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PRELIMINARY REPORT ON SOIL AND PERMAFROST SAMPLING: BEACON, ARENA AND PEARSE VALLEYS, DRY VALLEYS, ANTARCTICA, NOV-DEC 2001

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April 2005

Soil profile in central Beacon Valley.
At the base of the profile is the massive ice at least 20 m thick and reported to be 8 Ma.
Photo courtesy Ron Sletten

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SUMMARY

This report compiles field data collected in November and December 2001 as part of Event K-047. The sampling programme of this report aims to test a model of permafrost development at Table Mountain by examining soils and ice-cemented sediments from three geologically different locations, which are in close proximity to each other in the Dry Valleys. The three areas include: Beacon Valley for its polygonal ground, glacial sediments and reported old ice, Arena Valley for its potentially old, non glacial soils, and Pearse Valley for its abundance of young glacial sediments at a low elevation. There were three aims to the sampling: 1) To determine if a chemical and mineralogical relationship exists between the soils and ice-cemented sediments. 2) To determine if there are differences in the chemistry and mineralogy of the soils and ice-cemented sediments between the different areas. 3) To determine the relationship of relative soil age, chemistry and ice content to polygonal ground. Evaluation of analytical results may lead to shallow core drilling of certain sites in the future.

1. Introduction

A model to explain the occurrence of ground ice* in glacial sediments and bedrock at high altitudes (>1000m) throughout the Dry Valleys where liquid water is rare was developed from work on Table Mtn. (Dickinson and Rosen, 2003). This model is based on mineralogical, chemical and isotopic analyses of ground ice and frozen sediments that come from cores of Sirius Group sediments at Table Mtn. It indicates that the ground ice and diagenetic minerals accumulated over long periods of time from atmospheric water vapour and brine films formed on the surface of the ground. Although this model may apply at Table Mtn. for the very old glacial sediments of the Sirius Group, it has yet to be tested at other locations in the Dry Valleys.

The sampling programme of this report aims to test the Table Mtn. model by examining soils and ice-cemented sediments from three geologically different locations, which are in close proximity to each other in the Dry Valleys. The three areas include: Beacon Valley for its polygonal ground, glacial sediments and reported old ice (Marchant et al., 2002; Sugden et al., 1995), Arena Valley for its potentially old, non glacial soils (Marchant et al., 1994), and Pearse Valley for its abundance of young glacial sediments at a low elevation.

In sampling and analyzing the soils and their underlying ice-cemented sediments there are three aims: 1) To determine if a chemical and mineralogical relationship exists between the soils and ice-cemented sediments. 2) To determine if there are differences in the chemistry and mineralogy of the soils and ice-cemented sediments between the different areas. 3) To determine the relationship of relative soil age, chemistry and ice content to polygonal ground. Evaluation of analytical results may lead to shallow core drilling of certain sites in the future.

Sampling took place during 3 weeks in Nov – Dec 2001 as part of event K047. Soil pits were generally dug in the centers of polygons to control the comparison between different sites and areas. Polygon centres are thought to be the least active area and hence should contain the oldest most chemically developed soil.

The following method was used in digging most all of the soil pits: In the area to be excavated (1m x 1m x 0.5m), the surface material was scrapped off and placed on a 2m square polythene

*The term "ground ice" refers to all types of ice formed in freezing and frozen ground (Subcommittee, 1988). Permafrost refers to the permanently frozen (<0° C) condition and includes both dry and wet (ice) materials. Subsurface conditions in the Dry Valleys are generally different from those in arctic and alpine environments in that there is usually 30 to 60 cm of dry frozen sediments above ice-cemented sediments. However, because most workers think of permafrost as ice-cemented, the term permafrost in this report will include only the ice-cemented sediments.

tarpaulin. The underlying soil was then dug out and placed on another 2m square polythene tarpaulin. Loose soil material was dug to a depth of one metre or the top of the ice-cemented sediment which ever was the shallowest. The top of the ice-cemented sediment was sampled by using a gasoline powered hammer drill to excavate fist-sized samples. After the soil profile and permafrost were described and sampled, all material from the respective polythene tarpaulins was replaced. The ground surface was raked and swept to restore as much as possible of the original appearance. Analyses of the samples will include; thinsections of soil clods as well as major cation and anion chemistry of soluble salts in the soils and ice from the permafrost. These methods will be used to achieve the three aims listed above.

2. Beacon Valley

Beacon Valley together with its 12 side valleys (McKelvey and Webb, 1959) have the most extensive and best-defined polygonal ground in the Dry Valley area. Elevations of the main valley floor are between 1300 and 1500 m while elevations of the side valleys are about 200 m higher. Winds during the field visit were generally down valley and less than 10 knots, however, diurnal up-valley winds were also encountered. Our camp location was on a small patch of snow on the southwestern flank of University Valley (1650m; S77°51.368′ E160°41.987′) and was selected for the snow patch and central location to the valley. However, due to the rugged terrain and subsequent slow walking, it probably would have been more convenient and as climatically comfortable to camp adjacent to the main valley bottom on the southeastern flank.

The polygonal ground of Beacon Valley was studied in the 1960s (Berg and Black, 1966) and soils of the area have been described by Bockheim (1982), Bockheim and Ugolini (1972), Linkletter et al. (1973), Potter and Wilson (1983), and Ugolini et al. (1973). More recently, weather stations with ground temperature probes have been installed in the lower and central parts of the main Beacon Valley along with strain gauges across polygon troughs (Sletten and Hallet, 2003). In addition, rock glaciers, which are uncommon in the Dry Valleys, emerge out of Friedmann and Mullins Valleys onto the floor of Beacon Valley.

The origin of the debris material on the floors of Beacon Valley and its side valleys remains unclear. Although it appears that at one time a tongue of the Taylor Glacier must have occupied the valley floor, there is no obvious moraine to support this supposition. In addition, recent drilling and ground penetrating radar (GPR) indicate that debris-laden ice lies below 2 – 3 m of ice-cemented sediment on the floor of central Beacon Valley. The thickness of this ice is unknown because surface salts obscure GPR results (R. Sletten, pers. comm.) but it may be over 150 m thick (A. Hubbard, pers. comm.). Marchant et al. (1996) and Sugden et al. (1995) dated volcanic ashes associated with this ice and have suggested that it is more than 8 Ma old.

Polygons on the floor of Beacon Valley have a 10-20 m diameter and 2 – 3 m height differential between trough and polygon centres. Although the diameter of the polygons is not uncommon, the large height differential is and may result from a long development period or the glacial ice core of the valley. The height differential of the polygons in the side valleys is less and does not appear to exceed 1 m. Adjacent to and along the southeast flank of the main valley floor, is a lateral strip that is either absent of polygons or has polygons with the least amount of relief in the area. Depth to ice-cemented ground appears to be 40 – 60 cm throughout the area. In one of the rock glaciers, clear ice was found below the ice-cemented ground at about 30 cm.

The activity of any single polygon or part of it may be reflected by the distribution of the material in the troughs. Parts of troughs are flat having been filled with sand while other parts are steep and rocky with angular cobbles and boulders. This angular material may be sorted or unsorted. On the active part of a polygon, clasts may roll off the steep sides and into the trough. Sorting of clasts in the trough may occur by what the center crack is able to accommodate. On the inactive part of a polygon, wind blown sand may accumulate in the trough. This observation suggests that polygon activity may be dynamic so parts of it are active while at the same time other parts are inactive.

A major problem apparent from the fieldwork is to understand what controls the age of the surface and the relationship to polygon development in Beacon Valley. Alternatively, it may be the ice content below the surface that controls polygon development. Soil development and age may be more of a function of the material, aspect and moisture regime, rather than the depositional age of the material in which the soil is forming. The absence of recognizable glacial deposits in Beacon Valley may reflect the activity of the polygons, which has destroyed the structure of the moraines making them unrecognisable.

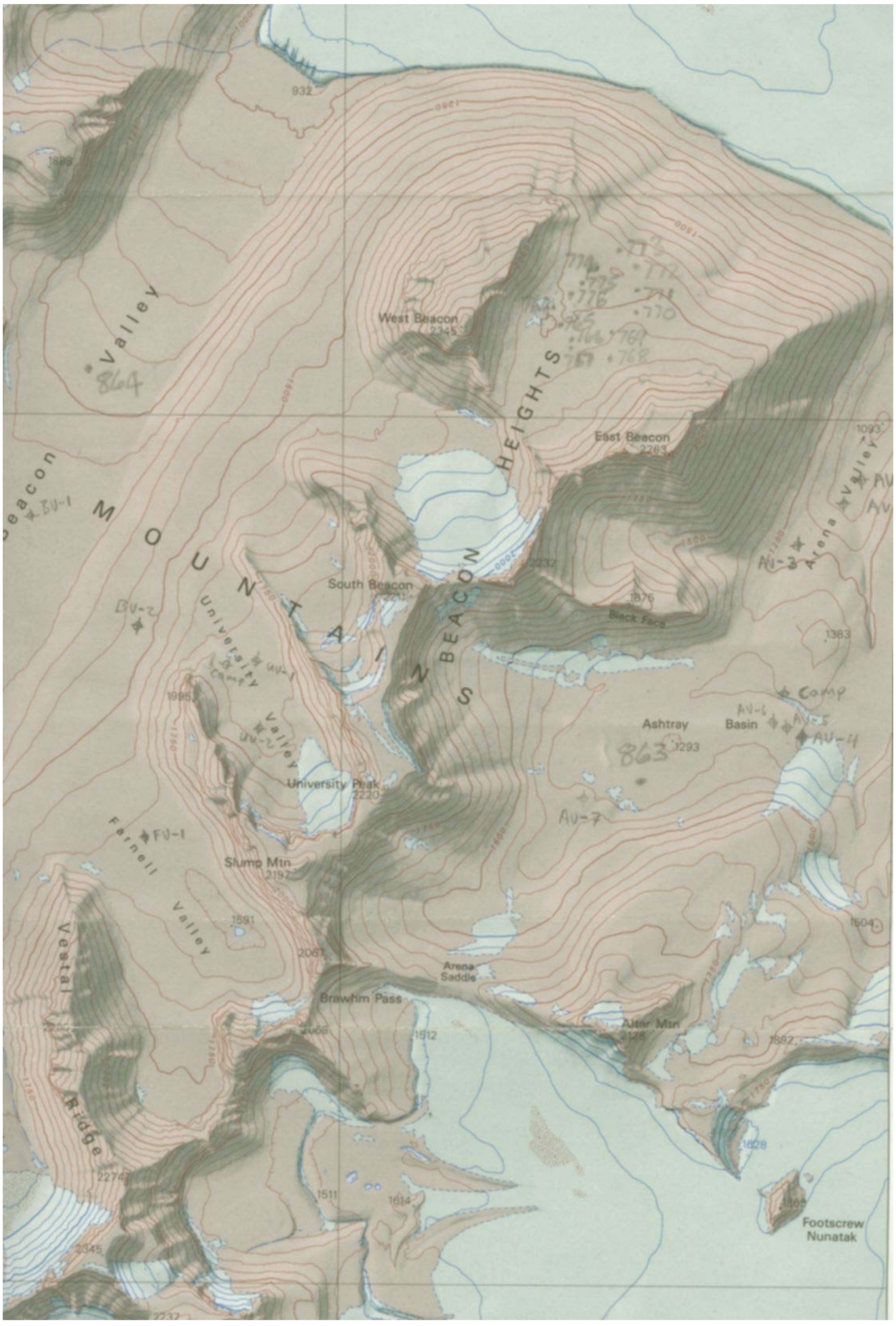

Fig.1 Topographic map showing most of sample sites in Beacon & Arena Valleys

3. Arena Valley

In contrast to Beacon Valley, Arena Valley has little polygonal ground and is mostly underlain by bedrock of Ferrar Dolerite and Beacon Supergroup sediments. Elevations of the main valley floor are about 200 m lower that Beacon Valley and lie between 1100 and 1300 m. Winds, generally down valley, were 10 – 15 knots stronger than Beacon Valley during the field visit and probably averaged between 15 and 25 knots. Our camp was located at the western end (generally the leeward end) of a linear snow patch at the northern edge of Ashtray Basin (1130m; S77°51.593′ E160°56.915′) and was selected for the snow patch and central location to the valley. Wind strength and duration at this location was about average for the valley floor.

Most soils in Arena Valley have developed directly on bedrock, but in some areas they have developed on talus and scree, which have slid off steep valley sides. Except for the terminal moraines marking the retreat of the Taylor Glacier at the mouth of the valley, there are no glacial deposits in the valley. Polygonal ground probably covers less than 10% of the area of the valley bottom and slopes, and appears to be restricted to talus and scree deposits. This would suggest that the lack of polygonal ground in Arena Valley is due mainly to the absence of loose material upon which it can develop. However, local climatic conditions cannot be excluded because most of the polygonal ground also appears to be in areas of increased moisture and snow accumulation. In addition, the overall windy nature of the valley may remove much of the moisture making polygonal ground more difficult to develop.

In addition to talus and scree, polygonal ground was also found to form on sand dunes climbing up the sides of the valley (sites AV-4-6). Pits in the terminal moraines of the Taylor Glacier, showed muds and silts with horizontal bedding suggesting that small lakes or ponds originated from glacial melt water.

Soils in Arena Valley should be relatively older than those in Beacon Valley because of the mobility of polygonal ground that would homogenize soils rather than promote horizonation. Therefore, soils in Arena should be more horizonated both chemically and physically than those in Beacon Valley. Most pavement surfaces in Arena are similar to that apolygonal ground which is found on the southeastern flank of Beacon Valley with well-sorted pebble sized and highly ventifacted pavement surface. The main question in Arena Valley is why there is such an absence of glacial deposits when the adjacent Beacon Valley has been so highly glaciated. In addition, why is polygonal ground absent from the few glacial deposits that are present in Arena Valley?

4. Pearse Valley

In contrast to Beacon and Arena Valleys, the elevation Pearse Valley is much lower and ranges between 400 and 500 m MSL. Our camp was on an alluvial terrace located at the eastern edge of Lake House (325m; S77°42.101′ E161°26.924′) and was selected for its proximity to a source of water. Wind direction and strength seems highly variable throughout the valley and diurnal variations were common. During the field visit, winds did not exceed 20 knots and seemed strongest from 2 – 5 am. In general wind strength and duration were in between those of Beacon and Arena Valleys.

Pearse Valley contains mostly glacial deposits representing the retreat of the main Taylor Glacier and subsequent retreat of the lateral valley glaciers. As a result, the chemical development of the soils should reflect this Holocene deposition and contrast to the older soils in Beacon and Arena valleys. Polygonal ground covers 40 – 50% of the valley floor and slopes, however, this was difficult to estimate due to the lack of snow in polygon troughs.

About 10% of the valley floor is covered by sand from eolian deposition and this does not include numerous pockets of sand lodged in troughs of polygons and in other sheltered areas. Much of this sand is protected by a lag of 5 – 8 mm granules, and therefore, is not mobile under winds of about 50 knots. Much of the sand probably came from stream systems draining meltwater from the retreating glaciers. The main sand dune, climbing the northeast slope of the valley apparently has brine flowing on top of ice-cemented sediment, which accumulates in salt pond (dry on the surface) at the base of the dunes. Ice-cemented samples from the dune and brine from approximately 50 cm deep in the salt pond were taken for chemical analysis.

Depth to ice cement and clear ice under moraines varies in the valley from 0.25 m to >1m and was encountered in every pit except PV-LAK1, the sediments of which may represent an old lake deposit. It is not clear what factors control the depth to ice cement but aspect and moisture regime do not seem to have a direct relationship. In addition, the degree of polygonal ground development does not appear to be directly related to the depth of the ice cement. For example, two pits were dug in the vicinity of PV-7, one in well-developed polygonal ground and the other in poorly developed polygonal ground and ice cement was found at 25 cm in both pits.

Perhaps our most interesting find in Pearse Valley is the presence of clear ice in pits PV-1, 2, 3 & 6. This ice possibly represents an ice-cored moraine, which may have derived from the Schlatter Glacier. The surface of this ice is smooth and it is not clear how the contact between it and loose sand above can be so sharp. Why there is not ice-cemented sand above, suggests the clear ice is ablating under the sand. Although the clear ice seems to have a limited extent, it may have a greater extent if it lies below ice-cemented sediments in other parts of the valley.

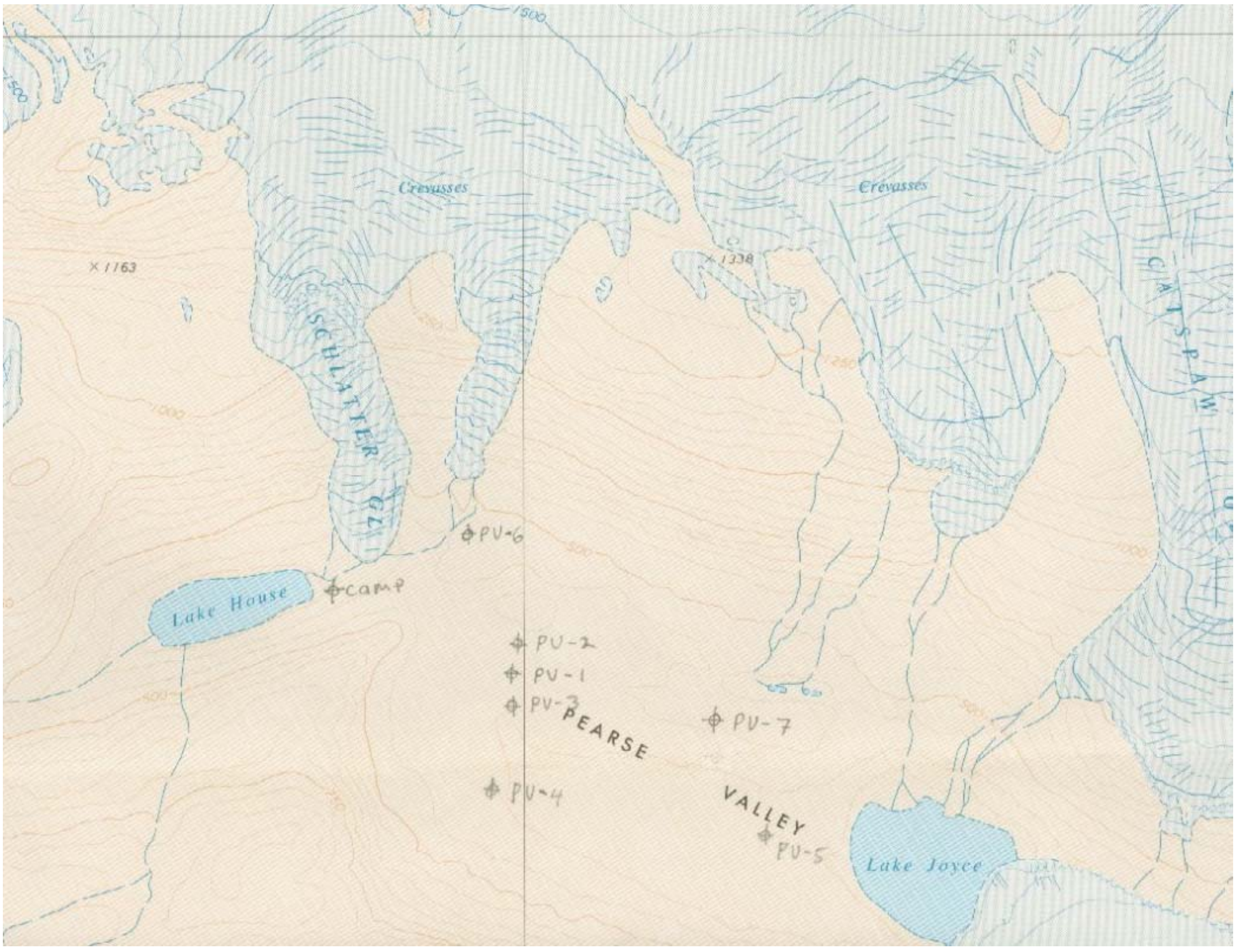

Fig.2 Topographic map showing sample sites in Pearse Valley

Acknowledgements

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Table 1 Summary of survey transects across soil pits

Plate 1 Soil profile of sites Arena Valley and University Valley

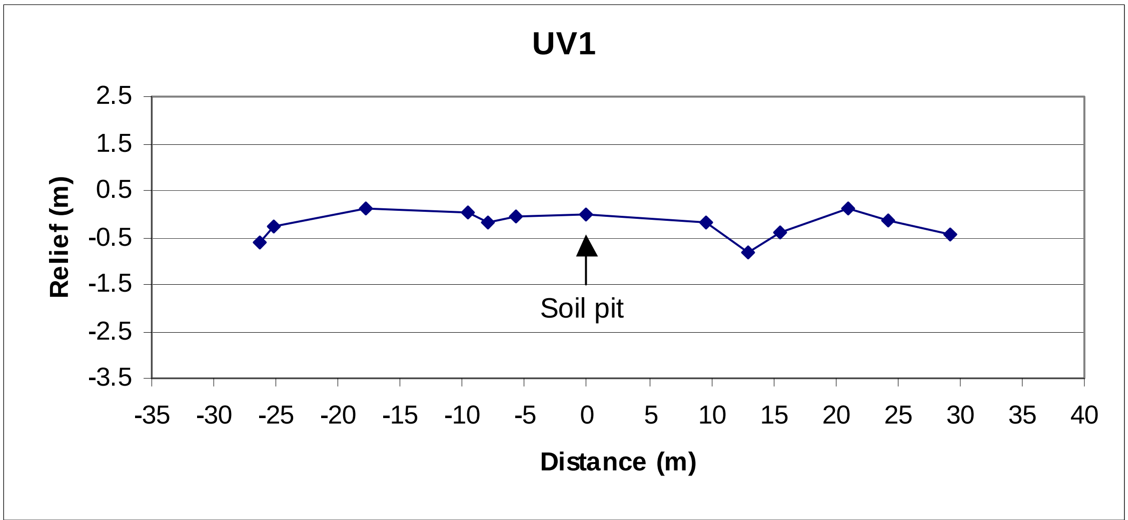
Plate 2 Soil profile of site Pearse Valley

Appendices: Soil Profile Descriptions – Antarctica 2001

Appendix 1: University Valley

UV1 latitude: S77°51.397 longitude: E160°42.536 elevation: 1709m
The first pit was dug near camp in the center of University Valley. It was felt that the chemical development of the soil would be representative of the side valleys. This site was used to test methods and standardize the data collection for other sites. For comparative purposes, all soil pits were dug near the centre of polygons. (Plate 1)
Date: 17/11/01
Depth of oxidation: throughout whole profile with stronger patches 1-12cm
Depth of salt: throughout depth to 22cm – small nodules/flecks
Depth of ghosts: -
Depth of coherence: 22cm
Depth to permafrost: 46cm
Slope: flat
Comments: In center of polygon, not far up valley. More central than camp is in valley. Boulders + gravels oxidized and pitted.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Encrustations	smooth	< 1cm Abrupt
0-1cm	D.P. protected layer	10YR 6/4	slightly gravelly sand	10-15%	nodules	Wavy	1-2cm abrupt
1-12cm	oxidation in patches	10YR 6/3	v. sl. Gravelly sand	5%	Nodules	Wavy	1-2cm abrupt
12-22cm	Less oxidized than above	10YR 7/4	v. sl. Gravelly sand	5%	Nodules	Wavy	2-4cm distinct
22-46cm (PF)	-	10YR 6/4	sand	1%	-	Undulating/ Wavy	-



UV2 latitude:S77°51.859 longitude:E160°42.925 elevation:1726m

A pit was dug near the head of University Valley and used to compare with the UV-1 site. At this site soil development should represent a younger age if glacial retreat was up the valley.

Date: 17/11/01

Depth of oxidation: whole profile, not very strong, decreasing down profile

Depth of salt: surface encrustations only

Depth of ghosts: -

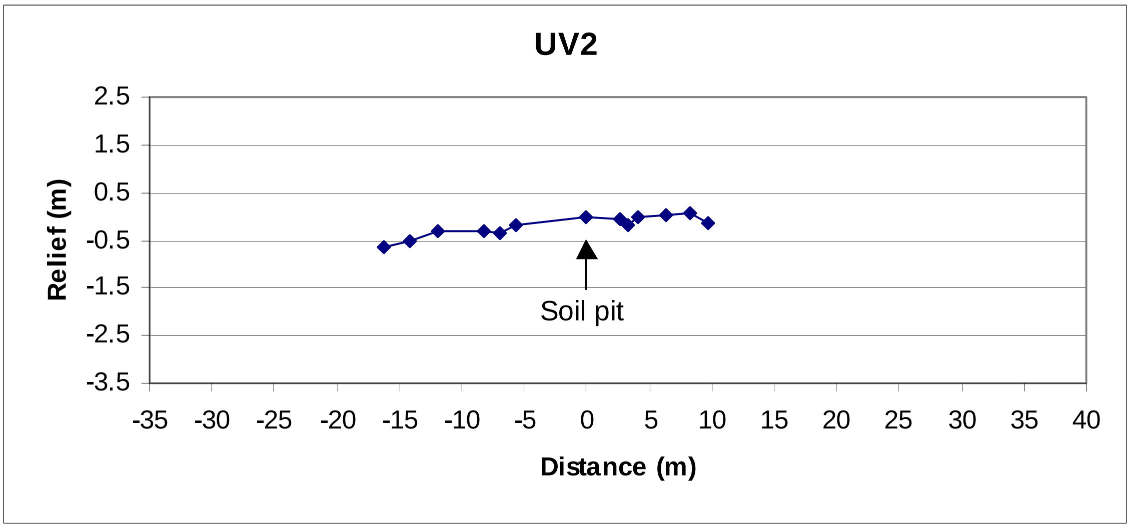
Depth of coherence: 1-8cm

Depth to permafrost: 25cm

Slope: flat

Comments: In center of polygon. Further up UV, away from camp on camp side.

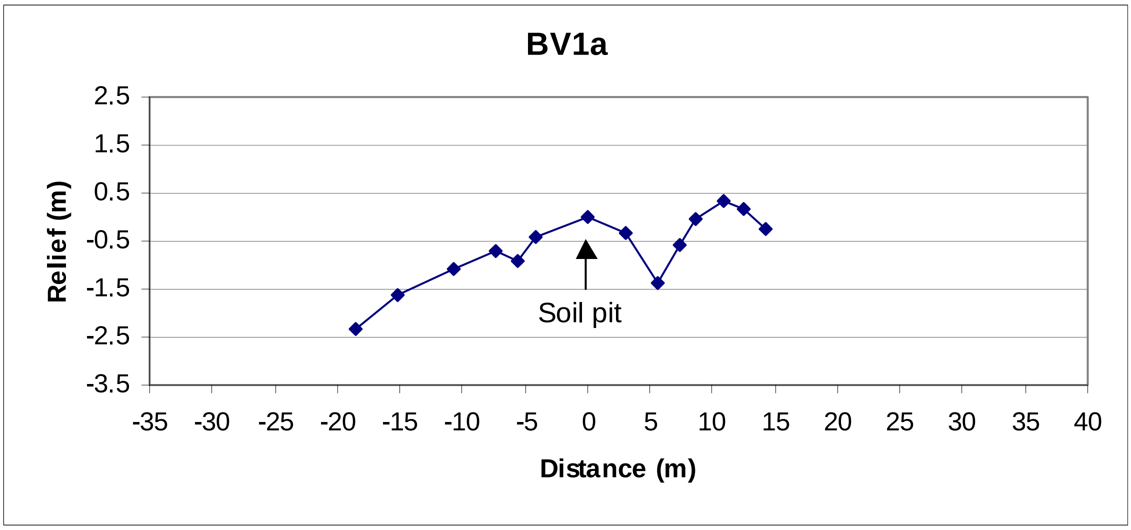
Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	encrustations	smooth	< 1cm Abrupt
0-1cm	D.P. protected layer	5YR 4/4	slightly gravelly sand	10%	-	Wavy	1-2cm abrupt
1-8cm		7.5YR 5/3	coarse sand	-	-	Wavy	5-10cm indistinct
8-25cm (PF)	-	7.5YR 6/4	sand	-	-	Wavy, but less than UV1	-

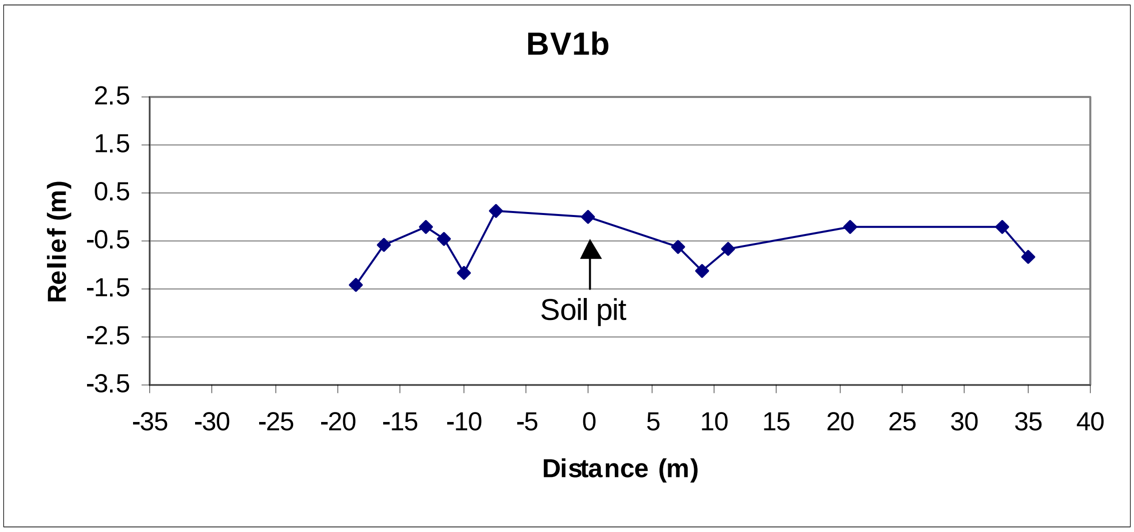


Appendix 2: Beacon Valley

BV1 latitude:S77°50.708 longitude:E160°3.361 elevation:1331m
The pit was dug on centre of a polygon which had a 3 m2 area of pebbles and small clasts to make for easy digging. Soil from this pit should be representative of the central Beacon Valley.
Date: 18/11/01
Depth of oxidation: 45cm
Depth of salt: 45cm
Depth of ghosts: -
Depth of coherence: not noted
Depth to permafrost: 50-65cm
Slope: flat
Comments: In center of polygon, almost directly out from mouth of University Valley into Beacon Valley. Desert pavement boulders up to 1.6m, subangular, oxidized.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
3-0cm	Desert pavement	-	-	-	-	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 5/3	gravelly sand	Not recorded	-	Not recorded	Not recorded
1-15cm		7.5YR 5/6	Coarse sand	-	Encrustations, 4cm nodules, weak pan ~ 3mm thick	Not recorded	Not recorded
15-45cm		10YR 6/3	Gravelly sand	Up to 10cm	Nodules 3cm	Not recorded	Not recorded
45-50cm (PF)	Pale dusty layer	2.5Y 7/2	Sandy silt	-	-	Undulating	-





BV2 latitude:S77°51.070 longitude:E160°39.289 elevation:1460m

A pit was dug on the southeast flank of Beacon Valley on a surface lateral to the floor of the valley. This surface appears to have a unique age and compared to the valley floor is relatively smooth with pebble-sized clasts, which are highly ventifacted. Adjacent to the valley floor this surface has low relief polygons which gradually lose their definition upwards on the valley flanks. There were no polygons and ice cement was deeper than 75 cm at the pit. Soil development should be compared specifically with BV-1 but also with the other sites in the Beacon Valley area.

Date: 21/11/01

Depth of oxidation: -

Depth of salt: -

Depth of ghosts: 7cm diameter (5-12cm) in pale part of profile 2.5Y 5/3

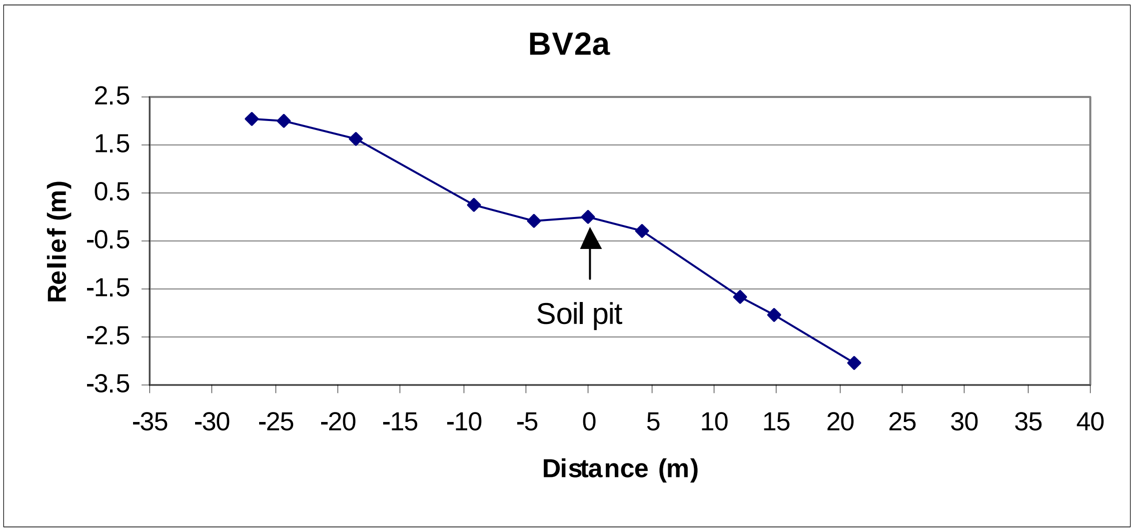
Depth of coherence: 1-15cm for sandy part, whole profile for silty part

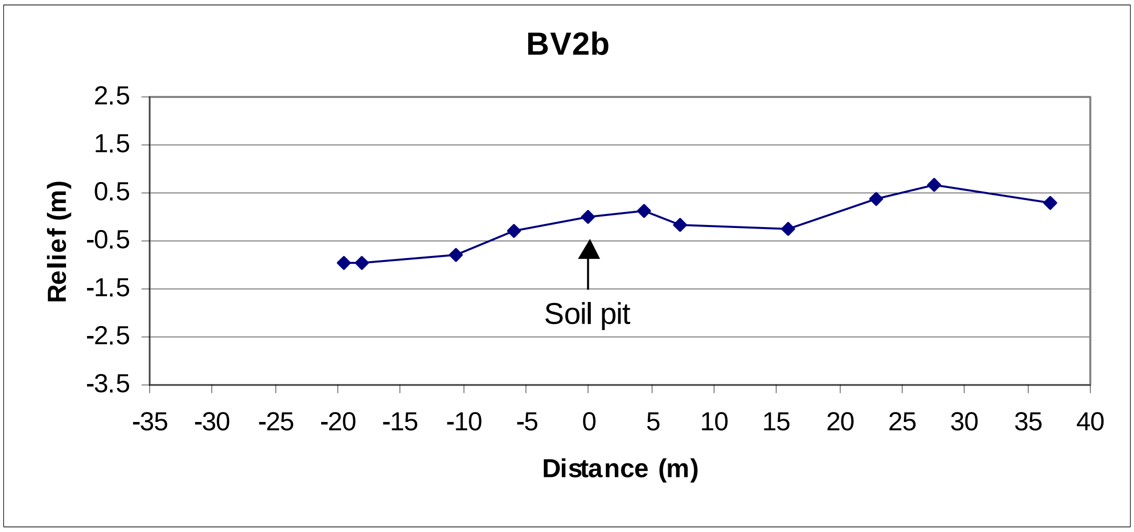
Depth to permafrost: -

Slope: not recorded

Comments: Lateral valley fill for Beacon Valley at mouth of valley. 2 very different profiles in hole one sandy & mostly free flowing, other finer grained sandy silt & pale, holding up in hole. Sandy silt profile same throughout profile but with increasing platy gravel/cobbles with depth. Sampled 1-30cm + 30-75cm. Surface boulders/gravels – lots of sandstone, quartz, diorite, some dolerite. Angular and wind eroded, oxidized. Lots of cobbles (5-10cm)

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
5-0cm	Desert pavement	-	-	-	-	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 7/3	gravelly sand	Not recorded	-	Not recorded	Not recorded
1-15cm	Coherent layer	10YR 6/2	Sand with gravel	Not recorded Subangular-subrounded	-	Not recorded	Not recorded
15-75cm (B.O.P.)	Free flowing sandy layer	10YR 6/2	Sand with gravel	Not recorded	-	Not recorded	Not recorded
1-75cm (B.O.P.)	Pale dusty layer	2.5Y 8/2	Sandy silt	-	-	Not recorded	-

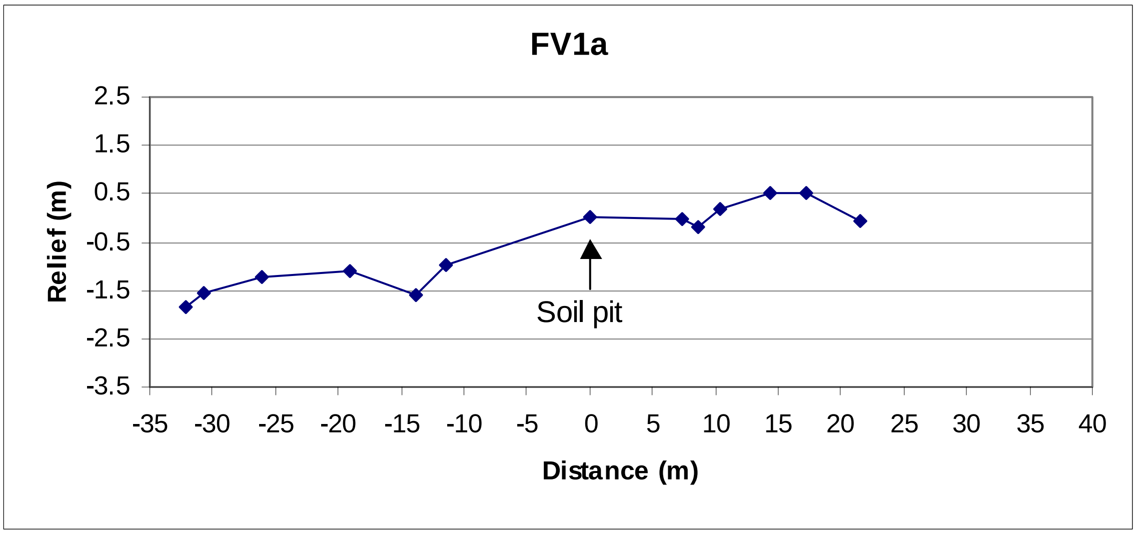

BV2a
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Relief (m)
Soil pit
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
Distance (m)

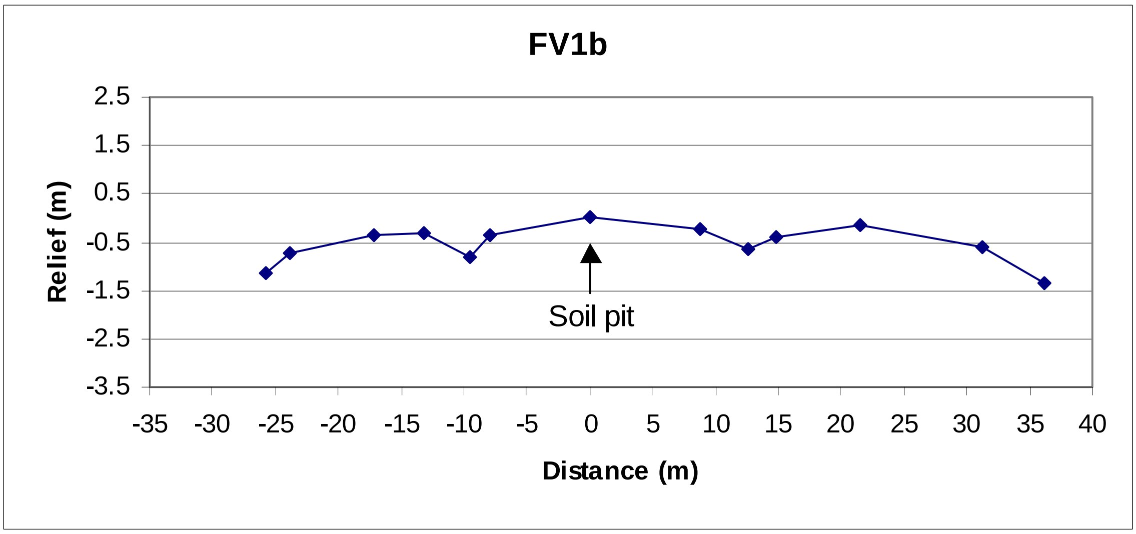

BV2b
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Relief (m)
Soil pit
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
Distance (m)

Appendix 3: Farnell Valley

FV1 latitude:S77°52.577 longitude:E160°39.879 elevation:1610m
This pit is in the centre of the Farnell Valley and soil development should be contrasted with central Beacon Valley as well as University Valley. The side valleys seem to have a parent material of mostly sand which has come from Beacon Group sandstone rather than the doleritic material which is common to the central Beacon Valley.
Date: 19/11/01
Depth of oxidation: whole profile (weakly oxidized)
Depth of salt: 23cm
Depth of ghosts: -
Depth of coherence: not noted
Depth to permafrost: 14-44cm
Slope: flat
Comments: Boulders dominantly dolerite up to 60cm diameter. 15cm common, 5cm common. Sandstone boulders rare.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
3-0cm	Desert pavement	-	-	-	-	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 5/3	gravelly sand	Not record ed	Encrusta tions	Not recorded	Not recorded
1-10cm	-	10YR 5/4	gravelly sand	Not record ed angula r ~2cm	Encrusta tions on gravel	Not recorded	Not recorded
10-23cm	-	10YR 6/4	sand	-	Encrusta tions	Not recorded	Not recorded
23-44cm (PF)	-	10YR 6/4	Sand	-	-	Undulating	-




FV1b
Relief (m)
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Soil pit
-35
-30
-25
-20
-15
-10
-5
0
5
10
15
20
25
30
35
40
Distance (m)

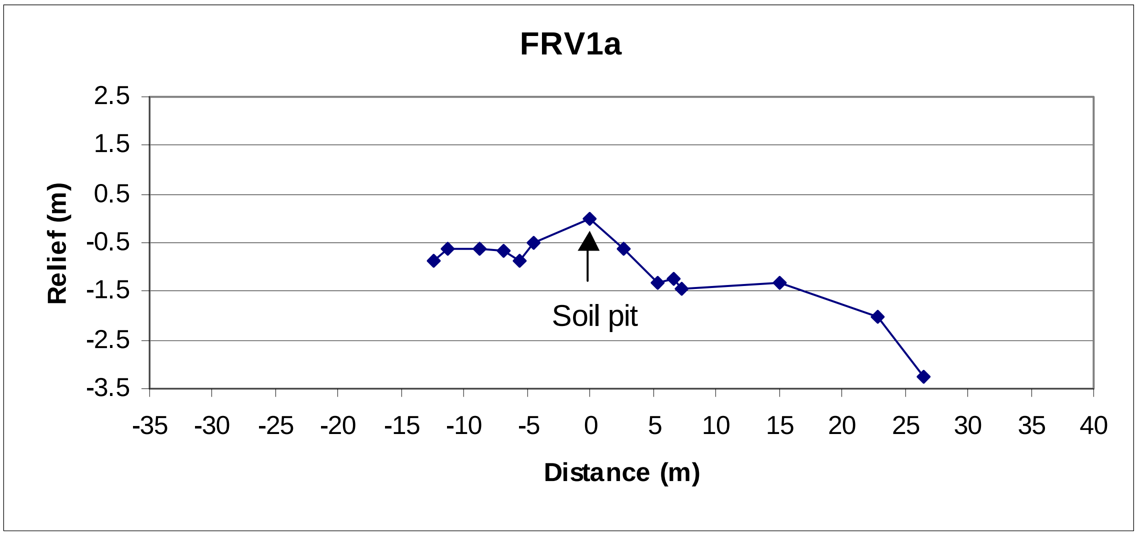
Appendix 4: Friedmann Valley

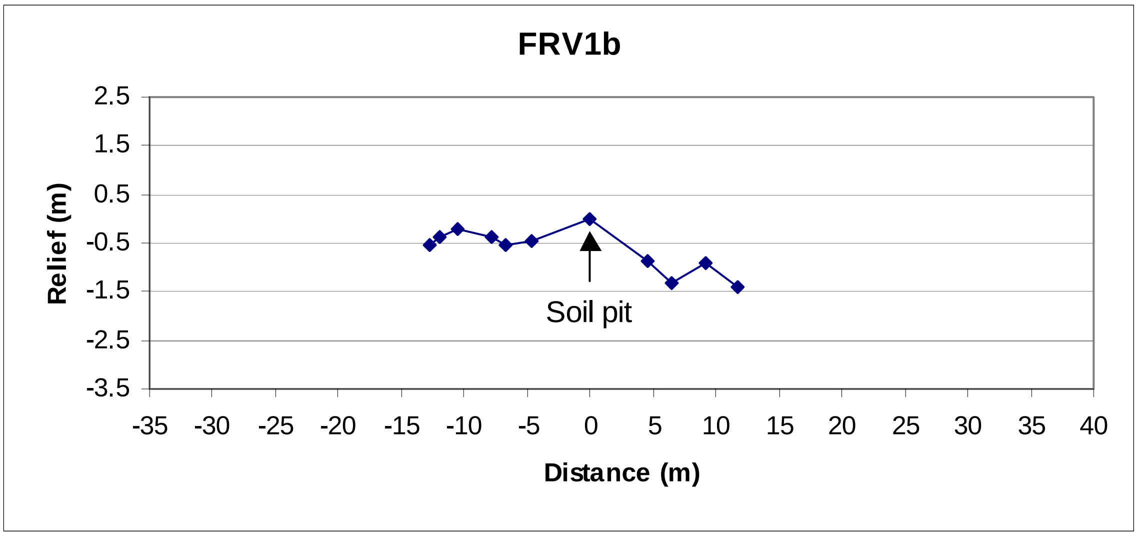
FRV1 latitude:S77°53.553 longitude:E160°30.278 elevation:1450m

This pit was dug on the snout of the main rock glacier emerging from Friedmann Valley. The soil was very thin with ice-cemented soil at 10 cm overlying glacial ice at 30 cm. This soil should be contrasted with that from FRV-2 on the floor of Beacon Valley in front of the rock glacier.

Date: 20/11/01
Depth of oxidation: patchy 1-10cm
Depth of salt: desert pavement
Depth of ghosts: -
Depth of coherence: -
Depth to permafrost: 10cm
Slope: flat
Comments: Boulders common, dolerite angular – subangular up to 70cm diameter. No pitting.

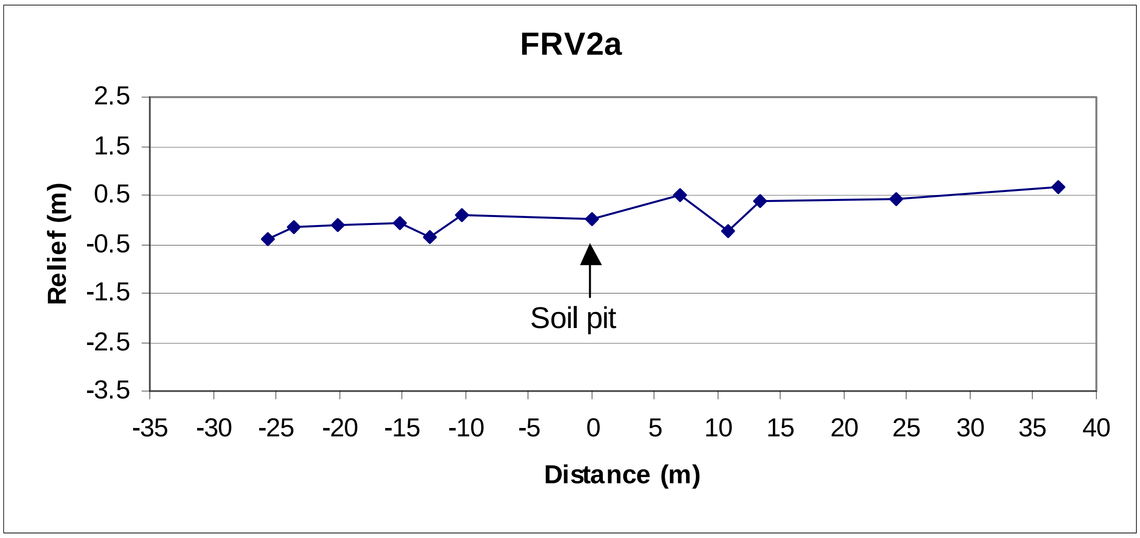
Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Encrustations (a little)	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 5/4	gravelly sand	Not recorded	-	Not recorded	Not recorded
1-10cm (PF)	Oxidized in patches	10YR 4/3	V. slightly gravelly coarse sand	1% fine gravel	-	Not recorded	-

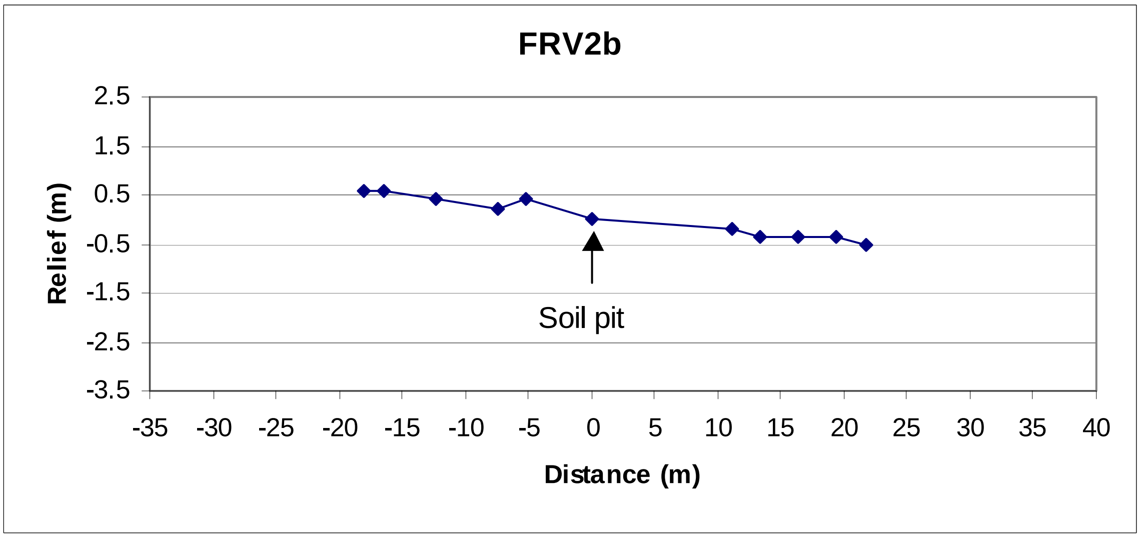




FRV2 latitude:S77°53.414 longitude:E160°30.768 elevation1410m:
The pit was dug on the valley floor which is being over ridden by the Friedmann Valley rock glacier. Soil development should be compared to that of BV-1 & 2 as well as FRV-1.
Date: 20/11/01
Depth of oxidation: whole profile (weakly oxidized)
Depth of salt: Desert pavement
Depth of ghosts: -
Depth of coherence: 20cm
Depth to permafrost: 42-56cm
Slope: flat
Comments: Boulders dominantly dolerite up to 30cm diameter, smaller than FRV1. Subangular – subrounded. Lots of ventifacts, pitting, oxidation, appears to be an older surface than FRV1. Boulders/cobbles/gravel in hole mostly angular/subangular.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Encrustations	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 5/4	Moderately gravelly sand	30%	-	Not recorded	Not recorded
1-3cm	-	10YR 5/6	Fine sand	-	-	Not recorded	Not recorded
3-12cm	-	10YR 5/6	V. slightly gravelly sand	1%	-	Not recorded	Not recorded
12-20cm	-	10YR 5/4	Slightly gravelly sand	5-10%	-	Not recorded	Not recorded
20-45cm (PF)		10YR 5/4	sand	-	-	Undulating	-


FRV2a
Relief (m)
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Soil pit
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Distance (m)


FRV2b
Relief (m)
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Soil pit
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Distance (m)

Appendix 5: Arena Valley

AV1 latitude:S77°50.287 longitude:E160°58.876 elevation:1144m

The site is on a termainal moraine deposit which is probably less than 2 m thick but includes compacted muds with horizontal bedding, suggestive of deposition in standing water. Samples were collected to determine if a nitrate-inventory age is possible and to contrast this with the soils at AV-2.

Date: 26/11/01

Depth of oxidation: 1-3cm weakly oxidized

Depth of salt: not recorded

Depth of ghosts: -

Depth of coherence: 55cm (B.O.P.)

Depth to permafrost: -

Slope: not recorded

X-Ray (only soluble salts + gypsum)

(0 m) efflorescence or encrustation on surface

Halite NaCl

Gypsum CaSO4•H2O

Thenardite Na2SO4

Soda Nitre NaNO3

Bloedite Na2Mg(SO4)2•4H2O

Darapskite Na3(NO3)(SO4) •H2O

(2-5 cm) nodule

Soda Nitre NaNO3

Darapskite Na3(NO3)(SO4) •H2O

(10 cm) accumulation on clast

Soda Nitre NaNO3

Darapskite Na3(NO3)(SO4) •H2O

Gypsum CaSO4•H2O

(depth?) red salt accumulation on dolerite clast

Soda Nitre NaNO3

Epsomite MgSO4•7H2O

Gypsum CaSO4•H2O

Comments: DP boulders – exfoliation, ventifacted & pitting on dolerite surfaces. Up to 2m diameter (rare), subangular – subrounded. Some granite gravels, rounded quartz and some sandstone gravels. Non sorted pavement. No pattern ground. NB: 2 descriptions for 35-55cm, given for different sides of pit.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Up to 3cm thick below gravel	Not recorded	Not recorded
0-1cm	D.P. protected layer	10YR 7/3	Sandy gravel	Not recorded	-	Not recorded	Not recorded
1-3cm	-	10YR 6/4	sand	-	-	wavy	Abrupt, 1cm
3-15cm	Salt pan layer	10YR 7/3		Not recorded gravel present	Salt pan (5cm thick)	Not recorded	Not recorded
15-25cm	Less coherent than above layer	10YR 7/4	gravelly sand	Angular gravel present	-	Not recorded	Not recorded
25-35cm	Granite/ dolerite clast(15cm)			-	-	Not recorded	Not recorded
A 35-55cm (B.O.P.)		10YR 7/4	Silty sand	-	-	-	-
B 35-55cm (B.O.P.)	Lake sediments??	2.5Y 7/3	Silt/clay	-	-	-	-

AV2 latitude: S77°50.508 longitude: E160°58.476 elevation: 1149m
The pit was dug in the uppermost and hence stratigraphically oldest Taylor Glacier moraine about 200 m away and 20 m higher than site AV-1. (Plate 1)
Date: 27/11/01
Depth of oxidation: 1-6cm
Depth of salt: 6cm
Depth of ghosts: -
Depth of coherence: 6-44cm
Depth to permafrost: -
Slope: 1-2° north facing
X-Ray (only soluble salts + gypsum)

(0 m) efflorescence or encrustation on surface

Soda Nitre $NaNO_3$
Darapskite $Na_3(NO_3)(SO_4)\cdot H_2O$
Epsomite $MgSO_4\cdot 7H_2O$

(depth?) accumulation on dolerite clast
Bloedite $Na_2Mg(SO_4)_2\cdot 4H_2O$

Comments: slightly sorted gravel (dolerite and sandstone) up to 7-8cm. Boulders (dolerite) common, 0.5cm - 2m. Larger, plus more boulders than AV1. Gravel subangular – subrounded. Wind carved / salt eroded, exfoliation, oxidation, some pitting. Not much salt below desert pavement – difficult to find. No pattern ground. Moraine deposit on / with deformed beds of sand, gravel + clay. Clays = compact, sands = loose.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	-	-	-
0-1cm	D.P. protected layer	10YR 7/3	Moderately gravelly sand	30%	-	Wavy	<1cm
1-6cm	oxidised	7.5YR 5/6	Moderately gravelly sand	20%	encrustations	Wavy	1-2cm
6-16cm	Compact sandy gravel	10YR 7/3	Very gravelly sand	50%	-	Wavy	<1cm
16-28 cm	Compact gravelly sand	10YR 6/6	Moderately gravelly sand	15%	-	Wavy	1-2cm
28-39 cm	Sandy silt	10YR 7/6	V. slightly gravelly sandy silt	2%	-	Wavy	1-2cm
39-44 cm	Compact sandy gravel	10YR 6/4	Slightly gravelly sand	10%	-	Wavy	<1cm
44-76 cm (B.O.P.)	Non coherent	10YR 7/3	V. slightly gravelly sand	1%	-	-	-

AV3 latitude:S77°50.699 longitude:E160°57.327 elevation:1240m

This site is about 400 m away and 90 m higher than AV-2 and represents the surface over which the Taylor moraines would have been deposited. Stratigraphically, it is the surface which underlies and hence is older than the oldest moraine at AV-2. Need to compare chemistry with AV-1 & 2.

Date: 27/11/01
Depth of oxidation: 1-2cm
Depth of salt: 33cm (B.O.P)
Depth of ghosts: -
Depth of coherence: -
Depth to permafrost: -
Slope: flat

X-Ray (only soluble salts + gypsum)

(0 cm) efflorescence or encrustation on surface

Soda Nitre $NaNO_3$
Epsomite $MgSO_4 \cdot 7H_2O$

(10-15 cm) nodule
Soda Nitre NaNO3
Epsomite MgSO4•7H2O
Gypsum CaSO4•H2O

Comments: well sorted pebble lag on surface. Very windy spot. Salt under desert pavement common, up to 2-3cm thick. Desert pavement mostly gravel, with a few rare dolerite boulders, ventifacted, wind eroded, some pitting, oxidized surfaces. Gravels, mostly dolerite subangular – subrounded. Ventifacted and oxidised surfaces. Rare round quartz gravel.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Up to 3cm thick below gravel	-	-
0-1cm	D.P. protected layer	10YR 7/2	-	-	-	Not recorded	Not recorded
1-2cm	Slightly oxidised	10YR 6/3	-	-	-	Not recorded	Not recorded
2-18cm	Darker and less gravel than below	2.5Y 7/3	V. slightly gravelly silt	2%, sub rounded 2-3cm	Salt nodules 2-3mm	Not recorded	>10cm
18-33 cm (B.O.P)		2.5Y 8/3	Slightly gravelly silt	10% angular	Salt flecks 2-3mm	-	-

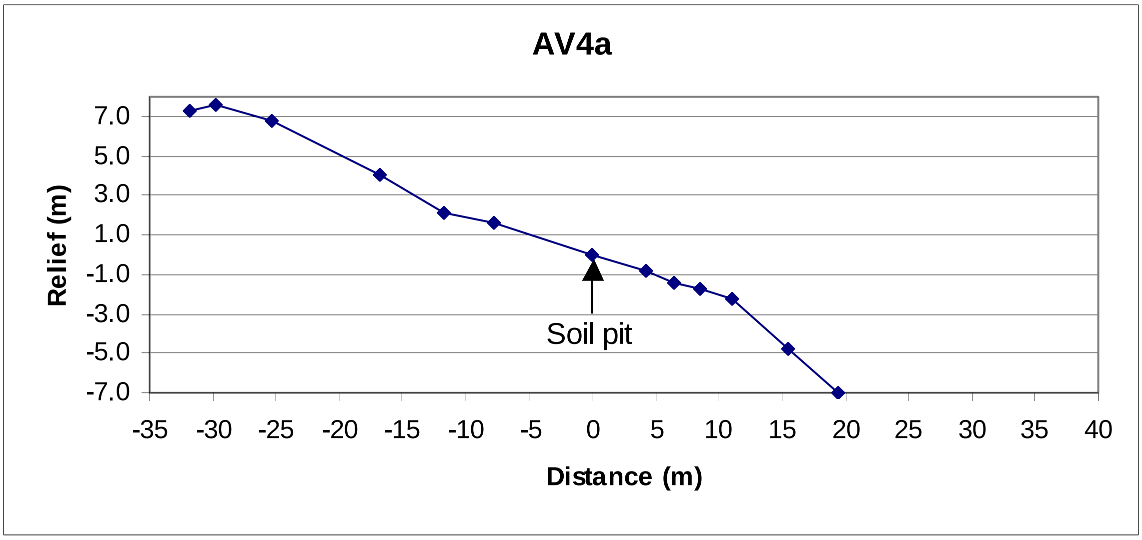
AV4 latitude:S77°52.042 longitude:E160°56.602 elevation:1350m
The pit was dug in distinct polygonal ground on the high centre of a polygon. It is the first in a transect with 2 other sites (AV-5 & 6) to compare soil and permafrost development from an area of polygonal ground to no polygonal ground. The polygonal ground at this site appears to have developed on a paleo dune which climbed up the valley side. Trenching outwards from pits AV-4 &5 confirmed that the surface of the top of the permafrost domes near the centre of the polygons. (Plate 1)
Date: 28/11/01
Depth of oxidation: 50cm (weak to permafrost)
Depth of salt: 50cm (to permafrost)
Depth of ghosts: -
Depth of coherence: 16cm
Depth to permafrost: 25-75cm
Slope: ~4°
X-Ray (only soluble salts + gypsum)
(depth?) encrustation on sandstone clast
Soda Nitre NaNO3
Epsomite MgSO4•7H2O
Bloedite Na2Mg(SO4)2•4H2O

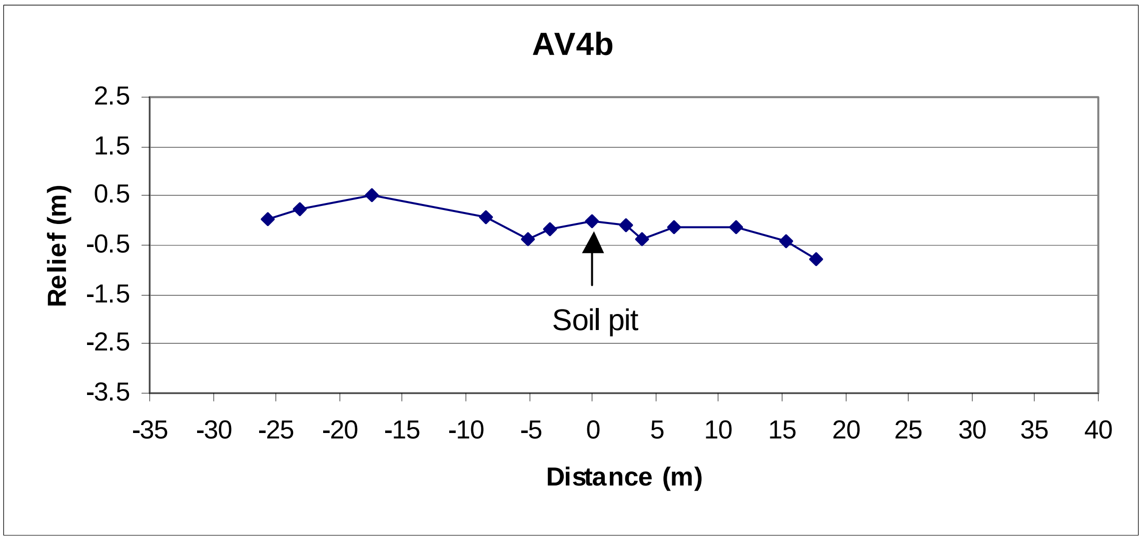
(depth?) encrustation on dolerite clast

Soda Nitre	$NaNO_3$
Epsomite	$MgSO_4 \cdot 7H_2O$
Halite	NaCl

Comments: desert pavement fairly well sorted. Sandstone gravels dominant. Sandstone boulders up to 1.5m. Dolerite gravels and cobbles common. Boulders rare and small (up to 0.5m). Patterned ground. Sandstone, chemical weathering, pitting, win/salt carving, some exfoliation. Dolerite, pitting and some salt/wind carving. No ventifacts. Salt under desert pavement common up to 2-3cm thick. Permafrost domed at 25cm at edge of pit. Sampled top 3cm of permafrost at 25cm and at 60cm. Salt nodule concentration (1-2cm) at 15cm. Parent material dune sand with minor scree on top.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Up to 3cm thick below gravel	-	-
0-1cm	D.P. protected layer	7.5YR 7/3	Gravel	Not recorded	-	wavy	1cm
1-6cm	Cohesive, less gravel than above and below	10YR 6/4	V. slightly gravelly sand	2%	-	wavy	1cm
6-16cm	Cohesive	10YR 6/4	Very gravelly sand	50% angular-subangular	-	wavy	1cm
16-50 cm (PF)	Non cohesive	10YR 6/4	V. slightly gravelly sand	5%	-	irregular	-





AV5 latitude:S77°52.042 longitude:E160°56.500 elevation:1330m
This site was about 150 m downslope from AV-4 in weakly developed polygonal ground. We wanted to check the depth to ice-cemented ground and found the depth to the centre of the 'domed' ground ice was 15 cm whereas in AV-4 it was about 40 cm deep. Because pattern ground was less developed around AV-5, we expected to find the depth to ice cement deeper than in AV-4 but it was shallower. No samples were taken at this site because the mostly sandy material appeared very similar to that in AV-4.

Date: 29/11/01

No soil description made, very similar profile to AV4. Clod sample taken ~7cm. Permafrost boundary wavy surface. Shallower to top of permafrost than more advanced polygonal ground (AV4).
Desert pavement boulders dominantly sandstone up to 2m, subrounded. Dolerite up to 0.5m, rare, subangular. Gravels sandstone and dolerite (50:50), rare round quartz. Pitting common, some oxidation, slight ventifaction. Some vague polygonal formation.

AV6 latitude: S77°51.958 longitude: E160°56.497 elevation: 1310m
The pit was dug about 200 m downslope from AV-5 in polygon-free ground to compare with AV-4 & 5. It was dug to essentially large blocks of dolerite parent material and no ice cement was encountered. Stratigraphically the surface underlies the sandy 'dune' material found in AV-4 & 5 and should have and older soil chemical development.
Date: 29/11/01
Depth of oxidation: 16cm
Depth of salt: 42cm (B.O.P.), large nodules ~ 20cm
Depth of ghosts: -
Depth of coherence: 42cm (B.O.P.)
Depth to permafrost: - (bedrock)
Slope: flat
X-Ray (only soluble salts + gypsum)
(0 cm) efflorescence or encrustation on surface

Soda Nitre	$NaNO_3$
Epsomite	$MgSO_4 \bullet 7H_2O$
Darapskite	$Na_3(NO_3)(SO_4) \bullet H_2O$
Gypsum $CaSO_4 \bullet H_2O$	

(depth?) encrustation on dolerite clast
Epsomite $MgSO_4 \cdot 7H_2O$

Comments: fairly well sorted desert pavement. Rare sandstone boulders up to 2m, angular-subangular. Few sandstone boulders up to 0.5m. Rare dolerite boulders up to 0.2m, subrounded. Dominant dolerite gravel (angular-subangular). Sandstone gravel subangular. Rare rounded quartz. Pitting common, some ventifacts, oxidized surfaces. No patterned ground. Abundant salt.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	encrustations	-	-
0-1cm	D.P. protected layer	7.5YR 6/3	Moderately gravelly sand	30 %	encrustations	wavy	<1cm
1-4cm	consolidated	7.5YR 5/3	V. slightly gravelly sand	1%	Weak salt nodules	wavy	1-2cm
4-16cm	Salt pan	White, some oxidized flecks	-	-	Salt pan	wavy	>10cm
16-42 cm (B.O.P.)	consolidated	10YR 7/4	V. slightly gravelly silt	5%	flecks	-	-

AV7 latitude: S77°51.967 longitude: E160°52.487 elevation: 1350m
This pit was dug to determine the presence of a paleo lake catching runoff from the windpacked snow at Arena Saddle. However, bedrock of Beacon Supergroup was found at 7 cm.
Date: 30/11/01
Depth of oxidation: slight oxidation 0-2cm (in patches)
Depth of salt: -
Depth of ghosts: -
Depth of coherence: slight coherence, small clods 1-3cm (NB: over boundary 1-4cm)
Depth to permafrost: - (bedrock)
Slope: flat (at bottom of small basin)
X-Ray (only soluble salts + gypsum)
(0 cm) efflorescence or encrustation on surface
Gypsum $CaSO_4 \cdot H_2O$
Thenardite Na_2SO_4
Epsomite $MgSO_4 \cdot 7H_2O$
Soda Nitre $NaNO_3$
Bloedite $Na_2Mg(SO_4)_2 \cdot 4H_2O$
Darapskite $Na_3(NO_3)(SO_4) \cdot H_2O$

Comments: very well sorted pebbles/gravels (~55% sandstone, 40% dolerite and 5% quartz), rounded-subrounded, some pitting, little oxidation. No patterned ground. Few small sandstone boulders (0.2-0.3m)

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	Small gravel	-	Little encrustations on edges	-	-
0-2cm	D.P. protected layer	10YR 8/2	sand	-	-	smooth	<1cm
2-7cm	White silt, unconsolidated bedrock	Too white for match	silt	-	-	smooth	<1cm
7+	Hard white siltstone	Too white for match	silt	-	-	-	-

Appendix 6: Pearse Valley

PV Salt pond 2/12/01
Latitude: S77°42.060 longitude: E161°30.422 elevation: 403m
Dried up salt pond at base of sand dune. Greenish/brown tinge on surface. Water seeped into hole at ~30cm. Water sample taken. Water salty. Surface salt crusting – sample taken.

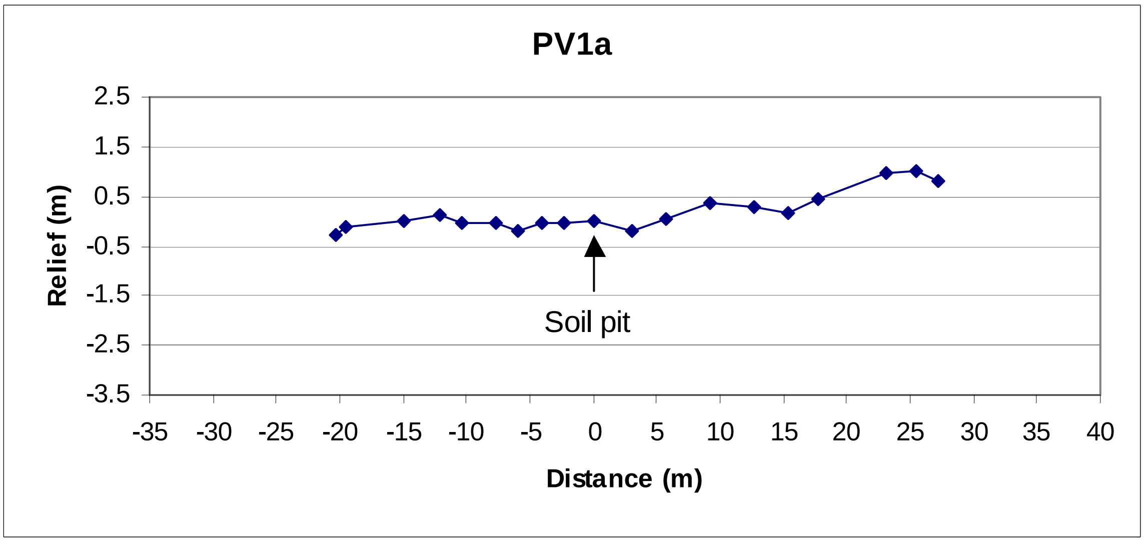
PV Upper dune 2/12/01
Latitude: S77°41.734 longitude: E161°31.132 elevation: 510m
Upper dune on Northern side of Pearse Valley. Surface well sorted coarse sand with rare granite boulders. Depth to permafrost 27cm. Slope 3-4°. Layering of coarse and fine sand in profile.
Permafrost sample collected at 0-3cm.

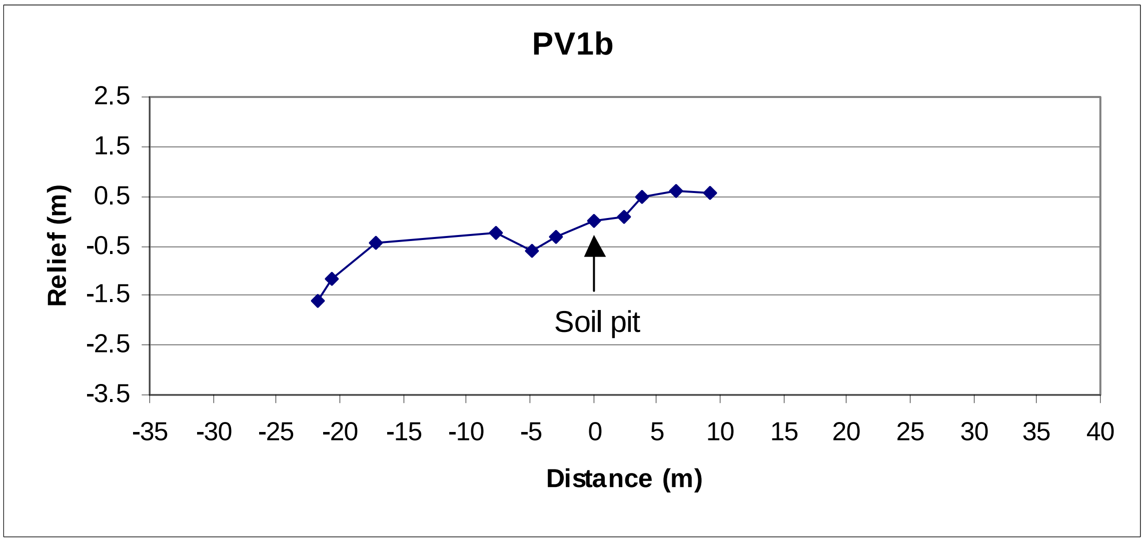
PV Mid dune 2/12/01
Latitude: S77°41.904 longitude: E161°30.319 elevation: 470m
Mid slope of dune. Well sorted coarse sand with gravel up to 0.5cm, no boulders. Slope 11.5°. Depth to permafrost 40cm. Layering in profile of coarse sand and fine gravel.
Permafrost samples collected at 0-2cm and 2-4cm. (see Plate 2)

PV1 latitude: S77°42.168 longitude: E161°30.340 elevation: 425m
Dug in well defined polygonal ground about 400 m south of the main sand dune to determine the depth of the ice cement. The parent material is mostly eolian sand on top of clear ice. (Plate 2)
Date: 2/12/01
Depth of oxidation: 18cm (patchy)
Depth of salt: -
Depth of ghosts: 30cm (granite)
Depth of coherence: 0-20cm, 40-50cm (B.O.P.)
Depth to permafrost: 50cm (Black ice)
Slope: flat

Comments: Granite and dolerite boulders, subangular to subrounded, up to 2m. Wind carved salt eroded, small cobbles. Granite and dolerite gravel.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	-	-	-
0-6cm	Oxidized layer	2.5Y 5/4	Moderately gravelly sand	20%	-	wavy	<1cm
6-18cm	cohesive	2.5Y 5/4	V. slightly gravelly sand	5%	-	wavy	2cm
18-40 cm	Non cohesive	2.5Y 6/2	Slightly gravelly sand	10%	-	wavy	2-4cm
40-50 cm (Black ice)	cohesive	5Y 6/3	Very gravelly sand	70%	-	smooth	-





PV2 latitude: S77°42.094 longitude: E161°30.380 elevation: 413m
This pit was dug about half way to the salt pond from PV-1 to determine the extent of the clear ice. Clear ice was found in the centre of the polygon but sandy ice cement was in the trough about 1 m on either side of the joint to the crest of the lip (sketch).
Date: 3/12/01
Depth of oxidation: ~10cm (patchy)
Depth of salt: -
Depth of ghosts: 35-40cm (Black ice)
Depth of coherence: patchy
Depth to permafrost: 35-40cm
Slope: flat
X-Ray (only soluble salts + gypsum)

(0 cm) efflorescence or encrustation on surface

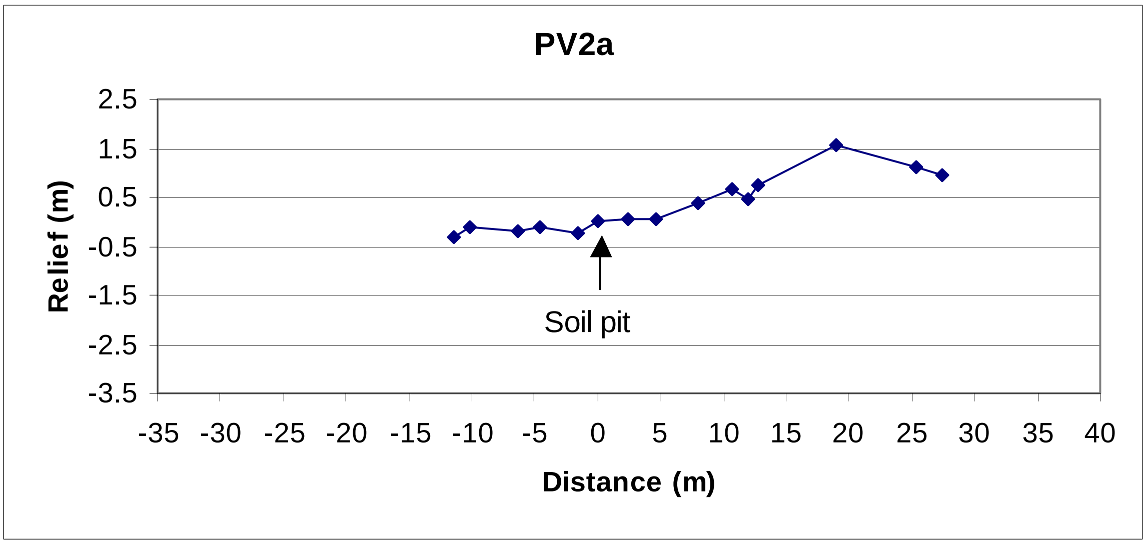
Halite	NaCl
Gypsum	$CaSO_4 \bullet H_2O$

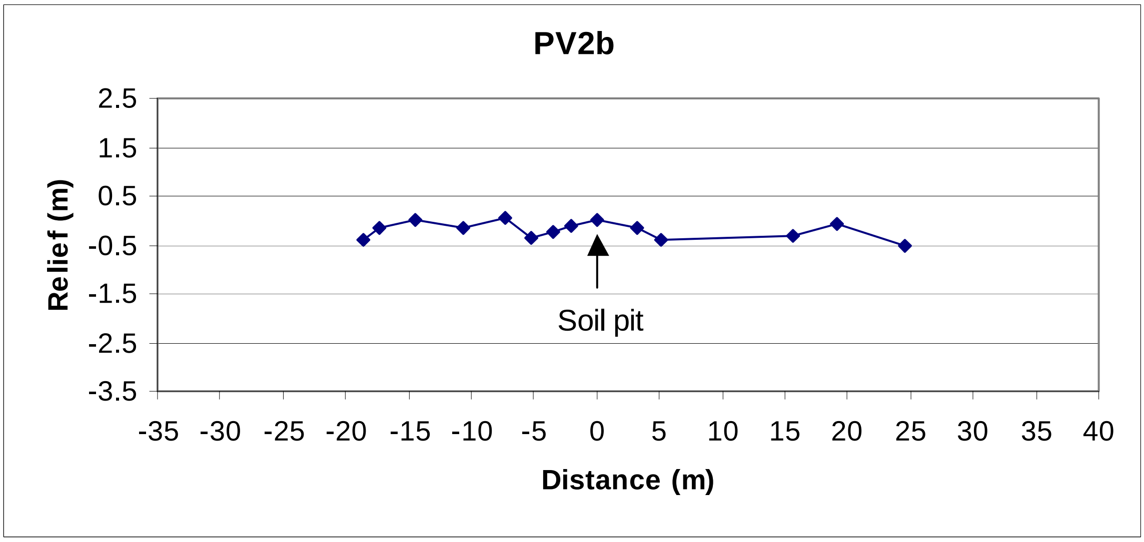
(10 cm) weak salt horizon

Gypsum CaSO4•H2O

Comments: Few granite and dolerite boulders, 1-2m. Small subangular to subrounded desert pavement of sandstone, dolerite and granite. Few 10-20cm, abundant 2-5cm. Patchy oxidation in top 5-10cm. Some ventifacts, little salt under boulders.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	-	-	Little under boulders	-	-
All through out profile to black ice	Fine greenish sediment	5Y 6/3	Slightly gravelly silt	15%	-	-	-
All through out profile to black ice	Sandy sediment	2.5Y 6/3	Coarse sand	-	-	smooth	-

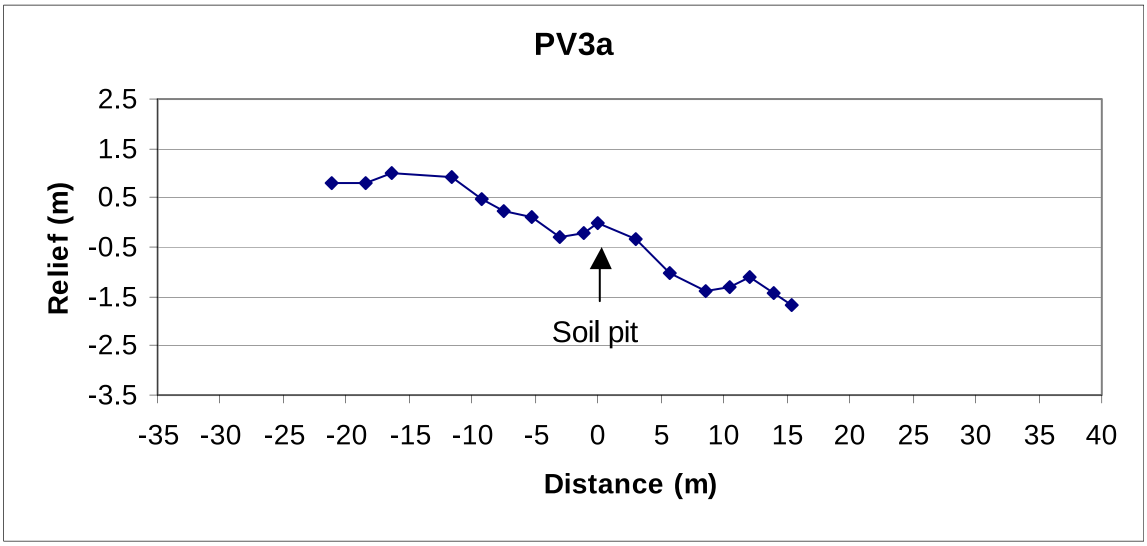


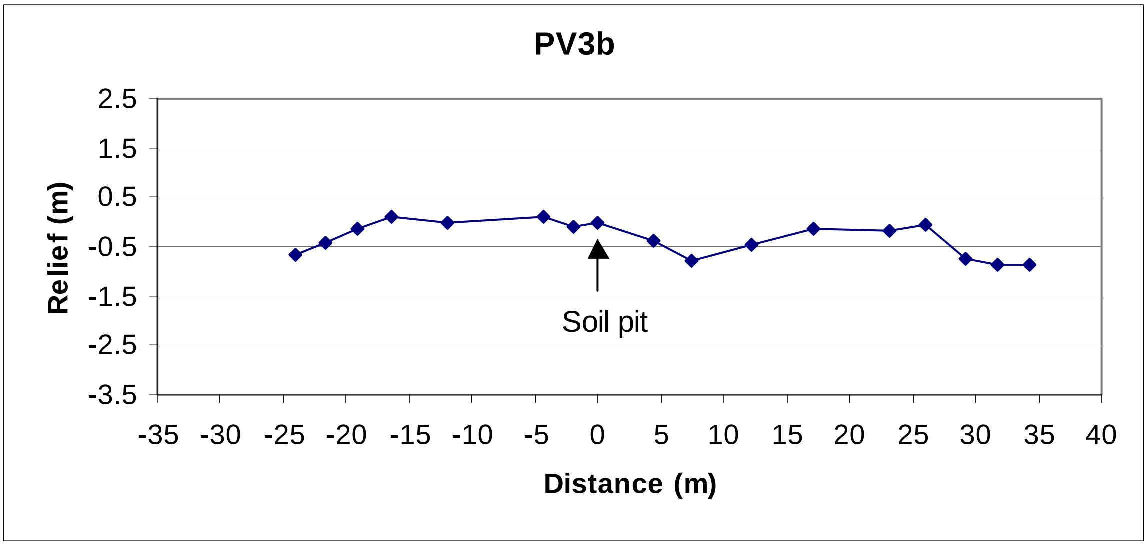


PV3 latitude: S77°42.274 longitude: E161°30.257 elevation: 420m
This pit was about 200 m south of PV-1 and part of the transect across the valley to determine the extent of clear ice. In this pit, the clear ice is deeper than in PV-1 & 2 and the polygons are less well developed than at the other two sites. (Photo of pit in Plate 2)
Date: 3/12/01
Depth of oxidation: 6cm
Depth of salt: possibly some down to 6cm
Depth of ghosts: 29cm
Depth of coherence: 60cm (Black ice)
Depth to permafrost: 55-60cm (Black ice)
Slope: flat
X-Ray (only soluble salts + gypsum)
(0 cm) efflorescence or encrustation on surface
Halite NaCl
Gypsum CaSO4•H2O

Comments: South side of ridge, very wind/salt carved boulders, 1-2m few pitting (granite and sandstone). Cobbles 2-10cm, many granite, dolerite common, fine desert pavement. More oxidized than PV2, large troughs infilled with sand. (inactive polygons?)

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	-	-	-	-	-
0-1cm	Protected layer	2.5Y 7/3	V. gravelly silty sand	40%	?	wavy	<1cm
1-6cm	-	10YR 5/4-6	V. slightly gravelly silt	2%	Flecks?	wavy	<1cm
6-29 cm	Ghost layer	2.5Y 6/3	V. slightly gravelly silt	5%	-	wavy	3cm
29-31 cm	Loose pale layer	5Y 7/2	V. slightly gravelly silt	5%	-	undulating	5cm
31-45 cm	gravelly	2.5Y 7/3	Slightly gravelly silt	10%	-	wavy	3cm
45-60 cm (Black ice)	Fine, slightly coherent	5Y 6/3	V. slightly gravelly silt	3%	-	wavy	-





PV4 latitude:S77°42.670 longitude:E161°29.422 elevation:432m

The pit was about 400 m south or PV-LAK1. It was located to provide the southernmost point on the transect and determine if clear ice was present on the south side of the valley. Ice cement was found at 80 cm and polygons were weakly developed (??).

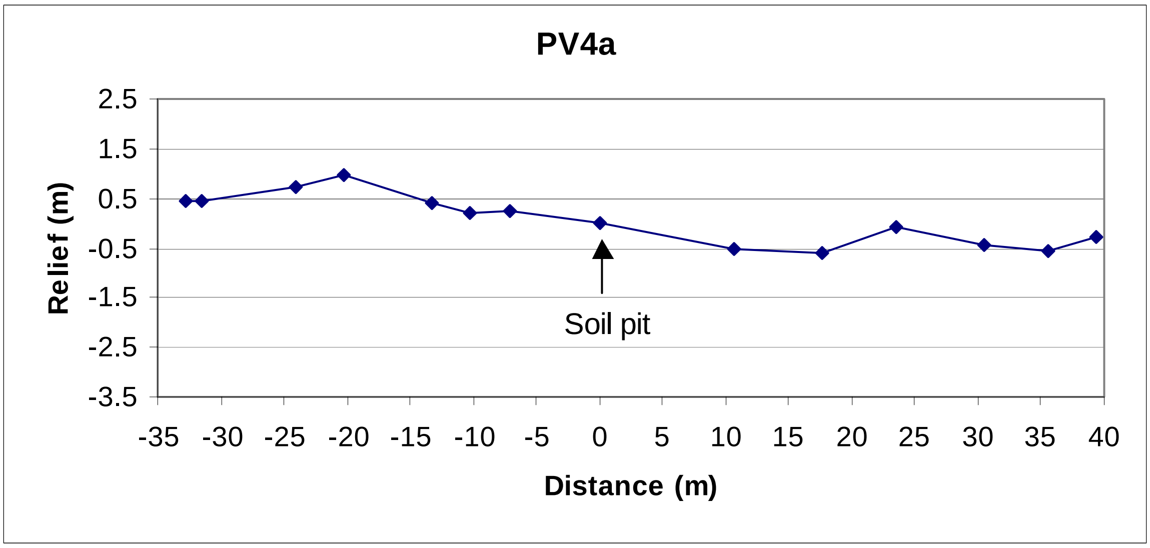
Date: 4/12/01
Depth of oxidation: 10cm
Depth of salt: 10cm
Depth of ghosts: 10cm
Depth of coherence: 80cm (to permafrost)
Depth to permafrost: 80cm
Slope: flat
X-Ray (only soluble salts + gypsum)

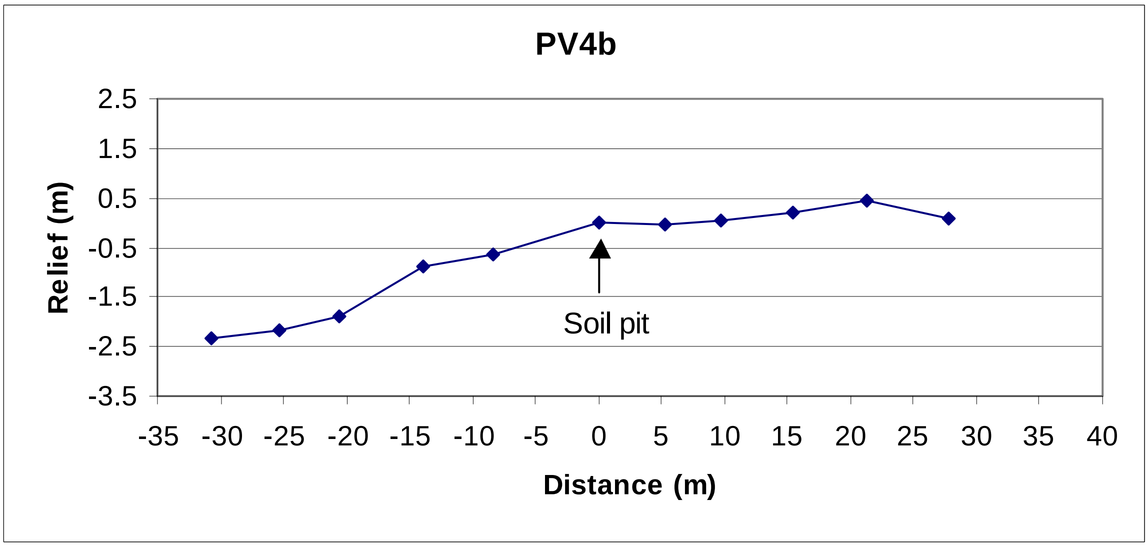
(0 cm) efflorescence or encrustation on surface

Gypsum $CaSO4 \bullet H2O$

Comments: Granite and dolerite boulders common up to 2m, ranging down to sand in desert pavement. Angular-subrounded, some ventifacts, some salt/wind erosion, some oxidation. Non sorted. Some pitting, no patterned ground.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	-	-	Some under boulders	-	-
0-1cm	-	2.5Y 5/3	Slightly gravelly sand	10%	-	wavy	1cm
1-10cm	-	2.5Y 5/4	Moderately gravelly silt	20%	nodules	smooth	5-10cm
10-40 cm	Non sorted angular gravel	2.5Y 6/4	Very gravelly silt	40%	-	smooth	1cm
40-50 cm	Sandy layer small gravel	2.5Y 7/2	Moderately gravelly sand	25%	-	wavy	1cm
50-80 cm (PF)	Blocky appearance	2.5Y 8/2	V. slightly gravelly silty clay	1%	-	smooth	-





PV5 latitude:S77°43.127 longitude:E161°35.611 elevation:358m

This pit was dug about 100 m west of an old camp near Lake Joyce and located to represent the soils at the lower end of the valley. Ice cement was found at 57 cm but polygonal ground was not evident on the surface.

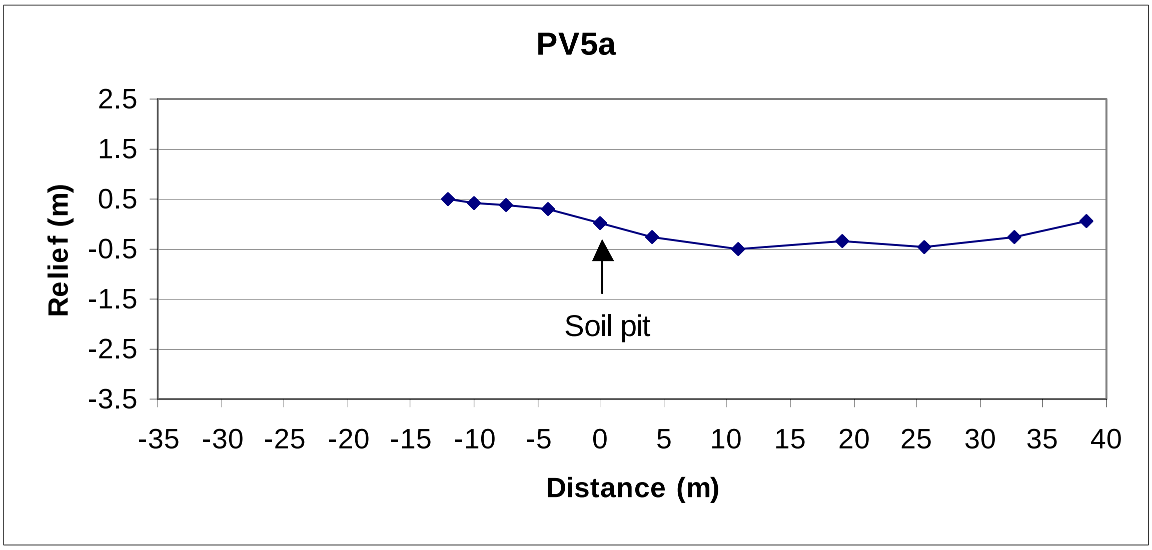
Date: 4/12/01
Depth of oxidation: 7cm
Depth of salt: -
Depth of ghosts: -
Depth of coherence: 57cm (to permafrost)
Depth to permafrost: 50-60cm
Slope: flat
X-Ray (only soluble salts + gypsum)

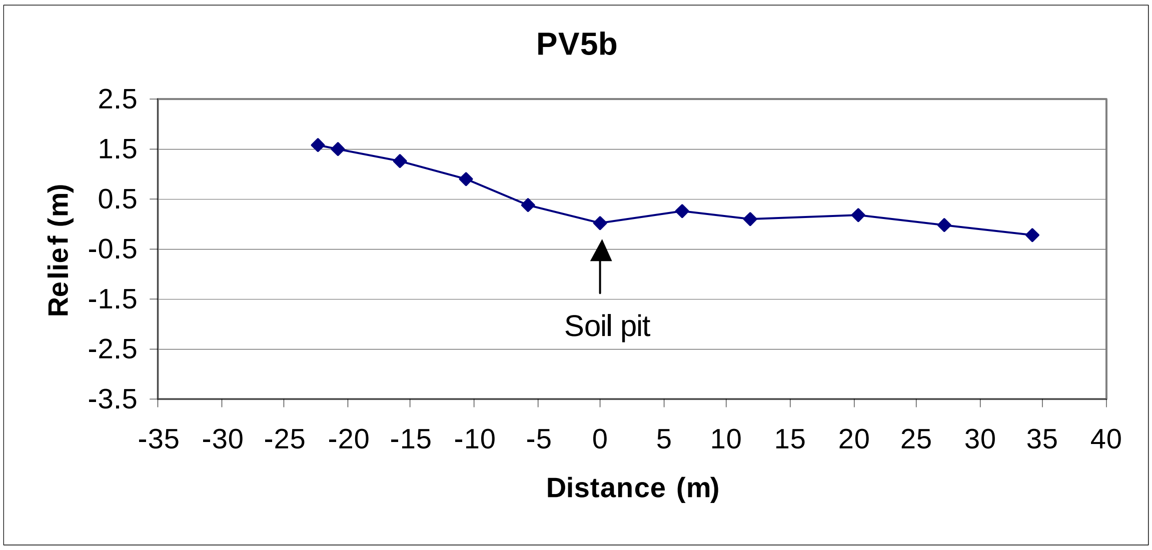
(0 cm) efflorescence or encrustation on surface

Halite	NaCl
Gypsum	$CaSO4 \bullet H2O$

Comments: Granite and dolerite boulders up to 2m. Salt/wind erosion, pitting, few ventifacts. Abundant small cobbles 2-5cm. No patterned ground, not much moisture in permafrost.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	-	-	Some under boulders	-	-
0-1cm	-	2.5Y 6/2	V. gravelly sand	50%	-	wavy	<1cm
1-7cm	silty	2.5Y 6/3	V. slightly gravelly silt	1%	-	wavy	<1cm
7-57cm (PF)	Layering of gravel and silt	2.5Y 6/2	Slightly gravelly grading to V. slightly gravelly sandy silt	15% at top to 1% at bottom	-	wavy	-



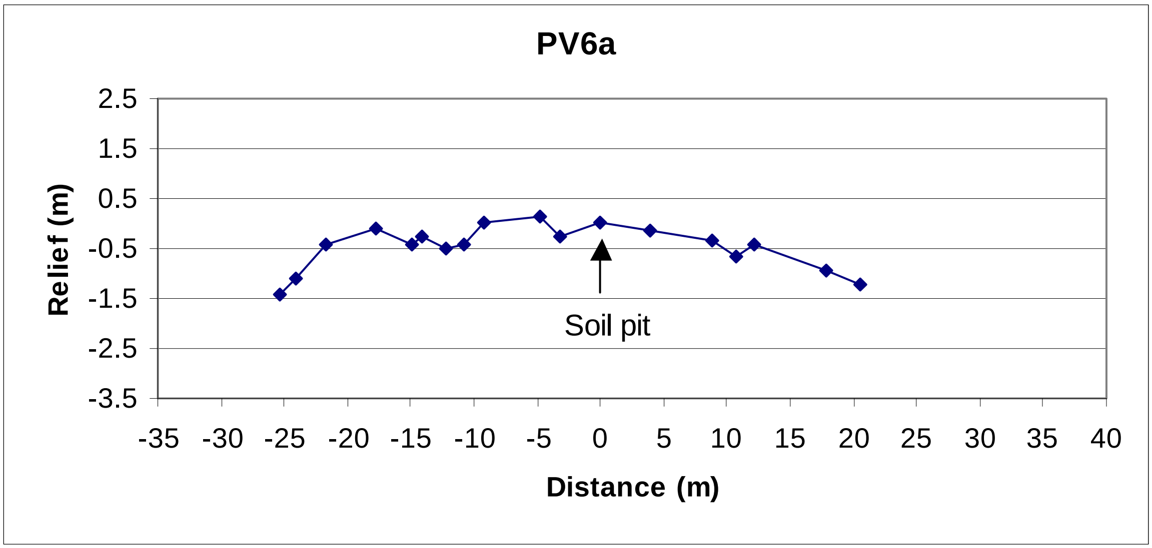


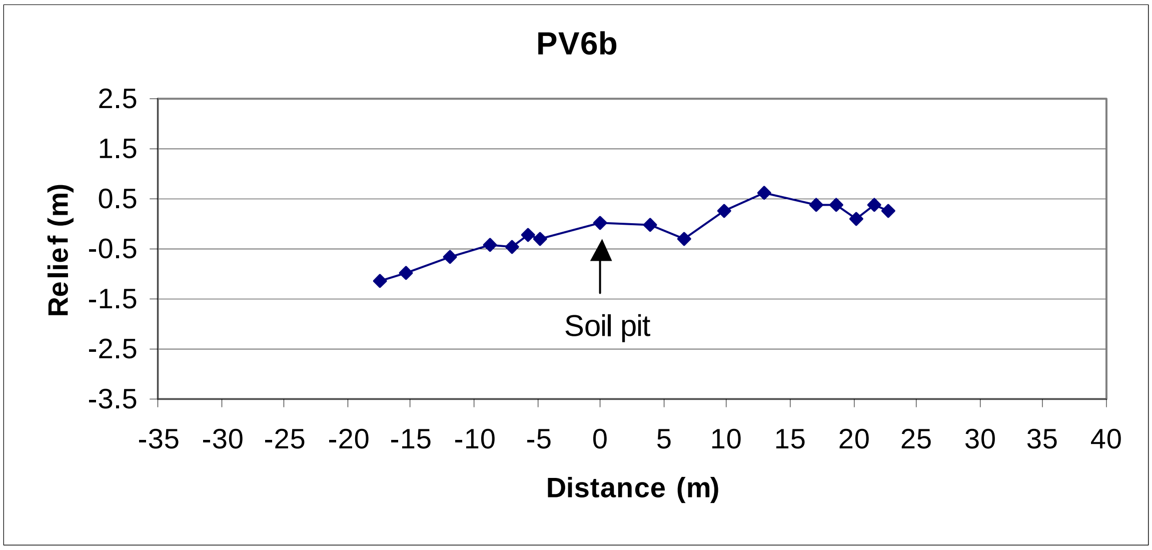
PV6 latitude:S77°42.002 longitude:E161°29.540 elevation:489m
This pit was dug in well defined polygons near the Schlatter Glacier to determine if ice cored moraine was present. However, clear ice below 25 cm of loose eolian sand with little chemical development was found. An additional pit was dug about 200 m toward the Schlatter Glacier and not described. Clear ice was present at 25 cm but there was an oxidized and salt horizon at about 5 cm. (see Plate 2)
Date: 5/12/01
Depth of oxidation: -
Depth of salt: -
Depth of ghosts: -
Depth of coherence: 45cm (to permafrost)
Depth to permafrost: 45cm
Slope: flat

Comments: Subrounded granite boulders up to 1m, subrounded dolerite boulders up to 0.5m. Gravel mostly dolerite (subangular-angular). Ventifacts, pitting rare, no oxidation on rock surfaces.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
2-0cm	Desert pavement	-	-	-	Some under boulders	-	-
0-10cm	-	2.5Y 6/3	V. slightly gravelly sand	2%	-	wavy	2cm
10-20 cm	Coarser than above layer	2.5Y 6/3	V. slightly gravelly sand	3%	-	wavy	10cm
20-45 cm (PF)	Larger gravel up to 7cm	2.5Y 6/2	Slightly gravelly sandy	10%	-	smooth	-

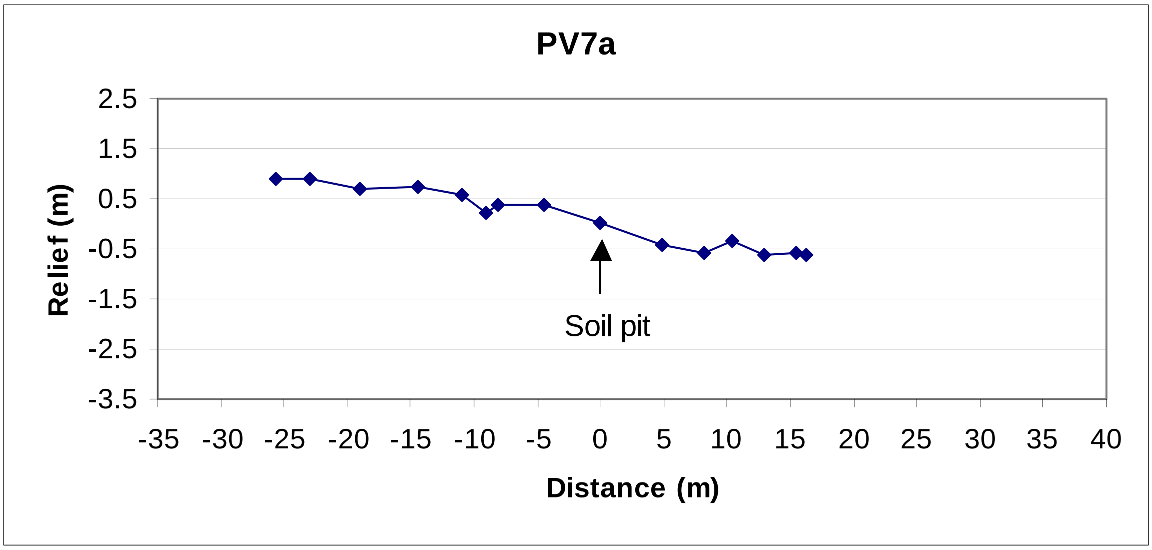
			silt				

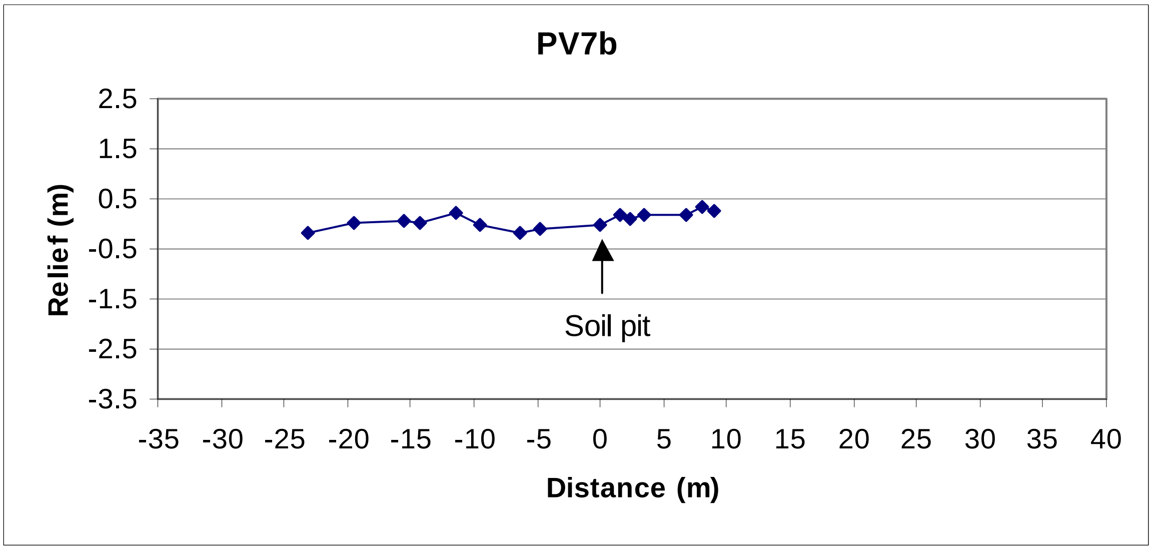




PV7 latitude:S77°42.378 longitude:E161°32.785 elevation:401m
This was dug to determine the northeast extent of clear ice which was not found in the pit.
Date: 5/12/01
Depth of oxidation: -
Depth of salt: -
Depth of ghosts: -
Depth of coherence: 6-25cm (to permafrost)
Depth to permafrost: 25cm
Slope: 5°
Comments: Large polygons, wind carved boulders – rare. Subangular – subrounded boulders. Granite dominant. Desert pavement small, sorted granite and dolerite. Layering throughout whole profile.

Depth	Description of layer	Colour	Texture	% gravel	Salt stage	Boundary shape	Boundary distinctness
1-0cm	Desert pavement	-	-	-	Some under boulders	-	-
0-1cm	Protected layer	2.5Y 6/3	V. slightly gravelly sand	2%	-	wavy	<1cm
1-6 cm	-	2.5Y 6/2	V. slightly gravelly sand	1%	-	wavy	<1cm
6-13 cm	-	2.5Y 6/2	V. slightly gravelly sandy silt	3%		wavy	1-2cm
13-25 cm (PF)	Dark/pale layering	2.5Y 5/2	V. slightly gravelly sandy	1%	-	smooth	-




PV7b
Relief (m)
2.5
1.5
0.5
-0.5
-1.5
-2.5
-3.5
Soil pit
-35 -30 -25 -20 -15 -10 -5 0 5 10 15 20 25 30 35 40
Distance (m)