70	416.77
3.76	333.82	3.75	370.87	3.76	369.04	3.76	391.07	3.75	424.12	3.73	396.58	3.76	400.25	3.73	398.41	3.74	416.16
3.81	407.59	3.80	372.21	3.80	340.68	3.80	394.74	3.80	377.21	3.78	394.74	3.81	402.08	3.78	400.25	3.79	411.27
3.86	409.43	3.86	370.54	3.85	438.80	3.86	402.08	3.86	378.22	3.83	437.30	3.86	409.43	3.83	405.96	3.84	409.43
3.91	407.26	3.91	387.40	3.90	436.97	3.90	414.93	3.90	398.91	3.88	435.13	3.91	407.59	3.88	388.90	3.89	411.27
3.97	385.56	3.96	395.57	3.95	436.97	3.96	414.94	3.96	398.41	3.94	436.97	3.96	409.43	3.93	389.23	3.94	413.10
4.02	385.56	4.01	396.58	4.00	435.63	4.00	416.77	4.01	398.41	3.98	435.63	4.01	407.59	3.98	409.43	3.99	414.93
4.08	385.56	4.07	396.57	4.06	407.59	4.06	413.10	4.06	398.91	4.04	418.61	4.06	407.59	4.03	409.43	4.04	414.93
4.13	387.40	4.12	402.08	4.11	411.27	4.11	411.27	4.12	451.65	4.09	416.77	4.11	409.43	4.08	409.43	4.09	411.27
4.18	387.40	4.16	400.25	4.16	428.96	4.16	411.27	4.16	451.66	4.14	418.94	4.16	407.59	4.13	409.43	4.14	411.27
4.23	389.23	4.22	400.58	4.21	431.46	4.20	409.43	4.22	420.44	4.20	416.77	4.21	409.43	4.18	411.27	4.19	407.59
4.28	387.40	4.27	400.58	4.26	429.62	4.26	411.27	4.26	418.61	4.24	418.94	4.26	407.59	4.23	414.93	4.24	392.90
4.33	387.40	4.32	400.25	4.31	429.63	4.30	409.43	4.32	420.44	4.30	424.12	4.31	427.79	4.28	416.77	4.29	407.59
4.38	464.51	4.38	402.08	4.36	430.62	4.36	409.43	4.36	420.61	4.35	422.28	4.36	427.79	4.33	414.93	4.34	438.80
4.43	466.35	4.42	405.75	4.42	429.63	4.40	383.72	4.42	413.10	4.40	422.28	4.41	427.79	4.38	437.30	4.39	440.64
4.48	435.13	4.48	407.26	4.46	427.79	4.46	385.56	4.47	411.27	4.45	424.12	4.46	427.79	4.44	435.13	4.44	438.80
4.53	433.30	4.53	407.59	4.51	425.95	4.50	383.72	4.52	413.10	4.50	422.28	4.51	433.30	4.49	436.97	4.49	418.61
4.58	433.30	4.58	422.28	4.57	415.60	4.56	387.40	4.57	411.27	4.56	424.12	4.56	435.13	4.54	424.12	4.54	414.93

4.63	433.30	4.63	437.30	4.62	414.94	4.61	414.93	4.62	413.10	4.61	422.28	4.61	407.59	4.58	422.28	4.59	416.77
4.68	433.30	4.69	427.29	4.67	416.77	4.66	416.77	4.67	411.26	4.66	422.28	4.66	385.56	4.64	422.28	4.64	414.93
4.73	433.30	4.74	427.29	4.72	414.94	4.70	414.94	4.72	413.10	4.71	438.80	4.71	400.25	4.69	424.12	4.69	411.27
4.78	443.98	4.80	427.79	4.77	416.77	4.76	414.93	4.77	411.27	4.76	438.80	4.76	398.41	4.74	422.28	4.74	409.43
4.84	446.15	4.84	425.62	4.82	415.60	4.80	416.77	4.82	424.12	4.81	438.80	4.81	400.25	4.78	424.12	4.79	409.43
4.88	444.31	4.90	424.12	4.88	435.13	4.86	427.79	4.87	438.80	4.86	438.80	4.86	475.52	4.84	422.28	4.84	422.28
4.94	396.58	4.95	425.95	4.92	435.13	4.90	459.00	4.92	440.64	4.91	438.60	4.91	528.77	4.88	407.59	4.89	455.33
4.99	403.92	5.00	424.12	4.98	433.30	4.96	457.16	4.97	440.64	4.96	436.56	4.96	528.77	4.94	422.28	4.94	453.49
5.04	405.76	5.05	425.62	5.03	435.13	5.00	459.00	5.02	438.80	5.00	435.13	5.01	528.77	4.99	435.13	4.99	433.30
5.08	405.75	5.11	425.95	5.08	436.97	5.06	457.17	5.07	440.64	5.05	436.97	5.06	528.77	5.04	435.13	5.04	403.92
5.14	407.59	5.16	424.12	5.12	440.64	5.11	459.00	5.12	438.80	5.10	436.97	5.11	528.77	5.08	435.13	5.09	403.92
5.18	405.76	5.20	405.75	5.18	440.64	5.16	446.15	5.17	409.43	5.15	435.13	5.16	411.27	5.14	431.46	5.14	403.92
5.24	405.76	5.26	407.59	5.22	436.97	5.20	442.48	5.22	403.92	5.20	436.97	5.21	409.43	5.18	425.95	5.19	418.61
5.28	412.26	5.30	405.76	5.28	436.97	5.26	442.48	5.27	405.75	5.25	435.13	5.26	403.92	5.24	424.12	5.24	435.13
5.34	418.61	5.36	412.27	5.32	436.97	5.30	442.48	5.32	403.92	5.30	436.97	5.31	420.45	5.28	424.12	5.29	435.13
5.39	416.77	5.41	422.28	5.38	438.80	5.36	442.47	5.37	405.75	5.35	436.56	5.36	447.98	5.34	425.95	5.34	435.13
5.44	417.27	5.46	435.13	5.42	436.97	5.40	442.48	5.42	449.82	5.40	411.27	5.41	446.15	5.38	425.62	5.39	435.13
5.50	418.61	5.51	435.13	5.48	436.97	5.46	444.31	5.47	451.66	5.44	411.26	5.46	447.98	5.44	425.95	5.44	433.29
5.54	471.85	5.56	435.13	5.52	440.64	5.50	442.48	5.52	449.82	5.50	411.27	5.51	446.15	5.49	427.79	5.49	435.13
5.60	470.02	5.61	433.30	5.58	449.82	5.56	438.80	5.57	449.82	5.54	411.27	5.56	442.48	5.54	444.31	5.54	435.13
5.64	471.85	5.66	435.13	5.62	446.15	5.60	436.97	5.62	433.30	5.60	411.26	5.61	442.48	5.59	444.31	5.59	433.30
5.70	471.85	5.71	427.79	5.68	438.80	5.66	436.97	5.67	427.79	5.64	452.88	5.66	442.48	5.64	444.31	5.64	416.77
5.74	471.24	5.76	427.79	5.72	436.97	5.70	436.97	5.72	429.62	5.69	451.66	5.71	442.48	5.69	444.31	5.69	416.77
5.79	440.64	5.81	436.56	5.78	438.80	5.76	436.97	5.77	431.46	5.74	453.49	5.76	444.31	5.74	446.15	5.74	397.24
5.84	424.32	5.86	464.51	5.82	470.02	5.80	444.31	5.82	449.82	5.79	453.49	5.81	440.64	5.79	444.31	5.80	323.14
5.88	460.84	5.90	407.59	5.88	471.85	5.86	446.76	5.87	447.98	5.84	451.65	5.86	442.68	5.84	444.31	5.84	387.40
5.94	460.83	5.96	418.61	5.92	470.02	5.90	453.49	5.92	462.68	5.89	453.50	5.90	440.64	5.89	444.31	5.90	471.85

(table continues)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
5.98	460.84	6.00	468.18	5.98	470.02	5.95	453.49	5.97	473.69	5.94	462.34	5.95	449.82	5.94	446.15	5.94	470.02
6.04	462.67	6.06	466.35	6.02	471.85	6.00	447.32	6.02	475.52	6.00	460.67	6.00	460.83	5.99	446.15	6.00	468.18
6.08	460.84	6.10	466.35	6.08	469.20	6.06	425.95	6.07	473.69	6.05	462.67	6.05	462.68	6.04	447.98	6.04	457.16
6.14	457.16	6.16	468.18	6.12	451.65	6.10	425.95	6.12	475.52	6.10	462.67	6.10	460.83	6.09	460.84	6.10	457.17
6.18	438.81	6.20	469.20	6.17	446.15	6.16	425.62	6.17	473.69	6.15	460.84	6.15	459.00	6.14	464.51	6.14	457.16
6.24	438.80	6.25	471.85	6.22	446.15	6.21	444.72	6.22	475.53	6.20	462.67	6.20	447.98	6.19	464.51	6.20	455.33
6.28	440.64	6.30	470.02	6.27	447.98	6.26	444.31	6.27	451.65	6.25	469.20	6.25	446.15	6.24	464.51	6.24	457.16
6.34	438.80	6.35	471.85	6.32	446.15	6.30	446.15	6.32	442.48	6.30	470.02	6.30	447.98	6.29	464.51	6.30	455.33
6.38	438.81	6.40	471.85	6.37	446.15	6.36	444.31	6.37	424.12	6.34	468.18	6.35	447.98	6.34	453.49	6.34	453.49
6.44	460.83	6.45	471.85	6.42	449.82	6.40	442.48	6.42	424.12	6.40	470.02	6.40	446.15	6.39	411.26	6.40	460.83
6.48	459.00	6.50	436.97	6.47	481.04	6.46	442.48	6.47	424.12	6.44	468.18	6.45	457.16	6.44	411.27	6.44	466.35
6.54	471.85	6.55	435.13	6.52	481.03	6.50	442.48	6.52	440.64	6.50	470.02	6.50	460.84	6.49	464.51	6.50	464.51
6.59	470.02	6.60	436.97	6.57	479.19	6.56	442.48	6.57	446.15	6.54	470.02	6.55	460.83	6.54	464.51	6.54	464.51
6.64	470.02	6.65	436.97	6.62	481.03	6.60	438.80	6.62	446.15	6.60	468.18	6.60	473.69	6.59	464.51	6.60	466.35
6.69	470.02	6.70	436.97	6.67	481.04	6.66	436.97	6.67	446.15	6.64	446.15	6.65	471.85	6.64	462.67	6.64	464.51
6.74	471.85	6.75	435.13	6.72	481.03	6.70	436.97	6.72	488.38	6.70	447.98	6.70	471.85	6.69	464.51	6.70	477.36
6.79	469.01	6.80	443.70	6.77	479.19	6.76	435.13	6.77	468.18	6.74	446.15	6.75	473.69	6.74	464.51	6.74	482.86
6.84	470.02	6.86	411.27	6.82	492.05	6.80	462.67	6.82	438.81	6.80	468.18	6.80	471.85	6.79	464.51	6.80	482.87
6.90	470.02	6.91	433.29	6.87	492.05	6.86	460.84	6.87	440.64	6.84	477.36	6.85	473.69	6.84	464.51	6.84	455.33
6.94	470.02	6.96	440.64	6.92	490.21	6.90	466.35	6.92	438.80	6.90	477.36	6.90	481.44	6.89	464.51	6.90	436.97
7.00	453.49	7.00	447.98	6.97	492.05	6.96	466.34	6.97	440.64	6.94	479.19	6.94	482.87	6.94	455.33	6.94	470.02
7.04	451.65	7.06	449.82	7.02	490.21	7.00	471.85	7.02	438.80	7.00	477.36	7.00	451.65	6.99	455.32	7.00	474.02
7.10	451.65	7.10	457.16	7.07	488.38	7.06	481.03	7.07	440.64	7.04	477.36	7.04	451.66	7.04	457.17	7.05	473.69
7.14	451.65	7.16	464.51	7.12	471.85	7.10	479.20	7.12	464.51	7.10	477.36	7.10	451.65	7.09	455.32	7.10	473.69

7.20	452.33	7.20	473.69	7.17	473.69	7.16	481.03	7.17	482.87	7.14	477.36	7.14	451.65	7.14	455.33	7.15	473.69
7.25	422.28	7.26	479.20	7.22	473.69	7.20	481.03	7.22	477.36	7.20	477.36	7.20	471.85	7.19	456.96	7.20	473.69
7.30	416.77	7.30	479.19	7.27	473.69	7.26	481.03	7.27	451.65	7.24	483.48	7.24	488.38	7.24	460.84	7.25	473.69
7.35	470.02	7.36	473.69	7.32	471.85	7.30	488.38	7.32	451.66	7.29	486.54	7.30	488.38	7.28	460.84	7.30	473.69
7.40	470.02	7.40	460.83	7.37	473.69	7.36	488.38	7.37	451.65	7.34	488.37	7.34	488.37	7.34	460.83	7.35	473.69
7.45	470.02	7.46	460.84	7.42	473.69	7.40	488.38	7.42	453.49	7.39	486.54	7.40	488.38	7.38	460.84	7.40	449.82
7.50	471.85	7.50	459.00	7.47	473.69	7.46	471.85	7.47	450.84	7.44	486.54	7.44	488.38	7.44	471.24	7.45	449.82
7.55	470.02	7.56	462.67	7.52	475.52	7.50	464.51	7.52	452.88	7.49	468.18	7.50	539.78	7.48	493.88	7.50	447.98
7.60	470.02	7.60	466.35	7.57	473.69	7.56	464.51	7.56	462.67	7.54	468.18	7.54	741.75	7.53	492.05	7.55	466.35
7.65	470.02	7.66	464.51	7.62	475.52	7.60	464.51	7.61	462.68	7.59	470.02	7.60	741.75	7.58	493.88	7.60	471.85
7.70	470.02	7.70	464.51	7.67	475.52	7.66	464.51	7.66	462.67	7.64	470.02	7.64	743.58	7.63	493.88	7.65	470.02
7.75	471.85	7.76	466.35	7.72	473.69	7.70	464.51	7.71	462.67	7.69	481.03	7.70	574.67	7.68	493.88	7.70	470.02
7.80	468.18	7.81	464.51	7.77	475.52	7.76	453.49	7.76	488.38	7.74	479.19	7.74	462.67	7.73	469.20	7.75	470.02
7.85	468.18	7.86	470.02	7.82	497.56	7.81	442.48	7.81	488.38	7.79	479.20	7.80	466.35	7.78	470.02	7.80	466.35
7.90	480.70	7.90	470.02	7.87	497.55	7.86	449.82	7.86	488.37	7.84	471.85	7.84	473.69	7.82	470.02	7.85	459.00
7.96	481.03	7.96	468.18	7.92	497.55	7.90	455.33	7.91	464.51	7.89	470.02	7.90	473.69	7.88	470.02	7.90	460.83
8.01	481.03	8.01	470.02	7.97	497.55	7.96	479.19	7.96	359.04	7.94	468.18	7.94	497.55	7.92	483.48	7.95	459.00
8.06	481.04	8.06	470.02	8.02	497.56	8.01	477.36	8.01	481.03	7.99	470.02	8.00	497.55	7.97	492.05	8.00	459.00
8.10	480.69	8.10	466.34	8.07	497.55	8.06	479.20	8.06	482.87	8.04	468.18	8.04	497.56	8.02	492.05	8.05	459.00
8.16	446.15	8.15	464.51	8.12	490.21	8.10	477.36	8.10	481.03	8.09	471.85	8.10	497.55	8.07	447.98	8.10	460.84
8.21	446.15	8.20	464.51	8.17	481.03	8.15	479.20	8.15	481.03	8.14	481.04	8.14	497.76	8.12	449.82	8.15	459.00
8.26	446.15	8.26	464.51	8.22	479.19	8.20	475.52	8.20	481.04	8.19	481.03	8.19	473.69	8.17	449.82	8.20	459.00
8.31	444.31	8.30	464.51	8.27	479.20	8.26	473.69	8.26	482.86	8.24	481.03	8.24	473.69	8.22	449.82	8.25	459.00
8.36	490.21	8.36	462.67	8.32	481.03	8.30	473.69	8.30	481.04	8.29	481.03	8.29	475.52	8.27	448.98	8.30	459.00
8.41	488.38	8.40	477.36	8.37	479.19	8.36	470.68	8.36	481.03	8.34	481.03	8.34	473.69	8.32	475.53	8.35	471.85
8.46	488.38	8.46	481.03	8.42	481.03	8.41	471.85	8.40	479.19	8.39	479.20	8.39	473.69	8.38	475.52	8.40	477.36
8.51	490.21	8.51	471.85	8.47	486.54	8.46	470.02	8.46	475.52	8.44	481.03	8.44	475.52	8.43	475.52	8.45	477.36

(*table continues*)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
8.56	488.37	8.56	468.18	8.52	492.05	8.51	470.02	8.51	477.36	8.49	481.03	8.49	473.69	8.48	475.52	8.50	475.52
8.61	490.21	8.60	466.35	8.57	493.88	8.56	471.85	8.56	477.36	8.54	481.03	8.54	482.87	8.52	475.52	8.55	479.20
8.66	488.38	8.65	468.18	8.62	492.05	8.61	470.02	8.60	497.55	8.59	481.03	8.59	490.21	8.58	475.52	8.60	477.36
8.71	488.38	8.70	466.35	8.67	493.88	8.66	471.85	8.65	517.75	8.64	475.52	8.64	490.21	8.62	504.90	8.65	479.19
8.76	479.03	8.76	475.52	8.72	492.05	8.71	470.02	8.70	512.25	8.69	471.85	8.69	488.38	8.68	506.74	8.70	477.36
8.82	479.19	8.80	486.54	8.77	491.64	8.76	503.88	8.76	504.90	8.74	468.18	8.74	489.60	8.72	475.52	8.75	477.36
8.86	479.20	8.86	486.54	8.82	519.59	8.80	503.07	8.80	506.73	8.79	466.34	8.78	489.60	8.78	429.62	8.80	488.38
8.92	477.36	8.90	488.38	8.86	517.75	8.86	459.00	8.86	506.74	8.84	477.36	8.83	493.88	8.83	429.62	8.85	514.08
8.96	479.03	8.96	490.21	8.92	517.75	8.90	459.00	8.90	499.39	8.89	486.54	8.88	495.72	8.88	429.62	8.90	512.25
9.02	501.23	9.01	488.38	8.96	501.23	8.96	459.00	8.96	471.85	8.94	488.38	8.93	493.88	8.93	482.37	8.95	512.24
9.07	501.22	9.06	488.38	9.02	475.52	9.01	459.00	9.01	471.85	8.99	488.38	8.98	493.88	8.98	482.87	9.00	512.25
9.12	503.06	9.10	490.21	9.06	475.52	9.06	460.83	9.06	471.85	9.04	493.88	9.03	493.88	9.03	482.87	9.05	508.58
9.17	501.23	9.15	492.05	9.12	473.69	9.10	497.56	9.10	471.85	9.09	510.41	9.08	493.88	9.08	481.03	9.10	506.73
9.22	501.23	9.20	492.05	9.17	475.52	9.15	508.57	9.15	471.85	9.14	510.41	9.13	495.72	9.13	447.98	9.15	504.90
9.27	501.22	9.26	490.21	9.22	475.53	9.20	479.19	9.20	493.88	9.19	512.25	9.18	495.72	9.18	449.82	9.20	506.74
9.32	479.03	9.30	492.05	9.26	492.05	9.26	361.69	9.26	492.05	9.24	510.41	9.22	497.55	9.23	447.98	9.25	504.90
9.38	477.36	9.36	492.05	9.32	495.72	9.30	506.74	9.30	492.05	9.29	510.41	9.28	495.72	9.28	447.98	9.30	512.25
9.43	477.36	9.40	493.88	9.36	495.72	9.36	506.74	9.36	493.88	9.34	512.25	9.33	497.56	9.33	448.80	9.35	512.24
9.48	479.19	9.46	492.05	9.42	495.72	9.40	506.73	9.40	501.84	9.39	510.41	9.38	495.72	9.38	471.85	9.40	510.41
9.53	477.36	9.51	493.88	9.46	493.88	9.46	506.74	9.45	504.90	9.44	510.41	9.43	504.90	9.43	488.37	9.45	482.87
9.58	477.36	9.56	493.88	9.52	497.55	9.51	506.74	9.50	503.88	9.49	512.24	9.48	510.41	9.48	486.54	9.50	479.20
9.63	495.72	9.60	493.88	9.56	504.90	9.56	506.74	9.54	504.90	9.54	510.41	9.52	510.41	9.52	486.54	9.55	477.36
9.68	517.75	9.65	493.88	9.62	503.06	9.60	506.73	9.60	504.90	9.59	497.56	9.58	488.38	9.58	514.08	9.60	479.19
9.73	519.59	9.70	488.37	9.67	504.90	9.65	515.92	9.64	505.92	9.64	482.87	9.62	468.18	9.62	514.08	9.65	479.19

9.78	497.39	9.76	479.20	9.72	503.06	9.70	519.59	9.69	506.74	9.69	484.70	9.68	468.18	9.68	512.24	9.70	493.88
9.84	470.02	9.80	477.36	9.76	517.75	9.76	519.59	9.74	523.26	9.74	512.04	9.72	468.18	9.72	514.08	9.75	517.75
9.88	471.85	9.86	503.06	9.82	539.78	9.80	514.08	9.79	523.26	9.78	514.08	9.78	462.68	9.78	514.08	9.80	515.92
9.94	471.85	9.90	514.08	9.86	517.75	9.86	489.60	9.84	457.17	9.84	514.08	9.83	454.92	9.83	512.25	9.85	517.75
9.98	519.59	9.96	514.08	9.92	504.90	9.90	488.38	9.89	477.36	9.88	514.08	9.87	506.74	9.88	515.92	9.90	517.75
10.04	519.59	10.01	512.25	9.96	504.90	9.95	510.41	9.94	495.72	9.94	514.08	9.92	508.57	9.93	515.92	9.95	515.92
10.09	519.59	10.06	506.73	10.02	503.06	10.00	510.41	9.99	495.72	9.98	514.08	9.97	506.74	9.98	517.75	10.00	503.06
10.14	519.59	10.10	506.74	10.06	504.90	10.05	512.24	10.04	493.88	10.04	497.55	10.02	507.96	10.02	517.75	10.05	492.05
10.18	519.59	10.15	504.90	10.12	495.72	10.10	510.41	10.09	495.72	10.09	497.55	10.06	507.96	10.08	493.68	10.10	492.05
10.24	519.09	10.20	506.74	10.17	486.54	10.15	510.41	10.14	495.72	10.14	497.56	10.11	508.57	10.12	495.72	10.15	492.05
10.29	517.75	10.26	504.90	10.22	484.71	10.20	508.57	10.19	495.72	10.18	497.55	10.16	510.41	10.17	505.92	10.20	492.05
10.34	517.75	10.30	504.90	10.26	484.70	10.25	501.23	10.24	493.88	10.24	495.72	10.21	508.58	10.22	517.75	10.25	501.84
10.39	517.75	10.36	504.90	10.32	501.23	10.30	499.06	10.29	495.72	10.28	497.56	10.26	510.40	10.26	517.75	10.30	512.25
10.44	515.92	10.40	504.90	10.36	530.60	10.36	510.00	10.34	503.06	10.34	497.55	10.31	508.58	10.32	517.75	10.34	514.08
10.49	517.75	10.46	501.22	10.42	528.77	10.40	506.74	10.39	508.58	10.38	497.55	10.36	510.40	10.36	519.59	10.40	514.08
10.54	518.16	10.50	497.56	10.46	514.08	10.45	508.57	10.44	508.57	10.44	497.56	10.41	508.58	10.42	517.75	10.44	508.57
10.58	482.87	10.56	499.39	10.52	508.58	10.50	506.74	10.49	508.57	10.48	495.72	10.46	510.41	10.46	518.16	10.50	510.41
10.64	484.71	10.60	497.56	10.56	506.74	10.55	508.57	10.54	510.74	10.54	497.55	10.51	508.56	10.51	519.59	10.54	508.58
10.68	543.46	10.66	499.39	10.62	506.74	10.60	512.24	10.60	510.40	10.58	495.72	10.56	510.41	10.56	521.42	10.60	508.57
10.74	541.61	10.70	499.39	10.66	506.73	10.65	510.41	10.64	510.41	10.64	495.72	10.61	508.58	10.61	519.59	10.64	508.57
10.78	528.77	10.76	497.55	10.72	508.58	10.70	512.24	10.70	506.74	10.69	493.88	10.66	510.40	10.66	521.42	10.70	504.90
10.84	526.93	10.80	499.40	10.76	510.41	10.75	512.25	10.74	501.22	10.74	495.72	10.71	508.58	10.71	519.59	10.74	506.74
10.88	526.93	10.86	517.75	10.82	510.40	10.80	512.24	10.80	501.22	10.79	495.72	10.76	510.40	10.76	521.42	10.80	506.74
10.94	526.94	10.90	519.59	10.86	510.41	10.85	521.42	10.84	499.40	10.84	493.88	10.81	508.58	10.81	520.20	10.84	506.74
10.98	519.58	10.96	519.58	10.92	510.40	10.90	521.43	10.90	501.22	10.89	506.73	10.86	510.40	10.86	529.10	10.90	504.90
11.04	517.75	11.00	517.75	10.96	510.41	10.95	521.43	10.94	508.58	10.94	506.74	10.91	508.58	10.91	528.77	10.94	506.74
11.08	517.75	11.06	519.59	11.02	512.24	11.00	521.42	11.00	514.08	10.99	506.74	10.96	510.41	10.96	528.77	11.00	490.21

(*table continues*)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
11.14	517.75	11.10	517.75	11.06	510.41	11.05	525.09	11.04	515.92	11.04	504.90	11.01	508.56	11.01	528.77	11.04	490.21
11.18	517.75	11.16	512.24	11.12	510.40	11.10	526.93	11.10	515.92	11.09	501.22			11.06	528.77	11.10	488.38
11.24	519.58	11.20	484.71	11.16	512.24	11.15	525.10	11.14	514.08	11.14	499.40			11.11	528.77	11.14	488.37
11.28	528.77	11.26	486.53	11.22	521.43	11.20	525.09	11.20	515.92	11.19	499.39			11.16	528.77	11.20	497.56
11.34	528.77	11.30	492.06	11.26	521.43	11.25	517.75	11.24	515.92	11.24	499.40			11.21	528.77	11.24	512.24
11.38	526.93	11.36	521.42	11.32	521.42	11.30	515.92	11.30	523.27	11.29	475.69			11.26	517.41	11.30	510.41
11.44	528.77	11.40	523.27	11.36	543.46	11.35	515.74	11.34	532.43	11.34	457.16			11.32	515.92	11.34	512.24
11.48	528.77	11.46	521.42	11.42	547.12	11.40	514.09	11.40	530.61	11.40	455.34			11.36	515.92	11.40	510.40
11.54	526.93	11.50	521.43	11.46	547.12	11.46	512.24	11.44	530.61	11.44	520.20			11.42	515.92	11.44	510.41
11.58	528.77	11.56	523.26	11.52	547.14	11.50	514.08	11.50	530.61	11.49	519.59			11.46	515.92	11.50	512.24
11.64	532.44	11.60	521.43	11.56	541.62	11.56	514.08	11.54	530.60	11.54	521.42			11.52	514.09	11.54	510.41
11.68	532.43	11.66	521.42	11.62	497.55	11.60	512.25	11.60	530.61	11.59	521.43			11.56	515.92	11.60	510.40
11.74	532.44	11.70	523.27	11.66	503.06	11.66	514.08	11.64	530.61	11.64	523.26			11.62	515.92	11.64	521.43
11.78	532.44	11.76	521.42	11.72	552.64	11.70	514.08	11.70	528.77	11.69	521.43			11.66	523.26	11.70	525.09
11.84	532.43	11.80	506.74	11.76	552.64	11.76	514.08	11.74	526.93	11.74	523.26			11.72	525.09	11.74	525.09
11.88	532.44	11.86	482.87	11.82	537.95	11.81	514.08	11.80	517.75	11.79	523.26			11.76	523.27	11.80	526.93
11.94	532.43	11.90	534.27	11.86	537.95	11.86	523.26	11.84	515.92	11.84	523.27			11.82	526.93	11.84	523.27
11.98	489.05	11.96	536.12	11.92	537.95	11.91	523.27	11.90	515.92	11.89	519.59			11.86	526.93	11.90	523.26
12.04	436.96	12.00	534.27	11.96	537.96	11.96	523.26	11.94	515.92	11.94	515.92			11.92	526.93	11.94	523.27
12.09	436.97	12.06	536.11	12.02	537.95	12.01	523.27	12.00	515.92	11.99	517.75			11.96	526.93	12.00	521.42
12.14	492.38	12.10	534.28	12.06	534.10	12.06	523.26	12.04	521.43	12.04	515.92			12.02	525.09	12.04	525.09
12.20	541.62	12.16	534.27	12.12	493.88	12.11	517.75	12.10	532.43	12.09	515.92			12.06	526.93	12.10	523.27
12.24	541.62	12.20	530.61	12.17	493.88	12.16	515.92	12.14	532.44	12.14	515.92			12.12	526.94	12.14	517.75
12.30	541.62	12.26	532.44	12.22	493.88	12.21	515.92	12.20	530.61	12.19	519.08			12.16	526.93	12.20	517.75

12.34	541.61	12.30	530.60	12.27	508.58	12.26	515.92	12.24	532.43	12.24	519.59	12.22	525.76	12.24	515.92
12.40	529.11	12.36	530.61	12.32	515.92	12.31	515.92	12.30	530.61	12.30	519.58	12.27	523.27	12.30	543.45
12.45	515.92	12.40	532.44	12.37	517.75	12.36	473.69	12.34	519.59	12.34	519.59	12.32	525.09	12.34	561.82
12.50	515.92	12.46	530.60	12.42	517.75	12.41	455.32	12.40	517.75	12.40	519.59	12.37	525.09	12.40	559.99
12.55	514.07	12.50	536.12	12.47	517.75	12.46	536.52	12.44	537.95	12.44	539.11	12.42	530.61	12.44	547.12
12.60	536.12	12.56	536.11	12.52	515.92	12.50	536.11	12.50	547.12	12.50	539.78	12.47	530.61	12.50	492.05
12.66	534.27	12.60	536.11	12.57	503.06	12.56	537.95	12.54	545.29	12.55	537.95	12.52	530.77	12.54	492.05
12.70	534.28	12.66	530.61	12.62	484.71	12.60	536.12	12.60	545.30	12.60	530.61	12.58	523.26	12.60	510.00
12.76	536.11	12.70	526.93	12.67	486.53	12.66	536.52	12.64	540.78	12.65	528.77	12.62	523.27	12.64	575.28
12.80	534.27	12.76	525.09	12.72	532.44	12.70	537.95	12.70	534.28	12.70	530.61	12.68	521.42	12.68	552.64
12.86	534.28	12.80	530.61	12.77	543.45	12.75	536.11	12.75	532.43	12.75	530.60	12.72	523.26	12.74	537.95
12.90	536.11	12.86	545.30	12.82	543.46	12.80	530.40	12.80	534.28	12.80	530.61	12.78	521.43	12.78	534.27
12.96	534.28	12.90	545.29	12.87	545.30	12.84	483.49	12.85	534.27	12.85	528.77	12.82	548.96	12.84	534.28
13.00	534.27	12.96	547.12	12.92	543.45	12.89	481.03	12.90	534.27	12.90	530.61	12.88	550.80	12.88	534.27
13.06	535.78	13.00	545.30	12.97	561.82	12.94	550.80	12.95	534.28	12.95	530.61	12.92	548.96	12.94	537.95
13.11	537.95	13.06	547.12	13.02	560.82	12.99	548.96	13.00	532.43	13.00	530.60	12.98	550.80	12.98	539.78
13.16	537.95	13.10	528.77	13.08	562.48	13.04	548.96	13.05	532.44	13.05	528.77	13.02	548.96	13.04	541.62
13.21	548.96	13.16	528.77	13.13	565.48	13.09	548.96	13.10	510.41	13.10	543.46	13.08	550.80	13.08	539.78
13.26	556.31	13.20	526.93	13.18	567.33	13.14	536.11	13.15	510.40	13.15	548.96	13.12	548.96	13.14	541.62
13.31	558.14	13.26	526.93	13.23	565.49	13.19	537.96	13.20	530.61	13.20	548.96	13.18	550.80	13.18	539.78
13.36	548.96	13.30	528.77	13.28	567.32	13.24	537.95	13.25	539.78	13.25	548.96	13.22	530.61	13.24	541.62
13.41	532.44	13.36	523.27	13.33	565.49	13.29	536.11	13.30	537.95	13.30	547.14	13.28	532.44	13.28	537.95
13.46	532.43	13.40	525.09	13.38	567.32	13.34	537.95	13.35	537.95	13.35	548.96	13.32	537.95	13.34	536.11
13.51	532.44	13.46	525.09	13.43	543.46	13.39	536.11	13.40	539.78	13.40	548.96	13.38	536.11	13.38	537.95
13.56	541.62	13.50	536.11	13.48	545.30	13.44	537.95	13.45	541.62	13.45	548.96	13.42	537.95	13.44	536.11
13.61	561.82	13.56	539.78	13.53	545.29	13.49	537.96	13.50	547.12	13.50	548.96	13.48	537.95	13.48	536.12
13.66	561.82	13.60	537.95	13.58	543.46	13.54	530.77	13.55	545.30	13.55	548.96	13.52	537.95	13.54	536.11

(table continues)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
13.71	561.82	13.66	537.96	13.63	545.29	13.60	530.60	13.60	545.29	13.60	543.46			13.58	536.12	13.58	537.95
13.76	542.45	13.70	539.77	13.68	561.82	13.64	528.77	13.65	554.48	13.65	541.62			13.62	537.95	13.64	541.62
13.82	541.62	13.76	537.96	13.73	591.20	13.70	528.77	13.70	545.29	13.70	543.46			13.68	537.95	13.68	543.46
13.86	541.61	13.80	537.95	13.78	589.35	13.74	539.12	13.75	547.14	13.75	543.45			13.72	547.12	13.74	545.29
13.92	541.62	13.86	589.35	13.83	589.36	13.80	536.11	13.80	547.12	13.80	543.46			13.78	563.65	13.78	558.14
13.96	541.62	13.90	536.12	13.88	543.46	13.85	519.59	13.85	517.75	13.85	530.61			13.82	563.65	13.84	559.99
14.02	536.52	13.96	536.11	13.93	545.29	13.90	545.29	13.90	515.92	13.90	525.09			13.88	563.65	13.88	558.14
14.06	536.11	14.00	536.11	13.98	543.46	13.95	543.46	13.95	515.92	13.95	525.09			13.92	563.65	13.94	559.98
14.11	536.11	14.06	543.46	14.03	545.29	14.00	545.29	14.00	521.42	14.00	525.09			13.98	561.82	13.98	558.15
14.16	537.96	14.10	548.96	14.08	543.46	14.05	543.46	14.05	526.94	14.05	561.82			14.02	556.30	14.04	559.98
14.21	550.80	14.16	550.80	14.13	545.29	14.10	545.29	14.10	532.43	14.10	569.17			14.08	550.80	14.08	559.98
14.26	552.64	14.20	550.80	14.18	543.46	14.15	545.30	14.15	541.62	14.15	570.99			14.12	552.64	14.14	558.14
14.32	550.80	14.26	550.80	14.23	556.30	14.20	545.29	14.20	541.62	14.20	569.16			14.18	550.80	14.18	559.98
14.36	552.63	14.30	550.80	14.28	556.31			14.25	541.62	14.25	571.00			14.22	552.64	14.24	558.15
14.42	552.64	14.36	550.80	14.33	556.31			14.30	543.45	14.30	569.16			14.28	550.80	14.28	548.96
14.46	537.95	14.40	550.80	14.38	578.34			14.35	537.95	14.35	550.80			14.32	552.64	14.34	510.41
14.52	536.12	14.46	543.46	14.44	576.81			14.40	536.12	14.40	547.12			14.38	550.80	14.38	508.56
14.56	561.82	14.50	539.78	14.50	548.96			14.45	534.27	14.45	545.30			14.42	554.48	14.44	537.95
14.62	602.20	14.56	539.78	14.55	547.12			14.50	534.27	14.50	545.29			14.48	558.14	14.48	583.85
14.66	558.96	14.60	539.78	14.60	548.96			14.55	534.28	14.55	556.31			14.52	559.98	14.54	583.86
14.71	561.82	14.66	539.77	14.65	543.46			14.60	534.27	14.60	556.30			14.58	559.98	14.58	580.17
14.76	559.99	14.70	543.46	14.70	541.62			14.65	534.28	14.65	554.48			14.62	558.15	14.64	563.65
14.81	561.82	14.76	543.46	14.75	541.62			14.70	557.47	14.70	556.31			14.68	559.98	14.68	563.65
14.86	559.98	14.80	545.29	14.80	543.45			14.76	558.15	14.75	556.30			14.72	559.98	14.74	563.65

14.91	561.82	14.86	580.18	14.85	545.30	14.80	554.46	14.80	554.48	14.78	554.48	14.78	563.65
14.96	559.98	14.90	589.35	14.90	552.64	14.86	552.64	14.85	556.30	14.82	552.64	14.84	561.82
15.01	561.82	14.96	583.85	14.95	550.80	14.90	552.64	14.90	554.48			14.88	536.11
15.06	559.98	15.00	569.17	15.00	552.63	14.96	552.64	14.95	556.30			14.94	536.11
15.11	559.99	15.06	569.16	15.05	550.80	15.00	552.64	15.00	554.48			14.98	536.11
15.16	561.82	15.10	565.49	15.10	552.64	15.06	552.64	15.05	556.31			15.04	526.93
15.21	545.29	15.16	558.14	15.15	558.15	15.10	552.63	15.10	554.46			15.08	525.10
15.26	543.46	15.20	556.31	15.20	563.64	15.16	554.48	15.15	554.48			15.14	526.93
15.31	545.29	15.26	543.45	15.25	561.83	15.20	552.64	15.20	556.31			15.18	526.93
15.36	544.68	15.30	543.46	15.30	563.64	15.26	554.48	15.25	554.46			15.24	525.09
15.40	547.14	15.36	543.46	15.35	562.48	15.30	552.63	15.30	554.48			15.28	550.80
15.46	545.29	15.40	543.45	15.40	561.83	15.36	547.14	15.35	552.64			15.34	552.64
15.50	545.30	15.46	545.30	15.46	563.64	15.40	536.11	15.40	552.64			15.38	550.80
15.56	567.32	15.50	548.76	15.50	559.99	15.46	537.95	15.45	552.63			15.44	554.48
15.60	580.18	15.55	548.96	15.56	558.14	15.50	546.72	15.50	554.48			15.49	565.48
15.66	578.33	15.60	548.96	15.60	558.14	15.55	548.96	15.55	554.48			15.54	565.49
15.70	580.18	15.65	550.80	15.66	558.15	15.60	547.12	15.60	556.30			15.58	567.33
15.76	580.17	15.70	548.96	15.70	558.14	15.65	547.14	15.65	556.31			15.64	561.82
15.80	563.65	15.75	548.96	15.76	558.14	15.70	543.45	15.70	561.82			15.68	556.30
15.86	559.98	15.80	550.80	15.80	558.97	15.75	545.30	15.75	561.82			15.74	558.15
15.90	561.82	15.84	554.48	15.85	534.27	15.80	543.45	15.80	563.65			15.78	556.30
15.96	559.99	15.90	556.30	15.90	525.09	15.85	543.46	15.85	563.65			15.84	556.31
16.00	559.98	15.94	554.89	15.95	525.09	15.90	545.29	15.90	563.65			15.88	556.30
16.06	561.82	15.99	575.28	16.00	523.26	15.95	543.46	15.95	563.64			15.94	556.31
16.10	466.65	16.04	583.85	16.05	525.09	16.00	556.31	16.00	563.65			15.99	556.30
16.16	509.07	16.08	572.83	16.10	523.27	16.05	559.98	16.05	561.82			16.04	556.31
16.22	468.18	16.14	525.09	16.15	525.09	16.10	559.98	16.10	563.65			16.08	556.30

(table continues)

TABLE A2 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density	Depth	Density
		16.18	525.10	16.20	523.26			16.15	559.98	16.15	563.65					16.14	556.31
		16.24	525.09	16.25	525.10			16.20	510.74	16.20	512.41					16.18	556.30
		16.28	523.26	16.30	523.26			16.26	559.98	16.26	563.65					16.24	563.04
		16.34	532.44	16.35	525.09			16.30	509.08	16.30	563.65					16.28	559.98
		16.39	536.11	16.40	523.27					16.36	561.82					16.33	561.00
		16.44	537.96	16.45	477.36					16.40	563.65					16.38	561.82
		16.49	537.95							16.46	563.65					16.42	552.84
		16.54	537.95							16.50	626.27					16.47	552.84
		16.59	537.95													16.52	552.63
		16.64	595.68													16.57	564.15
																16.62	565.48
																16.67	564.15
																16.73	565.49
																16.77	563.65
																16.82	514.08
																16.88	512.40
																16.93	565.49

[a]The core sample extends from the corresponding depth to the next deeper depth.

TABLE A3

Oxygen Isotope Ratio (‰) at Depth (m) below the Surface for 1981 Core Samples[a]

L1 (1001)		L2 (12.18)		L5 (15.12)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
0.10	-22.03	0.10	-21.62	0.10	-21.81	0.20	-26.27	0.10	-22.47	0.09	-21.11	0.10	-21.14
0.20	-29.02	0.20	-22.49	0.20	-26.24	0.30	-28.66	0.20	-24.04	0.19	-20.83	0.20	-26.69
0.30	-28.44	0.30	-29.00	0.30	-26.87	0.40	-32.38	0.30	-23.24	0.29	-19.95	0.30	-29.31
0.40	-27.65	0.40	-31.58	0.40	-24.93	0.50	-39.42	0.40	-23.42	0.40	-24.37	0.40	-32.44
0.50	-26.45	0.50	-28.48	0.50	-27.26	0.60	-32.29	0.50	-28.72	0.51	-27.80	0.50	-29.40
0.60	-26.98	0.60	-25.33	0.60	-25.79	0.70	-27.15	0.60	-32.63	0.61	-32.22	0.60	-27.62
0.70	-25.67	0.70	-25.94	0.70	-25.95	0.80	-26.28	0.70	-31.51	0.69	-30.61	0.70	-28.04
0.80	-24.73	0.80	-27.97	0.80	-23.93	0.90	-26.24	0.80	-29.66	0.80	-26.29	0.80	-25.06
0.90	-23.16	0.90	-26.97	0.90	-22.39	1.00	-25.74	0.90	-27.67	0.89	-24.41	0.90	-25.30
1.00	-24.92	1.00	-24.78	1.00	-22.71	1.10	-29.56	1.00	-26.67	1.00	-24.69	1.00	-25.14
1.10	-28.91	1.10	-23.09	1.10	-21.10	1.20	-32.27	1.10	-25.08	1.09	-24.84	1.10	-25.98
1.20	-22.84	1.20	-27.33	1.20	-20.34	1.30	-32.46	1.20	-24.43	1.20	-23.96	1.20	-29.31
1.30	-20.59	1.30	-32.04	1.30	-21.01	1.40	0.00	1.30	-26.12	1.30	-23.49	1.30	-29.14
1.40	-19.44	1.40	-32.33	1.40	-17.98	1.50	-28.08	1.40	-30.01	1.38	-23.36	1.40	-30.99
1.50	-20.93	1.50	-31.64	1.50	-20.39	1.60	-25.91	1.50	-32.90	1.50	-21.37	1.50	-31.04
1.60	-24.75	1.60	-32.04	1.60	0.000	1.70	0.000	1.60	-29.53	1.61	-24.97	1.60	-29.40
1.70	-29.02	1.70	-29.32	1.70	-22.67	1.80	0.000	1.70	-27.21	1.71	-27.37	1.70	-26.74
1.80	-26.14	1.80	-25.90	1.80	-23.18	1.90	-25.15	1.80	-23.74	1.80	-28.91	1.80	-25.16
1.90	-24.40	1.90	-23.00	1.90	-23.15	2.00	-27.80	1.90	-24.73	1.89	-26.88	1.90	-22.01
2.01	-24.36	1.99	-20.56	2.00	-20.84	2.08	-30.49	2.00	-24.54	2.01	-24.45	2.00	-22.87

(*table continues*)

TABLE A3 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
2.10	-23.84	2.09	-21.29	2.11	-22.64	2.17	-32.87	2.12	-22.63	2.11	-25.99	2.09	-28.19
2.21	-22.60	2.20	-20.93	2.22	-23.35	2.23	0.00	2.22	-28.67	2.22	-27.22	2.16	-29.26
2.35	-23.56	2.30	-25.06	2.32	-22.66	2.39	-30.34	2.37	-31.05	2.32	-29.60	2.26	-29.60
2.45	-22.79	2.39	-27.09	2.41	-23.07	2.51	-24.14	2.48	-30.99	2.42	-31.77	2.35	-31.77
2.53	-22.48	2.50	-29.77	2.51	-22.22	2.66	-23.13	2.55	-28.91	2.52	-27.16	2.46	-31.45
2.68	-24.06	2.60	-30.97	2.61	-20.84	2.77	-26.75	2.69	-25.70	2.64	-28.06	2.56	-27.26
2.83	-23.98	2.70	-29.93	2.71	-22.00	2.86	-29.37	2.82	-23.64	2.74	-27.59	2.63	-25.05
2.94	-22.31	2.80	-30.29	2.83	-23.19	2.96	-30.48	2.92	-23.68	2.88	-25.16	2.72	-25.12
3.03	-22.80	2.91	-27.22	2.86	-22.67	3.06	-30.60	3.02	-24.65	2.97	-29.56	2.83	-24.77
3.14	-22.22	3.02	-26.89	2.89	-22.42	3.16	-28.76	3.10	-28.99	3.08	-29.75	2.93	-26.89
3.21	-23.50	3.10	-26.83	3.00	-23.36	3.26	-29.92	3.21	-30.68	3.18	-28.66	3.01	-29.78
3.35	-24.52	3.21	-24.97	3.05	-23.04	3.36	-29.68	3.35	-28.80	3.28	-26.85	3.09	-31.80
3.48	-24.64	3.30	-24.80	3.23	-23.32	3.52	-22.65	3.45	-28.74	3.38	-26.41	3.20	-30.56
3.62	-25.32	3.40	-24.85	3.28	-22.15	3.65	0.00	3.53	-28.73	3.44	-26.31	3.29	-29.11
3.72	-24.56	3.50	-25.55	3.39	-23.29	3.76	-22.73	3.62	-24.13	3.55	-26.26	3.40	-27.18
3.83	-23.58	3.61	-26.57	3.48	-24.80	3.89	-28.92	3.76	-22.77	3.66	-25.15	3.49	-23.75
3.91	-23.80	3.72	-27.56	3.57	-22.36	4.00	-26.19	3.87	-29.34	3.76	-28.13	3.62	-23.62
4.04	-26.65	3.81	-26.72	3.67	-22.19	4.09	-21.15	3.97	-29.04	3.86	-30.70	3.71	-23.57
4.17	-27.04	3.91	-25.64	3.74	-21.80	4.17	-29.34	4.08	-23.91	3.96	-29.67	3.82	-27.63
4.28	-24.93	4.03	-27.41	3.84	-23.03	4.41	-30.41	4.23	-30.31	4.06	-27.07	3.92	-30.55
4.39	-24.74	4.12	-26.68	3.90	-24.35	4.51	-29.40	4.27	-21.56	4.15	-23.84	4.02	-30.80
4.51	-24.39	4.23	-23.68	3.97	-24.50	4.64	-30.01	4.37	-25.04	4.27	-22.03	4.14	-25.04
4.61	-27.81	4.34	-22.75	4.06	-24.21	4.74	-29.80	4.51	-28.80	4.36	-23.80	4.24	-17.66
4.70	-26.78	4.42	-25.12	4.16	-23.45	4.87	-25.04	4.58	-30.72	4.46	-24.51	4.36	-29.30

4.80	-27.09	4.52	-25.30	4.27	-23.60	4.93	-22.69	4.68	-31.29	4.55	-25.53	4.46	-22.06
4.90	-24.54	4.63	-23.52	4.36	-24.28	5.09	-22.99	4.78	-32.74	4.65	-26.13	4.53	-21.94
4.97	-22.79	4.71	-23.92	4.42	-25.81	5.20	-24.32	4.88	-34.40	4.75	-26.02	4.58	-25.87
5.06	-24.30	4.77	-24.86	4.53	-25.23	5.30	-25.91	4.98	0.00	4.81	-26.72	4.71	-28.82
5.15	-26.02	4.89	-25.06	4.63	-25.12	5.35	-26.62	5.02	-28.98	4.93	-25.52	4.82	-29.40
5.22	-26.57	4.97	-27.06	4.74	-25.36	5.45	-26.76	5.11	0.00	5.02	-28.88	4.91	-27.41
5.34	-26.62	5.07	-27.06	4.82	-23.97	5.50	-31.57	5.20	-25.77	5.12	-28.92	5.01	-29.42
5.44	-26.93	5.17	-27.47	4.91	-24.08	5.60	-30.74	5.32	0.00	5.21	-27.99	5.10	-30.08
5.52	-26.21	5.27	-27.84	5.02	-25.06	5.69	-30.58	5.43	0.00	5.31	-29.61	5.20	-28.71
5.61	-25.69	5.39	-27.09	5.10	-25.27	5.80	-24.94	5.54	0.00	5.40	-31.93	5.29	-28.01
5.75	-25.82	5.49	-26.24	5.17	-24.63	5.90	-24.36	5.64	-31.29	5.47	-28.19	5.39	-27.85
5.85	-25.86	5.59	-26.61	5.28	-25.93	6.01	-28.35	5.70	0.00	5.56	-26.69	5.46	-26.82
5.98	-23.42	5.69	-25.24	5.38	-26.27	6.10	-29.51	5.79	0.00	5.65	-26.41	5.54	-27.31
6.11	-26.19	5.75	-25.01	5.46	-24.36	6.20	-29.63	5.89	-27.53	5.75	-24.82	5.63	-28.58
6.21	-24.77	5.86	-24.65	5.53	-24.11	6.24	-28.11	5.99	-24.95	5.85	-25.66	5.74	-30.47
6.33	-25.77	5.96	-25.50	5.64	-24.30	6.34	-27.07	6.10	0.00	5.95	-26.02	5.85	-32.84
6.43	-24.64	6.06	-23.33	5.73	-23.55	6.44	-25.09	6.18	-30.18	5.99	-26.31	5.92	-32.84
6.52	-23.61	6.16	-24.24	5.82	-22.94	6.55	-24.59	6.25	-31.38	6.10	-23.38	6.02	-32.32
6.63	-23.14	6.26	-27.03	5.93	-22.14	6.78	-31.73	6.35	-31.49	6.20	-21.49	6.12	-31.57
6.75	-22.02	6.36	-27.75	6.04	-21.90	6.84	-32.34	6.43	-29.85	6.29	-20.94	6.24	-29.90
6.89	-23.25	6.47	-25.16	6.11	-22.36	6.95	-28.63	6.53	-27.90	6.40	-21.27	6.33	-26.19
7.05	-23.01	6.56	-24.47	6.21	-21.81	7.06	-27.11	6.63	-26.39	6.52	-25.30	6.43	-26.76
7.16	-23.30	6.66	-25.30	6.29	-23.52	7.15	-26.03	6.73	-24.58	6.61	-27.14	6.57	-30.78
7.27	-24.73	6.77	-23.13	6.37	-23.35	7.28	-25.47	6.84	-23.85	6.72	-26.54	6.67	-34.55
7.35	-25.87	6.88	-23.09	6.48	-23.71	7.37	-30.82	6.95	-28.08	6.82	-26.94	6.78	-34.06
7.48	-25.51	7.02	-28.63	6.57	-23.47	7.48	-29.38	7.05	-29.28	6.96	-29.10	6.87	-30.35
7.51	-24.11	7.12	-29.22	6.66	-22.37	7.58	-27.61	7.12	-30.80	7.07	-30.20	6.97	-27.93

(table continues)

TABLE A3 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
7.58	-23.44	7.23	-28.26	6.77	-23.20	7.68	-26.15	7.22	-29.74	7.17	-29.24	7.08	-25.32
7.69	-23.54	7.33	-28.08	6.84	-23.48	7.80	-26.96	7.34	-28.70	7.27	-29.20	7.15	-24.73
7.82	-25.70	7.40	-24.79	6.88	-24.12	7.90	-26.29	7.43	-25.40	7.37	-26.42	7.23	-25.19
7.92	-22.42	7.50	-24.10	6.96	-24.43	7.98	-22.55	7.53	-29.12	7.48	-22.31	7.38	-27.61
8.03	-22.90	7.60	-24.63	7.06	-22.14	8.05	-23.59	7.64	-32.22	7.55	-22.44	7.48	-30.06
8.14	-23.95	7.70	-25.52	7.17	-21.72	8.17	-26.59	7.75	-30.42	7.64	-25.50	7.58	-31.96
8.25	-23.94	7.79	-29.65	7.23	-21.48	8.26	-26.41	7.85	-27.99	7.74	-22.23	7.69	-31.80
8.34	-24.78	7.89	-29.45	7.33	-22.10	8.40	-26.95	7.95	-26.65	7.84	-22.17	7.78	-28.61
8.45	-24.67	7.98	-28.34	7.43	-22.30	8.50	-25.36	8.05	-26.06	7.95	-23.03	7.89	-26.70
8.56	-24.46	8.08	-26.70	7.53	-21.48	8.61	-23.86	8.10	-23.82	7.99	-24.35	7.99	-26.75
8.67	-23.03	8.22	-25.44	7.63	-22.39	8.71	-24.44	8.21	-22.25	8.10	-25.49	8.09	-27.98
8.73	-23.75	8.32	-25.36	7.75	-23.48	8.76	-22.30	8.30	-26.97	8.19	-27.83	8.19	-29.16
8.85	-24.71	8.41	-24.92	7.85	-22.84	8.88	-22.48	8.41	-28.11	8.29	-27.55	8.29	-29.63
8.92	-26.13	8.50	-26.18	7.95	-22.78	8.99	-25.68	8.48	-27.66	8.43	-29.50	8.39	-30.85
8.97	-24.36	8.61	-29.52	8.02	-23.32	9.11	-25.78	8.58	-28.06	8.51	-29.78	8.54	-30.68
9.08	-25.41	8.71	-31.69	8.13	-23.49	9.32	-26.42	8.68	-25.19	8.61	-30.00	8.64	-29.79
9.15	-25.62	8.81	-29.42	8.25	-22.89	9.53	-25.95	8.79	-23.01	8.70	-30.69	8.74	-29.33
9.25	-24.22	8.91	-27.23	8.35	-22.43	9.68	-26.90	8.88	-24.22			8.83	-28.28
9.35	-24.15	9.01	-25.05	8.39	-22.46	9.77	-28.21	9.02	-23.04			8.94	-23.70
9.39	-23.35	9.10	-25.90	8.48	-22.51	9.88	-27.46	9.12	-30.89			9.03	-24.53
9.49	-23.68	9.20	-27.22	8.56	-23.01	9.96	-25.55	9.22	-30.57			9.11	-26.25
9.60	-24.15	9.30	-26.70	8.66	-22.68	10.07	-24.49	9.32	-30.02			9.22	-29.37
9.70	-24.10	9.41	-24.60	8.77	-21.73	10.18	-26.73	6.46	-27.07			9.30	-30.50
9.73	-23.05	9.48	-23.00	8.87	-22.07	10.28	-28.66	9.57	-25.15			9.43	-27.93

9.84	-22.14	9.58	-22.89	8.97	-22.42	10.35	-29.32	9.68	-26.35	9.55	-23.63
9.94	-22.36	9.70	-23.75	9.07	-23.09	10.49	-27.36	9.74	-27.36	9.65	-24.15
10.06	-23.54	9.81	-22.12	9.11	-23.91	10.57	-24.86	9.85	-28.20	9.76	-26.02
10.10	-22.08	9.91	-22.95	9.21	-22.75	10.65	-23.73	9.94	-27.00	9.81	-27.90
10.19	-23.02	10.01	-23.74	9.31	-23.34	10.74	-29.22	10.03	-25.79	9.92	-30.46
10.29	-22.80	10.15	-23.72	9.42	-23.69	10.82	-30.88	10.13	-24.58	10.02	-33.32
10.38	-24.28	10.27	-24.52	9.52	-23.80	10.92	-31.53	10.23	-27.59	10.12	-32.97
10.50	-24.35	10.39	-25.38	9.62	-25.43	11.03	-30.26	10.33	-28.69	10.21	-30.08
10.62	-23.61	10.50	-25.14	9.72	-24.16	11.13	-28.74	10.48	-28.51	10.27	-26.71
10.73	-24.82	10.57	-24.27	9.76	-23.81	11.23	-27.01	10.58	-26.75	10.36	-25.81
10.80	-24.08	10.64	-26.92	9.83	-23.91	11.33	-25.07	10.68	-25.59	10.47	-28.47
10.91	-24.13	10.74	-26.70	9.93	-23.54	11.43	-23.96	10.90	-30.10	10.59	-29.99
10.98	-24.20	10.83	-25.26	10.03	-23.35	11.51	-23.80	11.00	-31.58	10.69	-31.01
11.09	-24.04	10.91	-24.03	10.13	-24.00	11.60	-27.39	11.10	-31.36	10.80	-29.30
11.20	-23.77	10.97	-23.07	10.24	-23.90	11.70	-25.60	11.20	-29.54	10.93	-25.55
11.29	-23.89	11.04	-23.64	10.34	-23.70	11.81	-24.77	11.32	-26.35	11.02	-26.93
11.38	-23.68	11.13	-22.38	10.39	-21.88	11.87	-22.16	11.43	-26.30	11.13	-28.32
11.46	-23.25	11.25	-25.15	10.51	-23.02	11.93	-22.58	11.52	-27.47	11.23	-27.80
11.54	-23.02	11.34	-23.80	10.61	-23.99	12.04	-27.07	11.64	-27.52	11.34	-27.92
11.64	-23.19	11.45	-23.79	10.72	-24.22	12.14	-26.77	11.74	-26.59	11.47	-26.25
11.74	-22.35	11.54	-22.55	10.83	-23.95	12.22	-26.34	11.84	-22.63	11.57	-24.91
11.86	-23.34	11.58	-21.84	10.85	-25.33	12.33	-26.21	11.95	-29.11	11.67	-25.34
11.94	-22.57	11.70	-22.56	10.95	-22.85	12.40	-25.19	12.05	-31.55	11.76	-28.53
12.05	-23.54	11.80	-25.94	11.05	-23.92	12.54	-25.90	12.16	-28.18	11.88	-30.75
12.11	-23.59	11.89	-26.58	11.15	-24.13	12.63	-26.02	12.25	-26.97	11.99	-31.89
12.21	-22.11	11.99	-27.31	11.25	-22.42	12.72	-27.12	12.35	-25.91	12.09	-30.33
12.32	-22.52	12.07	-25.15	11.35	-23.01	12.83	-29.27	12.45	-25.31	12.19	-26.75

(*table continues*)

TABLE A3 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
12.38	-21.92	12.21	-22.23	11.45	-22.80	12.91	-29.72	12.56	-26.89			12.24	-22.96
12.49	-22.52	12.28	-22.69	11.54	-22.01	13.11	-29.04	12.67	-27.45			12.34	-26.39
12.59	-22.87	12.44	-23.48	11.64	-22.46	13.22	-27.83	12.77	-29.26			12.44	-28.04
12.71	-23.98	12.55	-22.78	11.74	-23.51	13.31	-27.08	12.85	-30.85			12.54	-27.84
12.79	-24.14	12.64	-27.76	11.85	-23.44	13.41	-28.48	12.96	-29.66			12.67	-27.28
12.86	-23.91	12.74	-28.85	11.95	-23.91	13.51	-28.51	13.07	-28.31			12.76	-22.84
12.98	-23.90	12.86	-26.88	12.00	-22.59	13.63	-27.29	13.16	-26.80			12.86	-23.01
13.09	-23.99	13.00	-27.49	12.11	-23.06	13.73	-25.89	13.21	-24.51			12.96	-30.04
13.21	-23.61	13.10	-23.61	12.21	-23.08	13.84	-26.05	13.31	-23.48			13.02	-30.68
13.32	-24.00	13.20	-23.87	12.29	-24.69	13.93	-28.64	13.41	-28.38			13.12	-29.98
13.43	-23.24	13.30	-24.54	12.40	-23.97	13.98	-28.09	13.50	-28.97			13.22	-27.55
13.49	-23.54	13.40	0.00	12.50	-25.75	14.08	-27.48	13.61	-28.03			13.31	-25.68
13.58	-23.54	13.51	-24.44	12.58	-25.97	14.20	-26.69	13.72	-26.48			13.44	-25.40
13.69	-23.80	13.60	0.00	12.69	-24.96	14.28	-26.74	13.84	-26.81			13.55	-26.74
13.78	-24.36	13.68	0.00	12.80	-24.69	14.37	-23.83	13.94	-27.81			13.64	-28.00
13.88	-23.63	13.78	0.00	12.92	-23.31	14.47	-30.98	14.04	-25.19			13.74	-28.33
13.97	-24.81	13.87	0.00	12.94	-23.56	14.57	-30.45	14.09	-25.01			13.83	-29.09
14.09	-24.70	13.96	0.00	13.04	-23.96	14.67	-27.81	14.18	-24.38			13.93	-30.62
14.19	-24.85	14.06	-25.83	13.14	-22.05	14.83	-25.71	14.27	-24.88			14.03	-30.36
14.28	-22.16	14.12	-25.59	13.22	-23.18	14.93	-24.32	14.38	-27.55			14.12	-27.44
14.39	-23.27	14.22	-25.84	13.32	-24.40	15.01	-25.14	14.51	-29.14			14.22	-28.09
14.49	-25.75	14.31	-22.17	13.35	-24.58			14.61	-29.35			14.31	-28.48
14.59	-26.32	14.36	-23.91	13.44	-24.44			14.71	-28.42			14.42	-29.55
14.69	-24.35	14.44	-25.13	13.54	-23.99			14.78	-24.91			14.53	-28.69

14.73	-24.57	14.54	-25.04	13.63	-23.64	14.88	-26.78	14.62	-27.55
14.83	-23.55	14.60	-26.82	13.73	-23.92	14.97	-24.59	14.72	-27.27
14.95	-22.83	14.69	0.00	13.83	-23.05	15.05	-24.26	14.82	-30.70
15.03	-22.11	14.80	-30.48	13.94	-23.73			14.91	-32.07
15.13	-23.04	14.91	-26.91	14.03	-23.83			15.02	-28.31
15.24	-24.01	15.01	0.00	14.13	-23.43			15.11	-25.97
15.34	-25.22	15.12	-26.74	14.24	-23.70			15.25	-26.18
15.46	-25.56	15.21	-25.48	14.32	-24.19			15.35	-26.89
15.57	-23.62	15.32	-26.76	14.42	-24.03			15.44	-28.26
15.67	-23.97	15.42	-25.82	14.52	-24.03			15.56	-30.40
15.71	-25.17	15.50	-26.10	14.57	-23.64			15.69	-29.51
15.80	-25.18	15.61	-25.55	14.64	-23.85			15.79	-26.66
15.91	-24.91	15.71	-25.08	14.72	-23.06			15.88	-24.43
16.01	-24.37	15.81	-25.75	14.84	-22.97			16.01	-24.43
16.12	-24.42	15.93	-25.31	14.93	-22.60			16.11	-26.25
16.21	-25.32	16.04	-24.60	15.03	-23.61			16.21	-28.30
16.32	-23.23	16.13	-24.61	15.11	-22.69			16.32	-28.75
16.40	-24.01	16.23	-22.81	15.16	-22.26			16.43	-26.82
16.45	-25.03	16.34	-23.71	15.26	0.00			16.53	-25.24
16.56	-22.49	16.39	-24.58	15.36	-24.63			16.63	-24.73
16.66	-22.48	16.51	-27.07	15.46	0.00			16.73	-23.64
16.78	-23.94	16.60	-25.87	15.52	-24.43			16.84	-23.05
16.87	-23.76	16.71	-24.46	15.62	-24.66			16.93	-25.07
16.96	-24.13	16.82	-24.28	15.72	-24.51			17.03	-28.17
17.08	-24.02	16.92	-24.51	15.83	0.00			17.13	-30.27
17.17	-23.90	17.02	-24.34	15.85	-23.59			17.27	-29.99
17.27	-23.75	17.12	-23.05	15.95	-25.20			17.60	-27.80

(table continues)

TABLE A3 (Continued)

L1 (1001)		L2 (12.18)		L5 (15.12)		U6 (2006)		U7 (2007)		1D (3001)		8D (3008)	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
17.37	-23.89	17.22	-22.78	16.06	-24.47							17.69	-26.24
17.49	-24.05	17.31	-24.70	16.15	-24.17							17.82	-28.14
17.57	-23.48	17.41	-26.99	16.25	-24.79							17.92	-30.32
17.67	-24.21	17.49	-27.95	16.35	-24.26							18.03	-29.46
17.77	-24.51	17.59	-26.96	16.39	-24.61							18.12	-28.54
17.88	-24.31	17.69	-25.21	16.49	0.00							18.26	-25.62
17.98	-24.12	17.81	-24.66	16.59	-25.13								
18.07	-24.06	17.89	-25.26	16.69	0.00								
18.18	-23.74	17.99	-26.03	16.78	0.00								
18.29	-22.98	18.09	-25.96	16.84	-23.17								
18.37	-23.58	18.19	-25.92	16.94	-22.75								
18.49	-23.85	18.27	-26.94	17.01	-24.11								
18.60	-24.00	18.38	-27.58	17.12	-25.49								
18.70	-23.78	18.48	-26.42	17.24	-25.12								
18.80	-23.92	18.59	-25.40	17.33	-24.42								
18.87	-23.95	18.68	-25.08	17.44	-24.04								
18.97	-24.69	18.79	-26.49	17.49	-23.42								
19.08	-22.77	18.87	-24.53	17.63	-23.37								
19.28	-23.11	18.97	-23.55	17.74	0.00								
19.19	23.11	19.06	-24.07	17.85	-23.67								
19.28	-23.65	19.18	-23.10	17.93	-23.57								
19.38	-26.17	19.28	-24.25	18.03	0.00								
19.49	-27.86	19.37	-29.20	18.13	-23.99								

19.56	-25.39	19.41	-25.38	18.24	-23.60
19.67	-25.90	19.51	-23.32	18.33	0.00
19.78	-22.15	19.62	-25.24	18.44	-22.84
19.88	-23.38	19.71	-28.14	18.54	0.00
19.97	-25.07	19.77	-24.41	18.60	-23.87
		19.85	-22.01	18.70	0.00
		19.92	-20.76	18.80	-25.15
		20.03	-22.61	18.90	-24.87
		20.12	-20.92	18.99	0.00
				19.09	-24.79
				19.20	-24.93
				19.30	-23.85
				19.36	-24.70
				19.46	0.00
				19.58	-23.25
				19.70	-22.25
				19.80	-21.69
				19.88	-23.16
				19.95	-23.60
				20.01	-23.54
				20.16	-23.34
				20.26	-23.00
				20.36	-23.18
				20.47	-24.71
				20.58	-23.03
				20.70	-22.23

[a]The core sample extends from the corresponding depth to the next deeper depth.

TABLE A4

Oxygen Isotope Ratio (‰) at Depth (m) below the Surface for the 1987 Cores[a]

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
0.00	-36.84	0.00	-38.11	0.00	-34.23	0.00	-31.52	0.00	-28.12	0.00	-33.28	0.00	-33.85	0.00	-30.59	0.00	-35.33
0.10	-39.19	0.10	-36.00	0.10	-38.48	0.10	-37.33	0.10	-31.06	0.10	-28.88	0.10	-37.49	0.10	-37.66	0.10	-33.82
0.20	-35.87	0.20	-38.31	0.20	-36.94	0.20	-35.59	0.20	-35.39	0.20	-35.55	0.20	-33.83	0.20	-36.31	0.20	-34.45
0.30	-38.39	0.30	-38.50	0.30	-41.62	0.30	-40.51	0.30	-35.46	0.30	-38.90	0.30	-37.39	0.30	-36.52	0.30	-34.66
0.40	-36.74	0.40	-34.33	0.40	-40.48	0.40	-36.28	0.40	-39.11	0.40	-37.11	0.40	-36.39	0.40	-39.43	0.40	-42.10
0.50	-34.84	0.50	-32.15	0.50	-30.56	0.50	-33.58	0.50	-41.71	0.50	-42.07	0.50	-38.24	0.50	-37.10	0.50	-34.38
0.60	-31.48	0.60	-37.82	0.60	-29.89	0.60	-34.04	0.60	-39.40	0.60	-29.37	0.60	-35.00	0.60	-34.10	0.60	-31.22
0.70	-37.03	0.70	-39.31	0.70	-32.19	0.70	-32.38	0.70	-29.31	0.70	-33.19	0.70	-30.42	0.70	-30.95	0.70	-30.43
0.80	-36.55	0.80	-39.19	0.80	-30.37	0.80	-33.00	0.80	-32.17	0.80	-30.62	0.80	-32.52	0.80	-32.09	0.80	-32.16
0.90	-35.76	0.90	-30.90	0.90	-34.29	0.90	-39.71	0.90	-32.26	0.90	-29.29	0.90	-36.84	0.90	-37.82	0.90	-34.94
1.00	-36.62	1.00	-30.16	1.00	-38.03	1.00	-43.66	1.00	-34.38	1.00	-32.09	1.00	-38.85	1.00	-39.52	1.00	-40.04
1.10	-28.78	1.10	-34.38	1.10	-36.22	1.10	-34.00	1.10	-39.16	1.10	-38.34	1.10	-38.04	1.10	-39.21	1.10	-38.65
1.20	-26.84	1.20	-36.79	1.20	-37.67	1.20	-31.51	1.20	-40.02	1.20	-39.63	1.20	-36.30	1.20	-29.24	1.20	-33.42
1.30	-36.01	1.30	-35.88	1.30	-35.08	1.30	-34.95	1.30	-39.05	1.30	-37.12	1.30	-27.73	1.30	-32.86	1.30	-31.32
1.40	-37.10	1.40	-34.67	1.40	-33.58	1.40	-34.68	1.40	-33.21	1.40	-32.30	1.40	-30.91	1.40	-36.04	1.40	-24.53
1.50	-36.65	1.50	-32.49	1.50	-29.05	1.50	-34.45	1.50	-28.87	1.50	-26.35	1.50	-36.52	1.50	-36.62	1.50	-30.66
1.60	-31.54	1.60	-33.08	1.60	-33.39	1.60	-33.23	1.60	-33.44	1.60	-26.87	1.60	-36.15	1.60	-33.19	1.60	-39.29
1.70	-30.45	1.70	-39.68	1.70	-34.79	1.70	-34.10	1.70	-34.71	1.70	-25.52	1.70	-31.81	1.70	-29.35	1.70	-37.89
1.80	-29.95	1.80	-36.57	1.80	-34.32	1.80	-30.89	1.80	-35.62	1.80	-34.12	1.80	-32.64	1.80	-29.28	1.80	-39.14
1.90	-35.65	1.90	-36.82	1.90	-37.45	1.90	-30.33	1.90	-36.73	1.90	-34.87	1.90	-31.20	1.90	-31.71	1.90	-36.31
2.00	-31.87	2.00	-34.65	2.00	-30.81	2.00	-39.26	2.00	-32.80	2.00	-35.58	2.00	-36.81	2.00	-36.19	2.00	-29.80

2.05	-30.83	2.05	-34.24	2.05	-29.75	2.05	-36.78	2.05	-32.14	2.05	-38.91	2.05	-39.70	2.04	-37.29	2.05	-29.39
2.10	-32.40	2.10	-36.49	2.10	-29.34	2.10	-34.48	2.10	-30.53	2.10	-39.65	2.10	-40.50	2.10	-39.13	2.10	-29.10
2.15	-35.15	2.15	-39.29	2.15	-28.12	2.15	-34.28	2.15	-30.86	2.15	-38.54	2.15	-40.04	2.14	-40.09	2.15	-29.26
2.20	-36.27	2.20	-41.39	2.20	-27.45	2.19	-34.15	2.20	-33.57	2.20	-37.45	2.20	-39.57	2.19	-39.33	2.20	-30.98
2.26	-36.06	2.25	-42.27	2.26	-31.15	2.24	-33.13	2.25	-35.76	2.25	-33.98	2.25	-39.02	2.24	-37.83	2.25	-34.73
2.31	-34.57	2.30	-37.51	2.31	-34.96	2.30	-32.20	2.30	-37.33	2.30	-29.63	2.30	-37.25	2.30	-37.57	2.30	-38.05
2.36	-33.06	2.35	-32.34	2.36	-37.30	2.35	-33.87	2.35	-40.41	2.35	-27.50	2.35	-34.11	2.35	-37.15	2.35	-39.64
2.41	-31.74	2.40	-30.37	2.41	-38.70	2.40	-38.89	2.40	-44.02	2.40	-26.63	2.40	-32.52	2.40	-34.85	2.40	-38.93
2.46	-31.27	2.45	-30.51	2.46	-41.51	2.44	-41.22	2.45	-44.80	2.45	-27.19	2.45	-34.05	2.44	-31.79	2.45	-36.22
2.50	-31.35	2.50	-34.58	2.50	-41.99	2.50	-39.98	2.50	-43.38	2.50	-28.03	2.50	-32.24	2.49	-30.21	2.50	-34.81
2.56	-33.23	2.55	-38.41	2.56	-38.64	2.54	-38.82	2.55	-40.49	2.55	-29.48	2.55	-32.85	2.54	-30.30	2.55	-36.16
2.60	-35.17	2.60	-40.02	2.60	-35.21	2.60	-37.84	2.60	-37.80	2.60	-32.14	2.60	-34.64	2.59	-32.57	2.60	-38.33
2.66	-38.02	2.65	-39.70	2.66	-36.00	2.64	-37.75	2.65	-35.77	2.65	-34.38	2.65	-37.18	2.64	-37.75	2.65	-37.05
2.70	-39.67	2.70	-37.40	2.70	-35.86	2.70	-38.38	2.70	-34.69	2.70	-36.93	2.70	-39.23	2.69	-39.96	2.70	-35.31
2.76	-39.97	2.75	-34.03	2.76	-33.57	2.74	-36.44	2.75	-33.18	2.75	-39.41	2.75	-40.02	2.74	-41.20	2.75	-34.47
2.80	-39.11	2.80	-31.17	2.80	-33.28	2.80	-35.84	2.80	-34.04	2.80	-37.47	2.80	-35.15	2.79	-41.05	2.80	-33.24
2.86	-37.37	2.85	-31.57	2.86	-32.91	2.84	-35.67	2.85	-36.36	2.85	-35.07	2.85	-32.95	2.84	-40.76	2.85	-31.10
2.90	-34.40	2.90	-33.79	2.90	-31.93	2.90	-34.62	2.90	-38.85	2.90	-35.31	2.90	-32.10	2.89	-38.35	2.90	-30.29
2.96	-32.27	2.95	-37.09	2.96	-32.41	2.94	-35.61	2.95	-40.15	2.94	-37.19	2.95	-34.94	2.94	-35.59	2.95	-32.62
3.00	-32.99	3.00	-39.07	3.00	-35.29	3.00	-34.92	3.00	-39.77	2.99	-35.43	3.00	-40.96	2.99	-33.88	3.00	-35.09
3.06	-36.63	3.05	-38.58	3.06	-38.94	3.06	-32.26	3.05	-40.89	3.04	-32.23	3.05	-38.59	3.04	-34.39	3.05	-36.67
3.10	-39.93	3.10	-36.04	3.10	-40.95	3.10	-30.88	3.10	-41.45	3.09	-32.94	3.10	-36.25	3.09	-35.34	3.10	-37.17
3.16	-41.85	3.15	-31.83	3.16	-42.57	3.16	-28.84	3.15	-39.46	3.14	-33.55	3.15	-37.28	3.14	-36.99	3.15	-35.38
3.20	-42.13	3.20	-31.00	3.20	-44.04	3.20	-28.99	3.20	-34.52	3.18	-31.24	3.20	-35.16	3.19	-35.76	3.20	-35.16
3.26	-40.69	3.25	-32.30	3.26	-42.99	3.26	-31.17	3.25	-31.77	3.23	-30.32	3.25	-32.70	3.24	-34.54	3.25	-37.32
3.30	-36.99	3.30	-34.80	3.30	-37.66	3.30	-35.18	3.30	-30.79	3.28	-33.25	3.30	-30.52	3.29	-32.14	3.30	-36.72
3.36	-33.58	3.35	-36.64	3.36	-32.66	3.36	-38.17	3.35	-32.54	3.33	-37.54	3.35	-31.30	3.34	-29.87	3.35	-34.43

(table continues)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
3.40	-32.28	3.40	-36.69	3.40	-31.23	3.40	-39.41	3.40	-36.71	3.38	-39.93	3.40	-33.39	3.38	-29.46	3.40	-33.87
3.46	-33.21	3.45	-36.08	3.46	-31.03	3.46	-38.08	3.45	-38.30	3.43	-39.56	3.45	-35.93	3.43	-29.61	3.45	-32.41
3.50	-35.37	3.50	-35.18	3.50	-30.85	3.50	-35.47	3.50	-39.20	3.48	-36.61	3.50	-38.24	3.48	-31.02	3.50	-30.27
3.56	-37.16	3.55	-34.20	3.56	-33.64	3.56	-34.49	3.55	-39.02	3.53	-34.44	3.55	-38.60	3.53	-33.70	3.55	-29.90
3.60	-40.22	3.60	-34.42	3.60	-35.42	3.60	-36.18	3.60	-37.50	3.58	-34.06	3.60	-37.40	3.58	-37.17	3.60	-32.34
3.66	-43.98	3.65	-34.68	3.66	-37.66	3.66	-37.96	3.65	-34.77	3.63	-33.32	3.66	-35.93	3.63	-38.65	3.64	-35.21
3.70	-43.10	3.70	-36.16	3.70	-37.81	3.70	-38.75	3.70	-31.58	3.68	-31.68	3.71	-32.26	3.68	-37.55	3.70	-37.11
3.76	-39.00	3.75	-38.06	3.76	-36.57	3.76	-38.13	3.75	-30.07	3.73	-31.41	3.76	-30.24	3.73	-35.39	3.74	-38.38
3.81	-38.24	3.80	-38.40	3.80	-36.34	3.80	-37.88	3.80	-29.90	3.78	-31.44	3.81	-31.52	3.78	-33.86	3.79	-38.20
3.86	-37.95	3.86	-38.14	3.85	-34.59	3.86	-37.64	3.86	-32.18	3.83	-35.83	3.86	-37.25	3.83	-34.42	3.84	-36.75
3.91	-36.18	3.91	-36.70	3.90	-33.99	3.90	-37.58	3.90	-37.84	3.88	-37.98	3.91	-37.96	3.88	-37.93	3.89	-34.08
3.97	-32.92	3.96	-33.80	3.95	-31.37	3.96	-37.05	3.96	-40.06	3.94	-40.72	3.96	-37.25	3.93	-38.57	3.94	-31.41
4.02	-33.23	4.01	-34.44	4.00	-29.58	4.00	-35.91	4.01	-38.95	3.98	-42.29	4.01	-36.69	3.98	-38.25	3.99	-30.56
4.08	-35.82	4.07	-36.38	4.06	-30.43	4.06	-35.25	4.06	-36.24	4.04	-37.67	4.06	-35.14	4.03	-37.42	4.04	-30.46
4.13	-37.56	4.12	-38.28	4.11	-32.48	4.11	-36.47	4.12	-35.24	4.09	-33.07	4.11	-34.23	4.08	-36.07	4.09	-31.23
4.18	-38.52	4.16	-39.18	4.16	-38.06	4.16	-38.58	4.16	-33.45	4.14	-31.15	4.16	-34.45	4.13	-34.28	4.14	-32.92
4.23	-39.17	4.22	-38.96	4.21	-40.81	4.20	-39.59	4.22	-28.62	4.20	-29.72	4.21	-33.96	4.18	-34.04	4.19	-36.15
4.28	-38.16	4.27	-37.29	4.26	-41.09	4.26	-38.13	4.26	-28.77	4.24	-28.43	4.26	-33.73	4.23	-34.57	4.24	-38.13
4.33	-36.07	4.32	-33.77	4.31	-39.01	4.30	-33.83	4.32	-30.89	4.30	-30.47	4.31	-38.16	4.28	-35.41	4.29	-37.95
4.38	-32.59	4.38	-32.36	4.36	-36.77	4.36	-31.69	4.36	-33.61	4.35	-32.69	4.36	-38.86	4.33	-35.89	4.34	-37.50
4.43	-33.74	4.42	-32.74	4.42	-33.87	4.40	-30.69	4.42	-36.97	4.40	-35.37	4.41	-38.45	4.38	-34.93	4.39	-37.27
4.48	-36.89	4.48	-34.38	4.46	-29.28	4.46	-31.79	4.47	-38.45	4.45	-37.54	4.46	-36.81	4.44	-33.12	4.44	-36.23
4.53	-38.50	4.53	-38.32	4.51	-29.50	4.50	-34.09	4.52	-39.76	4.50	-39.05	4.51	-36.44	4.49	-31.53	4.49	-33.88
4.58	-37.05	4.58	-39.17	4.57	-32.22	4.56	-36.20	4.57	-41.10	4.56	-40.61	4.56	-35.79	4.54	-30.74	4.54	-32.45

4.63	-35.52	4.63	-38.05	4.62	-35.38	4.61	-35.72	4.62	-41.01	4.61	-39.82	4.61	-33.72	4.58	-32.44	4.59	-30.31
4.68	-32.31	4.69	-35.74	4.67	-37.25	4.66	-35.52	4.67	-38.87	4.66	-36.85	4.66	-33.25	4.64	-34.74	4.64	-29.22
4.73	-30.17	4.74	-34.36	4.72	-38.60	4.70	-35.00	4.72	-35.18	4.71	-34.50	4.71	-34.71	4.69	-36.10	4.69	-31.82
4.78	-28.00	4.80	-35.00	4.77	-38.87	4.76	-33.71	4.77	-33.29	4.76	-33.05	4.76	-36.02	4.74	-36.79	4.74	-36.11
4.84	-26.88	4.84	-38.16	4.82	-38.98	4.80	-33.78	4.82	-35.08	4.81	-30.98	4.81	-35.37	4.78	-36.36	4.79	-36.85
4.88	-27.61	4.90	-40.43	4.88	-39.63	4.86	-35.17	4.87	-39.24	4.86	-28.69	4.86	-32.73	4.84	-34.80	4.84	-36.48
4.94	-32.54	4.95	-40.17	4.92	-37.82	4.90	-35.46	4.92	-39.62	4.91	-27.86	4.91	-30.11	4.88	-32.54	4.89	-37.67
4.99	-36.31	5.00	-38.37	4.98	-35.02	4.96	-35.20	4.97	-37.86	4.96	-30.60	4.96	-29.52	4.94	-30.32	4.94	-37.75
5.04	-37.32	5.05	-35.09	5.03	-33.70	5.00	-34.46	5.02	-36.57	5.00	-33.65	5.01	-29.56	4.99	-29.44	4.99	-36.37
5.08	-37.24	5.11	-31.98	5.08	-33.85	5.06	-33.06	5.07	-36.05	5.05	-35.78	5.06	-29.98	5.04	-30.00	5.04	-34.32
5.14	-36.95	5.16	-33.54	5.12	-35.07	5.11	-31.93	5.12	-34.02	5.10	-37.01	5.11	-30.48	5.08	-31.29	5.09	-32.69
5.18	-35.89	5.20	-37.42	5.18	-36.89	5.16	-31.40	5.17	-30.19	5.15	-38.24	5.16	-31.77	5.14	-33.27	5.14	-32.68
5.24	-34.21	5.26	-37.61	5.22	-39.51	5.20	-33.34	5.22	-30.18	5.20	-38.54	5.21	-34.21	5.18	-35.09	5.19	-34.08
5.28	-31.84	5.30	-36.80	5.28	-40.75	5.26	-36.34	5.27	-31.92	5.25	-38.05	5.26	-36.13	5.24	-36.75	5.24	-36.88
5.34	-31.36	5.36	-34.92	5.32	-41.12	5.30	-39.30	5.32	-33.10	5.30	-35.85	5.31	-35.22	5.28	-37.06	5.29	-36.92
5.39	-32.24	5.41	-33.97	5.38	-39.10	5.36	-40.73	5.37	-34.25	5.35	-33.37	5.36	-32.70	5.34	-36.19	5.34	-37.96
5.44	-34.25	5.46	-36.10	5.42	-36.70	5.40	-41.34	5.42	-35.42	5.40	-31.92	5.41	-31.29	5.38	-33.59	5.39	-37.47
5.50	-35.80	5.51	-39.75	5.48	-32.86	5.46	-40.30	5.47	-35.23	5.44	-32.07	5.46	-28.84	5.44	-30.17	5.44	-35.28
5.54	-34.68	5.56	-41.49	5.52	-30.23	5.50	-37.17	5.52	-33.84	5.50	-33.15	5.51	-28.42	5.49	-29.00	5.49	-32.64
5.60	-37.02	5.61	-40.02	5.58	-28.43	5.56	-33.73	5.57	-31.41	5.54	-33.45	5.56	-29.18	5.54	-30.47	5.54	-29.81
5.64	-38.93	5.66	-37.66	5.62	-29.10	5.60	-31.85	5.62	-29.18	5.60	-34.44	5.61	-31.71	5.59	-34.21	5.59	-27.27
5.70	-39.26	5.71	-35.81	5.68	-32.22	5.66	-32.82	5.67	-28.14	5.64	-33.32	5.66	-34.70	5.64	-37.90	5.64	-26.58
5.74	-38.47	5.76	-36.33	5.72	-34.48	5.70	-35.38	5.72	-28.17	5.69	-33.26	5.71	-37.07	5.69	-39.37	5.69	-28.60
5.79	-35.42	5.81	-38.02	5.78	-37.19	5.76	-38.83	5.77	-28.55	5.74	-35.22	5.76	-37.76	5.74	-38.86	5.74	-31.07
5.84	-33.08	5.86	-38.73	5.82	-38.36	5.80	-40.70	5.82	-29.55	5.79	-36.08	5.81	-37.59	5.79	-37.93	5.80	-33.04
5.88	-31.55	5.90	-36.19	5.88	-39.57	5.86	-41.32	5.87	-31.52	5.84	-35.27	5.86	-37.12	5.84	-36.78	5.84	-34.59
5.94	-31.43	5.96	-33.72	5.92	-38.06	5.90	-39.71	5.92	-33.75	5.89	-32.53	5.90	-36.34	5.89	-36.18	5.90	-35.95

(*table continues*)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
5.98	-32.72	6.00	-31.37	5.98	-34.74	5.95	-36.97	5.97	-36.89	5.94	-29.66	5.95	-33.72	5.94	-34.12	5.94	-36.13
6.04	-35.34	6.06	-32.47	6.02	-31.21	6.00	-34.97	6.02	-36.37	6.00	-28.19	6.00	-31.09	5.99	-32.46	6.00	-34.96
6.08	-36.96	6.10	-34.86	6.08	-28.32	6.06	-35.44	6.07	-35.33	6.05	-28.89	6.05	-30.79	6.04	-32.77	6.04	-33.80
6.14	-37.88	6.16	-37.71	6.12	-28.04	6.10	-37.29	6.12	-33.92	6.10	-30.44	6.10	-32.59	6.09	-34.67	6.10	-31.64
6.18	-37.94	6.20	-39.14	6.17	-27.94	6.16	-38.30	6.17	-31.54	6.15	-31.43	6.15	-34.19	6.14	-36.65	6.14	-28.00
6.24	-36.70	6.25	-40.10	6.22	-27.52	6.21	-39.12	6.22	-30.28	6.20	-32.82	6.20	-36.01	6.19	-39.02	6.20	-26.24
6.28	-33.88	6.30	-40.75	6.27	-27.59	6.26	-38.89	6.27	-30.29	6.25	-36.05	6.25	-37.63	6.24	-39.48	6.24	-26.39
6.34	-32.16	6.35	-39.86	6.32	-28.59	6.30	-37.67	6.32	-31.15	6.30	-37.45	6.30	-38.51	6.29	-38.20	6.30	-27.00
6.38	-31.41	6.40	-37.69	6.37	-30.85	6.36	-37.71	6.37	-35.82	6.34	-38.15	6.35	-36.63	6.34	-35.17	6.34	-27.83
6.44	-32.25	6.45	-34.91	6.42	-34.05	6.40	-38.70	6.42	-37.90	6.40	-37.60	6.40	-34.18	6.39	-33.00	6.40	-29.54
6.48	-32.83	6.50	-33.57	6.47	-36.53	6.46	-39.42	6.47	-38.53	6.44	-36.52	6.45	-32.22	6.44	-33.76	6.44	-32.12
6.54	-34.15	6.55	-35.31	6.52	-38.22	6.50	-39.35	6.52	-38.13	6.50	-35.06	6.50	-32.17	6.49	-36.91	6.50	-34.11
6.59	-35.99	6.60	-37.53	6.57	-38.38	6.56	-38.33	6.57	-37.24	6.54	-31.53	6.55	-33.98	6.54	-38.50	6.54	-34.84
6.64	-38.20	6.65	-37.77	6.62	-37.85	6.60	-35.64	6.62	-35.24	6.60	-28.30	6.60	-36.67	6.59	-39.59	6.60	-34.25
6.69	-38.67	6.70	-36.64	6.67	-34.67	6.66	-33.16	6.67	-31.83	6.64	-27.42	6.65	-37.68	6.64	-39.98	6.64	-33.50
6.74	-36.43	6.75	-34.26	6.72	-31.04	6.70	-32.37	6.72	-30.09	6.70	-27.29	6.70	-37.08	6.69	-38.64	6.70	-31.35
6.79	-33.42	6.80	-33.99	6.77	-30.05	6.76	-32.64	6.77	-30.24	6.74	-26.48	6.75	-34.91	6.74	-36.32	6.74	-29.82
6.84	-32.15	6.86	-35.92	6.82	-30.63	6.80	-33.96	6.82	-31.57	6.80	-27.13	6.80	-33.11	6.79	-34.38	6.80	-29.78
6.90	-32.19	6.91	-37.75	6.87	-30.72	6.86	-35.25	6.87	-33.05	6.84	-27.38	6.85	-32.33	6.84	-34.10	6.84	-29.85
6.94	-34.09	6.96	-37.94	6.92	-30.71	6.90	-36.32	6.92	-34.78	6.90	-28.91	6.90	-33.82	6.89	-35.26	6.90	-30.48
7.00	-37.29	7.00	-36.95	6.97	-31.99	6.96	-36.95	6.97	-37.93	6.94	-30.81	6.94	-33.61	6.94	-36.66	6.94	-32.62
7.04	-37.65	7.06	-35.49	7.02	-34.65	7.00	-36.42	7.02	-41.01	7.00	-33.19	7.00	-33.89	6.99	-37.10	7.00	-35.88
7.10	-35.82	7.10	-34.47	7.07	-37.78	7.06	-37.96	7.07	-41.92	7.04	-34.91	7.04	-33.07	7.04	-36.30	7.05	-37.99
7.14	-34.49	7.16	-34.03	7.12	-39.23	7.10	-39.15	7.12	-40.79	7.10	-36.81	7.10	-31.89	7.09	-34.77	7.10	-39.38

7.20	-32.78	7.20	-35.62	7.17	-38.08	7.16	-38.52	7.17	-37.26	7.14	-36.17	7.14	-30.95	7.14	-33.23	7.15	-38.31
7.25	-33.80	7.26	-36.82	7.22	-35.95	7.20	-35.98	7.22	-34.38	7.20	-34.08	7.20	-30.34	7.19	-31.79	7.20	-37.53
7.30	-32.76	7.30	-36.66	7.27	-33.71	7.26	-34.17	7.27	-33.21	7.24	-30.60	7.24	-29.36	7.24	-31.94	7.25	-36.56
7.35	-33.33	7.36	-34.79	7.32	-30.98	7.30	-34.35	7.32	-34.41	7.29	-28.81	7.30	-30.52	7.28	-33.16	7.30	-35.74
7.40	-35.06	7.40	-32.22	7.37	-29.41	7.36	-34.67	7.37	-37.72	7.34	-29.10	7.34	-32.07	7.34	-34.60	7.35	-33.30
7.45	-36.59	7.46	-31.06	7.42	-29.18	7.40	-35.31	7.42	-39.94	7.39	-30.06	7.40	-33.73	7.38	-34.44	7.40	-30.69
7.50	-36.86	7.50	-31.13	7.47	-29.36	7.46	-35.14	7.47	-40.47	7.44	-30.72	7.44	-34.15	7.44	-34.34	7.45	-30.14
7.55	-35.28	7.56	-32.24	7.52	-30.25	7.50	-33.62	7.52	-39.19	7.49	-33.37	7.50	-34.25	7.48	-34.92	7.50	-31.59
7.60	-32.82	7.60	-34.49	7.57	-31.99	7.56	-32.18	7.56	-36.36	7.54	-38.50	7.54	-35.34	7.53	-36.29	7.55	-32.86
7.65	-31.26	7.66	-36.57	7.62	-33.85	7.60	-32.55	7.61	-34.04	7.59	-39.51	7.60	-36.14	7.58	-36.85	7.60	-33.97
7.70	-32.23	7.70	-36.68	7.67	-35.54	7.66	-35.17	7.66	-32.84	7.64	-37.89	7.64	-36.38	7.63	-35.33	7.65	-34.49
7.75	-34.79	7.76	-36.66	7.72	-37.80	7.70	-37.83	7.71	-33.40	7.69	-36.62	7.70	-33.84	7.68	-32.66	7.70	-36.27
7.80	-38.81	7.81	-35.48	7.77	-39.95	7.76	-38.95	7.76	-35.06	7.74	-34.87	7.74	-30.70	7.73	-31.26	7.75	-37.80
7.85	-40.84	7.86	-34.68	7.82	-37.81	7.81	-39.75	7.81	-36.15	7.79	-32.53	7.80	-29.32	7.78	-31.94	7.80	-38.00
7.90	-42.01	7.90	-34.65	7.87	-36.98	7.86	-39.41	7.86	-36.30	7.84	-30.92	7.84	-31.59	7.82	-33.52	7.85	-36.07
7.96	-40.27	7.96	-35.66	7.92	-34.83	7.90	-36.42	7.91	-37.20	7.89	-29.22	7.90	-33.45	7.88	-33.87	7.90	-33.64
8.01	-38.20	8.01	-35.99	7.97	-33.74	7.96	-32.94	7.96	-35.48	7.94	-27.19	7.94	-35.09	7.92	-33.04	7.95	-32.70
8.06	-35.42	8.06	-35.27	8.02	-31.35	8.01	-33.19	8.01	-32.32	7.99	-26.43	8.00	-35.14	7.97	-31.14	8.00	-34.43
8.10	-32.94	8.10	-34.52	8.07	-30.63	8.06	-35.14	8.06	-32.77	8.04	-27.09	8.04	-33.82	8.02	-29.82	8.05	-36.84
8.16	-32.81	8.15	-33.66	8.12	-31.55	8.10	-36.24	8.10	-34.93	8.09	-29.10	8.10	-32.10	8.07	-30.32	8.10	-37.92
8.21	-32.02	8.20	-35.53	8.17	-34.36	8.15	-36.12	8.15	-36.97	8.14	-32.95	8.14	-30.70	8.12	-32.21	8.15	-37.50
8.26	-30.53	8.26	-37.87	8.22	-36.64	8.20	-34.51	8.20	-36.83	8.19	-35.57	8.19	-29.89	8.17	-34.44	8.20	-35.66
8.31	-31.42	8.30	-38.54	8.27	-37.43	8.26	-33.71	8.26	-37.82	8.24	-37.53	8.24	-30.89	8.22	-35.38	8.25	-32.97
8.36	-32.50	8.36	-37.90	8.32	-36.82	8.30	-34.32	8.30	-38.67	8.29	-38.89	8.29	-33.55	8.27	-34.86	8.30	-30.56
8.41	-34.02	8.40	-36.97	8.37	-35.03	8.36	-35.79	8.36	-37.65	8.34	-39.55	8.34	-36.14	8.32	-30.82	8.35	-29.35
8.46	-34.27	8.46	-37.02	8.42	-32.39	8.41	-37.61	8.40	-35.04	8.39	-36.63	8.39	-36.91	8.38	-30.78	8.40	-30.69
8.51	-34.98	8.51	-37.57	8.47	-32.30	8.46	-38.11	8.46	-32.83	8.44	-32.89	8.44	-36.47	8.43	-31.75	8.45	-32.16

(*table continues*)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
8.56	-36.05	8.56	-37.53	8.52	-33.01	8.51	-37.03	8.51	-29.85	8.49	-30.08	8.49	-34.92	8.48	-33.77	8.50	-33.64
8.61	-37.90	8.60	-38.70	8.57	-33.78	8.56	-36.23	8.56	-29.17	8.54	-28.83	8.54	-32.19	8.52	-35.33	8.55	-34.95
8.66	-37.92	8.65	-39.00	8.62	-33.65	8.61	-35.36	8.60	-30.84	8.59	-29.75	8.59	-30.56	8.58	-35.16	8.60	-36.23
8.71	-36.98	8.70	-37.94	8.67	-33.47	8.66	-35.80	8.65	-34.56	8.64	-30.72	8.64	-31.30	8.62	-34.89	8.65	-36.64
8.76	-35.76	8.76	-35.77	8.72	-34.35	8.71	-36.63	8.70	-36.64	8.69	-32.72	8.69	-33.87	8.68	-35.34	8.70	-36.01
8.82	-36.00	8.80	-33.77	8.77	-35.57	8.76	-36.69	8.76	-37.98	8.74	-34.21	8.74	-36.13	8.72	-36.84	8.75	-34.73
8.86	-37.20	8.86	-33.11	8.82	-35.38	8.80	-36.06	8.80	-36.43	8.79	-34.39	8.78	-36.44	8.78	-38.94	8.80	-34.10
8.92	-36.76	8.90	-34.63	8.86	-34.26	8.86	-34.62	8.86	-33.96	8.84	-33.88	8.83	-36.62	8.83	-41.35	8.85	-33.48
8.96	-35.72	8.96	-35.72	8.92	-32.34	8.90	-35.32	8.90	-32.10	8.89	-32.70	8.88	-35.91	8.88	-40.07	8.90	-32.07
9.02	-34.45	9.01	-36.99	8.96	-31.04	8.96	-36.59	8.96	-31.53	8.94	-31.41	8.93	-34.00	8.93	-37.86	8.95	-30.79
9.07	-36.59	9.06	-36.55	9.02	-30.48	9.01	-37.16	9.01	-33.07	8.99	-31.44	8.98	-33.14	8.98	-35.68	9.00	-30.45
9.12	-38.91	9.10	-35.46	9.06	-31.48	9.06	-35.36	9.06	-35.19	9.04	-33.24	9.03	-33.71	9.03	-34.68	9.05	-31.62
9.17	-40.31	9.15	-34.65	9.12	-33.58	9.10	-33.72	9.10	-36.84	9.09	-35.76	9.08	-35.52	9.08	-34.49	9.10	-33.85
9.22	-39.55	9.20	-33.99	9.17	-36.97	9.15	-32.63	9.15	-38.17	9.14	-38.40	9.13	-37.32	9.13	-34.46	9.15	-36.08
9.27	-37.61	9.26	-33.47	9.22	-38.64	9.20	-33.36	9.20	-38.87	9.19	-39.93	9.18	-38.26	9.18	-34.43	9.20	-38.05
9.32	-34.69	9.30	-33.86	9.26	-40.36	9.26	-34.83	9.26	-37.73	9.24	-41.90	9.22	-37.32	9.23	-35.34	9.25	-38.41
9.38	-34.09	9.36	-34.25	9.32	-40.14	9.30	-37.93	9.30	-35.39	9.29	-41.26	9.28	-36.07	9.28	-37.89	9.30	-37.95
9.43	-35.03	9.40	-34.29	9.36	-37.64	9.36	-37.21	9.36	-32.90	9.34	-38.51	9.33	-35.85	9.33	-38.08	9.35	-36.18
9.48	-35.42	9.46	-35.38	9.42	-35.25	9.40	-35.78	9.40	-31.96	9.39	-36.73	9.38	-36.13	9.38	-37.12	9.40	-33.88
9.53	-34.83	9.51	-37.84	9.46	-31.28	9.46	-33.64	9.45	-33.31	9.44	-34.87	9.43	-38.07	9.43	-35.85	9.45	-32.46
9.58	-33.84	9.56	-39.49	9.52	-28.81	9.51	-32.67	9.50	-34.59	9.49	-34.36	9.48	-40.45	9.48	-34.35	9.50	-30.05
9.63	-33.53	9.60	-40.35	9.56	-29.13	9.56	-32.83	9.54	-36.35	9.54	-33.76	9.52	-40.04	9.52	-33.79	9.55	-28.62
9.68	-34.06	9.65	-38.94	9.62	-31.68	9.60	-33.74	9.60	-36.38	9.59	-33.89	9.58	-39.06	9.58	-34.36	9.60	-29.60
9.73	-34.78	9.70	-37.39	9.67	-34.77	9.65	-35.14	9.64	-36.19	9.64	-33.00	9.62	-37.60	9.62	-35.19	9.65	-31.88

9.78	-36.80	9.76	-35.96	9.72	-36.49	9.70	-36.93	9.69	-35.16	9.69	-35.03	9.68	-38.66	9.68	-35.90	9.70	-33.91
9.84	-38.12	9.80	-35.93	9.76	-36.09	9.76	-37.45	9.74	-32.89	9.74	-36.46	9.72	-37.76	9.72	-35.92	9.75	-35.35
9.88	-37.40	9.86	-37.12	9.82	-35.99	9.80	-37.07	9.79	-31.44	9.78	-37.09	9.78	-36.35	9.78	-34.73	9.80	-35.92
9.94	-36.02	9.90	-37.65	9.86	-35.74	9.86	-35.56	9.84	-30.68	9.84	-37.66	9.83	-35.43	9.83	-33.53	9.85	-35.71
9.98	-37.20	9.96	-37.25	9.92	-34.89	9.90	-34.37	9.89	-31.36	9.88	-38.79	9.87	-34.20	9.88	-33.17	9.90	-34.33
10.04	-37.43	10.01	-36.17	9.96	-32.60	9.95	-34.41	9.94	-33.86	9.94	-40.38	9.92	-34.56	9.93	-33.62	9.95	-32.95
10.09	-36.38	10.06	-36.93	10.02	-30.43	10.00	-35.25	9.99	-36.66	9.98	-39.06	9.97	-35.05	9.98	-35.11	10.00	-31.85
10.14	-36.00	10.10	-37.87	10.06	-29.71	10.05	-35.59	10.04	-39.82	10.04	-33.95	10.02	-35.21	10.02	-36.17	10.05	-32.21
10.18	-34.70	10.15	-38.57	10.12	-31.30	10.10	-34.72	10.09	-41.22	10.09	-31.29	10.06	-35.49	10.08	-35.86	10.10	-33.99
10.24	-33.22	10.20	-39.57	10.17	-32.80	10.15	-34.40	10.14	-40.24	10.14	-30.00	10.11	-34.70	10.12	-34.91	10.15	-34.79
10.29	-32.66	10.26	-39.63	10.22	-33.81	10.20	-36.22	10.19	-37.57	10.18	-31.62	10.16	-33.53	10.17	-33.50	10.20	-36.01
10.34	-33.70	10.30	-38.51	10.26	-33.75	10.25	-37.82	10.24	-35.56	10.24	-33.50	10.21	-32.63	10.22	-33.06	10.25	-36.49
10.39	-36.25	10.36	-36.06	10.32	-33.44	10.30	-39.58	10.29	-34.64	10.28	-34.84	10.26	-32.60	10.26	-33.53	10.30	-36.13
10.44	-37.81	10.40	-33.73	10.36	-33.94	10.36	-40.12	10.34	-35.02	10.34	-35.11	10.31	-32.85	10.32	-34.58	10.34	-35.41
10.49	-37.01	10.46	-32.54	10.42	-34.73	10.40	-40.35	10.39	-36.51	10.38	-35.33	10.36	-33.94	10.36	-35.25	10.40	-34.35
10.54	-36.07	10.50	-32.83	10.46	-33.71	10.45	-38.85	10.44	-36.60	10.44	-34.35	10.41	-34.33	10.42	-35.04	10.44	-33.60
10.58	-34.32	10.56	-34.40	10.52	-32.99	10.50	-37.21	10.49	-35.18	10.48	-32.83	10.46	-35.27	10.46	-34.19	10.50	-32.95
10.64	-33.52	10.60	-36.40	10.56	-32.38	10.55	-37.03	10.54	-33.55	10.54	-31.30	10.51	-35.73	10.51	-33.41	10.54	-33.51
10.68	-32.39	10.66	-38.13	10.62	-32.70	10.60	-38.94	10.60	-31.74	10.58	-31.23	10.56	-35.42	10.56	-33.40	10.60	-35.10
10.74	-32.72	10.70	-37.73	10.66	-33.37	10.65	-40.38	10.64	-31.68	10.64	-33.00	10.61	-34.64	10.61	-33.43	10.64	-35.51
10.78	-32.82	10.76	-36.54	10.72	-33.90	10.70	-38.91	10.70	-33.11	10.69	-35.69	10.66	-34.51	10.66	-35.21	10.70	-34.87
10.84	-34.48	10.80	-35.36	10.76	-33.68	10.75	-37.42	10.74	-35.26	10.74	-37.04	10.71	-34.60	10.71	-35.05	10.74	-33.49
10.88	-34.33	10.86	-35.43	10.82	-33.89	10.80	-36.04	10.80	-34.85	10.79	-37.67	10.76	-35.47	10.76	-34.87	10.80	-32.21
10.94	-32.96	10.90	-36.66	10.86	-33.11	10.85	-35.89	10.84	-33.63	10.84	-37.17	10.81	-35.81	10.81	-33.87	10.84	-30.66
10.98	-32.06	10.96	-37.70	10.92	-31.83	10.90	-36.61	10.90	-33.14	10.89	-37.79	10.86	-35.85	10.86	-33.59	10.90	-29.70
11.04	-32.53	11.00	-38.81	10.96	-30.45	10.95	-37.36	10.94	-33.83	10.94	-38.28	10.91	-35.35	10.91	-33.67	10.94	-29.53
11.08	-33.77	11.06	-38.37	11.02	-29.60	11.00	-37.66	11.00	-34.50	10.99	-38.06	10.96	-34.68	10.96	-33.99	11.00	-34.29

(*table continues*)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
11.14	-34.70	11.10	-38.10	11.06	-29.31	11.05	-36.28	11.04	-34.58	11.04	-35.78	11.01	-33.77	11.01	-34.50	11.04	-37.92
11.18	-34.81	11.16	-36.85	11.12	-29.93	11.10	-35.66	11.10	-35.70	11.09	-32.98			11.06	-34.59	11.10	-36.34
11.24	-34.00	11.20	-36.12	11.16	-31.61	11.15	-34.06	11.14	-35.76	11.14	-32.92			11.11	-34.53	11.14	-34.08
11.28	-32.94	11.26	-36.54	11.22	-33.78	11.20	-33.52	11.20	-34.60	11.19	-33.66			11.16	-33.94	11.20	-32.44
11.34	-31.91	11.30	-36.83	11.26	-35.40	11.25	-33.87	11.24	-32.67	11.24	-33.71			11.21	-33.69	11.24	-37.60
11.38	-31.45	11.36	-36.03	11.32	-36.29	11.30	-33.55	11.30	-32.12	11.29	-34.03			11.26	-33.79	11.30	-35.66
11.44	-32.53	11.40	-34.77	11.36	-36.85	11.35	-33.53	11.34	-31.77	11.34	-34.05			11.32	-34.27	11.34	-33.28
11.48	-33.50	11.46	-34.13	11.42	-35.80	11.40	-35.00	11.40	-31.63	11.40	-34.15			11.36	-35.19	11.40	-32.55
11.54	-35.02	11.50	-35.41	11.46	-34.56	11.46	-36.57	11.44	-32.65	11.44	-34.07			11.42	-35.73	11.44	-32.25
11.58	-35.88	11.56	-37.12	11.52	-33.68	11.50	-36.79	11.50	-34.39	11.49	-33.84			11.46	-36.03	11.50	-33.46
11.64	-32.79	11.60	-38.83	11.56	-33.57	11.56	-37.10	11.54	-36.28	11.54	-32.51			11.52	-36.14	11.54	-34.58
11.68	-35.02	11.66	-39.85	11.62	-34.22	11.60	-36.42	11.60	-37.03	11.59	-30.55			11.56	-35.68	11.60	-34.95
11.74	-35.81	11.70	-38.51	11.66	-35.43	11.66	-36.28	11.64	-37.34	11.64	-29.81			11.62	-34.70	11.64	-35.63
11.78	-35.81	11.76	-37.43	11.72	-37.52	11.70	-35.84	11.70	-36.58	11.69	-29.73			11.66	-33.89	11.70	-34.40
11.84	-35.39	11.80	-36.05	11.76	-38.70	11.76	-35.89	11.74	-36.04	11.74	-31.07			11.72	-33.11	11.74	-33.70
11.88	-34.70	11.86	-34.51	11.82	-38.27	11.81	-36.74	11.80	-34.35	11.79	-32.97			11.76	-33.11	11.80	-33.22
11.94	-34.14	11.90	-34.30	11.86	-37.52	11.86	-38.00	11.84	-32.68	11.84	-34.74			11.82	-34.70	11.84	-35.16
11.98	-35.43	11.96	-34.64	11.92	-36.05	11.91	-39.04	11.90	-31.14	11.89	-35.32			11.86	-36.67	11.90	-36.51
12.04	-36.49	12.00	-35.78	11.96	-33.96	11.96	-38.30	11.94	-30.86	11.94	-36.01			11.92	-37.39	11.94	-37.86
12.09	-37.46	12.06	-37.03	12.02	-32.23	12.01	-37.23	12.00	-32.47	11.99	-36.65			11.96	-36.77	12.00	-37.47
12.14	-37.17	12.10	-36.53	12.06	-32.00	12.06	-36.69	12.04	-34.11	12.04	-35.40			12.02	-35.41	12.04	-36.16
12.20	-35.95	12.16	-36.04	12.12	-33.39	12.11	-35.88	12.10	-35.08	12.09	-33.32			12.06	-34.75	12.10	-34.80
12.24	-33.46	12.20	-35.20	12.17	-35.37	12.16	-36.56	12.14	-35.50	12.14	-31.77			12.12	-34.68	12.14	-34.09
12.30	-31.14	12.26	-34.57	12.22	-36.28	12.21	-38.24	12.20	-35.01	12.19	-31.20			12.16	-35.89	12.20	-34.15

12.34	-30.47	12.30	-35.05	12.27	-36.29	12.26	-38.47	12.24	-33.99	12.24	-31.15	12.22	-36.97	12.24	-35.27
12.40	-33.19	12.36	-35.97	12.32	-34.60	12.31	-37.93	12.30	-34.02	12.30	-32.32	12.27	-38.50	12.30	-35.73
12.45	-33.82	12.40	-36.84	12.37	-32.49	12.36	-36.97	12.34	-36.46	12.34	-34.07	12.32	-38.28	12.34	-35.73
12.50	-31.75	12.46	-37.38	12.42	-30.75	12.41	-35.90	12.40	-39.00	12.40	-34.85	12.37	-37.84	12.40	-35.92
12.55	-30.56	12.50	-37.02	12.47	-30.69	12.46	-35.91	12.44	-39.95	12.44	-35.53	12.42	-36.49	12.44	-35.42
12.60	-32.48	12.56	-35.96	12.52	-31.51	12.50	-35.80	12.50	-39.09	12.50	-35.05	12.47	-36.43	12.50	-35.68
12.66	-34.05	12.60	-34.88	12.57	-32.61	12.56	-37.16	12.54	-36.50	12.55	-34.56	12.52	-37.41	12.54	-35.46
12.70	-35.52	12.66	-34.74	12.62	-33.05	12.60	-37.72	12.60	-33.65	12.60	-32.72	12.58	-38.03	12.60	-34.76
12.76	-35.97	12.70	-35.91	12.67	-34.34	12.66	-38.54	12.64	-31.56	12.65	-31.39	12.62	-38.26	12.64	-33.38
12.80	-35.54	12.76	-36.38	12.72	-34.47	12.70	-36.79	12.70	-30.36	12.70	-32.19	12.68	-37.47	12.68	-31.89
12.86	-34.08	12.80	-36.93	12.77	-35.28	12.75	-34.94	12.75	-30.91	12.75	-34.03	12.72	-36.13	12.74	-30.81
12.90	-31.92	12.86	-35.94	12.82	-33.65	12.80	-34.29	12.80	-32.55	12.80	-36.21	12.78	-34.41	12.78	-30.29
12.96	-30.76	12.90	-34.72	12.87	-32.79	12.84	-34.53	12.85	-34.64	12.85	-36.60	12.82	-33.21	12.84	-30.66
13.00	-30.88	12.96	-33.36	12.92	-32.37	12.89	-35.45	12.90	-35.99	12.90	-36.34	12.88	-34.17	12.88	-31.98
13.06	-32.71	13.00	-32.44	12.97	-31.65	12.94	-36.86	12.95	-35.56	12.95	-35.11	12.92	-35.46	12.94	-32.77
13.11	-34.54	13.06	-33.02	13.02	-30.29	12.99	-37.69	13.00	-34.91	13.00	-32.69	12.98	-36.30	12.98	-33.98
13.16	-35.90	13.10	-34.18	13.08	-29.78	13.04	-37.53	13.05	-33.71	13.05	-30.48	13.02	-36.21	13.04	-34.41
13.21	-36.25	13.16	-35.61	13.13	-30.63	13.09	-37.17	13.10	-34.13	13.10	-29.65	13.08	-35.91	13.08	-35.31
13.26	-35.38	13.20	-35.81	13.18	-32.01	13.14	-35.64	13.15	-35.41	13.15	-29.99	13.12	-34.80	13.14	-35.79
13.31	-34.55	13.26	-35.43	13.23	-33.75	13.19	-35.24	13.20	-36.77	13.20	-31.24	13.18	-34.75	13.18	-35.46
13.36	-33.58	13.30	-35.00	13.28	-34.63	13.24	-35.23	13.25	-37.88	13.25	-32.64	13.22	-34.63	13.24	-35.21
13.41	-34.18	13.36	-35.00	13.33	-34.79	13.29	-36.80	13.30	-38.05	13.30	-34.26	13.28	-35.71	13.28	-33.60
13.46	-34.61	13.40	-35.48	13.38	-34.55	13.34	-38.38	13.35	-37.28	13.35	-35.12	13.32	-36.59	13.34	-33.25
13.51	-36.42	13.46	-36.94	13.43	-34.30	13.39	-39.47	13.40	-36.00	13.40	-36.49	13.38	-36.55	13.38	-33.44
13.56	-36.17	13.50	-37.64	13.48	-33.53	13.44	-39.38	13.45	-35.02	13.45	-36.69	13.42	-36.08	13.44	-34.39
13.61	-37.02	13.56	-38.25	13.53	-31.48	13.49	-38.59	13.50	-33.44	13.50	-36.22	13.48	-35.42	13.48	-35.45
13.66	-35.28	13.60	-39.18	13.58	-30.57	13.54	-36.81	13.55	-32.90	13.55	-35.01	13.52	-34.13	13.54	-36.31

(*table continues*)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
13.71	-35.18	13.66	-39.95	13.63	-31.52	13.60	-34.79	13.60	-32.41	13.60	-33.19			13.58	-33.86	13.58	-36.29
13.76	-35.48	13.70	-40.28	13.68	-32.63	13.64	-33.37	13.65	-33.91	13.65	-31.46			13.62	-34.79	13.64	-35.71
13.82	-36.98	13.76	-39.72	13.73	-33.80	13.70	-32.99	13.70	-36.17	13.70	-29.86			13.68	-35.80	13.68	-34.68
13.86	-38.92	13.80	-38.60	13.78	-34.16	13.74	-33.99	13.75	-37.33	13.75	-29.26			13.72	-36.47	13.74	-33.87
13.92	-39.11	13.86	-37.24	13.83	-34.16	13.80	-35.49	13.80	-37.15	13.80	-29.63			13.78	-36.18	13.78	-32.81
13.96	-37.69	13.90	-37.46	13.88	-34.38	13.85	-36.42	13.85	-35.51	13.85	-31.07			13.82	-34.59	13.84	-32.78
14.02	-34.55	13.96	-37.71	13.93	-34.30	13.90	-37.19	13.90	-33.58	13.90	-33.24			13.88	-33.68	13.88	-33.71
14.06	-33.06	14.00	-37.68	13.98	-33.24	13.95	-38.80	13.95	-32.43	13.95	-34.74			13.92	-32.43	13.94	-33.81
14.11	-33.19	14.06	-37.29	14.03	-32.01	14.00	-36.88	14.00	-31.85	14.00	-35.24			13.98	-31.45	13.98	-33.23
14.16	-33.74	14.10	-35.80	14.08	-31.24	14.05	-36.25	14.05	-32.52	14.05	-35.20			14.02	-30.83	14.04	-32.29
14.21	-36.44	14.16	-35.20	14.13	-32.20	14.10	-35.99	14.10	-34.07	14.10	-34.84			14.08	-30.67	14.08	-32.11
14.26	-36.01	14.20	-34.77	14.18	-34.16	14.15	-36.93	14.15	-36.13	14.15	-33.77			14.12	-31.43	14.14	-31.83
14.32	-34.49	14.26	-35.82	14.23	-35.55	14.20	-37.66	14.20	-37.92	14.20	-31.76			14.18	-33.33	14.18	-31.64
14.36	-32.99	14.30	-36.27	14.28	-36.63			14.25	-39.25	14.25	-29.97			14.22	-35.63	14.24	-31.84
14.42	-32.07	14.36	-35.41	14.33	-36.01			14.30	-39.34	14.30	-28.70			14.28	-36.46	14.28	-32.96
14.46	-33.32	14.40	-35.44	14.38	-34.14			14.35	-38.34	14.35	-30.14			14.32	-36.23	14.34	-34.35
14.52	-35.74	14.46	-34.17	14.44	-31.16			14.40	-36.74	14.40	-32.87			14.38	-35.54	14.38	-34.89
14.56	-36.38	14.50	-33.44	14.50	-30.81			14.45	-35.46	14.45	-35.48			14.42	-34.55	14.44	-34.66
14.62	-37.05	14.56	-33.82	14.55	-30.97			14.50	-34.44	14.50	-35.83			14.48	-34.37	14.48	-32.68
14.66	-36.36	14.60	-34.73	14.60	-30.67			14.55	-36.07	14.55	-35.66			14.52	-35.00	14.54	-31.14
14.71	-34.89	14.66	-35.53	14.65	-31.76			14.60	-38.49	14.60	-36.05			14.58	-35.97	14.58	-30.42
14.76	-34.04	14.70	-35.76	14.70	-34.56			14.65	-39.60	14.65	-35.88			14.62	-35.28	14.64	-31.70
14.81	-34.02	14.76	-35.68	14.75	-36.41			14.70	-39.75	14.70	-34.81			14.68	-34.40	14.68	-33.54
14.86	-35.32	14.80	-35.48	14.80	-36.28			14.76	-38.04	14.75	-33.16			14.72	-33.74	14.74	-35.59

14.91	-37.38	14.86	-36.27	14.85	-35.41	14.80	-35.64	14.80	-32.05	14.78	-33.33	14.78	-36.54
14.96	-38.38	14.90	-37.45	14.90	-33.53	14.86	-33.68	14.85	-32.77	14.82	-33.20	14.84	-36.25
15.01	-38.19	14.96	-37.39	14.95	-32.02	14.90	-33.57	14.90	-34.99			14.88	-35.09
15.06	-36.73	15.00	-36.50	15.00	-31.20	14.96	-33.88	14.95	-37.16			14.94	-33.32
15.11	-35.71	15.06	-35.31	15.05	-32.07	15.00	-35.14	15.00	-39.35			14.98	-31.22
15.16	-34.43	15.10	-34.47	15.10	-33.56	15.06	-34.89	15.05	-38.80			15.04	-29.57
15.21	-34.09	15.16	-33.30	15.15	-35.06	15.10	-34.71	15.10	-37.22			15.08	-29.33
15.26	-34.38	15.20	-32.85	15.20	-35.81	15.16	-34.81	15.15	-33.88			15.14	-31.09
15.31	-34.16	15.26	-33.30	15.25	-35.39	15.20	-34.17	15.20	-30.44			15.18	-33.03
15.36	-33.57	15.30	-34.35	15.30	-34.06	15.26	-34.18	15.25	-28.88			15.24	-34.97
15.40	-32.79	15.36	-35.63	15.35	-32.33	15.30	-33.60	15.30	-29.44			15.28	-35.96
15.46	-32.71	15.40	-36.21	15.40	-30.56	15.36	-34.49	15.35	-31.08			15.34	-36.59
15.50	-33.47	15.46	-35.70	15.46	-29.83	15.40	-36.09	15.40	-33.17			15.38	-35.56
15.56	-34.50	15.50	-34.88	15.50	-29.47	15.46	-37.78	15.45	-35.73			15.44	-34.77
15.60	-36.22	15.55	-34.66	15.56	-31.16	15.50	-38.98	15.50	-36.89			15.49	-33.61
15.66	-36.29	15.60	-34.99	15.60	-33.71	15.55	-39.62	15.55	-36.70			15.54	-32.18
15.70	-34.01	15.65	-36.69	15.66	-36.03	15.60	-38.65	15.60	-35.31			15.58	-31.43
15.76	-32.64	15.70	-38.45	15.70	-37.28	15.65	-36.62	15.65	-34.19			15.64	-32.08
15.80	-31.32	15.75	-37.87	15.76	-37.55	15.70	-33.97	15.70	-32.82			15.68	-33.56
15.86	-30.50	15.80	-36.93	15.80	-37.18	15.75	-33.79	15.75	-31.18			15.74	-35.34
15.90	-30.67	15.84	-36.40	15.85	-36.05	15.80	-33.99	15.80	-31.72			15.78	-36.46
15.96	-32.10	15.90	-36.26	15.90	-34.01	15.85	-34.87	15.85	-32.53			15.84	-36.73
16.00	-33.92	15.94	-35.88	15.95	-32.60	15.90	-36.49	15.90	-33.76			15.88	-36.94
16.06	-36.49	15.99	-35.85	16.00	-31.32	15.95	-37.40	15.95	-35.39			15.94	-36.28
16.10	-35.98	16.04	-35.38	16.05	-32.41	16.00	-37.62	16.00	-37.01			15.99	-34.36
16.16	-33.74	16.08	-35.17	16.10	-34.21	16.05	-36.63	16.05	-37.43			16.04	-32.97
16.22	-33.37	16.14	-35.10	16.15	-37.00	16.10	-33.90	16.10	-36.69			16.08	-32.81

(table continues)

TABLE A4 (Continued)

Site 13		Site 15		Site 31		Site 37		Summit		Site 51		Site 57		Site 571		Site 73	
Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$	Depth	$\delta^{18}O$
		16.18	-35.36	16.20	-39.04			16.15	-32.37	16.15	-35.42					16.14	-33.27
		16.24	-36.49	16.25	-40.07			16.20	-31.99	16.20	-33.55					16.18	-34.74
		16.28	-37.15	16.30	-40.65			16.26	-32.26	16.26	-31.80					16.24	-36.01
		16.34	-37.17	16.35	-39.34			16.30	-34.08	16.30	-31.05					16.28	-36.41
		16.39	-36.57	16.40	-37.90					16.36	-31.36					16.33	-36.00
		16.44	-35.33	16.45	-36.18					16.40	-32.75					16.38	-35.26
		16.49	-34.56							16.46	-34.70					16.42	-33.86
		16.54	-34.14							16.50	-35.87					16.47	-32.88
		16.59	-34.90													16.52	-32.85
		16.64	-35.14													16.57	-32.99
																16.62	-34.08
																16.67	-36.00
																16.73	-38.15
																16.77	-38.35
																16.82	-37.74
																16.88	-36.23
																16.93	-34.37

[a]The core sample extends from the corresponding depth to the next deeper depth. Note that the depth given here represents the actual depth below the surface, which differs from the ice equivalent depth used in Figure 10.