on Darwin Glacier. R. Ackert, B. G. Andersen, G. H. Denton, T. Lowell, S. Wilson, and P. Wolcott were in Antarctica from 18 October 1978 to 20 January 1979. J. Bockheim was in Antarctica from 18 October 1978 to 15 December 1978.

Reference

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Pedology of the Darwin Glacier area

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From late October 1978 until mid-January 1979, we worked with glacial geologists George H. Denton and Bjorn Andersen in continuing to investigate the history of the marine-based West Antarctic Ice Sheet. Our objectives were to use soils as a relative-age indicator and as a stratigraphic marker in separating glacial advances in the Darwin Glacier area and in correlating the glacial sequence developed there with the sequence examined previously in the McMurdo Sound area.

Our efforts were concentrated in the Darwin Mountains, Britannia Range, and Brown Hills (figure 1), but also included selected ice-free areas adjacent to the Byrd Glacier and several nunataks in the Darwin and Byrd névés. We described 65 soil profiles and collected 272 samples for chemical, physical, and mineralogical analysis. Surface weathering characteristics were recorded on line transects along moraine crests. Desert varnish, cavernous weathering, ventifaction, planing, pitting, spalling, and fracturing were tallied by rock type. At least 100 boulders were counted.

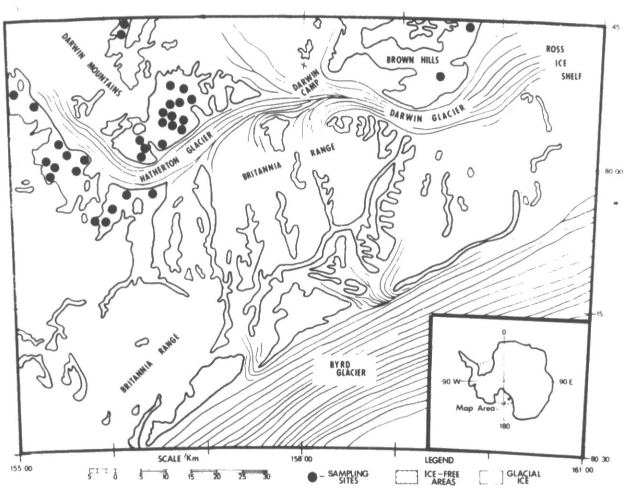

Figure 1. Location of soil sampling sites in Darwin Glacier area.

We examined chronosequences of soils on lateral moraines deposited by the Hatherton Glacier, the level of which appears to have been controlled by periodic grounding of the Ross Ice Shelf. Tentatively, soil-stratigraphic units have been named post-Britannia (advance I, II), post-Danum (III), and post-Isca (IV, V). The post-Britannia and post-Isca soils each may be divided into at least two subunits, possibly representing minor glacial advances. We also examined soils on ground moraine deposited by advances of ice from the polar plateau at elevations above 1,800 meters (Plateau soils).

Depths of oxidation, ghosts, coherence, and visible salts increase progressively with relative soil age (see table). Similarly, desert varnish, pitting, spalling, and fracturing of surface boulders increase with relative soil age. In addition, with relative soil age, surface boulder frequency declines and the ratio of diorite to sandstone boulders increases. Using the paired t-test and properties listed in the accompanying table, we found highly significant differences ($P < 0.01$) between the post-Britannia and post-Danum soils and between the post-Danum and post-Isca soils.

Coefficients of variation are greatest for depth of visible salts and diorite/sandstone. Desert varnish, pitting,

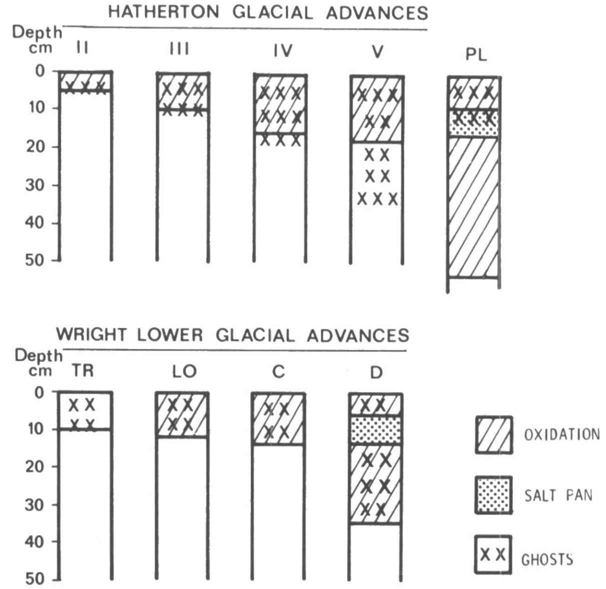

Figure 2. Comparison of soils on moraines deposited by the Hatherton Glacier (Darwin Glacier area) with soils on moraines deposited by the Wright Lower Glacier (McMurdo Sound area).

Table 1. Morphology of soil stratigraphic units and surface weathering characteristics of moraines in the Darwin Glacier area*

	Soil Stratigraphic Unit											
	post-Britannia			post-Danum			post-Isca			Plateau		
Property	n	x	%CV	n	x	%CV	n	x	%CV	n	x	%CV
Depth of oxidation, cm	15	4	62	8	10	34	18	20	80	6	51	62
Depth of ghosts, cm	15	4	110	8	10	50	18	25	64	6	13	72
Depth of coherence, cm	15	5	100	8	22	130	18	40	62	6	50	58
Depth of visible salts, cm	15	0	0	8	8	100	18	15	71	6	34	69
Depth to ice cement, cm	15	80	nd	8	nd	nd	18	nd	nd	6	nd	nd
Desert varnish, %	11	75	20	10	82	20	16	92	5	3	84	23
Pitting, %	11	19	51	10	30	44	16	39	28	3	53	69
Spalling, %	11	18	69	10	18	47	16	32	38	3	6	83
Fracturing, %	11	6	140	10	12	61	16	16	46	3	29	32
Surface boulder frequency	7	1100	63	7	875	29	15	840	44	3	nd	nd
Diorite/sandstone	10	4.2	84	9	8.7	100	16	12	93	2	100	0

* n = number of observations: x = mean value; CV = percent coefficient of variation, i.e., ratio of standard deviation to the mean; nd = not determined.

spalling, and depth of oxidation are least variable. Many of the surface weathering characteristics become more uniform with time. The high variability in post-Britannia and post-Isca soils may be attributable to the fact that each may represent more than one glacial advance.

The post-Britannia soils are similar to those described on the Trilogy end moraine in the eastern Wright Valley (Bockheim, 1978, 1979) (figure 2). Stuiver, Denton, and Hughes (1979) have correlated the Trilogy glacial episode with the Ross Sea glaciation in Taylor Valley. The maximum extent of the Ross Sea glaciation is dated at about 18,000 radiocarbon years before the present (BP). The post-Danum soil resembles the soil on the Loop end moraine and the post-Isca soils are similar to those on C and D moraines in Wright Valley. The D moraine soil was dated by rate of accumulation of soluble salts at about 800,000 to 900,000 years BP (Bockheim, 1979). Plateau soils are similar to those occurring in Taylor Valley on Taylor IV drift (Bockheim, 1977), which is 2.7 to 3.5 million years in age (Denton, Armstrong, and Stuiver, 1971).

These data suggest that the Ross Ice Shelf became grounded in the Darwin Glacier area around 1 million years BP and was last grounded about 18,000 years BP. Like the Wright Valley, but unlike the Taylor Valley, the Darwin Glacier area has ice-free valleys that have not been glaciated as a result of thickening of the East Antarctic Ice Sheet in the past 3 million years.

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