Taxonomy and
Management of Andisols

Proceedings of the

SIXTH INTERNATIONAL SOIL CLASSIFICATION WORKSHOP

Chile and Ecuador 9 to 20 January 1984

Part 2 : Tour-Guide for Chile

FIELD TRIP BACKGROUND
SITE AND PEDON DESCRIPTIONS
ANALYTICAL DATA

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CHILE

SOCIEDAD CHILENA
DE LA CIENCIA DEL SUELO

SOCIEDAD ECUATORIANA
DE LA CIENCIA DEL SUELO

UNIVERSIDAD
DE PUERTO RICO

SOIL MANAGEMENT SUPPORT SERVICES

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PREFACE
6TH INTERNATIONAL SOIL CLASSIFICATION WORKSHOP
CHILE

Steering Committee:

F. H. Beinroth	University of Puerto Rico, U.S.A. Chairman
R. W. Fenwick	National Coordinator, SMSS, SCS, Washington, D.C.
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Dr. F. Maldonado	USAID, Quito, Ecuador, Pres., Ecuatorian Society of Soil Science
Dr. M. Leamy	ICOMAND, Chairman, New Zealand

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Instituto Nacional de Capacitacion Profesional

Introduction

The Sixth (VI) International Soil Classification Workshop is one of a series of workshops and training activities of the Soil Management Support Services (SMSS). SMSS is a program of international technical assistance in soil survey, soil classification and correlation, and use and management of soils, primarily in tropical and subtropical areas. The program is funded by the U.S. Agency for International Development (USAID), and is carried out by the U.S. Dept. of Agriculture Soil Conservation Service (USDA/SCS). The previous workshops that have been held are:

	Country	Year	International Committee (ICOM)
I	Brazil	1977	ICOMLAC
II	Malaysia/Thailand	1978	ICOMLAC/ICOMOX
III	Syria/Lebanon	1980	ICOMMORT/ICOMID
IV	Rwanda	1981	ICOMLAC/ICOMOX/ICOMMORT
V	Sudan	1982	ICOMERT/ICOMID/ICOMMORT
VI	Chile/Ecuador	1984	ICOMAND

These workshops are an integral part of the activities of SMSS and provide a medium for soil scientists from all over the world to discuss the mandates of the International Committees. These committees are working to refine Soil Taxonomy with respect to use and application in intertropical areas and as a means for agrotechnology transfer.

The VI International Soil Classification Workshop is organized as a joint endeavor of the Sociedad Chilena de la Ciencia del Suelo and the Sociedad

Ecuatoriana de la Ciencia del Suelo, both acting in behalf of various universities and national institutions, the SMSS, the University of Puerto Rico (UPR), and USAID. In addition, on behalf of the Steering Committee and the Chilean Society of Soil Science, we would like to acknowledge the generous contributions received from:

I. Municipalidad de Puerto Varas
Direccion Regional (X Region) CONAF
Sr. Alejandro Acuña, Fundo Santa Ines
Sr. Helmut Gebauer, Llanquihue
Sr. Erwin Kilmer, Fundo Danguil
Sr. Sergio Wolf, Frutillar

This cooperation and collaborative effort has been the prime reason for the success of our previous workshops. The present workshop also promises to be most successful.

This tour guide is a compilation of some basic information on the history, climate, soils, volcanism, vegetation, and agriculture in Chile. It has been written by various professors and scientists from universities and organizations of Chile. The soils were described by W. Luzio, R. Honorato, C. Galindo, W. Vera, and F. Grez from the universities in Chile and by T. D. Cook of SMSS, SCS. The analyses of the soils were performed by the Comision Chilena de Energia Nuclear, the Centro de Estudios de la Cuenca del Maul, various universities, laboratories, and the National Soil Survey Laboratory (NSSL) of the SCS at Lincoln, Nebraska.

This workshop and tour guide could not have been accomplished without the assistance, contributions and cooperation of many people and organizations. To them we are most grateful. A special tribute is given to Dr. Walter Luzio L. He has contributed untold hours of organizing and attending to every detail to ensure that the entire tour, working sessions, and extracurricular activities would long be remembered. We would like to thank Dr. Steve Holzhey, Head, NSSL, and his staff for performing all the analyses in a timely manner. Special analyses were run by Dr. John Kimble, Soil Chemist, SMSS, that are required for the proposed orders of Andisols.

He also efficiently coordinated and compiled the data and information for the tour guides. Thin sections and micromorphological descriptions were made by Prof. Ricardo Honorato. His work and contributions are greatly appreciated. We are grateful for his cooperation. We also express our gratitude to Dr. Koji Wada, Kyushu University, for X-ray and mineralogical analysis.

We also appreciate the advice and suggestions from Dr. F. Colmet-Daage, Dr. Mike Leamy, Dr. A. Van Wambeke and Dr. K. Flach.

To make an international meeting like this successful, many Chilean colleagues and organizations have contributed untold hours of extra work beyond their normal duties. We acknowledge their assistance and support. This workshop, like the previous ones, is a model of international cooperation and achievement. In this same spirit, we anticipate beneficial and productive discussion at this workshop to advance and improve Soil Taxonomy and to exchange knowledge on soil classification and agrotechnology transfer between scientists.

RICHARD W. FENWICK
National Coordinator
SMSS

SIXTH INTERNATIONAL SOIL CLASSIFICATION WORKSHOP

- Taxonomy and Management of Andisols -

CHILE AND ECUADOR

9 to 20 January 1984

PROGRAM FOR CHILE

Saturday, 7 January 1984

Participants arrive in Santiago
Night in Santiago, Hotel Carrera

Sunday, 8 January 1984

0630 Dep. Hotel Carrera
0710 Arr. Santiago airport
0810 Dep. Santiago, LAN Chile flight 085
0930 Arr. Valdivia, transfer to hotel
1030 Registration of participants
Free afternoon and evening in Valdivia
Night in Valdivia, Hotel Isla Teja

Monday, 9 January 1984

0800 Registration of local participants

OPENING CEREMONY
Chairman: R. Grez
Venue: Universidad Austral de Chile

0900 Welcome -- J. Ferrer, Chancellor, Universidad Austral de Chile

Introductory remarks by:

W. Luzio, Professor of Soil Science and Chairman, Host Organizing Committee
R.W. Arnold, Director of Soils, USDA Soil Conservation Service and Principal Investigator, Soil Management Support Services
M.L. Leamy, Director, New Zealand Soil Bureau and Chairman, ICOMAND

1000 Refreshments

Technical Session I: PERSPECTIVES
Chairman: S. Alcayaga

1030 R.W. Arnold: The rationale for an order of Andisols in Soil Taxonomy

1115 V.E. Neall: Parent materials of Andisols

1200 Lunch

Technical Session II: PROPERTIES OF ANDISOLS
Chairman: E. Besoain
Rapporteur: G. Galindo

1330 R. Parfitt: The nature of andic and vitric materials

1415 G. Uehara: Physico-chemical characteristics of Andisols

1445 Discussion

1500 Refreshments

Technical Session III: TAXONOMIC FRAMEWORK FOR ANDISOLS
Chairman: R.W. Arnold
Rapporteur: B. Clayden

1530 M.L. Leamy: Proposed taxa and diagnostic features of Andisols

Technical Session IV: FIELD TRIP BACKGROUND
Chairman: A. Van Wambeke

1700 H. Moreno: Physiography of south-central Chile

1715 W. Luzio: Soils of south-central Chile

1730 P. Baherle: Land use in south-central Chile

1745 Panel Discussion

Topic: The soils of field trips
Panelists: P. Baherle, E. Besoain, A. Carrasco, A. Ellies, R. Honorato, W. Luzio, A. Mella, H. Moreno, F. Santibañez

1830 Adjourn

Night in Valdivia, Hotel Isla Teja

Tuesday, 10 January 1984

Field Trip I: VALDIVIA - LANCO - VALDIVIA

0730 Dep. Valdivia

0815 Arr. Pedon CHI-01 (Pelchuquín)
Discussion leader: M.L. Leamy
Rapporteur: B. Clayden

1015 Dep. Pedon CHI-01

1100 Arr. Pedon CHI-02 (Lanco)
Discussion leader: F.N. Muchena
Rapporteur: N. Ahmad

1300 Box lunch, Universidad Austral forest

1400 Dep. Lunch site

1500 Arr. Pedon CHI-03 (Los Olmos)
Discussion leader: H. Ikawa
Rapporteur: J.M. Kimble

1700 Dep. Pedon CHI-03

1745 Arr. Valdivia

Night in Valdivia, Hotel Isla Teja

Wednesday, 11 January 1984

Field Trip II: VALDIVIA - ANTILLANC..

0730 Dep. Valdivia

0930 Arr. Pedon CHI-08 (Puerto Fonck)
Discussion leader: R.W. Arnold
Rapporteur: R.W. Fenwick

1130 Dep. Pedon CHI-08

1300 Arr. Aguas Calientes, box lunch

1400 Dep. Aguas Calientes

Wednesday, 11 January 1984 (cont'd)

1445 Arr. Pedon CHI-06 (Chanleufú)
Discussion leader: W.G. Sombroek
Rapporteur: F.N. Muchena

1645 Dep. Pedon CHI-06

1715 Arr. Pedon CHI-05 (Antillanca)
Discussion leader: K. Wada
Rapporteur: T.D. Cook

1915 Dep. Pedon CHI-05

1930 Arr. Antillanca

Night in Antillanca, Hotel Antillanca

Thursday, 12 January 1984

Field Trip III: ANTILLANCA - PUERTO VARAS

0730 Dep. Antillanca

0815 Arr. Pedon CHI-07 (Puyehue)
Discussion leader: R.L. Parfitt
Rapportuer: V.E. Neall

1015 Dep. Pedon CHI-07

1245 Arr. Frutillar, box lunch

1345 Dep. Frutillar

1400 Arr. Pedon CHI-09 (Frutillar)
Discussion leader: S. Alcayaga
Rapportuer: G. Galindo

1600 Dep. Pedon CHI-09

1630 Arr. Pedon CHI-10 (Puerto Octay)
Discussion leader: C.O. Scoppa
Rapporteur: R.T. Meurisse

1830 Dep. Pedon CHI-10

1900 Arr. Puerto Varas, hotel check-in

Thursday, 12 January 1984 (cont'd)

1945 Dep. hotels for Club Aleman

2000 Dinner, Club Aleman

2100 Review of Field Trips in Chile
Discussion leader: M.L. Leamy
Rapporteur: B. Clayden

2200 Dep. Club Aleman for hotels

Night in Puerto Varas

Friday, 13 January 1984

0730 Dep. hotels for meeting room

Technical Session V: PROPERTIES OF ANDISOLS CRITICAL TO VARIOUS LAND USES (1)
Chairman: R. Dudal

0800 R. Meurisse: Properties of Andisols important to forestry

0830 A. Alvarado and E. Bornemisza: Properties of Andisols important to crop production

0900 K. Wada: Properties of Andisols important to paddy rice

0930 Refreshments

Technical Session VI: PROPERTIES OF ANDISOLS CRITICAL TO VARIOUS LAND USES (2)
Chairman: G. Uehara
Rapporteur: H. Ikawa

1000 V.E. Neall: Properties of Andisols important to pasture and horticulture

1030 B.P. Warkentin: Properties of Andisols important to engineering

1100 Discussion

1130 Dep. for hotels, check-out

1200 Dep. hotels for Club Aleman

1215 Lunch at Club Aleman, Puerto Varas

Friday, 13 January 1984 (cont'd)

1330 Dep. Puerto Varas

1400 Arr. Tepual airport

1500 Dep. Tepual airport, LAN Chile, flight 084

1635 Arr. Santiago

Night in Santiago, Hotel Carrera

Saturday, 14 January 1984

0715 Dep. Hotel Carrera

0800 Arr. Santiago airport

0930 Dep. Santiago, flight EU 042

1300 Arr. Quito, Ecuador

Night in Quito, Hotel Inter-Continental Quito

PHYSICAL ENVIRONMENT

Dr. Eduardo Besoaín

Geographical location

Chile is a republic located south west of South America between the 17°30' and 90° south latitude and between the 66°30' and the 75°40' west longitude. Its length, between the northern and southern boundaries, that is Peru and Cape Horn respectively, is of approximately 4.200 kms. If included the Chilean Antartic territory, its longitude exceeds the 8.000 kms.

The region of the Antartic continent situated between the 53° and 90° longitude west, is also part of Chile, and conforms a triangle ending in the south pole.

The national area, both continental and insular, amounts to 756,626 sq km. and that of the antartic territory to 1.250.000 sq km.

Chile is very asymmetrical in its length and width; while in the meridian sense it exceeds the 4.200 kms., its mean width is of approximately 177 kms; the maximum insular width is of 468 kms. and is located at the 52°21' south latitude. The maximum continental width is found in Antofagasta, between the Mejillones peninsula and the Bolivian boundary, situated at 27°7' south latitude with 380 kms. The minimum continental width can be found near Illapel, at 31°37' south latitude.

The Chilean borders are: to the north with Peru, through the "Linea de la Concordia"; to the east with Bolivia and Argentina by the huge Andean hights; to the south with the south pole and to the west with the Pacific Ocean.

Population

The data thrown by the last population census held in 1981 indicate a population of 11.200.000 inhabitants for Chile. Compared with the 9.780.000 inhabitants of 1970, it means an annual increase of 2.13%. The mean density is of 14.3 inhabitants per square km. Almost 60% of the Chilean territory is not habitable land due to its mountains, deserts, glaciers, huge salt deposits and swamps. The rural population is estimated to amount to approximately 25% of the total.

Physiography

In the Chilean territory it is possible to distinguish three physiographic units that, can be clearly observed lenghth and width wise: The Cordillera of the Andes or the Andean Mountain Range, the

Intermediate Depression and the Cordillera of the Coast or the Coastal Mountain Range. Sometimes another physiographic unit, called the coastal plains, is considered. (See Figure 1 for Broad Topographic Units.)

These physiographic units are subjected to major changes in their longitudinal development and from the combination of these physiographic bodies, eight territorial regions can be distinguished:

1. Big North (Norte Grande): from the septentrional limit to the hydrographic basin of the Copiapó river.
2. Small North (Norte Chico): from the mentioned reliefs to the southern limit of the Aconcagua river basin.
3. Central Region: from the preceding limit to the Bío-Bío river.
4. The Frontier (La Frontera): from the Bío-Bío river to the stripe that divides the Toltén river from the Valdivia river.
5. Lake Region: from the preceding stripe to the Gulf of Ancud.
6. Chiloé: Island of Chiloé, the Chonos archipel.go and the Taitao peninsula.
7. Mountain Range and Patagonian islands.
8. Magellanic pampas: territories located east of the Cordillera of the Andes, both in continental Chile and in Tierra del Fuego.

Among these regions, the Central Region, the Frontier and the Lake Region, from now on the Central-Southern region of Chile, conform the area in which Andisols develop, and therefore, we shall limit our discussion to it. It is located between the 33° and 42° south.

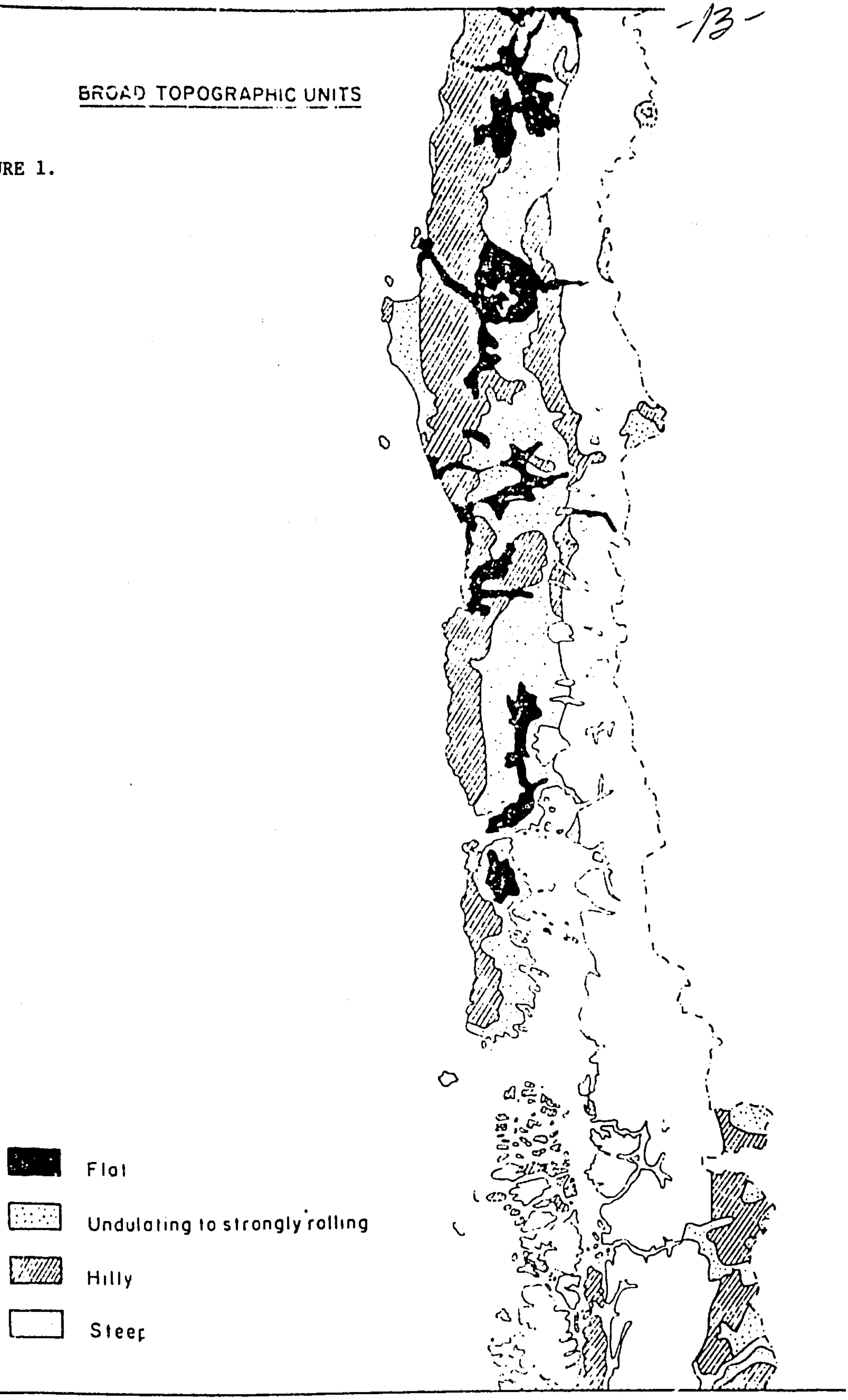
In the Central-Southern region of Chile the geomorphological description is done based on the three physiographic units aforementioned, which develop parallel to the coast and which correspond to a depresed fault blocks area - the Central Valley or Intermediate Depression - between two areas of a greater altitude: the Coastal and the Andes Mountain Range. It is believed this formation concluded at the end of the Tertiary and Pleistocene periods, approximately one million years ago.

The Coastal Mountain Range shows a mature landscape, with rounded summits, greatly eroded. It has an undulated topography and its width is of approximately 50 km. The highest elevations are eastward and diminish rapidly towards the west. South of the Maule river, the cordillera shows significant ranges which later decrease strongly towards the south.

The Central Depression is a rift valley or graben, and the limiting cordilleras constitute the blocks of the "horst". This tectonic depression has been the sedimentation basin of glacial, glaci-fluvial, fluvial and volcanic deposits from the Andean Mountain Range and to a lesser extent, from the Coastal Mountain Range. Evidence exists (Laugenie et al., 1975;) that the sediments in it alternate with quaternary laharic deposits of a significant thickness. The height of the

BROAD TOPOGRAPHIC UNITS

FIGURE 1.



Central Depression ranges from 25 to 800 mts. with a width of 50 to 65 kms. and a level or nearly level topography.

A particular physiographic feature between the Andean Range and the Central Depression takes place beginning in Talca (35°50' L.S.): the pre-Cordillera of the Andes. It has an undulated topography, with hights that do not exceed 1.000 mts. and a width that increases towards the south. Glacial, lacustrine, glacifluvial, volcanic and alluvial deposits are the sediments that form this unit. It is plenty of valleys relatively dry during the summer, and by some other deep cut valleys holding low flow rivers. This pre-cordillera, parallel to the Andes, is interrupted by consequent rivers coming from the Andes and running to the lower zones of the Central Valley. In fact, this rivers are the continuation of the Central Valley towards the Andes.

The Andean Mountain Range. It runs from north to south following the eastern border of the Chilean territory. It is one of the biggest mountain ranges in the Earth. It is a young cordillera, consolidated during the Tertiary and Quaternary periods and in the Big and Small North its elevations reach spectacular heights (Llullaillaco Volcano: 6.730 mts; Socompa: 6.050 mts; Ojos del Salado: 6.908 mts; Cerro de las Tórtolas: 6.323 mts. etc.). The vulcanism reappears in the Central Region towards Santiago (Tupungato Volcano: 6.550 mts.), gradually decreasing in height towards the south where the maximum elevations coincide with the presence of volcanoes. In Curicó and Talca the highest elevations are coincident with volcanic cones: Peteroa (4.903 mts.); Descabezado Grande (3.850 mts.); Descabezado Chico (3.250 mts.); Quizapú (3.050 mts.). Facing Ñuble (37° S.L.), the Nevados volcano does not surpass the 3.180 mts. Southward, the Cordillera has been affected by a severe glacial and fluvial erosion resulting in very deep valleys with steep slopes, giving it a basically alpine appearance (Fajardo, 1975), where relict peneplain zones of the Tertiary topography can be observed. The volcanoes of the Lake Region are somewhat higher: Llaima (3.050 mts.); Villarrica (2.840 mts.); Choshuenco (2.360 mts.); Puyehue (2.240 mts.); Puntiagudo (2.490 mts.); Osorno (2.660 mts.). Southward of the Reloncaví Bay, the Andean relief becomes more complex and receives the name of Patagonian Cordilleras; it is also extremely weared out by glacial action, so in fact its base is sea-occupied. In the Magellan region the fiords cut the cordillera, with a broken up appearance, forming numerous islands.

Geology

The oldest rocks, supposedly pre-cambrian, constitute the metamorphic base formed by micaschists, amphibolites, gneisses and phyllites. Outcroppings are located in the narrow and discontinuous coastal strip of the Coastal Mountain Range, in front of Santiago; they become wider towards the south, specially in front of Valdivia (39-40° S.L.) where the lowest part of the Cordillera of the Andes can be found.

Sporadically, Paleozoic rocks can be found in the Lake Region, province of Valdivia, between the lakes Calafquén and Ranco, where conglomerates, sandstones, slates and phyllites outcrop, probably of the permocarboniferous age, they conform a sequence deposited in a marine environment (Fajardo, 1975). While plutonic granite-like outcroppings occupy great extensions as intrusive bodies in the crystalline base of the Cordillera of the Coast. Most probably granitic rocks are related to the evolution of the Paleozoic geosyncline.

The continental Triassic outcrops in the central-southern area, from the 8th. Region -Quilacoya- to the south, and is represented by shales and marine slates including fossiles of live origin and intercalations of anthracitic coal layers (Cautín). No triassic sediments are found south of Cautín.

The marine Triassic is present in the region of the Bío-Bío and includes invertebrated fossils in sandstones and shales with scarce limestone evidences.

The plain surface of the Triassic constituted the occidental border of the south american continental mass, which produced an instability zone of the surface crust during the Jurassic, Cretaceous and probably during the Lower Tertiary periods. The orogenic movements of the Middle Cretaceous, both in central Chile as in the Patagonia, produced the intrusion of the Andean Batholith-Andean diorite (Fuenzalida, 1950) -which greatly conforms the Earth crust and which is itself formed by plutonite, tonalite to granodiorite and gabbros.

The instability of the surface provoked the development of vast geosynclinal basins which, as the batholith, were longitudinally elongated. Within the Chilean territory, this process came along with an intense volcanism developing deformation processes of granitic intrusions and of accumulation of a great mass of marine sediment (Fajardo, 1975).

At the end of the Lower Tertiary, and possibly, during the Oligocene periods the instability of the territory originated orogenic phases of deformation and folds which were rather continuous during the Plio-Pleistocene period originating mountain ranges that later suffered erosion. During the Oligocene tectonic phase, the Cordillera of the Coast begins its formation process and, also during this period, an intense volcanic activity takes place, giving way to an accumulation of clastic continental deposits which joined the volcanic series.

South of parallel 33°, the great outcroppings of volcanic rock -andesitic and basaltic- are practically horizontally arranged over rocks of the Lower Tertiary.

During the Miocene period, an advance of the sea takes place, and marine deposits develop in a special way in the coastal region of Concepción, Ñuble, Arauco and Valdivia.

During the Pliocene period, the land was a peneplain area with an enormous volcanic cover invaded by small bays in the western part towards the inland. Also, during this period occurr orogenic movements that throw the waters to places near the present coast binding the various pieces of the Andean Cordillera, which, then, acquires a unitary character. This orographic configuration is emphasized during the Quaternary period.

Volcanism

The Tertiary geological activity continued during the Pleistocene period, characterized by an intense volcanism and strong tector movements; thus producing the differential outburst of great magnitude blo(which originated and definetely separated the Andean Mountain Range, the Central Depression and the Coastal Mountain Range.

The Central or Intermediate Depression, which is a tectonic basin or Graben, has been the receptacle of fluvial, glacial, glacio-fluvia an laharic sediments, all coming from the Andean Mountains, which have reached 500 mts. of thickness in the area of Santiago and more than 2.000 mts. in the area of Chillán.

Volcanism during the Pliocene and Miocene periods continued uninterruptedly up to the Quaternary period, though less intense or decreasing. The products of this volcanism, pyroclastic rocks and particul tephra gave origin to the volcanic soils. The Quaternary volcanism is limi mainly to the Andean Mountain Range; the Coastal Cordillera lacks the prese of young volcanism (Zeil, 1965).

The Chilean Quaternary period has produced, in the central-southern region abundant volcanic ejecta, covering vast areas. This activi together with the glacial actions from the Pleistocene period, has shapened the present landscape. Glacial, fluvial or glaci-fluvial deposits are somewhat subordinated, directly or indirectly, to the volcanic activity.

Notwithstanding, a number of observations indicate that the Chilean volcanism is on the way to extinction, due to the fact that a great number of volcanoes have been destroyed by erosion or have been inactive for long periods and that others simply limit their activity to vapor emissions. Besides, the explosive phases of basaltic volcanoes and the presence of feldspar phenocrystals in some lava flows are symptomatic. Illies (1960) has come to the conclusion that the volcanic chain from the south of Chile, the liquid emissions of the F--rly Pleistocene period have concluded. Today volcanism is characterized by isolated emissions, particularly ashes. A similar opinion is asserted by Casertano (1962) and by Stone Ingerson (1934).

Young vulcanites, petrographically, are composed of olivine basalts which vary from vitreous to aphanitic, andesitic, biotitic or augitic forms (Segerstrom, 1964). Tephras vary from basaltic to rhyolitic terms. In Muñoz's (1950) opinion, old lava are hypersthene basalts and the young ones are olivine basalts. Volcanic products comprise, mainly, "aa" type lava or blocky lava and above all, ashes widely dispersed in the central-southern region of the country.

CLIMATE

Dr. Fernando Santibañez
Prof. Haydée Castillo

Genetic factors

Considering the most striking physiographic features, the region presents a Central Valley which extends to the 41.4° south latitude. Parallel to the coast, this valley limits to the west with the Coastal Cordillera whose heighest elevations are found between the 37° and 38° latitude and between the 40 and 41° south latitude. To the east the Andean Mountains make up the highest mountain range of the country. Towards the south the Central Valley disappears giving way to the sea; separating the continent in islands which generally corespond to outbursts of the Coastal Range. These orographic characteristics determine pluviometric gradients from west to east, while the latitude determines a pluviometric gradient from north to south. The distribution of precipitations or characteristic pluviometric regimes in the zone are determined by the dynamics of the south-west Pacific anticyclone.

The thermal regime possesses oceanic characteristics all along the country; the continentality is revealed only in sectors protected from the oceanic influence as it is windward of a greatly developed mountain range. The altitude effect is another factor present, mainly towards the Andean Mountains whose elevations are higher than those of the Coastal Cordillera.

Latitude and orography, in turn, influence the incidental solar radiation and the insolation. Orography is specially important owing to its exposure effect.

Regime of precipitations

The pluviometric regimes of the zone are graphically showed in the ombrothermic diagrams of the annual precipitation chart and monthly figures are shown in table 1.

In the northern part of the zone up to the 39.5° south latitude through the central valley and 38° through the coast and the Andean Mountains, we found the mediterranean pluviometric regime characterize by winter precipitations and warm and dry summers. The amount of dry months is higher in the valley because it is located under the lee of the coastal relief. Nevertheless, the dry season is reduced towards the south due to the decrease in height of the coastal mountain range and to the lesser influence of the Pacific anticyclone, which, in turn, determines a greater effect of the latitude factor in this region. In the Central Valley the annual precipitations reach up to 1.200 mm and in the highest sectors of the coastal mountain range they come near the 2.000 mm. Eastward, the precipitations exceed the 3.000 mm due to the greater altitude

TABLE N° 1

RAINFALL AND WATER DEFICIT IN SELECTED METEOROLOGICAL STATIONS (in mm)

MET. STA.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN	ANNUAL DEFICIT
Temuco	34.9	36.9	66.6	109.6	217.4	206.7	193.7	158.4	98.5	69.4	72.5	57.7	1324.8	340.0
P. Domínguez	43.9	39.9	75.6	104.7	255.0	263.5	257.9	193.6	135.4	79.7	78.5	53.7	1580.7	300.0
Valdivia	66.1	62.3	105.3	198.5	376.1	384.1	352.7	287.1	204.1	107.5	110.2	94.7	2348.7	90.8
Frutillar	63.2	65.8	117.6	169.5	217.3	226.2	204.8	175.6	137.7	82.1	92.8	106.5	1659.6	0.0
Osorno	40.7	67.4	61.3	115.1	215.2	179.4	218.9	196.1	108.0	85.3	68.2	75.4	1431.6	107.5
Puerto Montt	92.5	94.4	142.7	149.8	240.6	240.5	255.0	221.3	169.7	119.8	108.4	106.6	1941.6	0.0
Ancud	104.5	102.6	147.1	206.7	334.7	330.8	323.3	279.3	205.7	160.9	127.4	116.8	2438.8	0.0
Castro	82.4	101.5	128.5	179.8	332.8	332.2	324.0	289.3	224.6	167.9	155.5	105.2	2423.7	0.0

in the Andean Mountains. Southward, the rainfall reaches the 2.000 mm in the limit zone of this pluviometric regime (Chart 1). (INDAP-U. de Chile, 1982.)

The second pluviometric regime corresponds to a rainy one with mediterranean influence extending along the southern region of the zone. It is characterized by rainfall all year long. In spite of this, the influence of the Pacific anticyclone determines a decrease of precipitations during the summer with resulting dry months in this season during drought years. Hence the name of this pluviometric regime. Towards the south, rainfall becomes more homogeneous throughout the year, due to a greater oceanic and latitudinal influence. This can be observed in the ombrothermic diagrams of southern localities. The amount of annual rainfall for the central valley is of 1.500 mm, 2.500 for the coast and of more than 3.000 in the highest parts of the Cordillera of the Andes. Southwards, amounts of rainfall exceed the 2.500 mm (Chart N° 1, Table N° 1).

Thermic regime

The minimum temperatures of the coldest month vary little on account of the oceanic characteristics of the country. There is a thermic constancy that is evident from the most septentrional areas and thus these temperatures present values similar to the ones of the semi-arid zone located in lower latitudes. The values of the isotherms of the coldest months reach 6°C in the coast, decrease to 2°C in the pre-cordillera zone and drop to less than 0°C in the highest points of the Andean Mountains (Chart N° 2, Table N° 2).

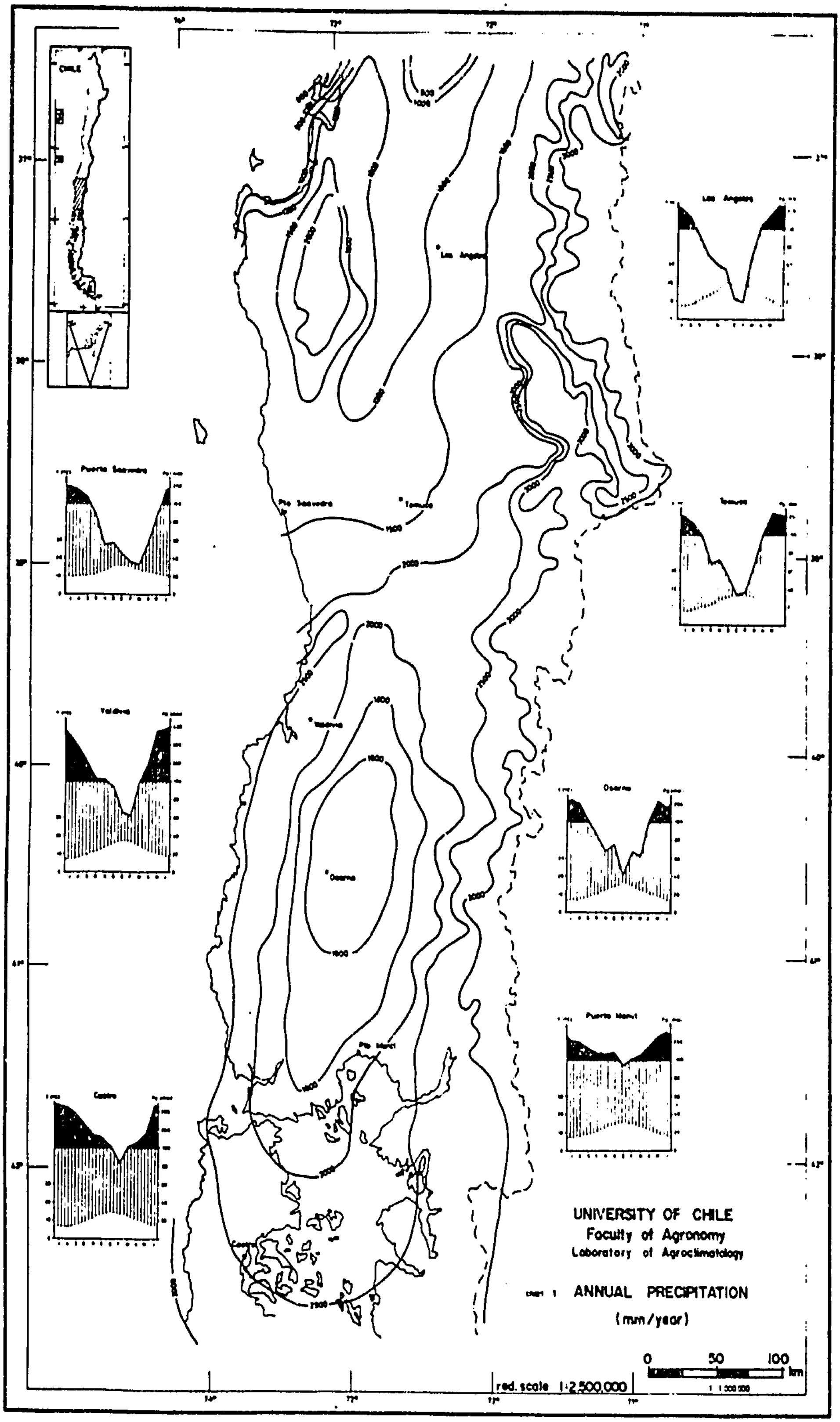
The maximum temperatures vary more due to the insolation and latitude effects, deriving in close isotherms. The continentality is revealed through higher temperatures in the Central Valley that diminish in the coast because of the oceanic effect and in the Andean zone because of altitude (Chart N° 3). In the Central Valley, the temperatures range from 27° to 20°C, and in the coastal and southern montainous zones reach 17° and 18°C respectively (Table N° 3).

Moisture regime

The amount of dry months vary according to the effect of climatic factors. In the areas with a mediterranean pluviometric regime the amount of months with water deficit ranges from 6 to 1. The greatest deficit is between the 37° and 38° latitude where the mountain range presents the highest elevations. The extension of the dry season diminishes gradually towards the south and towards the coast, and along the coastal zone it is limited to one month at 39.5° latitude (Chart N° 4).

In the oceanic pluviometric regime zone, where there are enough precipitations throughout the year, there is a mediterranean nucleus due to the influence of the coastal mountain range present between the 40° and 41° latitude in which a dry month occurs (Table N° 1).

CHART 1.



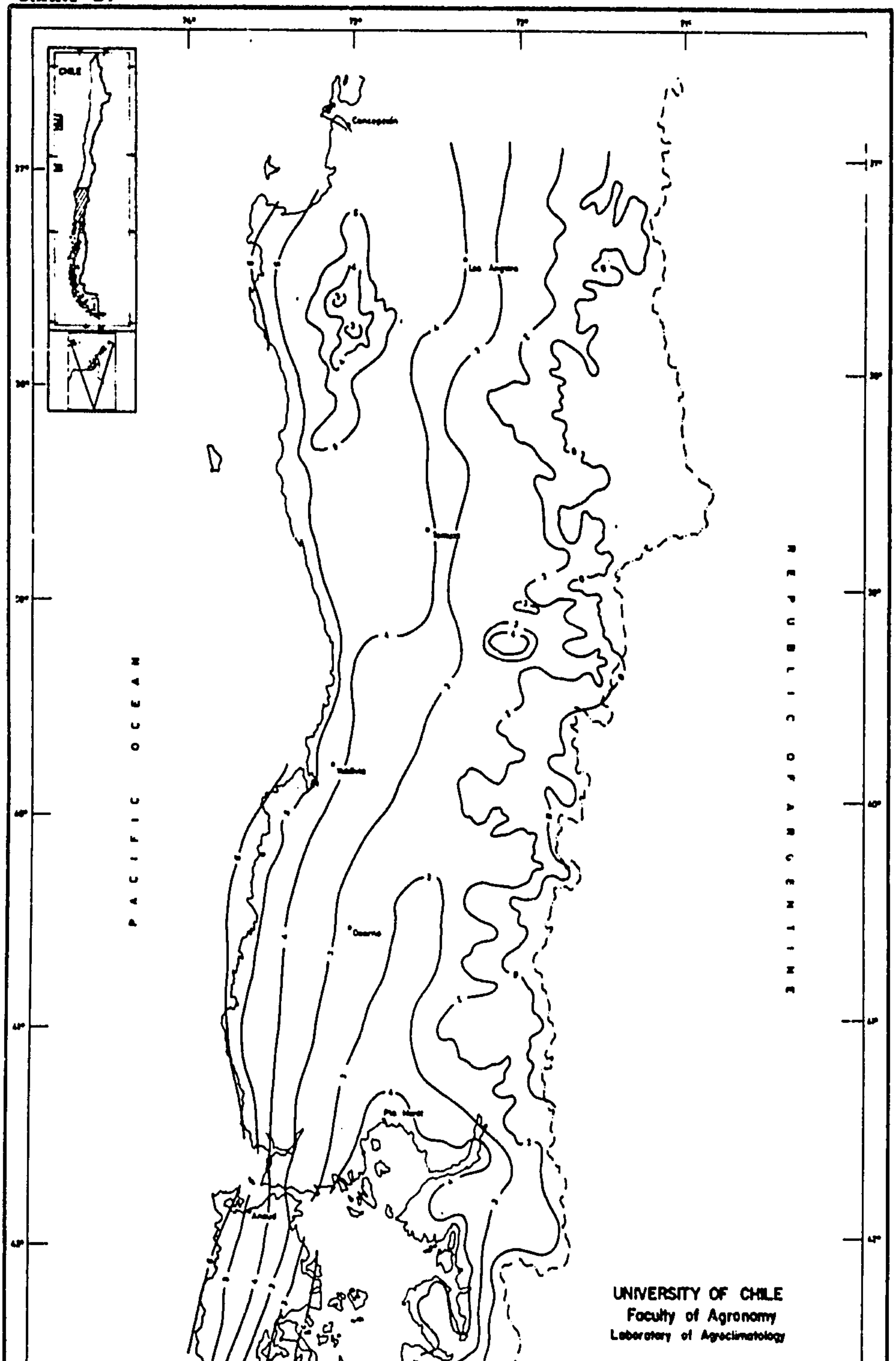
UNIVERSITY OF CHILE
Faculty of Agronomy
Laboratory of Agroclimatology
chart 1 ANNUAL PRECIPITATION
(mm/year)
0 50 100 km
red. scale 1:2.500.000
Los Angeles
Puerto Saavedra
Temuco
Valdivia
Osorno
Puerto Montt
Castro

TABLE N° 2

MONTHLY MINIMUM MEAN TEMPERATURE IN SELECTED METEOROLOGICAL STATIONS (in °C)

MET. STA.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
Temuco	10.4	10.1	8.8	6.8	5.6	4.6	4.2	4.1	5.1	6.5	7.9	9.4	7.0
P. Dominguez	9.2	9.3	8.5	6.9	5.8	5.5	5.1	4.5	5.5	6.4	7.7	8.8	6.9
Valdivia	10.8	10.4	9.1	7.1	6.9	5.6	4.8	4.6	5.3	6.6	8.4	9.9	7.5
Frutillar	9.0	9.0	7.9	6.1	4.8	3.8	3.0	3.2	3.5	5.1	6.3	7.8	5.8
Osorno	7.5	6.9	5.8	4.6	4.6	3.2	3.4	3.8	3.0	4.4	6.2	7.2	5.0
Puerto Montt	10.9	10.5	9.2	7.6	6.8	5.2	4.6	4.6	5.4	6.8	8.7	10.0	7.5
Ancud	9.5	8.4	8.1	6.3	5.4	4.5	4.6	4.2	4.2	5.4	7.0	8.0	6.3
Castro	9.4	8.2	7.3	5.9	5.0	3.9	3.7	3.2	3.9	5.3	6.5	8.2	5.9

CHART 2.



Concepción
Los Angeles
Osorno
Ancud
PACIFIC OCEAN
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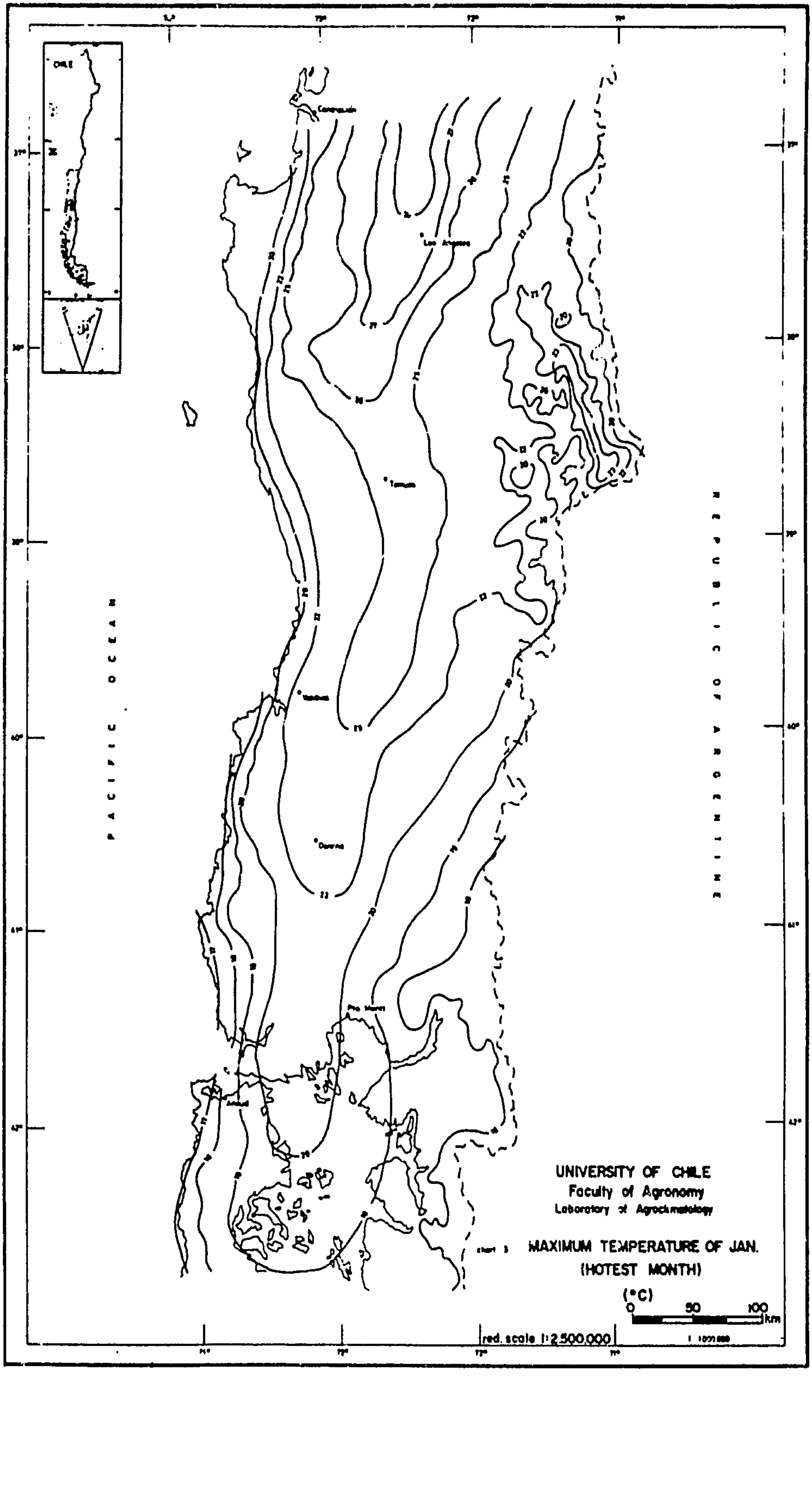
MINIMUM TEMPERATURE OF JULY
(COLDEST MONTH)
0 50 100 km
red. scale 1:2.500.000

TABLE N° 3

MONTHLY MAXIMUM MEAN TEMPERATURE IN SELECTED METEOROLOGICAL STATIONS (in °C)

MET. STA.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.	MEAN
Temuco	25.3	25.3	22.7	18.7	14.5	12.1	12.1	13.1	15.5	18.1	20.4	22.8	18.4
P. Domínguez	20.2	20.4	19.0	17.1	14.6	13.1	16.8	13.0	14.2	15.6	16.9	18.7	16.3
Valdivia	24.1	22.5	21.0	17.0	13.1	11.7	11.1	12.3	14.8	17.3	19.9	22.3	17.3
Frutillar	20.0	19.9	17.8	14.7	12.1	10.2	9.8	10.6	12.0	14.5	16.3	18.2	14.7
Osorno	23.2	22.5	20.7	17.0	13.5	10.7	10.9	11.7	14.1	16.9	18.8	21.5	16.8
Puerto Montt	19.5	18.8	17.6	15.2	13.2	11.5	11.0	11.3	12.0	14.5	16.8	18.4	15.0
Ancud	18.6	18.3	16.8	14.4	12.1	10.5	10.5	10.4	11.6	13.5	15.5	17.2	14.1
Castro	19.4	19.2	18.2	15.1	13.2	10.5	10.4	10.5	12.3	14.6	16.7	18.4	14.9

CHART 3.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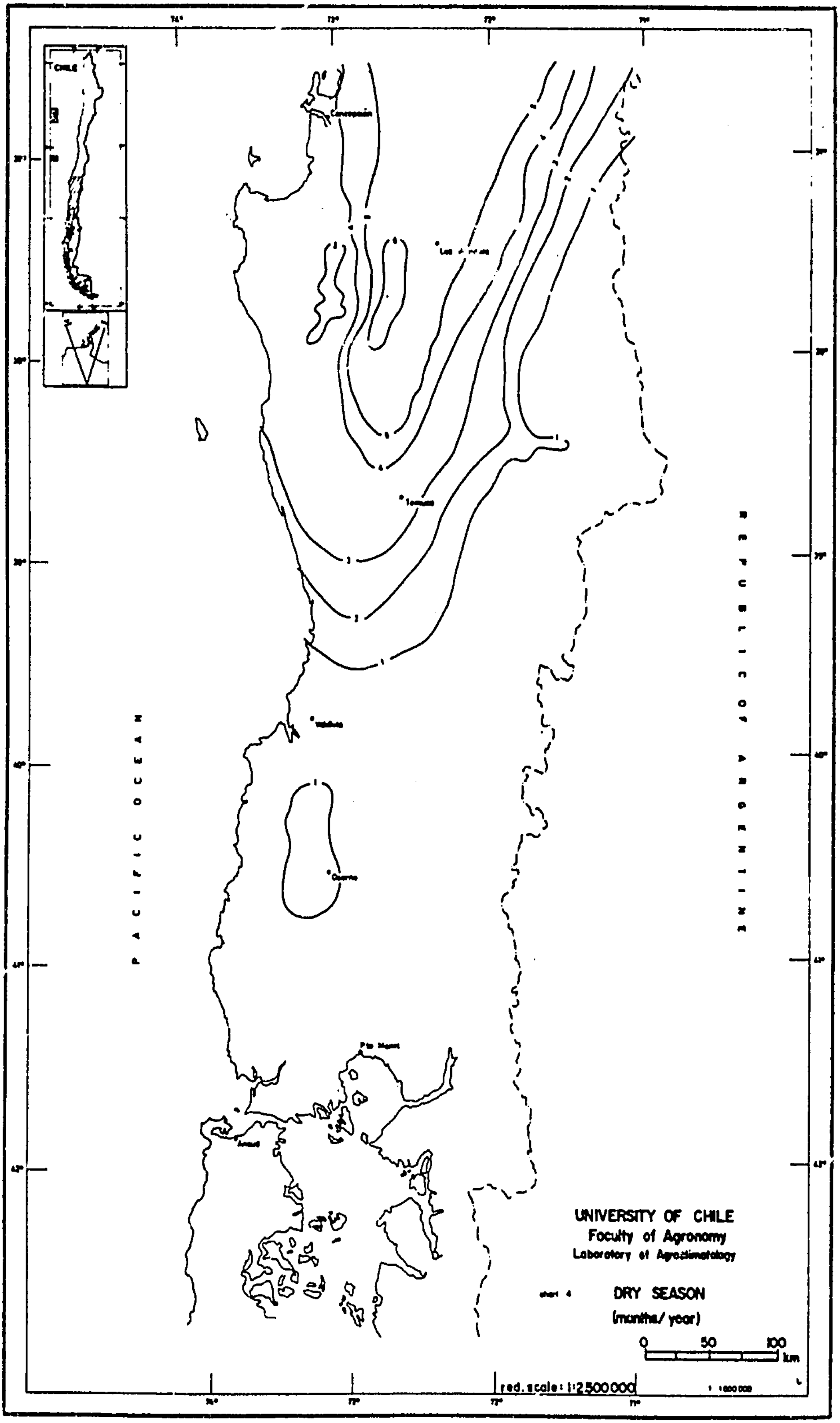
MAXIMUM TEMPERATURE OF JAN.
(HOTEST MONTH)
(°C)
0 50 100
km
red. scale 1:2.500.000

CHART 4.


PACIFIC OCEAN
REPUBLIC OF ARGENTINA
UNIVERSITY OF CHILE
Faculty of Agronomy
Laboratory of Agroclimatology
chart 4
DRY SEASON
(months/ year)
0 50 100
km
red. scale: 1:2500000

Radiation regime

The amount of incidental radiation depends on: latitude, cloudiness and season of the year. The highest values are obtained in December, varying from North to South between 350 - 450 cal/square cm per day. In June, the month with the highest cloudiness, the values drop clearly from north to south varying between 100 - 60 cal/square cm per day (Table N° 4).

The annual solar radiation varies from north to south between 130 - 90 kcal/square cm a year.

Climatic zones according to Köeppen

According to Köeppen's classification, these are in the zone three climatic types coinciding approximately with the distribution of the pluviometric regimes already described. (Figure 2.)

The first climatic type is the warm temperate climate with a short dry season (Csb 2). It is difficult to precise the southern limit for this climate due to the influence of the coastal mountain range (Cordillera of Nahuelbuta); but it could be determined in the dry months chart as an approximate value since a dry month was determined with the ratio between available humidity (pp) and potential evapotranspiration (ETP), that is pp/ETP.

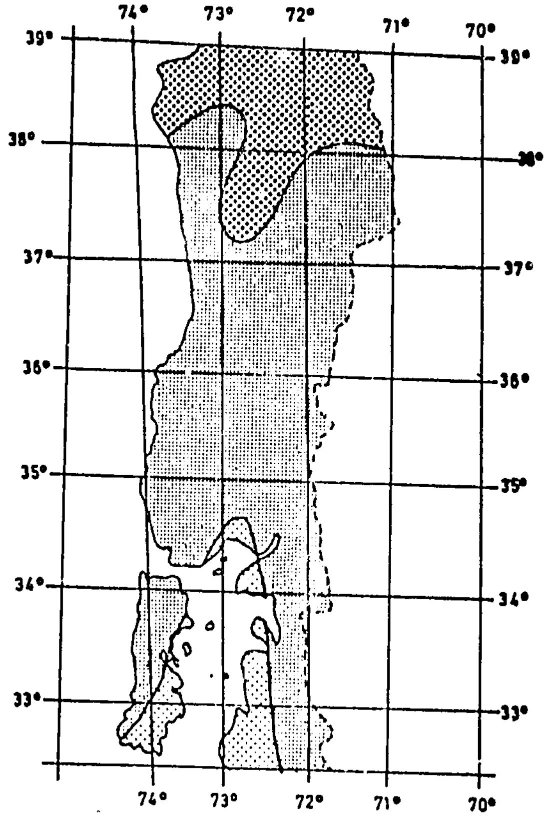
The second climatic type is the rainy temperate climate with mediterranean influence (Cfsb), extending to more southern areas of the described zone. In this type of climate the mediterranean influence is so marked that, for example, in Valdivia January's rainfall is 66.1 mm and June's 384.1 mm (Table N°1).

The third type of climate is the west coast cold temperate climate with a maximum of winter rains (Cfb). See enclosed map.

Agroclimatic districts of the region

Chart N° 5 presents the agroclimatic districts that correspond to the zone of our interest. We have used a system developed in Chile consisting in the integration of a set of variables that define the agricultural potential of a region. The climatic chartography of these variables leads to a chart of agroclimatic districts in which each area is characterized by twelve variables, summarized in a synthetic formula (Chart N° 5).

FIGURE 2.



Climatic characterization according to Koeppen
(adapted by H. Fuenzalida)

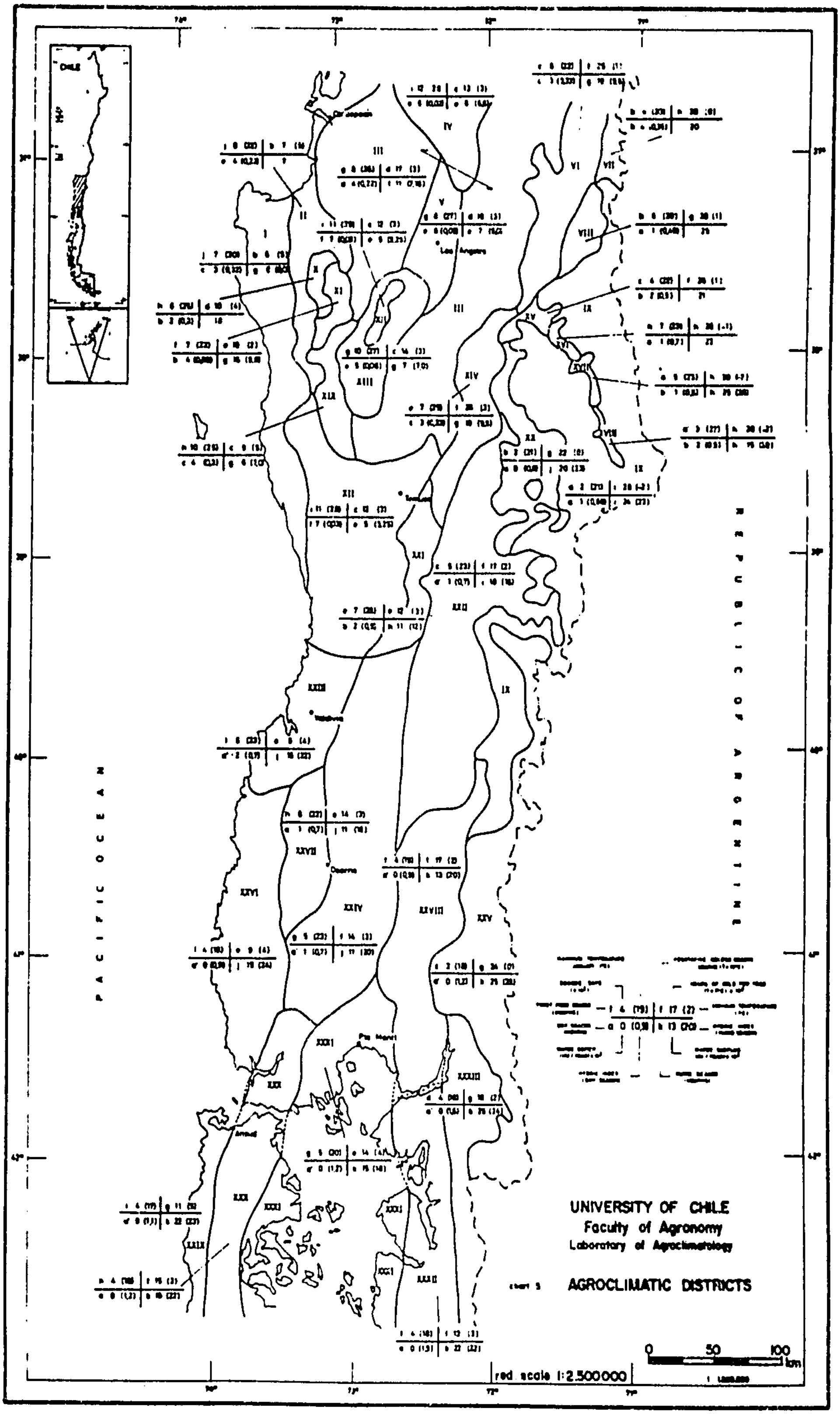
$C_s b_3$ Cfsb Cfb

TABLE N° 4

RADIATION REGIME IN SELECTED METEOROLOGICAL STATIONS (in cal/cm^2, per day)

MET. STA.	JAN.	FEB.	MARCH	APRIL	MAY	JUNE	JULY	AUG.	SEPT.	OCT.	NOV.	DEC.
Temuco	544	449	333	205	115	83	95	157	255	338	435	530
Valdivia	500	420	324	194	103	71	67	146	227	332	432	490
Osorno	489	421	309	194	92	71	76	134	227	332	432	445
Puerto Montt	458	392	277	170	100	61	73	134	233	327	404	445
Castro	431	344	296	156	90	61	73	122	200	284	352	417

CHART 5.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AGROCLIMATIC DISTRICTS
red scale 1:2.500000
0 50 100 km

GENERAL FEATURES OF QUATERNARY VOLCANISM IN CENTRAL-SOUTH CHILE*

Hugo Moreno Roa

Petrology

The most striking feature in this region is the abundant occurrence of high-alumina basalt associated with andesite and dacite of the calc-alkaline series, while rhyolite is rarely found (Larsson, 1940; Katsui and Katz, 1967; Katsui and González, 1968; Vergara and Katsui, 1969; González y Vergara, 1970; González, 1972; Katsui, 1972; Vergara and González, 1972; Moreno, 1974, 1975, 1977).

Tholeiitic basalt, however, does not occur in this region, although Kuno (1966) supposed that most of the southern Andean rocks are of tholeiitic derivation.

According to Moreno (1974) typical calc-alkaline character of volcanism prevails up to the latitude of Chillan volcanic area (37°00'), further to the south, mainly rocks related to the high-alumina basalt series can be found in the west Andean volcanic range.

On the other hand, in dacites Na_2O content increases from north to south, while K_2O content decreases in basalts, andesites and dacites.

Besides, it is necessary to point out that the thickness of the crust is around 65 km thick at the latitude of Santiago (33°30' south latitude) and only 25 to 30 at the latitude of Puerto Montt. On the other hand, subduction angle of Benioff plane is around eighteen degrees at the latitude of Santiago while in Puerto Montt seems to be no subduction angle at all (Kausel and Lomnitz, 1968; Draguicevic, 1970, 1974).

These facts indicate that there probably exists a close relationship between chemical composition of volcanism, thickness of the crust and the subduction angle of Benioff plane (Moreno, 1974).

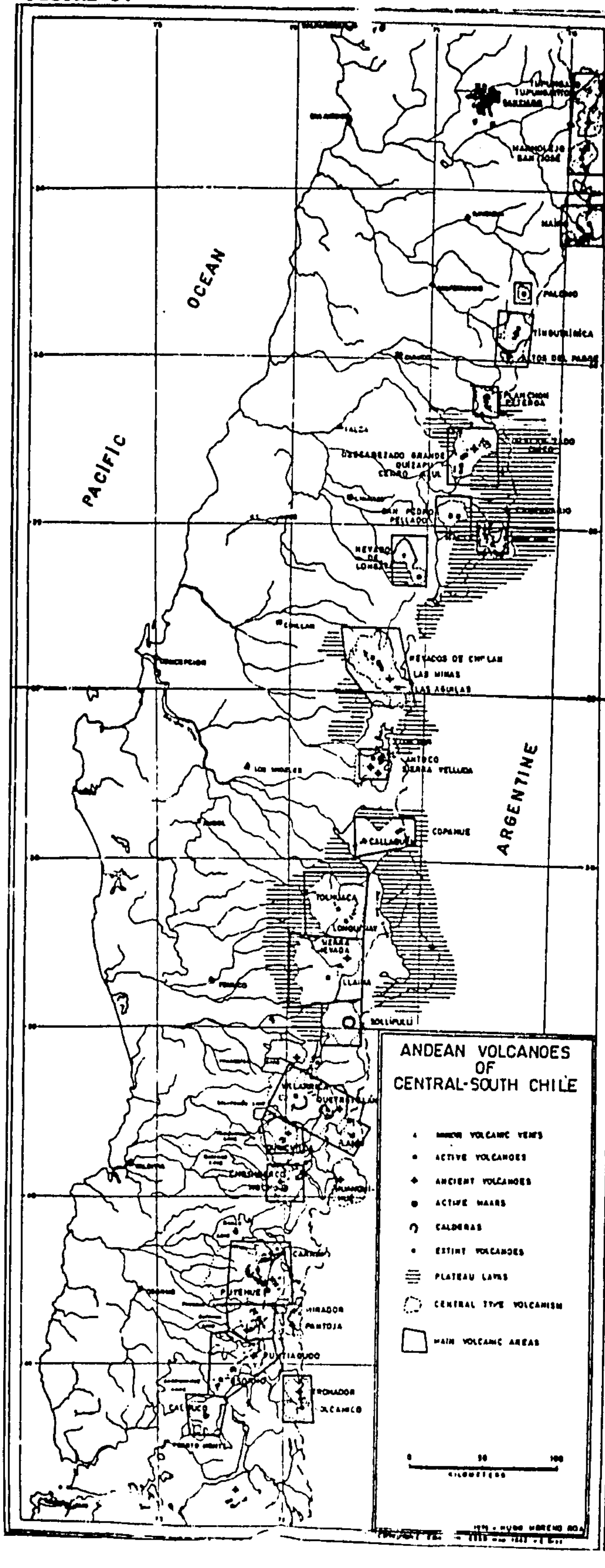
Tectonism

A remarkable tectonic control of volcanism in evident throughout the entire region. (Figure 3.)

From the latitude of Santiago (33° S) up to Valdivia (40° S) volcanic activity is controlled by N-S and NW-SE fractures and faults (González and Vergara, 1962; González, 1970; Katz, 1970; Vergara and González, 1972; González, 1972; Moreno, 1974).

(*) Partly extracted from: Hugo Moreno, 1974. Airplane flight over active volcanoes of Central-South Chile. International Symposium on Volcanology. Guide Book - Excursion D-3. IAVCEI.

FIGURE 3.



PACIFIC
OCEAN
ARGENTINE
ANDEAN VOLCANOES
OF
CENTRAL-SOUTH CHILE
ACTIVE VOLCANOES
ANCIENT VOLCANOES
ACTIVE MAARS
CALDERAS
PLATEAU LAVAS
MAIN VOLCANIC AREAS
TUPUNGATO
SAN JOSE
MAIPO
TINGUIRIRICA
DESCABEZADO GRANDE
QUIZAPU
CERRO AZUL
SAN PEDRO
PELLADO
NEVADO DE
LONGAVI
NEVADOS DE CHILLAN
LAS AGUILAS
ANTUCO
SIERRA VELLUDA
COPAHUE
CALLAQUI
TOLHUACA
LONQUIMAY
SIERRA NEVADA
LLAIMA
SOLLIPULLI
VILLARRICA
PUYEHUE
MIRADOR
PANTOJA
PUNTIAGUDO
TRONADOR
CALBUCO

Between 40° S and 40°40' S there is a transition zone in which the eruptive centers alignments are NW-SE; NE-SW and N-S (Katsui and Katz, 1967; Katz, 1970; Moreno and Parada, 1974; Moreno, 1974).

Further south from 40°40' S, volcanic vents are controlled exclusively by NE-SW and N-S fractures and faults (Katsui and Katz, 1967; Moreno, 1974).

The N-S fracture and fault system is related to the general rise of the Andes since Pliocene time (Klohn, 1955; Aguirre and Leví, 1964; Corvalán and others, 1967; Katsui and Katz, 1967; González, 1969, 1970; Katz, 1970; Vergara and González, 1972; Katsui, 1972; Moreno and Parada, 1974; Moreno, 1974).

Volcanic Areas

The description of volcanic areas will be limited to the most important centers which are closely related to volcanic ash soils in South Chile. These areas are: (Figure 4.)

1. Antuco - Sierra Velluda
2. Llaima - Sierra Nevada
3. Villarrica - Lanin
4. Mocho - Choshuenco
5. Puyehue - Carrán
6. Antillanca
7. Osorno - Puntiagudo
8. Calbuco

1. Antuco - Sierra Velluda

Location: 37°22' to 37°35' South latitude
71°15' to 71°30' West longitude

General features:

Volcanic activity since early Pleistocene up to the Present. A ruined andesitic stratovolcano of Pleistocene age represents the first stage; an eroded andesitic stratovolcano of Upper Pleistocene age performs a stage event. A final stage consists in the evolution of Antuco volcano of basaltic composition. It developed during Holocene time and consists in a somma with a central cone, lava flows, parasitic pyroclastic cones and ash deposits.

Basement is composed mainly of stratified and granitic Mesozoic rocks.

Volcanic groups:

- Antuco: composed of a somma (relict of Antuco I Caldera stratovolcano) and a central cone (Antuco II) with parasitic craters, cinder cones, pyroclastic deposits and recent lava flows.

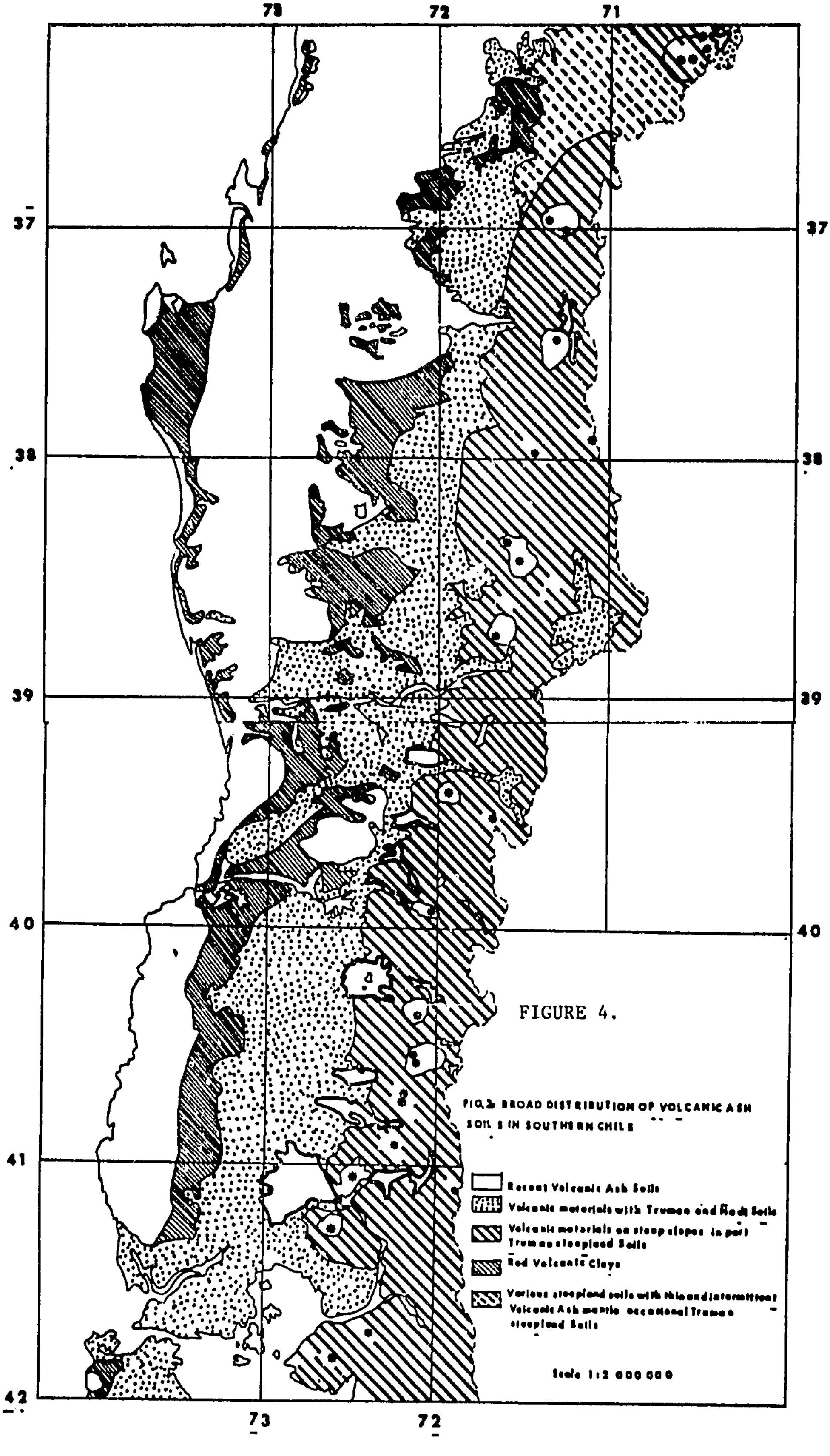

73
72
71
37
38
39
40
41
42
FIG.2 BROAD DISTRIBUTION OF VOLCANIC ASH SOILS IN SOUTHERN CHILE
Recent Volcanic Ash Soils
Volcanic materials with Trumao and Ñadi Soils
Volcanic materials on steep slopes in part Trumao steepland Soils
Red Volcanic Clays
Various steepland soils with thin and intermittent Volcanic Ash mantle occasional Trumao steepland Soils
Scale 1:2 000 000

FIGURE 4.

Antuco stratovolcano (2.895 m.a.s.l.).

- Sierra Velluda - Cerro Cóndor: consist of two eroded stratovolcanoes, the older of which is Sierra Velluda volcano.

Sierra Velluda ancient stratovolcano (3.385 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Andesites of Sierra Velluda - Cerro Cóndor volcanic group are aphiric and porphyric with phenocrystals of olivine, augite, hypersthene and labradorite in a hyalopilitic groundmass.

Basalts of Antuco volcanic group have olivine, augite and bytownite-labradorite phenocrysts in an intergranular to intersertal groundmass.

Chemical composition(*):

	Antuco Average of 8 basalts	Sierra Velluda - Cerro Cóndor Average of 5 andesites
SiO_2	51.61	56.92
Al_2O_3	18.51	17.15
Fe_2O_3 FeO	8.46	8.61
MgO	6.20	2.85
CaO	8.98	6.56
Na_2O	3.51	4.77
K_2O	0.75	1.25
TiO_2	1.01	1.29
P_2O_5	0.24	0.30
MnO	0.16	0.18
H_2O	0.47	0.81
Total:	99.90	100.69

Historic eruptions:

Antuco Volcano: 1752, 1806, 1828, 1839, 1845, 1852, 1853 1861, 1863, 1869, 1969, 1982 intermitent fumarollic activity.

2. Llaima - Sierra Nevada

Location: 38°28' to 38°52' South latitude
71°25' to 72'00' West longitude

General features:

Volcanic activity since Pliocene up to the present. Composed by a ruined stratovolcano deeply eroded by glaciers (Sierra

(*) Vergara y Katsui (1969); López et.al. (1981); Deruelle (1982).

Nevada) and a modern well shaped volcanic cone (Llaima) with numerous parasitic craters, pyroclastic cones, lava flows and lahar deposits. Basement consists in stratified and granitic mesozoic rocks.

Volcanic groups:

- Sierra Nevada: consists of and old Plio-Pleistocene eroded caldera stratovolcano.

Sierra Nevada stratovolcano (2.554 m.a.s.l.).

- Llaima: composed of a beautiful modern stratovolcano with fumarollic activity in its central crater, surrounded by numerous pyroclastic cones. It shows extense lava flows and lahar deposits.

Llaima stratovolcano (3.124 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Lavas and pyroclastics of Llaima volcano are olivine-bearing basalts with labradorite an augite, and olivine-augite andesites with andesine.

Chemical composition*:

	Average of 7 basalts	Average of 3 andesites
SiO_2	52.37	54.97
Al_2O_3	17.31	17.26
Fe_2O_3 FeO	9.41	9.75
MgO	5.22	3.29
CaO	9.16	7.97
Na_2O	3.03	3.65
K_2O	0.67	0.77
TiO_2	1.15	1.31
MnO	0.13	0.18
P_2O_5	0.25	0.24
H_2O	0.22	0.13
Total:	98.92	99.52

Tectonism:

Volcanic activity is controled by N 140° E and N 15° E fracture systems.

Historic eruptions:

Llaima volcano: 1640, 1751-52, 1852-53, 1862, 1864, 1866, 1872, 1874, 1876, 1887, 1889, 1903, 1917, 1922, 1927, 1930, 1941, 1957, 1960, 1979, permanent fumarollic activity.

(*) Klerkx (1965); Deruelle (1982); López y Moreno (in prep.).

3. Villarrica - Lanin

Location: 39°15' to 39°43' South latitude
71°23' to 72°08' West longitude

General features:

Volcanic activity since Pliocene up to date. Characterized by three large stratovolcanoes aligned in a NW-SE trend. The oldest unit consists in thick piles of stratified lava flows and pyroclastics, related to old stratovolcanoes deeply disected by glacial erosion. A number of pyroclastic parasitic cones, extense lava flows and lahars perform the youngest unit. Historic eruptions are related to Villarrica volcano, located at the NW end of the volcanic range. Volcanic materials are mainly of basaltic composition, nevertheless, andesites and dacites are also present.

Basement consists in Mesozoic granitic and stratified rocks.

Volcanic groups:

- Villarica: composed by a modern well shaped stratovolcano with a large somma displaced towards the SE. The main active cone is surrounded by several pyroclastic cones. A recent N° 30° E fracture can be distinguished at both sides of the summit, caused by the 1971 eruption.

Villarrica stratovolcano (2.840 m.a.s.l.).

- Quetrupillan: consists in a wide caldera with a central stratovolcano and numerous parasitic pyroclastic cones and craters. A ruined stratovolcano (Quinquilil) is located towards the NE of Quetrupillán volcanoes.

Quetrupillán stratovolcano (2.360 m.a.s.l.).

- Lanín: composed by a large stratovolcano partly disected by glaciers.

Lanín stratovolcano (3.774 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Basalts have Mg-olivine, labradorite and augite in an intergranular groundmass with pyroxene and iron ore.

Andesites have andesine-labradorite, olivine, augite and hypersthene in a groundmass with grains of plagioclase, pyroxene and iron ore.

Dacites have oligoclase-andesine, augite, hypersthene and ocasionally Fe-olivine in a vitrophyric groundmass with grains of plagioclase, pyroxene and iron ore.

Chemical composition*:

	Villarrica Average of 10 basalts	Villarrica Average of 7 andesites	Quetrupillán-Lanín Average of 8 dacites
SiO_2	51.59	55.85	64.05
Al_2O_3	18.00	16.79	15.21
Fe_2O_3 FeO	9.10	8.69	5.75
MgO	5.71	4.48	1.28
CaO	8.94	6.44	3.54
Na_2O	3.47	4.10	4.65
K_2O	0.86	1.18	2.86
TiO_2	1.12	1.11	1.06
MnO	0.12	0.11	0.11
P_2O_5	0.28	0.29	0.40
H_2O	0.68	0.61	0.70
Total	99.87	99.65	99.61

Tectonism:

Volcanism in this area is controled by a NW-SE fracture system.

Historic eruptions:

Villarrica volcano: 1640, 1806, 1860, 1869, 1874, 1875-76, 1877, 1883,1893-94, 1908, 1910, 1920, 1948, 1950, 1964, 1971, fumarollic activity today.

4. Mocho - Choshuenco

Location: 39°49' to 40°05' South latitude
71°51' to 72°11' West longitude

General features:

Volcanic activity since Middle Pleistocene up to the Present. Characterized by stratovolcanoes, a ruined caldera, pyroclastic cones, explotion craters and lava flows. Volcanic materials are of basaltic, andesitic and dacitic composition, they rest with unconformity upon mesozoic and paleozoic bedrock which consists mainly of granitoides and related rocks.

Volcanic groups:

- Mocho - Choshuenco: stratovolcanoes, a ruined caldera and a central pyroclastic cone. Parasitic explotion craters and pyroclastic cones.

Mocho volcano (central pyroclastic cone: 2.430 m.a.s.l.).

(*) Klerkx (1965); Deruelle (1982); Moreno y López (in prep.).

- Fui: numerous pyroclastic cones and lava flows.

Petrography and chemical composition:

Petrography:

Basalts have Mg-olivine, augite and labradorite in an iron-rich groundmass with clinopyroxene and andesine. Dacites have clinopyroxene and andesine. Dacites have clinopyroxene and oligoclase in a felsic groundmass with clino and ortopyroxene, oligoclase and iron ore.

Chemical composition*:

	Choshuenco Average of 4 basalts and basaltic-andesites	Mocho Average of 2 dacites	Fui Average of 2 basaltic-andesites
SiO_2	53.16	64.30	54.72
Al_2O_3	19.07	15.66	16.23
Fe_2O_3 FeO	8.88	6.46	10.56
MgO	3.99	1.57	3.34
CaO	8.70	3.16	7.67
Na_2O	3.40	5.10	3.99
K_2O	0.71	1.61	0.86
TiO_2	1.06	0.94	1.42
MnO	0.16	0.17	0.20
P_2O_5	0.19	0.29	0.28
ppc	0.55	0.56	0.59
Total:	99.87	99.82	99.86

Tectonism:

Two trends of volcanic centers alignement indicates a tectonic control of volcanism: N 140° E, N 60° E.

Historic eruptions:

Mocho volcano: 1864.

5. Puyehue - Carrán

Location: 40°16' to 40°40' South latitude
71°55' to 72°35' West longitude

General features:

Volcanic activity since Late Pliocene up to date. Characterized by stratovolcanoes, ruined calderas, fissural volcanic ranges and numerous pyroclastic cones, maars, lava-domes, lava flows and pyroclastic deposits widely spread. Volcanic materials are of basaltic, andesitic and dacitic composition, and they rest in unconformity upon Mesozoic and Paleozoic bedrock which consists mainly of granitoids and related rocks.

(*) Di Biase (1976); Deruelle (1982).

Volcanic groups:

- Carrán - Los Venados: stratovolcanoes, maars and numerous pyroclastic cones and lava flows.

Carrán Maar (300 m.a.s.l.).

- Mencheca: relicts of an old fissural volcanic range, an eroded caldera, volcanic necks and modern well preserved maars.

Mencheca volcano (1.840 m.a.s.l.).

- Puyehue - Cordón Caulle: stratovolcanoes (caldera), fissural volcanic ranges, domes and numerous pyroclastic cones, viscous lava flows and extense pumice deposits.

Puyehue volcano (2.236 m.a.s.l.).

- Cordillera Nevada: ancient ruined caldera with lava flows and old eruptive centers inside.

Cordillera Nevada volcano (1.799 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Basalts have Mg-olivine, augite and labradorite in an iron rich groundmass with clinopyroxene, olivine and labradorite.

Andesites have andesine-labradorite, augite and sometimes hypersthene.

Dacites and rhyolites have augite, Fe-olivine, hypersthene and oligoclase in a felsic groundmass with oligoclase, iron ore and some trydimite.

Chemical composition*:

	Carrán - Los Venados Average of 5 basalts	Cordón Caulle Average of 14 dacites-rhyolites	Puyehue Average of 10 dacites-rhyolites
SiO_2	52.56	69.98	67.66
Al_2O_3	18.56	14.12	14.68
Fe_2O_3	2.87	4.53	5.50
FeO	8.03		
MgO	4.34	0.40	0.77
CaO	7.00	2.12	2.83
Na_2O	3.83	5.09	4.94
K_2O	0.69	2.74	2.47
TiO_2	1.33	0.61	0.71
MnO	0.19	0.12	0.14
P_2O_5	0.13	0.12	0.17
ppc	0.98	-	-
Total:	100.51	99.83	99.87

Tectonism:

The tectonic control of volcanism is evident. The main trends of vent alignments are: N 120° - 130° E, N 60° E, N 5° - 10° E.

Historic eruptions:

1893(?) : Cordón Caulle (fissural eruption).
1907 : Corral Quemado or Riñinahue (maar explosive eruption with lava outpouring).
1921-22 : Cordón Caulle - Cordillera Nevada (fissural eruption).
1929 : Cordón Caulle (pumice eruption).
1934 : Cordón Caulle (fissural eruption).
1955 : Carrán, Nilahue or Pillanilahue (maar explosive eruption).
1960 : Cordón Caulle (fissural eruption).
1979 : Mirador, a pyroclastic cone of Carrán - Los Venados (pyroclastics and lava flows).

At present with solphataric, fumarollic and geyser activity.

6. Antillanca

Location: 40°40' to 40°52' South latitude
72°05' to 72°25' West longitude

General features:

Volcanic activity since late Pliocene up to Holocene time. Characterized by numerous pyroclastic cones and maars well preserved, stratovolcanoes and ruined calderas. Volcanic materials are of basaltic composition and they rest in unconformity upon Mesozoic and Paleozoic bedrock which consist mainly of granitoids and related rocks.

(*) Moreno (1974); Gerlach (in prep.).

Volcanic groups:

- Antillanca: stratovolcanoes, pyroclastic cones, lava flows and maars.

Casablanca volcano (1.990 m.a.s.l.).

- Fiucha: stratovolcanoes (eroded caldera) lava flows and pyroclastic cones.

Fiucha caldera (1.481 m.a.s.l.).

- Sarnoso: stratovolcanoes (volcanic ruin), pyroclastic cones, lava flows and maars.

Sarnoso volcano (1.630 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Mainly basalts with phenocrysts of Mg-olivine, augite and labradorite. Iron-rich groundmass with clinopyroxene, olivine and labradorite.

Chemical composition*:

	Antillanca Group Average of 6 basalts
SiO_2	51.21
Al_2O_3	19.55
Fe_2O_3	2.37
FeO	6.46
MgO	5.62
CaO	8.76
Na_2O	3.26
K_2O	0.58
TiO_2	0.95
P_2O_5	0.15
MnO	0.13
H_2O	0.60
Total:	99.64

Tectonism:

A tectonic control of volcanic activity is evident. Trends of alignment are: N 130° E, N 45-60° E, N 80° E, N 5-10°E.

History eruptions:

No record, but recent activity is evident.

(*) Moreno (1975); Pino (in prep.).

7. Osorno - Puntiagudo

Location: 40°52' to 41°13' South latitude
72°09' to 72°41' West longitude

General features:

Volcanic activity since late Pliocene up to the Present. Characterized by stratovolcanoes, an ancient fissural volcanic range and well preserved pyroclastic cones. Volcanic materials are mainly of basaltic composition and they rest in unconformity upon Mesozoic and Paleozoic bedrock which consists mainly of granitoids and related rocks.

Volcanic groups:

- Osorno: modern stratovolcano with a somma and numerous parasitic pyroclastic cones and lava flows.

Osorno volcano (2.652 m.a.s.l.).

- La Picada: stratovolcano (eroded caldera) with parasitic crater.

La Picada volcano (1.715 m.a.s.l.).

- Puntiagudo - Cordón Cenizos: stratovolcanoes (eroded), ancient fissural volcanic range and numerous pyroclastic cones with lava flows.

Puntiagudo volcano (2.493 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Mainly basalts with phenocrysts of Mg-olivine, augite and labradorite. Iron-rich groundmass with clinopyroxene, olivine and labradorite.

Chemical composition*:

	Osorno Average of 4 basalts
SiO_2	50.62
Al_2O_3	20.23
Fe_2O_3	1.43
FeO	7.91
MgO	3.65
CaO	11.31
Na_2O	2.78
K_2O	0.48
TiO_2	0.64
P_2O_5	0.16
MnO	0.14
H_2O	0.65
Total:	100.00

Tectonism:

Main trend of alignment is N 50-60° E.

Histotic eruptions:

Osorno volcano and parasitic pyroclastic cones of SW: 1719, 1790, 1834, 1835, 1850. Scarce fumarollic activity on the summit.

8. Calbuco

Location: 41°13' to 41°26' South latitude
72°30' to 72°45' West longitude

General features:

Volcanic activity since Pleistocene up to the Present. Characterized by a typical stratovolcano evolution, whose different stages were separated by glacial erosion. The final stage is represented by an active central cone with related lava flows and extense laharic deposits, volcanic materials are basaltic and andesitic; they rest in unconformity upon granitic mesozoic bedrock.

Calbuco volcano (2.015 m.a.s.l.).

Petrography and chemical composition:

Petrography:

Basalts have augite, hypersthene, labradorite and little olivine as phenocrysts.

Andesites have hypersthene, augite and labradorite-andesine as phenocrysts.

(*) Moreno et.al. (1979).

Chemical composition*:

	Calbuco	
	Average of 2 basalts	Average of 2 andesites
SiO_2	51.10	56.18
Al_2O_3	20.25	18.42
Fe_2O_3 FeO	8.20	8.13
MgO	4.26	3.89
CaO	8.86	7.52
Na_2O	4.07	3.93
K_2O	0.82	0.67
TiO_2	0.85	0.90
MnO	0.12	0.13
P_2O_5	0.15	0.18
H_2O	1.24	0.15
Total:	99.92	100.10

Historic eruptions:

Calbuco volcano: 1837-38, 1906, 1909, 1912, 1917, 1929, 1961, 1974.

(*) Klerkx (1965); Deruelle (1982).

VEGETATION SYNTHESIS OF THE CENTRAL-SOUTHERN REGION OF CHILE

Dr. Claudio Donoso Z.

Introduction

It is always somewhat complicated to characterize vegetation in the framework of a region within Chile given the fact that the individual behaviour of species in response to the environment determines gradual changes that materialize in a vegetation continum, in which occur overlappings that difficult a clear vision of discrete communities. An effort of abstraction to identify them is then needed.

Limits of the Central-Southern region of Chile

The geographic latitudinal limits of what might be called the Central-Southern region of Chile are not clearly defined. If we divide the territory in three thirds, the Central region can be located between parallels 30° and 42° S and therefore, the region comprised between parallels 36° and 42° S could be considered the Central-Southern region. The Northern limit can be moved somewhat towards the south, to parallel 36°30', with the aim of making it coincide in the cordilleras, with a natural limit occurring between the mediterranean vegetation and the more hygrophile southern vegetation. In the Central Valley, this limit is moved to parallel 38° S approximately and the southern limit must be shifted also towards the south to parallel 43° S, so as to make it coincide with the southern extreme of the island of Chiloé, which in itself is a natural limit appropiate from a vegetational point of view.

Plant Communities

The high precipitations and moderate temperatures, dominant characteristics of the Central-Southern region, allow the existence of a hydric regime normally favoring the development of trees, which, in turn, determines that the characteristic of the vegetation be the forest communities, with trees as the dominant individuals. The exception to this are the cordilleran areas located above the altitudinal tree limit, where low temperatures, strong winds, precipitation in the form of snow and lack of soil development prevent, in general, the growth of trees and woody vegetation giving way to the vegetation of high-andean prairies mainly composed of stunted shrubs, frequently seasonal herbs, some perennial grammineous, mosses and lichens and variable nude areas; this vegetation, during part of year, rests covered by snow. The most recent works published in relation to this subject, regarding the Central-Southern region, are those of Donoso (1981) and Veblen and Schlegel (1982). The following vegetational synthesis is based in both works following a North-South and East-West orientation.

Forest types of the Central-Southern region of Chile (Figure 5.)

1. Lenga forest type

This forest type can be found from the northern extreme of this region, at the latitude of the Chillán volcano, forming the altitudinal limit of the forest vegetation in the Andean Mountain Range and limiting towards the highest areas with the high andean vegetation or with the everlasting snows. In this conditions it extends as a strip between the 1.600 and 1.900 mts to the 37°27' S.L. In this latitude, it is interrupted by the forests where the dominant species is the Araucaria araucana Mol, continuing more towards the south at the 40°48' south latitude, between the 1.000 and 1.300 mts.

At the altitudinal limit, the Nothofagus pumilio (Poep.et. Endl.) Krasser forest (Lenga) presents itself shrub-sized or as Krummholz. Immediately below it, there occurs a pure Lenga forest with trees in a normal size; as one descends in altitude, Lengas become gradually associated with Nothofagus dombeyi (Mirb.) Blume (coigüe) towards the north and with Nothofagus betuloides (Mirb) Blume (Coigüe from Magallanes) southard of the 40°30' S, to finally dissappear towards lower altitudes.

The ticket forest of these forests is mainly dominated by Chusquea tenuiflora and Drimys winteri andean variety (small Winter's bark) in the highest areas and by Chusquea coleu (Desv. (Colihue) in lower areas.

Besides, Maytenus disticha, Ribes magellanicum (Zarzaparilla), Berberis spp. (Chaura), Myrceugenia chrysocarpa (white Luma), Desfontainea spinosa (Taique), other shrub - like species and other herb - like species of the Viola, Anemone, Valeriana, etc. genus are commun and typical of the grove.

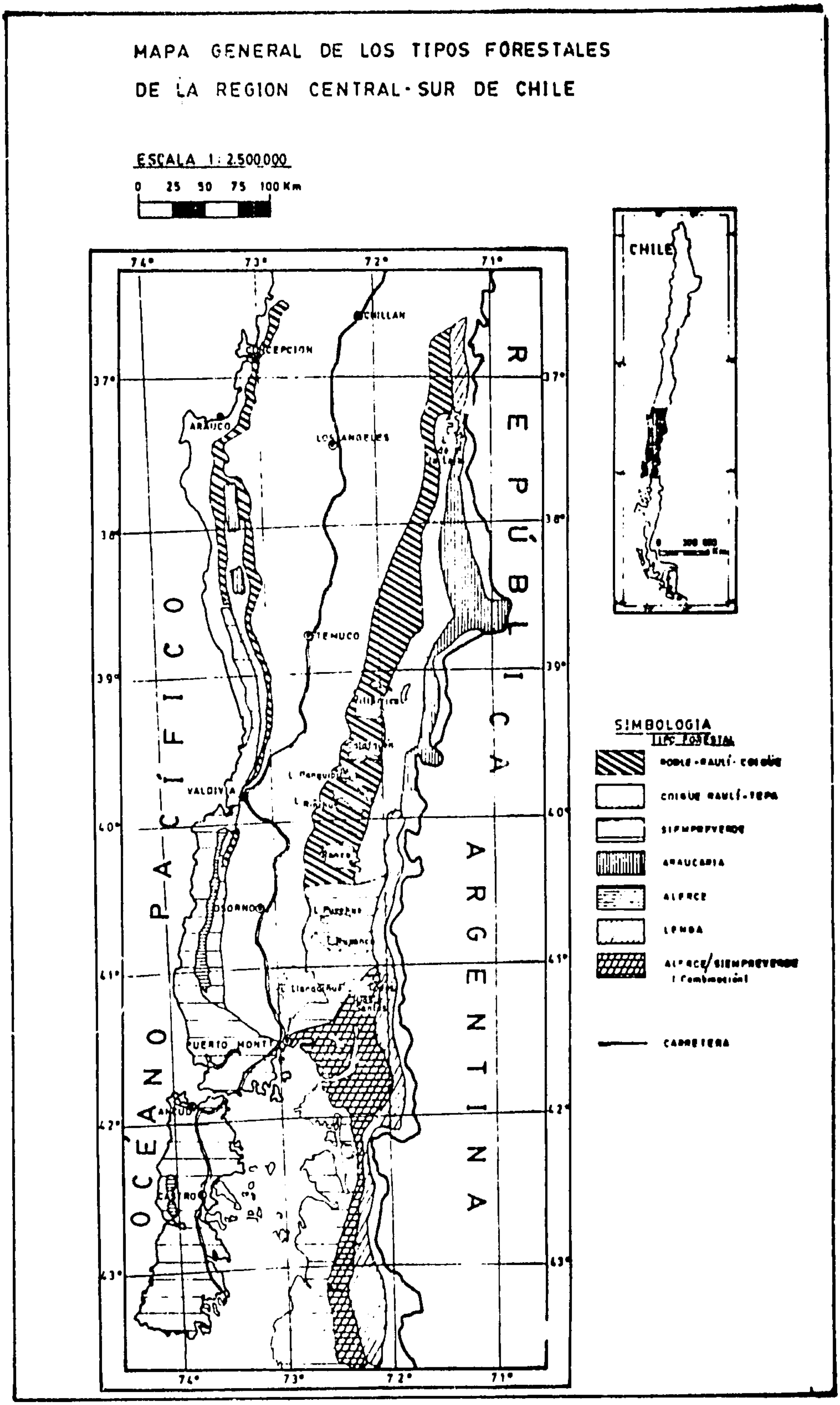
2. Roble-Raulí-Coigue forest type

This forest type develops from the north end of the central-southern region to the 40°30' S. between the 100 and 1.000 mts in both Cordilleras, specially in their inner hillsides and in the cordilleran valleys. South of the 40°30' S. pure forests of Nothofagus dombeyi (Mirb.) Blume (Coigue) may be found that can be considered in the Roble-Raulí-Coigue forest type.

In fact, this forest type corresponds to forests of a second growth, or forests renewed due to felling of trees, forest fires or natural disasters that have eliminated forests of other forestal types, and where the Nothofagus obliqua (Mirb) Oerst. (Roble), Nothofagus alpina (Poep. et. Endl) Blume (Raulí) species have taken advantage of their aggressiveness and colonizing capacity to form forests composed of one or more of these three species, depending on the altitude, latitude and original composition of the forest.

In the Andean Mountain Range, in Chillán area, this type is represented by Coigüe forest growing immediately below the Lenga forest type. Still lower, Roble (Oak) and Raulí appear and, naturally, below the

FIGURE 5.


MAPA GENERAL DE LOS TIPOS FORESTALES
DE LA REGION CENTRAL-SUR DE CHILE
ESCALA 1: 2.500.000
0 25 50 75 100 Km
CHILE
OCEANO PACIFICO
REPÚBLICA ARGENTINA
CHILLAN
CONCEPCION
ARAUCO
LOS ANGELES
TEMUCO
VALDIVIA
OSORNO
PUERTO MONTT
ANCUD
CASTRO
74°
73°
72°
71°
37°
38°
39°
40°
41°
42°
43°
SIMBOLOGIA
CARRETERA

500 mts. only new shoots can be found that limit near the Central Valley with the sclerophyll forest type, characteristic of the mediterranean region. Continuing towards the south the altitudinal andean limit of these renewed areas decreases; towards the highest areas they limit with the Araucaria or Coigue-Raulí-Tepa forest types, depending on the degree of alteration of those forest types; towards the Central Valley they limit with agricultural and cattle land characteristic of the Central-Southern Chile, or with remnants of the Roble-Laurel-Lingue forest type, which, according to the modern forest typology (Donoso, 1981) are considered to be a subtype of the Roble-Raulí-Coigüe forest type.

In all this area, the Coigüe shoots dominate in the higher zones, the Raulí shoots in the intermediate zones and those from Roble in the lower areas, with mixtures in different proportions of the three species.

In the Coastal Cordillera, the forest type is of very small and scarce Roble shoots south of the Itata river; the major part of this area, including the region called Arauco, west of the Cordillera of Nahuelbuta, is at present dominated by Pinus radiata D. Don (Pino insigne). South of the Bío-Bío river, the Roble shoots particularly and also those from Raulí dominate in the mountain slopes of the Cordillera of Nahuelbuta, mainly in the eastern slopes. Towards the higher areas they limit with the Araucaria forest type and towards the Central Valley with agricultural - cattle lands or with Pinus radiata D. Don plantations. Going southward, these new shoots are limited to scarce and small areas.

Besides the three Nothofagus species which characterize this forest type, some prototypes inherent to the original type can be found, depending then on the latitude and altitude in which the forest is located. The most common woody species among the accompanying species is Gevuina avellana mol. (Hazel tree), but also we can find Persea lingue Ness (Lingue), Laurelia sempervirens (R.et.Pav.) Tul (Laurel), L. phylippiana (Phil) Losser (Tepa), Aextoxicon punctatum R. et. Pav. (Olivillo), smaller species such as Luma apiculata (D.C.) Kaus. (Myrtle), Lomatia dentata (R.et.Pav.) R. Br. (small hazel tree or Piñol) and many others, among which stands out bamboo, sometimes very abundant, Chusquea quila (Mol.) Kunth, which in some coigüe forests of the highest areas is replaced by Colihue.

3. Coigüe-Raulí-Tepa forest type

In both Cordilleras, this forest type develops a little more towards the south than that of the Roble-Raulí-Coigüe type. In the Andean Mountains, it develops beginning the 37° S.L. approximately, due to the incorporation of Laurelia philippiana (Phil.) Losser (Tepa) to the Nothofagus dombeyi (Mirb) Blume (Coigüe) and Nothofagus alpina (Poep. et Endl.) Oerst (Raulí) forests; from that latitude they extend up to the 40°30' S.L. in a stripe located below the Lenga or Araucaria forest types and beneath the Nothofagus obliqua (Mirb.) Oerst. shoots or of the remnants of the Roble-Lingue-Olivillo type.

In the Coastal Cordillera, this forest type begins from approximately the 38° S.L. to the 40°30' S.L., also located in a strip which in its superior limit sometimes reaches the highest elevations, or else, limits with the Alerce (larch) forest type, while towards the lower areas it limits with the Roble shoots or with remnants of the Roble-Laurel-Lingue-Olivillo forest type or with the Evergreen forest type towards the western slope of the Cordillera.

The three species composing the name of this forest type are obviously the most characteristics. Nevertheless, there exists a latitudinal variation in the floristic composition; in the septentrional areas, among the dominant trees are common Aextoxicon punctatum R. et. Pav. (Olivillo) and Weinmannia trichosperma Cav. (Tineo), while in the meridional areas the Olivillo dissappears and a coniferous type, the Saxegothaea conspicua Lind. (short leave or female Mañío) becomes common. Throughout all the forest type, Dasyphyllum diacanthoides Less (Trevo or Tayú) is present, the only Chilean arboreal composite. In the grove there are differences as well; while towards the north the abundant species are Gevuina avellana Mol. (Hazel tree) and Lomatia dentata (R.et.Pav.) R. Br. (Piñol or avellanillo) together with other shrub-like species such as Gaultheria sp. (Chaura), Myoschilos oblonga, Chusquea quila (Mol.) Kunth and Ch. Coleu Desv. (Colihue), they almost dissappear more to the south and, in turn, the common species are Drimys winteri andean var. (Small Canelo), Chusquea tenuiflora (small quila) and other shrub-like species.

4. Araucaria forest type

This forest type develops in the Andean Mountain Range between the 900 and 1.700 mts. from the 37°27' to the 40°48' S.L. and in the Cordillera of Nahuelbuta, in the coast, between the 1.000 and 1.400 mts. from the 37°40' to the 38°40' S.L. It is found between the altitudinal forest limit and the Coigue-Raulí-Tepa or Roble-Raulí-Coigue forest types, in the lower areas where it is distributed.

In the highest sectors of its distribution, sometimes the Araucaria araucana species (Mol.) Koch. forms unmixed forests, but it is more common to find it associated with Nothofagus pumilio (Poep. et. Endl.) Krasser (Lenga). In lower altitudes, it associates with Nothofagus dombeyi (Mirb.) Blume (Coigue) and rarely with Nothofagus alpina (Poep. et. Endl.) Oerst. In the cold sites it is found together with Nothofagus antarctica (Forst) Oerst. (Ñirre) and rarely with Nothofagus obliqua (Mirb.) Oerst. (Oak).

The grove of the forest, relatively open, is mainly constituted by Drimys winteri andean var. (small winter's bark), Chusquea coleu Desv. (Colihue), diverse species of the Berberies genus and others.

5. Oak-Lingue-Laurel-Olivillo forest type

This forest type is reduced nowadays to the remnants of an original forest of great value that extended all along the Central Valley and throughout the hill-sides of both Cordilleras below the 400 mts, from the 38° to the 41° S.L.

Besides these scarce remnants, prairies and cultivated areas with big and dispersed individual of Nothofagus obliqua (Mirb.) Oerst. (Oak) and Laurelia sempervirens (R. et. Pav.) Tul (Laurel) are all what is left.

The composition of the remnants of this forest type is characterized by big specimens of N. obliqua and some smaller trees of L. sempervirens, Persea lingue Ness. (Lingue) and Aextoxicon punctatum R. et. Pav. (Olivillo) species. The presence of the coniferous species Podocarpus salignus D. Don (long leaves Maño) is common in these forests and that of the Nothofagus dombeyi (Mirb.) Blume (Coigüe) in the more humid sectors of it.

Towards the south, Laurelia philippina (Phil) Losser (Tepa) can be frequently found and in the cordilleran hillsides, Eucryphia cordifolia Cav. (Ulmo).

The grove is frequently formed by Gevuina avellana (Mol.) (Hazel tree) Raphithamnus spinosus (A. Juss) Moldenke (male myrtle) Chusquea quila, (Mol.) Kunth. (Quila) and by many other species whose presence will depend on the latitude and the state of the remainder forest. The climbing plant Lapageria rosea (Copihue) is also common in these forests.

6. Evergreen forest type

This forest type can be found approximately from the 40°30' to the south limit of the central-southern region below the 1.000 mts in the Cordillera, although thickets of this type, similar to those of the remnants can be found somewhat more to the north in lower areas. In the Coastal Cordillera, this type begins to appear in the coast at approximately the 38° S and continues towards the south limit of the central region in an increased expansion until it becomes the type that covers the whole Llanquihue and Chiloé regions.

This forest type is characterized for being constituted by a great number of species whose common elements are perennial leaves, hence the name evergreen. This species, which can amount to 20, combine in different ways, originating very variable and different associations. In the coast, where the northernmost limit of the type is found, the most common species is Aextoxicon punctatum R. et. Pav. (Olivillo) which sometimes forms almost unmixed forests up to Chiloé island included; this species associates with Eucryphia cordifolia Cav. (Ulmo) and with Laurelia philippiana (Phil.) Losser (Tepa) species that as elevation becomes higher, replace the Olivillo. Similar Olivillo thickets are also found in the borders of the lakes at the foot of the Andean Mountain Range.

At higher altitudes, the forest is dominated by big Ulmo species, with some Weinmannia thrichosperma Cav. (Tineo) in the upper levels.

As subdominant trees we find Tepas, Manius (Saxegothaea conspicua Lindl., Podocarpus nubigenus Lindl), Dasyphyllum diacanthoides Less. (Trevo) and Drimys winteri Forst, (Winter's bark); this last tree is specially important, and sometimes dominant in the Island of Chiloé. With greater humidity conditions, the Ulmo is absolutely replaced in this forest by another great height tree, Nothofagus nitida (Phil.) Krasser (Coigüe of Chiloé) without the rest of the composition varying too much. It is characteristic of these forests a great development of arboreal subdominant or intermediate species of Myrtaceas, particularly Amomyrtus luma (Mol.) Legr. et Kaus (Luma), Amomyrtus meli (Phil.) Legr. et Kaus (Meli), Myrceugenia ovata (Hook et Am). Berg. (Pataguilla) M. planipes (Hook et Arn) Berg(Picha or Patagua), sometimes Luma apiculata (Myrtle) and Tepualia stipularis (Hook et Arn.) Griseb (Tepú) in very humid areas.

In the Central Valley this type develops in very limited drainage conditions, known as Ñadis and Hualves. In these conditions, besides the mentioned species appear Myrceugenia exsucca (DC.) Berg, (Pitra), Temu divaricatum Berg. (Temu), Nothofagus dombeyi (Mirb.) Oerst. (Coigüe) and Maytenus boaria Mol. (Maitén).

The shrub-like species common in these forests area Azara lanceolata (Aromo), Chusquea spp. (Quila), Lomatia ferruginea (Cav.) R. Br. (Fuinque or Romerillo), Desfontainea spinosa Dum. (Taique), Rhaphithammus spinosus (A. Jun.) Moldenke (male myrtle), Pseudopanax laetevirens (Gay.) Harms. (elderberry) and diverse lianas, climbing and epiphyte plants, besides mosses and ferns.

7. Larch forest type

Larch forests are irregularly distributed from the 39°50' to the 43°30' S. In the Coastal Cordillera it grows in the high areas near the summits, from the south of Valdivia to the 41°15' S.L. in the continent and in thickets in the Cordillera of Saint Peter in Chiloé. In the Andean Mountain Range it is found from the Central Valley to the 1.200 mts in the arboreal height limit, between the 40° and the 43 30' S.L. The old thickets of the Central Valley do no longer exist and only stumps in decomposition remain.

The dominant species in these forests is Fitzroya cupressoides (Mol.) Johnston (Larch). Sometimes it forms almost unmixed forests and sometimes it combines with Nothofagus nitida (Phil.) Krasser (Coigüe of Chiloé) or with Nothofagus betuloides (Mirb.) Blume (Coigüe of Magallanes), Weinmannia trichosperma Cav. (Tineo), Drimys winteri Forst (Winter's bark), Podocarpus nubigenus Lindl. (sharpleave maniu), Saxegothaea conspicua (Lindl.) and also Laurelia philippiana (Phil.) Losser (Tepa) in the Andean Mountains. Common shrub-like species in these forests are Myrceugenia planipes (Picha), Desfontainea spinosa (Taique), Ugni candollei (myrtleberry) Crinodendron hookerianum (Chaquihue o Polizonte) and Philesia magellanica (Coicopihue) and several other shrubs).

Also in this region can be found groups of trees or isolated trees of Austrocedrus chilensis (D. Don.) Florin et Bout in volcanic or very rocky areas of the Andean Mountain Range.

THE VOLCANIC ASH SOILS OF CHILE(*)

The distribution of volcanic ash soils in Chile (Fig. 6)

Soils derived from volcanic ash fall into two well-defined divisions: those with a significant amount of amorphic material in their clay fraction, and those either without amorphic clay or with such a small amount that it has no practical significance for both the farmer and the soil scientist. Soils of the latter division are found where the volcanic ash has been deposited in regions with arid or semi-arid climates, and they also occur under the very cold conditions prevailing in very low latitudes or at very high altitudes. In Chile, such soils are widespread in the northern deserts, at the margin of the Patagonian desertic region, at high elevations in the southern Andes and, most probably, in Antarctica Chilena.

The distribution of volcanic ash soils in Chile can best be discussed under two headings.

- in the arid and semi-arid regions
- in the sub-humid and humid regions.

In the arid and sub-arid regions

In this kind of environment the soils are subject to minimal weathering and leaching, but may become strongly enriched by the upward movement of soluble salts. Furthermore, the organic regime (as defined by Taylor, 1949) is exceedingly weak. With weathering at such a low intensity, and under the intensely dry conditions that prevail for most of the time, the volcanic glasses in the parent material disintegrate very slowly, and if amorphous allophane is formed at all, it certainly does not remain long in colloidal form. Since the weathering environment is saturated with cations, most probably clays such as montmorillonite, illite and vermiculite are formed in place of allophane. In any case, extremely small amounts of clay are formed in these desertic soils.

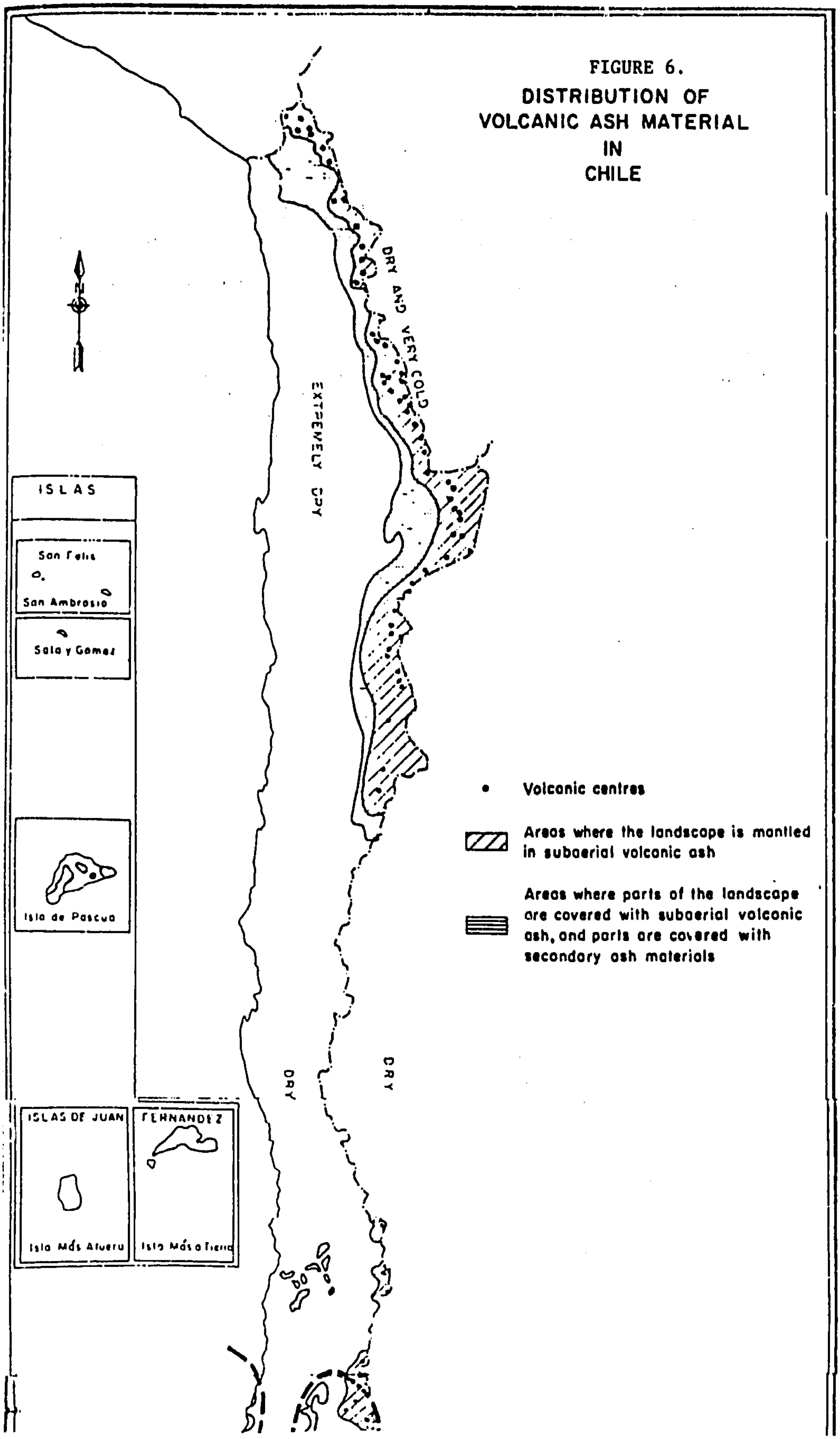
In quite a number of these soils, silica released during the weathering process may move slowly and bring about silica cementation of subsoil horizons. This is particularly noticeable in some desert soils formed from siliceous rhyolitic ash.

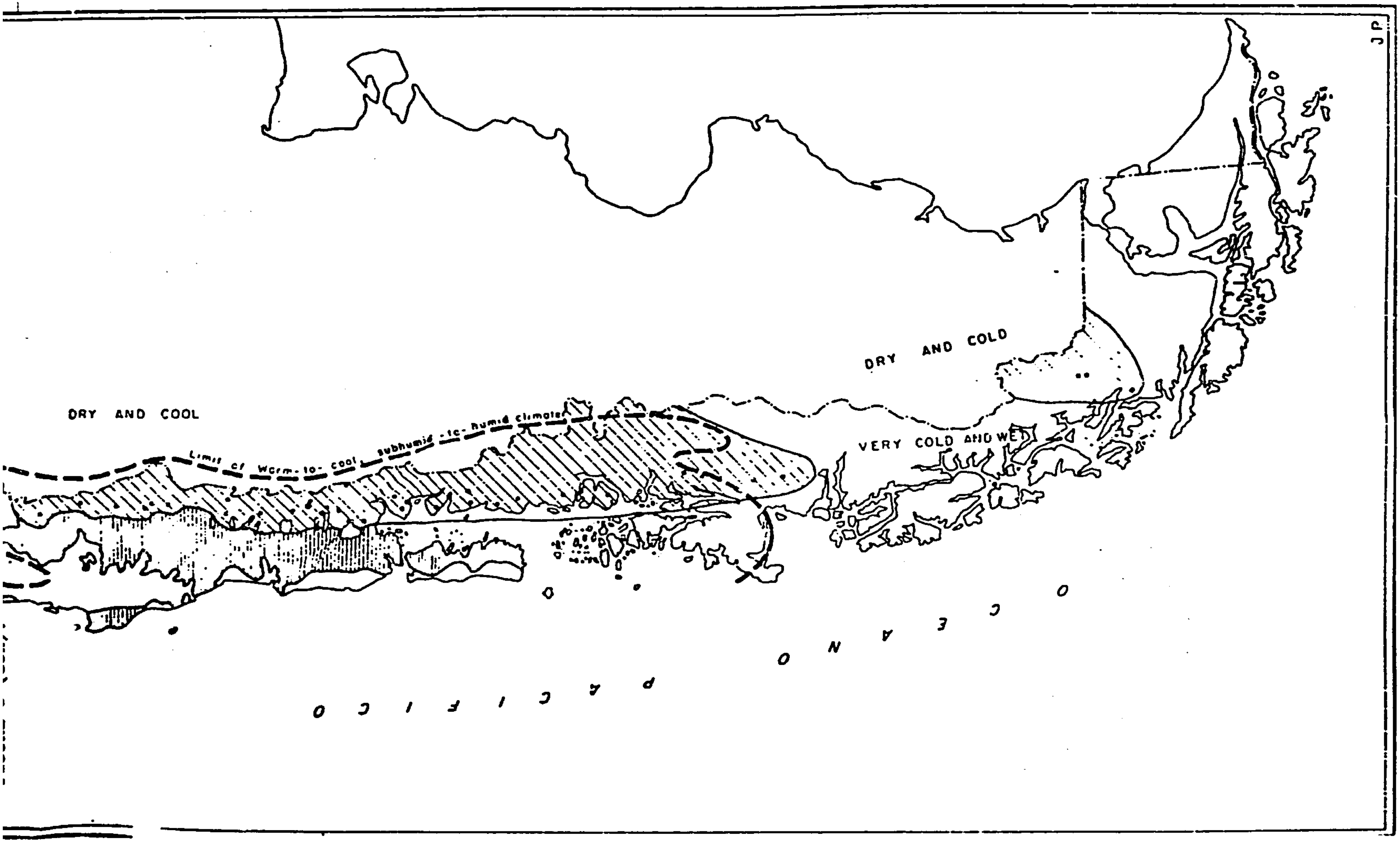
However, in general, there is little to differentiate the soils derived from volcanic ash from other soils in the arid landscape. Under extreme desert conditions, only the highly pumiceous ash soils stand out, and then mainly because of the presence of the white pumice gravel. Under slightly less desertic conditions, weak silica cementation often occurs in pumiceous soils, yet be absent from other soils in the landscape. Under semi-desertic conditions, soils derived from both

(*) Extracted from: Charles A. Wright, 1965. The volcanic ash soils of Chile. Report N° 2017. FAO, Rome, 201 p.

FIGURE 6.

DISTRIBUTION OF VOLCANIC ASH MATERIAL IN CHILE




DRY AND COOL
Limit of Warm-to-cool subhumid-to-humid climates
DRY AND COLD
VERY COLD AND WET
OCEANO PACIFICO
JP

acidic and intermediate kinds of volcanic ash may show a minor amount or amorphic clay formation, but this takes the form of silt rather than clay. Possibly the amorphous alumina colloid shrink to form clusters under the long interval of very dry conditions that follow the brief period when rain has moistened the soil enough to permit operations of the weathering processes, forming silt-sized compound particles which appear to be rather resistant to further wetting.

In the subhumid and humid regions

In Chile, one of the regions of very intense volcanic activity from Quaternary time onward was along the western flanks of the Andes in the south-central sector of the country. Most of this region lies well within the humid zone; and as a result post-glacial deposits of volcanic ash are at a stage of weathering marked by great abundance of amorphic clay. The soils forming in these ash beds the refore disply almost all the typical characteristics of soils rich in amorphic clay and the agriculturalists of Chile recognise a distinct region of volcanic ash soils. The great majority of these are called "trumao" soils from an Araucanian Indian word implying lightness or dustiness. A smalle group, on low lying land and with a seasonally perched watertable, are known as "ñadi" soils, which is another Araucanian word connoting land that is swampy, but possessing a firm subsurface so that it is transitable with care. In referring to volcanic ash soils of the subhumid and humid regions of Chile in this report, these indigenous and widely used local soil names will be employed. Trumao soils are essentially freely drained soils: ñadi soils are seasonally waterlogged (Wright, 1959, ii).

On the flanks of the Andean cordillera, and on some of the high plateaux, volcanic ash has accumulated as a direct subaerial deposit during the actual period of the eruptions. Since the prevailing winds are from the west and southwest, much of the ash clouds settled to the east of the Andean divide, and only a relatively small proportion was deposited in Chilean territory. Nevertheless, the lower foothills and high terraces of the Chilean side of the Andes do show a very heavy mantle of ash materials. Much of this is undoubtedly a secondary deposit derived from volcanic ash that was carried far out over the plains of the Central Valley by the large braided river systems and was, subsequent to deposition as volcanic alluvium, picked up by the strong westerly winds and drifted back over the foothill region. This ash material has been called "volcanic loess" to distinguish it from the subaerial volcanic ash of direct deposition. The name is open to question by those who wish to retain "loess" for the finer by-products of glacial action, but short of coining a new name ("aeolium"?) there is little to be done about it. The volcanic loess is usually somewhat more uniform in composition than subaerial ash, and often contains some rounded quartz grains and plant opal. Volcanic loess occurs not only on the Andean foothills, but appears at intervals on the western face of the coastal range where it is presumably derived as drift material from nearby coastal terraces and beaches. A similar aeolian material has also been found in areas where sedimentary rocks containing volcanic glass are being abraded by the wind.

In some parts of south-central Chile, the swift-flowing transverse rivers carry fresh volcanic ash (as well as eroded volcanic loess) right to the coast. Here it is picked up by the north-flowing current and eventually deposited along the beaches. This volcanic alluvium, as well as estuarine and coastal deposits with a high proportion of volcanic minerals, are comparatively commonplace in south-central Chile. In places, rivers overloaded during a particularly intense period of volcanic activity have built up high banks, changed their courses, and formed long, sloping alluvial fans. Steeper alluvial fans are common along the foot of the Andes: some of these originated as giant mudflows and sludge-like deposits, still besprinkled with enormous boulders (resembling glacial erratics) that were floated into position in a medium of high density (Wright & Espinosa, 1962). Volcanic ash lies very thickly on all but the steepest of the Andean slopes, although the thickness of this mantle often diminishes in the inmediate victinity of the volcano. It is apparent that where hot volcanic ash or noxious gases destroy the native forest, erosion subsequently strips away the ash; in areas where the vegetation is not killed, the fine ash is permitted to accumulate from one eruption to the next and ash beds several meters in thickness have been recorded from slopes in excess of 45°. These steepland volcanic ash soils (steepland trumao) erode rather rapidly when the forest is felled and young colluvial soils of mixed ash materials accumulate near the foot of the slopes. The stripping of the ash mantle from deforested slopes may assume catastrophic proportions when triggered by seismic movements (Wright & Mella, 1963, i and ii).

The distribution of volcanic ash and related materials in the subhumid and humid regions of Chile covers a range in latitude of about 20°; commencing with the appearance of small scattered areas in the Andean cordillera inmediately north of the Maule River (latitude 35°S). Thence, proceeding southward, trumao soils occur with increasing frequency in the foothills of the Andes, until they form an almost complete mantle in about latitude 36°30'S. On the lowlands, scattered patches of trumao-like soils of alluvial origin appear in latitude 35°30'S; and these grow more extensive to the south, until in about latitude 39°S almost the whole of the land between the Andean ranges and the sea is occupied by trumao or trumao-like soils. Further to the south, the ash mantle on the Andean ranges is very thick and complete, but does not extend (except in a few places) to the coastal ranges; in these latitudes, the ñadi soils appear on the plains and terraces of the Central Vale. This pattern is continued on the Chiloé Island, while on the very steep and dissected mountains of the Andes on the mainland opposite, the sub-aerial ash mantle continues unbroken, except where removed by, in historic times, man-induced erosion. At the latitude of the southern port of Aisén (latitude 45°S), the trumao soils still cover the undisturbed hill and mountainsides, and further extend westward into Argentina where their amorphic clay properties diminish owing to increasing dryness and coldness of the Patagonian climate. Trumao soils continue well below latitude 50°S, but are somewhat restricted to a narrow more humid foothill region on both sides of the Andean chain. At high elevations, and on the western Patagonian pampa, conditions are too cold or too dry for the formation of amorphic clay in significant amounts in the soils. On the hills east of Punta Arenas (latitude 53°S), there are podzolised soils which are in part formed from volcanic ash, but the amount of amorphic clay in their profiles is very small. In these latitudes, most bog soils have layers of volcanic ash clearly preserved in the peaty profile (see also Auer, 1950). By studying the extent of these ash layers it is possible to be certain that volcanic ash constitutes a part of all the soils in the Magallanes Provinces. Yet amorphic clays are not a significant feature of any of these soils.

This brief resumé of the distribution of volcanic ash soils in Chile would be incomplete without mention of the soil parent materials of Easter Island; the westernmost outpost of Chilean territory, 2000 miles from the Arauco peninsula, the nearest point on the South American mainland. The volcanic soils of Easter Island (Díaz, 1949, 1951; Wright and Díaz, 1963) are somewhat older and more basic in origin than most of the volcanic ash soils of the Chilean mainland. They occur mainly on the old volcanic cones where they are in part mixed with weathered scoria. Related soils, possibly formed from a type of loess rich in volcanic minerals, rasped from the steep cliffs surrounding most of the island by the persistent trade winds, occur in patches throughout the island.

There are many volcanic ash soils in the sub-humid and humid zones of Chile that do not achieve recognition as trumao or ñadi soils. These are all from older volcanic ash, in which the weathering process is more advanced and amorphous clays have been largely replaced by semi-crystalline and crystalline clays like halloysitic and kaolin. These soils no longer have the morphological, chemical, physical, nor the farming or engineering, attributes of trumao and ñadi soils: in Chile they are known collectively as the "red volcanic clay" soils, and they fall outside the terms of this enquiry; although some intergrades between these soils and trumaos are mentioned.

There are important pedological and farming differences amongst the various kinds of trumao and ñadi soils. However, before closing this introduction, it is well to remember that from time to time, almost the whole of the Chilean atmosphere must have been charged with fine volcanic dust, and every soil in the country likely contains some minerals of volcanic origin and that are not representative of the local rocks. The proportion may be small, as judged by the remaining resistant minerals (see also León, 1962); but the total contribution over the centuries may be considerable, and may account for some degree of similarity that may be observed throughout the Chilean soil assemblage. This may be even more true of the soils of Argentina, a patient land that has accepted without protest many million tons of volcanic dust blown across from volcanoes on the Chilean side of the Andes.

The common properties of Chilean amorphic volcanic ash soils are discussed in Section of this report, together with a brief summary of the main kinds of trumao and ñadi soils occurring in Chile.

A. Andosols[1/] of Chile: General characteristics, formative environment and main kinds of soil

1. Trumao Soils

(a) General characteristics

The general characteristics of the andosols of Chile are as follows:

i) The whole soil profile tends to be mellow and friable, usually with clearly distinguishable depositional stratification, and with a distinct colour difference, sharply defined, between the topsoil and the subsoil. Occasionally one or more of the subsoil layers may be pumiceous and cemented.

ii) Topsoils range from brown to nearly black, and the natural colour (as visible under the natural plant cover) persists for a long time after the onset of farming, even where no particular effort is being made to sustain the organic matter content of the surface soil. Textures are usually loam, with varying amounts of sand and silt.

iii) Subsoils are noticeably more yellowish than the topsoils; in extreme cases yellowish-brown or yellowish-red in colour; ranging in texture from loam to clay loam, and usually with a high content of silt (part of which may be aggregated clusters of dried amorphous allophane). When completely dry, the powdered soil behaves like fine sand and is slow to rewet, but often the soil is only apparently dry and when squeezed firmly between finger and thumb, there is an abrupt sheering sensation, and the soil becomes moist, with a rather "slippery", "soapy", or "greasy" feel. Naturally moist soils have an easily recognised greasy feel, and under pressure they become "smeary" or, when rubbed strongly for some time in the palm of the hand, the soil material may almost become liquid. All of these are useful tests for the presence of allophane in appreciable quantities.

iv) Deeper subsoil horizons are nearly always depositional strata, and may vary widely in nature; their boundaries are often very distinct and marked by abrupt changes in texture, compaction, consistance etc.

v) Seldom, if ever, are the qualities of stickiness or plasticity pronouced in the topsoil or upper subsoil horizon of trumao soils.

1/ The name "Andosol" is used by C. Wright to embrace both "trumao and "ñadi" soils.

If these appear in the lowermost strata, it is usually an indication that the passage of time has permitted the change of allophane clay toward meta-halloysite or one of the other structurally orientated clays.

vi) The whole soil has a very low bulk density, expressed as a notable "fluffiness", has low volume weight, and the peds are usually quite porous. When thoroughly dried, peds are often difficult to rewet, and may float briefly when thrown into water.

vii) The upper soil horizons have a high water-holding capacity, and a high water retaining capacity when once thoroughly wet. The upper subsoil horizon may develop very prominent shrinkage fissures on drying. Both topsoils and subsoils form long ice pillars and needles where roadside cuts are exposed to heavy frost; frost heaving of the topsoil is commonplace on ploughed land in winter.

viii) There is usually intense fibrous root development in the topsoil but relatively few tree roots penetrate into the deeper subsoil layers.

ix) The clay fraction is dominated by amorphic mineral compounds, usually allophane, which, lacking a permanent charge or possessing a high variable charge, causes the soils to be strongly buffered against changes in pH and gives the soils an apparently high base exchange capacity. Thus soils commonly have a base saturation seemingly inconsistent with their pH values. Chilean trumao soils range in acidity from around pH 6.7 to pH 4.5, but their base status may lie between 90 percent and 2 percent.

x) Trumao soils have characteristically a high base exchange capacity, a high anion exchange capacity, and a very high rate of phosphate "fixation".

xi) The soils are difficult to disperse properly for textural determination. Soils that are essentially clays by definition in properly dispersed material have field textures no heavier than silt loam or even fine sandy loam. Proper dispersion may usually be achieved by treating the soils with hot dilute peroxide solution, washing on a Buchner funnel first with water and then with N/20 hydrochloric acid, then again with water, and dispersing finally in sodium hexametasulphate solution at a strength of 3 grams per litre (Birrel, pers. comm. 1960).

xii) Total nitrogen is high to a remarkable depth in these soils, and this is often accompanied by such a high total carbon content that the C/N rations are commonly unusually high for a considerable depth down the soil profile.

xiii) On analysis by X-ray and D.T.A. equipment, and from inspection of electron microscope photographs, Chilean trumao soils (Besoaín, ibid, 1958; 1961; 1963, in press) have allophane as the dominant mineral in the clay fraction. Besoaín also reports that many Chilean trumao soils have considerable quantities of gibbsite present, even in the upper part of the subsoil horizon. In this, the Chilean soils differ from New Zealand amorphic soils where gibbsite appears mainly in the lower horizons and strata. In the lower strata of some trumao soils, where weathering of the older depositional materials is more advanced, kaolin and amorphous silica have been found along with halloysite, hydrated halloysite, gibbsite and hydrous oxides of iron.

xiv) The variable charge mechanism also poses problems for, where the pH is below 5.0, the soil should, in theory, become electropositive and release of active alumina should increase. Many trumao soils have been shown to contain a high proportion of exchangeable alumina, and free alumina compounds have also been detected quite frequently. These latter are quite toxic to alumina sensitive crops, such as sugar beet.

(b) The formative environment

Within the general limits of humidity (subhumid to perhumid) and temperature (warm to cool temperate) outline in the opening remarks, the trumao soils of Chile occupy a number of well-defined kinds of environment. The formative environment is thus somewhat varied but the approximate range in climate, topography, parent materials and natural plant cover is set down below. These are not only of interest to scientists studying soil genesis, but have considerable bearing on land use practices.

i) Climate

Precipitation: at the dry extreme, allophanic soils occur under a precipitation of somewhat less than 1000 millimeters per annum, with a very unequal distribution in that there are no less than five continuously dry months (in which the monthly rainfall is less than 60 millimeters), although rarely does any month have less than 10 millimeters. In this area evaporation rates during the dry summer months are very high.
At the other extreme of their moisture range, trumao soils occur under a precipitation of over 4000 millimeters par annum, with no well marked dry season. Some areas regularly experience winter snowfalls up to 3 meters in depth, lasting on the ground for one or two months; other areas are virtually frost free (e.g. parts of Chiloé Island) throughout the year.

Temperature: the average mean annual temperature ranges from about 15°C to less than 8°C; with a winter (July) range of less than 1°C to about 8.5°C; and an average summer (January) range of around 13°C to over 20°C. Freezing and thawing phenomena are characteristic of some areas, absent in others.

ii) Topography

Trumao soils may be found on almost any type of relief, from the extremely rugged and precipitous slopes of the Southern Andes, to the flat plains and terraces of the central vale. The topography perhaps most characteristic of the Chilean trumao soils is the strongly rolling to undulating "ceja de montaña" strip of foothill country extending along the face of the Andes from Chillán to near Villarrica. This is a most important farming region, but here the soils are only in part derived directly from subaerial volcanic ash: mainly it is a region where soils derived from re-sorted and re-deposited volcanic loess. The true subaerial volcanic ash soils are found further in towards the volcanoes, usually on steeper hill slopes, and as steepland soils amongst the ranges. On the plains of the central vale, trumao soils are mainly derived from volcanic loess and from volcanic alluvium; and along the coast there are some areas of rolling landscape covered with trumao-like soils derived mainly from loess originating from coastal drift materials.

iii) Parent materials

The most obvious difference in the soil parent materials lies in the presence or absence of pumice fragments and the proportion of angular or rounded quartz sand.

Pumiceous and conspicuously sandy volcanic materials are more common in the south of the trumao soil region (from Llanquihue Province southwards), but highly pumiceous areas also occur in the high cordillera at several places north of this limit. There is also a visible coarsening of the ash materials along any radius towards a volcano, ending at the point where all ash is obscured by coarse scoria and similar large ejecta or by recent lava. Stratification of the ash beds also increases along any radius towards the volcano. At some distance from the vent, where all ash is of a fine grade, stratification of the beds is sometimes very difficult to make out without laboratory investigation of selected samples.

General observations show that the great majority of the ash beds in Chile are of intermediate to acid origin: basic volcanic sands are comparatively rare, occurring chiefly in the Los Angeles area where they originated from Antuco volcano, and descended on the lowlands as a sudden sand flow connected with the rupture of a lava barrier across the front of Laguna del Laja; also over smaller areas near Llaima volcano; and in the vicinity of some of the more southerly groups of volcanoes, including several areas in Aisén Province.

iv) Natural plant cover

To a Chilean, the typical natural plant cover associated with trumao soil is the roble (Nothofagus obliqua); but this is true only over a limited part of the whole extent of trumao soils, - the sector between Chillán and Puerto Octay, along the face of the

Andean cordillera. Elsewhere, trumao soils are associated with broadleaf evergreen forests (the "laurel" forests with abundant Laurelia sempervirens, Laurelia serrata, Drimys winteri, Aextoxicon punctatum, and, especially in the south, Eucryphia cordifolia); with mixed forest containing podocarps such as the maño (Podocarpus nubigenus) and coigüe (Nothofagus dombeyi); with alerce forest (Fitzroya cupressoides), - although this magnificent timber tree has been cleared from most areas of trumao soils; with "north Pata gonian rainforest (Schmithüsen, 1956) dominated by coigüe, but with associate species of Weinmannia, Saxegothaea, Laurelia and Nothofagus nitida; with ñirre forest (Nothofagus antarctica); and with lenga forest (Nothofagus pumilio). In addition to the above types of forest cover, trumao soils also may be found with savanna-parkland natural vegetation in which the ground cover is grass, with nume rous scattered bushes of Acacia caven ("espino") and large isolated roble trees; and under a continuous low shrub vegetation dominated by maqui (Aristotelia sp.). In coastal areas, some small patches of trumao carry evergreen forest with abundant litre (Lithraea caustica), boldo (Peumus boldus), etc.

(c) The main kinds of trumao soils

There are six major subdivisions within the trumao group[1/], each characterized by a measure of difference in the degree of weathering, degree of leaching, and intensity of melanisation (humus incorporation). These are environmental factors operating during soil formation, and they operate not only on trumao soils but on all the other kinds of soil in the vicinity. Thus, by studying these other, somewhat older soils associated with trumao soils, one is able to get a more comprehensive idea of the regional environmental impress on soil formation than if the, generally younger, trumao soils were studied alone. By thus extending the scope of the enquiry, one can delimit with greater surety the appro ximate boundaries over which the present strength of the weathering, leaching and melanising factors are operating with about equal force.

There are six principal weathering categories: slight, slight-to-moderate, sub-moderate, moderate, and moderate-to-strong, and strong-to-very strong. The latter category is restricted to Easter Is land. Within these six categories, the soils show varying degrees of leaching and melanisation; which accord fairly well the recorded rainfall data, temperature data, and age of the soil, and other factors influen cing the intensity of the soil process.

i) In the first weathering category belong the scattered patches of trumao in the Andean foothills of the provinces of Talca and Li nares; their derived alluvial and colluvial associates on the Central Vale; a very small area of related soils, somewhat pumi ceous, around Laguna del Maule (at an altitude of 2.100 meters); a few patches of volcanic loess along the coast near Tregualemu; and some small areas of trumao at the margin of the Patagonian

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1/ C. Wright emphasize that at the moment when he wrote this paper there was no adequate laboratory information to make possible a precise statement on the limits of the main kinds of trumao soils.

pampa between latitude 45°S and 46°S. These soils are all of minor extent, but they are all no more than slightly weathered, and they all exist under relatively weak weathering environment; although they differ amongst themselves rather widely in age, in degree of leaching and in degree and type of melanisation. These are the "extreme northern" examples of trumao soils in Chile.

ii) In the second weathering category, where the present weathering impress is slight-to-moderate, we have the main area of trumao soils of the Andean foothills and ranges stretching from north of Chillán to south of Los Angeles; together with their derived alluvial and colluvial associates. Patches of recent volcanic ash, in which weathering is only just commencing occur near certain volcanoes; but apart from these, the degree of weathering appears to be fairly uniform over the zone, and the main variations in the soils are due to leaching and melanisation. These soils represent the "northern" group of trumao soils.

iii) In the third category, where the present weathering impress is submoderate (i.e. rather more than in the preceding zone but less than "moderate"), we have an important area of trumao soils centred about the Province of Cautín. In this zone, trumao soils extend from near the coast right to the Argentinian border, and include soils derived from volcanic loess, volcanic alluvium, coastal drift (volcanic) loess, and subaerial volcanic ash, some of which is markedly pumiceous. Soils range from slightly leached to very strongly leached, and from weakly melanised to strongly melanised. These soils represent the "modal" or "central" group of trumao soils in Chile.

iv) In the fourth category, where the weathering impress can be described as moderate, are the trumao soils of Valdivia, Osorno, Llanquihue and part of Chiloé Provinces. Here again, there are trumaos of various age and origin, ranging from slightly leached to strongly leached, and from slightly melanised to very strongly melanised. These soils represent the "southern" trumao soils.

v) In the fifth category, where the weathering impress is moderate-to strong, we have soils in the south of the island of Chiloé, in "Chiloé continental", and in the southern province of Aisén. Here most soils are fairly strongly leached and melanised, although the type of melanisation varies rather widely. These soils are the "extreme southern" type of trumao ash soil in Chile.

vi) In the six and last weathering category, we have only the soils developed near the volcanic cones on Easter Island, and their related loessic volcanic soils. These soils represent the Chilean "tropical" trumao soils.

With the exception of the sixth category, in which near tropical temperatures have markedly accelerated the rate of weathering, the remaining five categories cover a relatively small range in mean annual temperature (from about 15°C in the north to about 8°C in the south; and the weathering environment is clearly controlled more by the mean condition of soil humidity and by the pattern of the rainfall than by mean air temperatures or by the total precipitation. The five weathering categories correspond quite well with the mean length of the summer dry season; the somewhat cooler but continuously moist soils of the southern part of the trumao range are continuously moist soils and are thus subjected to considerably more weathering than the rather warmer soils of the northern sector where the soils are relatively dry for nearly half the year.

Admittedly, this subdivision of the trumao soils of Chile is still largely an experimental one, and much essential laboratory data still needed but, does accord reasonably well with land use practices and with farming experience. In some cases, the suggested subdivision of the trumao soils cuts across soils that, up to the present time, have been mapped as a single pedological unit; - for example the old San Bárbara trumao soils have been divided into two parts, the northern part carrying the old name and the southern part being provisionally named Cautín trumao soil.

2. Ñadi Soils

(a) General characteristics

Ñadi soils have many of the physical and chemical characteristics of trumao soils, but differ rather conspicuously in their morphology. They are essentially similar to "pseudogley" soils, in that they are seasonally waterlogged due to impeded drainage and the development of a perched watertable at from 18 to 36 centimeters below the surface. Unlike pseudogley and gley soils, subsoil mottling is rare or non-existent. The conspicuously dark topsoil colour of the trumao soils is usually present, but the subsoils are often a more pronounced yellowish-brown, and become brownish yellow or yellow in the zone most affected by the perched watertable. Thin, discontinuous iron pans or a layer of hard nodules often occur at the base of the ash layer, inmediately above the cemented glacial or alluvial gravel. On drying (as when drained), the upper part of the profile may develop strong vertical fissures of sufficient regularity to give the appearance of massive soil columns.

Ñadi soils are usually less "fluffy" and are more consolidated than trumao soils, and are often slightly more sticky and plastic when moist. Many of their chemical characteristics seem to be the same as trumao soils, although some of them tend to be intergrades to soils that do not have a significant amount of amorphic clay.

(b) The formative environment

i) Climate

Towards the northern limit of the "ñadis", the mean annual rainfall lies between 1.200 millimeters and 1.500 millimeters with up to two months with less than 100 millimeters, but in the region where the ñadi soils attain their maximum development, the mean annual rainfall lies between 1.500 millimeters and over 3.000 millimeters with no months in the year with less than 100 milli meters. In this latter zone the precipitation during the three winter months frequently exceeds 1.000 millimeters. Over the whole range of the "ñadis", the mean annual temperature lies between 10°C and 12°C. The warmest month (January) lies with the range 14°C and 17.5°C; while the coldest month (July) lies within the range 7°C and 8.5°C (Almeyda, 1958).. Cloud cover averages 60 per cent over the year. According to Papadakis (1961), annual evapotranspiration lies between 25 and 50 centimeters per annum, so that the excess precipitation theoretically available for leaching through the soil is in the range of 175 to 200 centimeters per annum. No actual evaporimeter data are available for the region of the "ñadis"; but field observations suggest that in some cases the removal of the forest results in the soil conditions becoming wetter than formerly, and hence water lost by direct transpiration may considerably exceed that lost by direct evaporation.

ii) Topography and parent materials

Any study of ñadi soils must begin by considering the origin of the typical landforms associated with these soils, and the probable manner of emplacement of the volcanic ash on this landscape. Recent drilling by petroleum exploration groups has shown that the shape of the bottom of this sector of the great Central Valley of Chile varies markedly. Usually the bedrock is micaschist, and this is covered with from 100 feet to over 4.000 feet of sediments, mainly sandy and gravelly. The uppermost part of this filling material is clearly of glacial origin (Weischet, 1958), and the ñadis occur on flattish to very gently undulating landforms between morainic debris. There is evidence to suggest that the parent materials of the ñadi soils were emplaced subsequent to the last glaciation; although buried ñadi-like soils, probably dating from earlier glacial periods, have also been found.

Not all ñadi soils are associated with glaciated landscapes. Those of the northern sector (e.g. Pitrufquen soils) are found on old terrace landforms, while some of those in Chiloé Island are also associated with terrace formations and even with local lacustrine deposits. None of these landscapes are likely to be older than the ultimate glaciation. All ñadi soils occur on flat or very gently undulating landforms.

The stratigraphic column of ñadi soils is much abbreviated as compared with adjacent trumao soils on more strongly rolling landforms, and there is usually no recognisable correlation of the stratigraphic sequence between the latter soils and ñadi soils in the vicinity. There is also the problem of the method of deposition of the original volcanic materials. Usually the material is free os stones and gravel; although on Chiloé Island, ñadi subsoils often contain very fine rounded quartz pebbles, especially common in the lower horizons. In Chiloé, it is easy to think of the soil materials as being emplaced by water, yet, apart from the fine rounded gravels there are no other indications of their possible alluvial origin. Moreover, the materials usually show a notable thickening toward the edge of the terrace which is difficult to contrive solely by deposition from water; and is almost impossible to imagine when there are several levels of terraces all apparently covered with the same kind of ash deposition and more or less following a common pattern of stratification.

A more feasible explanation is that the soil parent material was probably deposited mainly in the form of "loess" rich in volcanic glasses on the wide outwash plains of a periglacial zone. The presence of occasional rounded fine quartz pebbles in the material may indicate nothing more than the force of the wind, and the probability that the land surface was periodically frozen allowing the pebbles to roll for some distance. The source of these pebbles is never far distant; they are usually to be found in the sandy morainic deposits of the vicinity. A few cases have been noted where these pebbles have clearly been resorted by very local water movements, and this also is entirely feasible in a frozen landscape subject to periodic thawing and even solifluction.

The discrepancy between the depth of the volcanic materials on the ñadi plains and that on the trumao-covered downland is probably a matter of distortion of wind currents by the latter topography, allowing thicker deposition of the wind-borne volcanic dust for more turbulent air. The fact that weak stratification is visible in the ñadi parent materials, and very marked stratification is visible in the nearby trumao parent materials, serves as an indication that the source of the dust was not consistent over the whole period of accumulation. Well-defined shower layers also occur in the trumao soils, and in a few cases these shower layers can be traced, without break, into the ñadi stratification, where it is found to be much reduced in thickness but virtually of the same basic composition.

As a tentative theory, then, one would be inclined to suggest that the ñadi soil parent materials are mainly of aeolian origin, and that the great majority of them were deposited not earlier than date of the last withdrawal of the ice from this part of southern Chile. Older materials deposited in the same way at the end of earlier glaciations have been almost entirely destroyed by erosion of the lowland landscape associated with the cutting of new drainage channels during the various interglacial periods.

The process of loessic accumulation did not cease inmediately on the final retreat of the glaciers, but continued through the early part of the post-glacial period when the landscape was intermittently re-frozen; and was further prolonged, in some areas, to allow loessic deposition on the first alluvial terraces. The process probably finally ceased when the land was again clothed in vegetation.

Fragments of older ñadi-like soils, some very rich in organic matter (and perhaps containing valuable pollen remains), are occasionally preserved in cemented ash beds included in morainic debris. Cemented ash beds of this type are thought to represent ash materials that fell on the glacier surface, gradually becoming incorporated in the glacial ice. This ash was subsequently released when the glaciers retreated, the deposited material cemented (apparently by silicates of calcium and magnesium), permitting the preservation of other materials present in the glacial ice. Amongst these were relatively large and irregular patches of frozen soil, ploughed up from the pre-glacial land surface by the advancing snout of the glacier. These are not so common in the moraines of the last glaciation, which was a relatively minor one, but are very common in the morainic materials of the penultimate glaciation. Thus, still cemented in relatively unweathered ash materials, we can still find soils dating from at least the penultimate interglacial period. Some of these fossil soils are so well preserved that it is possible to re-construct their original orientation (some are inverted and some are now at right-angles to their original position), and to find the thin iron-pan of the original "B" horizon still intact. Many such relicts are not simply fossil volcanic ash soils, but are clearly fossil ñadi soils. They deserve much greater investigation than they have had up to the present time. Still older soils are preserved in cemented ash materials associated with the second glacial period; they must represent fossil remnants of the landscape that existed during the first interglacial period, and are even more worthy of study.

iii) Natural plant cover

In the north, where they first appear, the patches of "ñadi" vegetation are conspicuous as being something different in the landscape; in the center of their range, they are the dominant feature of the landscape; and at their southern limit they merge into peat bogs and cool temperate, very humid rainforest. Throughout this climatic range, no single plant species can be said to be characteristic of "ñadi" vegetation; and the dominant trees vary from north to south, and also vary with local soil conditions. By comparison with surrounding forest communities, the "ñadi" forests are, however, conspicuous for a preponderance of plants with xerophilous characteristics. The "ñadi" flora is rich "in Myrtaceae, Ericaceae, Berberidaceae, Juncaceae and Cyperaceae. The general aspect is of a stunted thicket, relatively dense, with a very dense herbaceous lower stratum of an abundance of mosses, especially sphagnum, and ferns" (Rodríguez, 1948). A further feature of the "ñadi" forests is the extreme shallowness of the root systems of the trees. Species commonly found in "ñadi" vegetation include *Drimys winteri* ("Canelo"), *Tepualia stipularis* ("tepu"), *Embothrium coccineum* ("Ciruelillo"), *Ovidia pillopillo* ("pillo-pillo"), *Aristotelia chilensis* ("Maqui"), *Lomatia ferruginea* ("Fuinque"), *Lomatia obliqua* ("Radal"), *Berberis buxifolia* ("Calafate"), *Gunnera chilensis*, *Verbena corymbosa*, *Lomatia sp.*, *Baccharis saggitalis*, *Oldenlandia uniflora*, *Isolepsis vivipara*, *Juncus procera* and *Juncus planifolius*. Less common generally, but sometimes of great local importance, are such species as *Myrceugenia planipes* ("patagua valdiviana"), Myrceugenia pitra ("pitra"), Myrtus luma ("Luma"), Podocarpus nubigenus ("mañío"), Saxegothaea conspicua, Pilgerodendron uviferum, Gevuina avellana ("avellano"), Eucryphia cordifolia ("ulmo"), Desfontainea spinosa ("taique"), Fitzroya patagonica ("alerce"), Weinmannia trichosperma, etc. In many areas, the most prominent tree is Nothofagus; colder situations favour N. antarctica ("ñirre") the more swampy situations favour N. nitida, while N. pumilio ("lenga") and N. dombeyi ("coigüe") are more common in the cooler and higher rainfall areas. Between Puerto Montt and Lake Llanquihue there formely existed an area of "ñadi" entirely dominated by very large Fitzroya trees.

In the case of the ñadi soils, where soil processes are in part strongly influenced by seasonal waterlogging, low oxigen content and the seasonal development of soil gleying processes, they can be regarded as poorly drained soils related to specific trumao soils of their particular weathering region. Ñadi soils first appear in the third weathering zone, reach their maximum expression in the fourth zone, and dissappear as a distinct entity in the fifth weathering zone; it may therefore be more convenient to regard them, as is the present policy in Chile, as a group quite distinct from the trumaos. In the southern half of the Province of Llanquihue, where the rainfall frequently exceeds 2.000 millimeters per annum, excessive accumulation of acid forest litter produces a distinct peaty topsoil in many of the localities with ñadi soils. Still further to the south, on Chiloé Island (in about latitude 42°00'S), peaty topsoil conditions become a general feature of all ñadi soils in their natural state. In about latitude 42°25'S, near Mocopulli on Chiloé Island, in some of the flatter lowlands areas some ñadi soils begin to show marked peat accumulation; and the forest vegetation becomes replaced by sedge communities, by Gleichenia - Pernettya - Baccharis associations, scattered Donatia cushions and with typical wet bog species such as Sphagnum, Tetroncium and Marsippospermum. In the extreme south of Chiloé Island, the distinctive pattern of the "ñadis" become lost, - completely submerged in the "north-patagonian rainforest" (Schmithusen, 1956) dominated by Nothofagus dombeyi. In this latitude, (i.e. at about 43°00'S) the "ñadi" concept is no longer applicable; it is no longer possible to identify specific seasonally swampy areas since, with a rainfall in excess of 3.000 millimeters per annum evenly distributed throughout the year, all the soils in the landscape are characterised by abundant humidity at all times.

SOILS OF SOUTH-CENTRAL CHILE

Walter Luzio L.

The main soils in the south-central part of Chile are those with udic and perudic moisture regimes, which form the most important areas where the volcanic ash soils are developed. Nevertheless it is known there are also Andisols with xeric moisture regimes.

The soils with udic moisture regime extend throughout the piedmont of the Andean Mountains, the Central Valley, and the Coastal Cordillera from 38° to 42° S latitude. The soils with a perudic moisture regime are distributed along a narrow belt of north-south direction at a higher altitude than the Andean Piedmont; and also from 42° to 52° S latitude throughout the region of fiords. However, no precise data are available with regard to this regime.

Between 33° to 42° S latitude Chile contains three fundamental physiographic units: the Andes Mountains, the Central Valley, and the Coastal Cordillera. The three regions show very distinct characteristics. The soils developed in those units differentiate themselves because of differences mainly due to parent material, relief, and time.

SOILS OF THE COASTAL CORDILLERA

Three different parent materials can be identified in this area: metamorphic rocks, granitic rocks, and old volcanic ash.

Moderately to strongly weathered micaschist forms the parent material for many important soils of the area. According to different surveys the pH of those soils is always below 5.5, the cation exchange capacity is around 25 meq/100 g of soil and decreases with depth. The total iron expressed as Fe_2O_3 is about 14%. The soils developed on this micaschist make up a rather extensive soil association and some of its members qualify as Paleudults and others as Thodudults. There are some areas where the strong weathering and the intense leaching have formed a strongly developed coarse-textured albic horizon. In these cases the underlying horizon is too weakly developed to meet the levels of accumulation of an argillic or a spodic.

The soils developed over granite normally have a high clay content that decreases regularly with depth below the argillic horizon. The pH is around 5 and the iron content is smaller than in the soils derived from micaschist. When they have a xeric moisture regime they meet the requirements of Palexeralfs and Haploxeralfs. In more humid conditions they qualify normally as Hapludults.

The last group of soils in the Coastal Cordillera are those derived from old volcanic ash. Different authors agree that this is the common parent material for an important group of soils. The clay fraction is dominated by metahalloysite, halloysite, and kaolinitic materials, assuming that this mineralogical suite corresponds to the weathering of the volcanic glass. The presence of fresh volcanic glass at different depths in the soil profiles is interpreted as recent rejuvenation due to modern events.

The most relevant research has been carried out by Dr. Eduardo Besoain who has proposed the following weathering sequence for the volcanic glasses in Chile: volcanic ash (glass) - allophane, imogolite - halloysite - kaolinite. These old volcanic ash soils have been reported over andesitic or basaltic tuff and also over highly weathered conglomerates of cobbles and pebbles. High clay contents of kanditic type are very common in the weathered rocks. The majority of these soils are located on the east side of the coastal cordillera. Considering the soils of this physiographic unit as a whole, the most striking feature, common of a great number of them, is the red color. Normally they are in the 5 YR of the Munsell Color Chart and many of them are in the 2.5 YR. This is the reason why they have locally been given the name of "red clay soils" in the first years of the colonization. They also have in common a rather high clay content and argillic horizons with prismatic to blocky structure.

SOILS OF THE CENTRAL VALLEY

Elevations in the Central Valley fluctuate from 25 m.a.s.l. to 300 m.a.s.l. and the relief varies between nearly level (0-1%) to moderately steep (20%). In the area with a xeric moisture regime, the soils have reached a higher degree of evolution, and argillic horizons are frequent. In wetter areas, volcanic ash soils dominate and are found with different degrees of evolution, each of which occupies different physiographic positions and are subjected to different drainage conditions.

The youngest volcanic ash soils normally have a cambic horizon which is very weakly developed. They are generally deep soils over andesitic tuff on usually convex slopes of less than 15%. Most of them qualify as Dystrandepts.

In landscapes with undulating relief, other volcanic ash soils with a higher degree of evolution have been identified. In these soils the allophane continues as the dominant clay mineral, but is associated with metahalloysite. This is interpreted as a more advanced stage of evolution, assuming that this mineral comes from the weathering of the allophane. In addition, the structure in the cambic horizon is more strongly developed and the bulk density is near to one. We think that this type of soil is at the boundary of the Andisol concept, even though they still show some andic properties like high rates of phosphorous retention.

Important areas of the Central Valley are found occupied by a particular type of soil derived from volcanic ash, locally known as "ñadis." The ñadis are located in sectors with low relief, level to nearly level, characterized by excessive wetness for prolonged periods during the year.

The ñadis are thin (25 to 50 cm) to moderately deep soils (50 to 100 cm) with clear horizon differentiation. The epipedon with a high organic matter content seldom qualifies as histic, because it does not have enough thickness. There is a dark brown Bs, normally with subangular blocky structure over a distinct yellowish B which rests abruptly on a placic horizon. The subtratum is a glacifluvial deposit that corresponds to the outwash of the piedmont glaciers. Under some local drier conditions, the upper part of this deposit is strongly cemented into a duripan.

There is one more morphological feature that characterizes this particular type of soil -- the placic horizon, present as a black to reddish-black, thin layer (from 1 to 5 cm thick) between the high-chroma B and the glacifluvial deposit.

Normally these soils have a high chroma and for that reason would not meet the color requirement to be classified as Aquand according to the ICOMAND (Circular No. 5). In addition, the epipedon seldom qualifies as histic and the flacifluvial deposit is not always indurated into a duripan. Furthermore, the soils are usually saturated with water more than half of the time, which is enough to be considered as having an aquic moisture regime. Thus, at present time there is no place for this type of soil following Circular No. 5. Our feeling is that Placaquand could be the best great group that represents in a precise way the conditions of the ñadi soils, taking into account that the placic horizon is the actual restricting layer.

SOILS OF THE ANDEAN MOUNTAINS

In this sector, two main subsectors can be recognized; first, the Andean Mountains Piedmont, located between the great mountains and the Central Valley; and second, the Andean Mountains proper.

The piedmont is characterized by rolling to hilly landscapes, with slopes between 10% to 35%. It is normally dissected by numerous streams of east-west direction; the slopes that face the streams are very steep and the soils vary considerably in depth. Some of them are developed over strongly cemented tuff. Medium to fine textures with high to very high water retention capacity and bulk densities lower than 0.8 are common features of these soils. In our opinion, most of them correspond to the central concept of the Typic Dystrandepts.

Some of the soils show a clear layering produced by the successive deposition of the volcanic ashes. In general the degree of evolution of the soils is rather incipient. Allophane and imogolite have been described as dominant minerals in the clay fraction. There is also some chlorite. The Durandepts are present in those areas where the tuff is found in the upper meter, and usually all the soils are in the medial families.

The other subsectors, the Andean Mountains proper, is characterized by a strong relief, with slopes over 25%; the valleys are narrow and confined. The parent materials are normally coarser volcanic materials than the ashes, like cinders and lappillis; in addition, there are scorias and lavas. Consequently, the cindery families are frequent. Most of these soils show only a thin accumulation of organic residues at the surface. They are shallow to very shallow over volcaniclastic materials and we can say that these are the least developed of all the volcanic soils.

The majority of these recent soils presently do not qualify as Andepts because the epipedon is too shallow to be considered as umbric. It seems logical to accommodate these recent soils on volcanic materials with the Entisols, considering they do not have any kind of diagnostic features.

This has been only a brief review of the main landscapes and the associated soils of the south-central region of Chile, taking into account the most relevant properties of them. There have been surely some omissions and this review is not a comprehensive one, but the time available only allowed for showing the most striking features of the soils and the general distribution of them.

ANALYTICAL METHODS

The following is a brief description of the procedures and methodology used by the National Soil Survey Laboratory. It a more detailed description of any procedure is needed, the following report should be consulted. "Soil Survey Investigations Report No. 1, Soil Survey Laboratory Methods and Procedures for Collecting Soil Samples," USDA, SCS, Revision, August 1982. For equivalent procedures but ones of a less automated and instrumented nature, the 1972 revision should be consulted.

Method codes are included in the column headings on the data printouts and can be used as a key to the methods and procedures.

Some general comments on how the samples are handled:

All samples are air-dried and crushed using a wooden roller and sieved to remove fragments greater than 2 mm in diameter. All determinations are made on sieve samples and reported on an ovendry weight basis unless otherwise stated. The ovendry weight basis is determined by ovendrying a sample at 105°C.

CONSIDERATIONS IN THE USE OF LABORATORY DATA

In consideration of the soil characterization data, be aware of the ways your concepts of specific properties compare with the same properties defined operationally. Each of us has mental pictures and conceptual definitions to aid in visualizing properties and processes. These frequently go far beyond the information supplied by any particular analysis, and we are tempted to give numbers on paper credit for connotations that are strictly our own. In this light, there are two pitfalls. One is the temptation to mix observations with concepts. Rather than first laying down observations and then building inferences, it is tempting to describe and interpret in terms of predetermined inferences. If, at some later date concepts change, there may be no way to untangle the observations from the outdated concepts to piece together new inferences.

The second pitfall is the temptation to remain unaware of the operations (analyses) involved in an observation or measurement. Results differ with different methods, but the nature of any particular operation remains the same so long as the same method is used. To compare one bit of data with another, it is important to know how both bits were gathered. This leads to operational definitions (methods). The operational definition is a device to describe a soil property in terms of the operations used to measure it. Look for operational and conceptual definitions as we discuss the following laboratory analyses. Then, as we use field and laboratory data to classify soils, we can attempt the difficult task of separating observations from concepts.

SYNOPSIS OF ANALYTICAL METHODS

PARTICLE SIZE DISTRIBUTION ANALYSIS (PSDA) AND COARSE FRAGMENTS--RECORDED AS WEIGHT PERCENT.

The fractions coarser than 20 mm are derived from screening and weighing in the field or from field volume estimates. Be sure to include volume estimates of the 20-75 mm and 75-250 mm fractions when sending samples to the laboratory. The 2-20 mm fraction is obtained by sieving in the laboratory. During sample preparation, the soil is crushed so all but the coarse fragments pass through a 2-mm sieve. In soil survey, coarse fragments are split into the 2-5 mm, 5-20 mm, and 20-75 fractions and reported as percent of the less than 75 mm, material. Fragments larger than 75 mm but smaller than 250 mm are included in the column labeled > 2 mm, percent of the whole soil (really percent of the < 250 mm material).

For PSDA, a portion of the fraction passing through the sieves is treated with H_2O_2 to remove organic matter and candle filtered to remove soluble salts. It is then dispersed in water with sodium hexametaphosphate, a dispersing agent, and with a specified physical agitation. The dispersed soil is poured through a sieve which catches the sands and allows the silt and clay to pass through. The various sand fractions are further separated by dry shaking in a nest of sieves. The silt fractions and clay are determined by pipetting known volumes from suspensions remaining after known settling times. Fine clay (< 0.0002 m) is determined by centrifugation and pipetting. The necessary settling and centrifugation times are based upon calculations which treat the particles as perfect spheres with consistent, designated specific gravity (Stokes Law). These calculations are used to determine the precise depths and times at which a pipetting will capture exactly the size fraction desired. Operationally then, the clay fraction is not the array of particles smaller than 0.002 mm. It is the array of particles that behaves in suspension in water as though it consists of perfect spheres of a designated specific gravity and a diameter of 0.002 mm. The actual dimensions may be uncertain and quite different from the conceptual perfect spheres. It is possible to calculate sedimentation rates for other shapes and specific gravities, but this is only done in special cases. The standard operation usually separates the more active fraction (clay), which is dominated by clay minerals, from the more inert fraction (silt) which is dominated by nonclay minerals. Thus, the operation would serve its purpose even if we had no concept of particle shape and specific gravity. In fact, the concept of clay as a distinct kind of soil material predates the development of modern concepts about clay-size particles and clay minerals.

Clay-sized carbonates are determined by treating the pipetted sample of clay with HCl and measuring the pressure of CO_2.

The specific chemical and physical treatments and calculations are indicated by codes in the headings. Detailed procedures are listed by these codes in Soil Survey Investigations Report No. 1.

ORGANIC CARBON--REPORTED AS WEIGHT PERCENT

Organic carbon is determined by the Walkley-Black method which is a wet combustion procedure. The sample is treated with a strong oxidizing agent (potassium dichromate) and digested in sulfuric acid. An empirical recovery factor is used in calculating percent organic carbon. The NSSL uses a recovery factor of 0.77 as proposed by Walkley. This organic carbon represents decomposed soil organic matter. It normally excludes relatively fresh plant residues, roots, charcoal, and carbon of carbonates. It can be multiplied by 1.72 for an approximation of organic matter content.

The standard procedure is not used when organic carbon content exceeds roughly 8 percent. Loss on ignition at 400°C is an acceptable substitute in such cases.

LOSS ON IGNITION--REPORTED AS WEIGHT PERCENT

This is a measure of organic matter content and generally used for samples high in organic carbon (> 8%). Ovendried samples are held overnight at 400°C, and the weight loss is measured. Some of the weight loss is sometimes caused by dehydration of clay minerals, but normally the weight loss is mostly from burning of organic matter. When there are large amounts of amorphous material or gypsum present, this weight loss by dehydration is more of a problem. Remember, this approximates organic matter not organic carbon.

NITROGEN

Nitrogen is determined by Kjeldahl digestion with ammonium being steam distilled into boric acid and titrated with HCl using an automatic titrator.

CITRATE--DITHIONITE EXTRACTABLE IRON, ALUMINUM, AND MANGANESE--REPORTED AS WEIGHT PERCENT

This procedure was originally developed for extraction of iron from soils. Some authors have designated the extracted iron as "free iron" reflecting beliefs about the nature of this component. This method extracts and measures amorphous forms and some of the crystalline forms but not total soil iron. Aluminum extracted during the rather severe chemical treatment is also recorded, and the two values together are used in the spodic horizon definition. Manganese extracted by this method is usually less than

1 percent. Some researchers use this Mn and relate it to internal soil drainage properties. Iron extracted by this procedure is often closely related to clay distribution with depth. Dithionite-citrate-extractable iron, aluminum, and manganese are determined by extracting a soil sample with an excess of sodium dithionite and sodium citrate in an 8-ounce bottle which is shaken overnight. Superfloc is added and an aliquot of the supernate is removed for the determination of iron, aluminum, and manganese by atomic absorption.

BULK DENSITY--REPORTED IN GRAMS PER CENTIMETER CUBED

Bulk densities are determined at two or more moisture contents. In coarse and moderately coarse-textured soils, they are determined at 1/10-bar moisture (moisture held against a 1/10 atmosphere pressure difference across a semipermeable membrane), and ovendry (moisture after drying at 110°C). In soils of medium and finer texture, they are determined at 1/3 bar and ovendry.

Most of the bulk densities are obtained by equilibration of Saran-coated clods at these suctions. Clods for this purpose are selected in the field and are dipped in Saran dissolved in methyl ethyl ketone. The dipped clods are dried by hanging them in air until the methyl ethyl ketone evaporates. The dry Saran then remains as a thin, tough film surrounding and supporting the clods for transport to the laboratory. This film is reinforced by added dipping in the laboratory, and supports the clods through wetting, equilibration at the desired suctions, and ovendrying. It can stretch and contract, thus allowing for changes in bulk density as moisture contents change. Bulk density is determined by weighing the clods in air, then weighing them in water. The first measurement is weight, and the difference between weight in air and weight in water is volume.

The bulk density as reported on the data sheet is calculated to represent the < 2 mm material.

COEFFICIENT--OF LINEAR EXTENSIBILITY (COLE)

COLE is a calculated value. It is based on the shrinkage of the natural soil clod between 1/3-bar moisture content (1/10 for sandier soils) and ovendryness. Therefore, bulk densities at these moisture contents are used to calculate COLE as follows:

$$\text{COLE} = \left[\left(\frac{\text{dry bulk density}}{\text{moist bulk density}}\right)^{1/3} - 1\right]$$

The cubed root of the ratio of the two bulk densities is used to correct the clod shrinking in three directions. The value obtained from the equation is corrected for coarse fragments, hence, COLE is on a whole soil base. COLE multiplied by 100 is called Linear Extensibility (LE) and is simply COLE in percent.

1/3-BAR WATER

The 1/3-bar water is determined by equilibrating natural fabric clods at 1/3 bar and determining the weight percent moisture as a percent of the ovendry weight of the soil.

15-BAR WATER

The 15-bar water is determined by pressure membrane extraction; < 2 mm soil material is used. The water retained is expressed as a percent of the ovendry weight of the soil.

WATER RETENTION DIFFERENCE--WRD

WRD, like COLE, is also a derived value based on moisture contents at 1/3 bar (1/10 bar for sandier soils) and 15 bar. The 1/3 bar or 1/10 bar moisture contents are often referred to as field capacity while the 15-bar content is often called the wilting point. WRD is the difference between 1/3 bar (1/10 bar) and 15 bar divided by 100 then multiplied by the moist bulk density to put it on a volume base. If the soil contains coarse fragments, the aforementioned value is corrected to represent the coarse fragment content, hence, WRD is on a whole soil base.

EXTRACTABLE BASES--REPORTED AS MEQs/100 g SOIL

These are the major exchangeable bases, calcium, magnesium, sodium, and potassium. They are extracted by displacement from the cation exchange complex by another cation, ammonium (ammonium acetate buffered at pH 7 is the extraction solution). The term extractable rather than exchangeable bases is used because any additional source of soluble bases will influence the results. In soils with soluble salts or carbonates, the soluble cations must be measured separately and the results subtracted from the extractable bases for determination of exchangeable bases (Exchangeable = extractable - soluble). Exchangeable Na can be computed with acceptable accuracy unless salt contents exceed approximately 20 mmhos/cm at 25°C. Exchangeable Na = (extractable Na) - (Na in saturation extract) x (saturation percentage, percent water in the saturated paste) divided by (1,000). Exchangeable Na can be derived with greater accuracy than the other cations in the presence of gypsum or carbonates. Assuming exchangeable K negligible compared to exchangeable Ca and Mg, then exchangeable Ca + Mg = CEC (NH_4OAc) - exchangeable Na. This approximation is suitably reproducible for comparison between soils and for classification. Exchangeable Mg can be computed in the same fashion as exchangeable Na. Results are not as satisfactory for exchangeable Ca when computed in the presence of carbonates or large amounts of gypsum. To prevent misuse of the Ca values, NH_4OAc extractable Ca is omitted from the data sheet when the carbonates are thought to significantly influence the results.

EXTRACTABLE ACIDITY--REPORTED MEQs/100 g SOIL

This is the acidity released from the soil by a barium chloride-triethanolamine solution buffered at pH 8.2. It includes all the acidity generated by replacement of the hydrogen and aluminum from permanent and pH dependent exchange sites.

EXTRACTABLE ALUMINUM--REPORTED MEQs/100 g SOIL

This measures exchangeable aluminum, which is a major constituent only in acid soils (pH < 4.5). Aluminum will precipitate if the pH rises above 4.5 to 5.0 during analysis. The Al extracted by 1N KCl approximates exchangeable Al. Because KCl is an unbuffered salt, it usually effects the soil pH only one unit or less, so the extraction is made near the pH of the soil. In acid soils, the sum of bases plus Al extracted by 1N KCl is close to the effective CEC of soil in the field.

CATION EXCHANGE CAPACITY--REPORTED AS MEQs/100 g SOIL

Several different reagents and pH levels are used to measure the CEC. It may be determined by summing all the exchangeable cations, by summing bases and extractable aluminum, or by saturating the exchange complex with one kind of cation, replacing it with another cation, and measuring the replaced cation. Ammonium in neutral ammonium acetate is the ion used for the later method.

The CEC-sum of cations is calculated by summing the extractable bases and extractable acidity. It represents the pH dependent charge. CEC-sum of cations is not calculated if soils contain soluble salts. The bases + aluminum CEC value is calculated by summing the extractable bases and KCl extractable aluminum. It is commonly called the effective CEC for acid soils since it more closely represents CEC at the soil pH. It also is not calculated for soils that have soluble salts.

The CEC-NH_4OAc is an analytically determined value. It is the value used in calculating CEC/clay ratios. The CEC-sum of cations - CEC NH_4OAc is the pH dependent charge from pH 7 to pH 8.2.

CEC measurements at other pH or by other cations may each yield somewhat different answers. It is important to know the operational definition (procedure, pH, and cation used) before evaluating the meaning of the measurement.

BASE SATURATION--REPORTED AS PERCENT OF CEC

Two values are frequently reported. One is derived from the equation:

Base saturation percentage by NH_4OAc, pH 7 is equal to sum of NH_4OAc extractable bases divided by NH_4OAc-CEC times 100.

The other is:

Base saturation percentage by sum of cations pH 8.2 is equal to the sum of NH_4OAc extractable bases divided by CEC sum of cations pH 8.2 times 100. This value is not reported if either extractable Ca or extractable acidity is omitted.

Differences between these two base saturations depend upon the size of the pH dependent CEC. Class definitions in our soil classification specify which is to be used.

The sum of bases is considered equal to exchangeable cations unless gypsum, salts, or carbonates are present. Normally, the bases extracted by this method exceed 100 percent when the more soluble constituents are present. We then assume 100 percent base saturation. The Ca from carbonates is usually much larger than Mg. Extractable Ca is omitted if more than a trace (> 0.4%) of carbonate (as $CaCO_3$) is present or if calculated base saturation exceeds 110 percent.

Other values can be obtained by using CEC derived from operationally differing methods. There are numerous differing methods utilized for numerous specific purposes. Always be sure which method you are dealing with.

EXCHANGEABLE SODIUM

Exchangeable sodium percentage (ESP). Calculated by dividing NH_4OAc extractable sodium minus water soluble sodium by NH_4OAc-CEC and multiplying by 100.

CALCIUM CARBONATE EQUIVALENT--REPORTED AS WEIGHT PERCENT

The amount of carbonate (CO_3) components in the soil are measured by treating the sample with HCl. The evolved CO_2 is measured manometerically. The amount of carbonate is then calculated on a $CaCO_3$ equivalent no matter what form (Na_2CO_3, $MgCO_3$, etc.). Calcium carbonate equivalent is most commonly reported on the < 2 mm base but, in some soils with hard carbonate concretions, carbonates are determined on both the < 2 and 2-20 mm material; and reported on a < 20 mm base.

CALCIUM SULFATE AS GYPSUM--REPORTED AS WEIGHT PERCENT

Calcium sulfate (gypsum) is determined by extracting gypsum in water and precipitation in acetone. Gypsum is reported on both the < 2 mm and < 20 mm base.

pH--WATER, SALT, NaF

The pH is measured by a glass electrode in a soil-water or soil-dilute salt solution. The extent of the dilution is shown in the heading. 1:1 means one part by weight of water was added for each part by weight of dry soil. This is important in spodic soils because, within the limits of dilutions used, the pH increases markedly with increasing dilution. Measurements in soil-water are usually 1:1 and are 2:1 for the dilute salt solution.

The use of dilute salt solutions is a popular method for masking seasonal variations in pH. Readings in the dilute salt solutions are usually lower than with distilled water. The values may be equal or even higher in highly weathered soils of the tropics. These soils would have a high anion exchange capacity. Readings in 0.01M $CaCl_2$ tend to be uniform regardless of time of year. Readings in 1N KCl tend to also be uniform. The former are more popular in regions lacking extremely acid soils. The latter are more popular in regions where many soils are quite acid and KCl is used to extract exchangeable aluminum. The pH reading then shows the pH at which the aluminum was extracted.

The pH may also be measured in 1N NaF. This measurement is done in soils where there is a large amount of amorphous material present. If there is a large amorphous component, this pH will be greater than 9.5. High values for the NaF pH will also be found if there are free carbonates. Therefore, care must be taken in interpreting this data. One gram of soil is placed in 50 ml of 1N NaF stirred and the pH read after 2 minutes.

SODIUM PYROPHOSPHATE (pH 10) EXTRACTABLE CARBON, IRON, AND ALUMINUM--REPORTED AS WEIGHT PERCENT C, WEIGHT PERCENT Fe AND WEIGHT PERCENT Al

This reagent has been used widely as an extractant of organic matter. It successfully removes much of the organo-metal accumulations in spodic horizons, but is relatively ineffective in extracting many forms of inorganically bound iron and aluminum. For this reason, it is a key to the chemical identification of spodic horizons.

MINERALOGY

The clay, silt, and sand fractions of selected horizons from each profile were analyzed to determine the mineralogical composition. The different techniques employed are briefly as follows:

1. X-ray diffraction analysis (XRD).

   A Phillips diffractometer with a copper tube is used. XRD is run on the untreated clays and also on K and Mg saturated clays with associated heating or glycerol solvation.

2. Differential thermal analysis (DTA) was done only on the clay fractions. The instrument used was the Columbia Scientific Thermal Analyzer. Semiquantitative estimates are made using the data.

PETROGRAPHIC ANALYSIS--RECORDED AS NUMBER PERCENT

This analysis is named after the petrographic microscope which is the chief tool for mineral identification and quantitative analyses in the sand and coarser silt fractions. The data are listed on a supplemental sheet or at the bottom of the newer data sheets. Minerals are grouped under two major headings: resistant and weatherable.

SOLUBLE CATIONS AND ANIONS IN WATER EXTRACTED FROM SATURATED PASTE--REPORTED AS MEQs/LITER OF SOLUTION

Soluble cations and anions are determined in the water extracted from a saturated paste made by adding distilled water to soil until the saturation point is reached. At saturation, the soil paste glistens as it reflects light, flows slightly when the container is tipped, and slides freely and cleanly off a spatula except for soils containing large amounts of clay. In calculations of exchangeable sodium percentage, soluble sodium is subtracted from extractable sodium to obtain an estimate of exchangeable sodium.

TOTAL SALTS

Measure of percent total estimated soluble salt in the soil. Calculated from conductivity of the saturated extract.

ELECTRICAL CONDUCTIVITY

Electrical conductivity (EC) of the saturate extracted obtained the saturated paste used in the determination of water soluble anions and cations.

SAR

Sodium adsorption ratio determined by the following equation:

$$SAR = \frac{Na^{+}}{\sqrt{\frac{Ca^{++} + Mg^{++}}{2}}}$$

The Ca, Mg, and Na are in meq/l and determined from the saturated extract of the water-soil saturated paste.

PHOSPHATE RETENTION CAPACITY

Determined by shaking 5 g of air-dry soil (< 2 mm) with 25 ml of a phosphate solution (1 ml = 1 mg P) for 24 hours in a 50 ml polypropylene centrifuge tube (Blakemore et al., 1981). Tubes are centrifuged and the P remaining in solution measured using the molybdo-vanadate method. Results are reported as percent, P-retained.

ACID OXALATE-EXTRACTABLE ALUMINUM AND SILICON

Determined by shaking 0.5 g air-dry soil (< 2 mm) with 50 ml acid oxalate reagent for 4 hours in a polyropylene centrifuge tube in the dark (Blakemore et al., 1981). Tubes are centrifuged and Al and Si determined by atomic absorption spectrophotometry.

KOH-Al

Determined by reacting 0.2 g soil with 2 ml 4N KOH for 10 minutes, filtering and determining the Al in the solution.

AVAILABLE PHOSPHOROUS (Bray-1)

Determined by shaking 1 g of air-dry soil (< 2 mm) with 10 ml of extracting solution (0.025N HCl + 0.03N NH_4F) for 5 minutes in a 50 ml Erlenmeyer flask. Extracts are filtered through Whatman No. 2 filter paper. A 2 ml aliquot is added to 8 ml solution of 50 ppm P prepared from reagent grade potassium hydrogen phosphate (KH_4PO_4). Phosphorous is measured using a colorimeter and reported in parts per million.

OTHER USEFUL INFORMATION

There are a couple ratios placed on the data sheet. These are useful in making internal checks of the data and making other useful determinations.

RELATIONSHIP OF MINERALOGY AND CATION EXCHANGE

Ratio of CEC (NH_4OAc, pH 7) to clay can be used to make an estimation of the clay mineralogy. For family placement, some CEC/clay relationships are as follows: Kaolinitic < 0.2, kaolinitic or mixed 0.2-0.3, mixed 0.3-0.5, mixed or montmorillonitic 0.5-0.7, and montmorillonitic > 0.7. When amorphous material is present, these relationships do not hold.

Ratio of CEC (at pH 8.2) to 15-bar water of greater than 1.5 and more exchange acidity than the sum of bases plus KCl extractable Al, would suggest a soil with a high pH dependent charge. This can be used along with bulk density to separate subgroups that have high levels of amorphous materials commonly derived from pyroclastics.

RELATIONSHIP OF 15 BAR TO CLAY

This value is used to give an indication of dispersion in the particle size determination. If the ratio is greater than 0.6 and soil related factors do not adequately explain the situation, incomplete dispersion in particle-size analysis may be the cause. Some soil-related factors that can cause deviation from the 0.4 reference point are: low activity clays (kaolinites, chlorites, and some micas) tend to lower the ratio to 0.35 or below. Clay-size carbonate tends to decrease the ratio. Organic matter increases the 15-bar water content. Amorphous mineral materials increase the ratio.

In "Soil Taxonomy," 1975 the inverse of this ratio is sometimes used. A ratio of < 1.25 used in conjunction with bulk density and poor dispersion qualities; i.e., ones high in amorphous materials.

pH DEPENDENT CHARGE

The pH dependent charge as inferred by "Soil Taxonomy," 1975 is the difference between the sum of bases (NH_4OAc) plus extractable acidity and sum of bases (NH_4OAc) plus 1N KCl exchangeable Al, divided by measured clay or by 15-bar water times 2.5 under conditions defined in "Soil Taxonomy," 1975.

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Pedon Description and Analytical Data

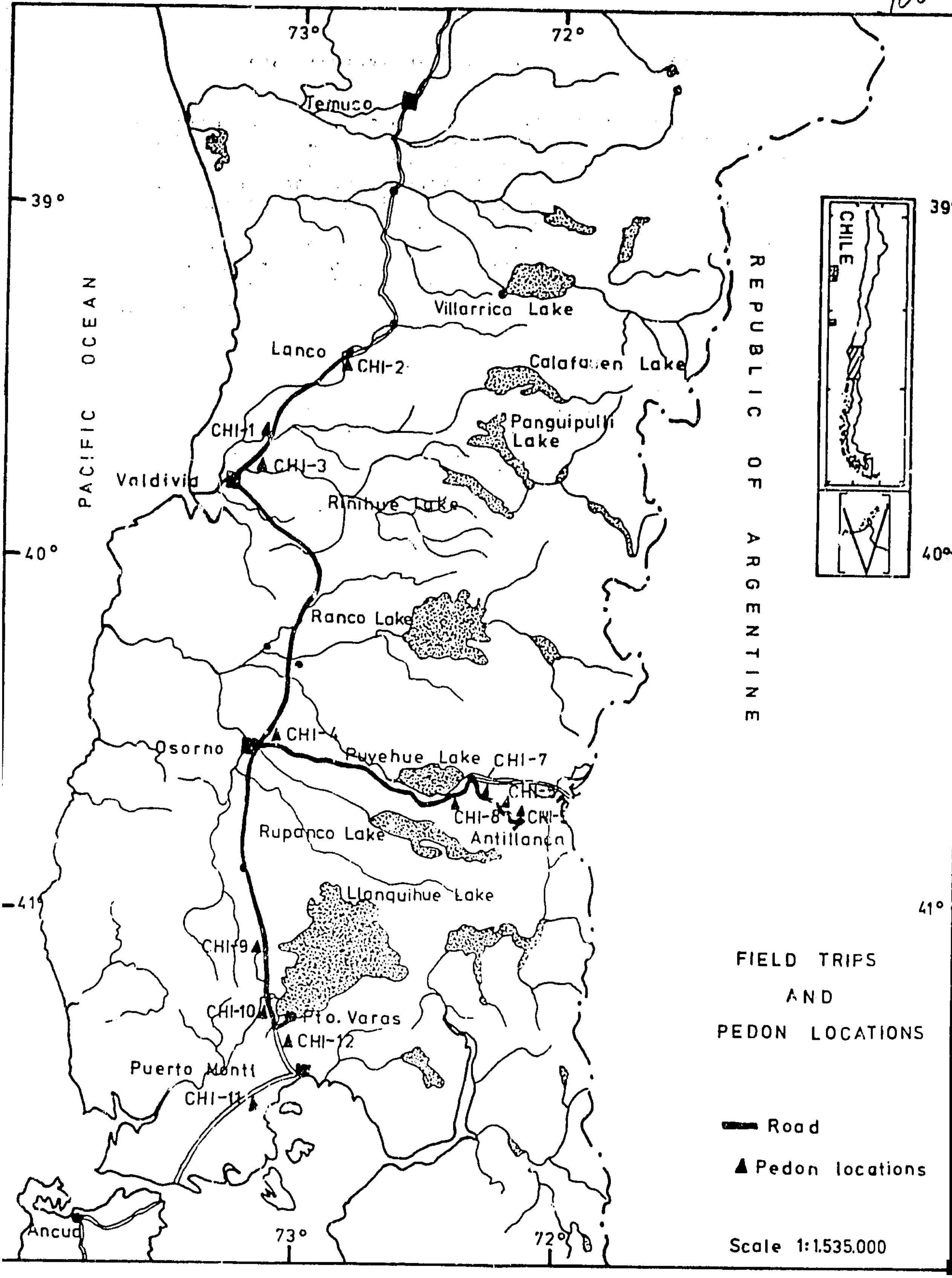
The section contains, for each pedon, a description for the pedon sampled, analytical data in two parts: the first sheet is the standard NSSL laboratory data sheet and the second shows the results of the mineralized analysis. For each pedon, there is a micromorphological description that was done by Prof. Ricardo Honorato.

Pedons that were sampled but not included in the tour part of the guide are in Appendix II. Supplement data produced by the Comision Chilena de Energia Nuclear and by the Centro de Estudios de la Cuenca del Maule is included in Appendix IV. Supplement data produced by Dr. K. Wada is included in Appendix V.

If there are questions on the data sheet, Appendix III should be checked for an explanation.

The pedons are placed in the order that we will visit them. No classification have been placed on any of them. If you have a chance, it would be useful to try and work through their classifications before we visit them in the field.

The location of each pedon is shown on Figure 7.



73°
72°
39°
40°
41°
Temuco
Villarrica Lake
Lanco
CHI-2
Calafquen Lake
Panguipulli Lake
CHI-1
CHI-3
Valdivia
Rinihue Lake
PACIFIC OCEAN
REPUBLIC OF ARGENTINE
CHILE
Ranco Lake
Osorno
CHI-4
Puyehue Lake
CHI-7
CHI-8
Antillanca
Rupanco Lake
Llanquihue Lake
CHI-9
CHI-10
Pto. Varas
CHI-12
Puerto Montt
CHI-11
Ancud
FIELD TRIPS AND PEDON LOCATIONS
Road
Pedon locations
Scale 1:1.535.000

Series: Pelchuquin 6/83
Pedon No: S83FN-275-001
Taxonomy: Medial, mesic Oxic Dystrandept
Latitude: S39°42' Longitude: W 73°06'
Location: Pelchuquin
Geomorphic Position: Terrace
Slope and Aspect: 1% planar Elevation: 17 m M.S.L
Air Temp. 13 C Summer: 15.9C Winter: 7.9C
Precipitation: 205 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: Pasture
Erosion or Deposition: none
Parent Material: volcanic ash
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 7, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-39 cm dry and 39-200 cm slightly moist.

Ap1 0 - 4 cm Very dark grayish brown (10YR 3/2) silt loam, brown to dark brown (10YR 4/3, dry); strong medium and coarse granular structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; many very fine to fine roots; many very fine and fine interstitial pores; pH= 5.3, strongly acid; abrupt smooth boundary.

Ap2 4 - 27 cm Very dark brown (10YR 2/2) silt loam, brown to dark brown (10YR 4/3, dry); moderate to strong very coarse granular structure parting to weak and coarse subangular blocky; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; many very fine and few medium roots; many very fine to fine interstitial pores; pH= 5.3, strongly acid; abrupt smooth boundary.

2BA 27 - 39 cm Dark yellowish brown (10YR 3/4) silt loam, brown (10YR 5/3, dry); weak coarse prismatic structure; very friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; common very fine and few medium roots; common coarse and very fine tubular pores; few 1.5 to 3 cm cylindrical hardened insect nests; few fine 1 to 3 mm pumice fragements, pieces of charcoal, and nodules; pH= 5.7, medium acid; clear smooth boundary.

2Bw1 39 - 73 cm Dark brown (7.5YR 3/4) silt loam; weak coarse prismatic structure parting to moderate medium and coarse subangular blocky; very friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; common very fine roots; many very fine tubular and few fine tubular, discontinuous pores; few 1.5 to 3 cm cylindrical hardened insect nests; few fine 1 to 3 mm pumice fragements, pieces of charcoal, and nodules; pH= 5.7, medium acid; clear smooth boundary.

2Bw2 73 - 98 cm Dark brown (10YR 3/3) silt loam; moderate coarse prismatic structure parting to weak medium subangular blocky; friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; many patchy silt coatings channels and pores; few very fine roots; many very fine, fine and, and medium tubular pores; few fine 1 to 3 mm pumice fragements, pieces of charcoal, and nodules; pH= 5.7, medium acid; gradual smooth boundary.

3Bw4 98 - 160 cm Dark yellowish brown (10YR 3/4) silt loam; structureless; friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; many patchy silt coatings in channels and pores; few very fine roots; many very fine, fine and medium tubular pores; pH= 5.7, medium acid; clear irregular boundary.

3Bw5b 160 - 200 cm Dark yellowish brown (10YR 4/4) silt loam; structureless; firm, sticky and slightly plastic; moderatly smeary, very moist or wet; many thin discontinuous clay films in pores; few very fine roots; many very fine, fine, and medium tubular pores; few thin seams and masses of uncoated fine sand:; pH= 5.7, medium acid.

PELCHUQUIN

LAR CLASSIF: MEDIAL, MESIC OXIC DYSTRANDEPT

S 83FN-275 -001 DATE 09/25/84

SAMPLE NO. 83P2246-2253
PEDON NO. 83P 481
PROJECT NO. 83P 84

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- WEIGHT 5 -20	-15- WEIGHT 20 -75	-16- WEIGHT .1- 75	-17- (>2MM WT PCT O WHOLE SOIL
				<- - -	- - -	- - -	- - -	-	PCT OF <2MM	(3A1) - -	- - -	- - -	- - -	- - -	- ->	<- PCT OF	<75MM(3B1)->			SOIL
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832246	1S	0- 4	AP1	10.4	68.8	20.8			44.4	24.4	10.5	5.1	2.2	2.7	0.3	TR	--	--	10	--
832247	2S	4- 27	AP2	5.9	72.7	21.4			45.1	27.6	13.7	5.4	1.2	0.9	0.2	TR	TR	--	8	--
832248	3S	27- 39	2BA	1.0	56.1	42.9			30.4	25.7	21.5	14.2	4.6	1.9	0.7	TR	--		21	--
832249	4S	39- 73	2BW1	--	42.7	57.3			17.7	25.0	24.9	21.7	6.7	3.1	0.9	TR	--	--	32	--
832250	5S	73- 98	2BW2	3.6	36.7	59.7			17.4	19.3	20.9	21.6	10.4	5.7	1.1	TR	TR	--	39	--
832251	6S	98-129	3BW3	4.7	35.0	60.3			16.7	18.3	21.8	20.8	10.9	6.2	0.6	TR	--	--	38	--
832252	7S	129-160	3BW4	2.2	29.0	68.8			13.5	15.5	24.9	24.3	11.6	6.6	1.4	TR	--	--	44	--
832253	8S	160-200	3BW5B	3.7	46.9	49.4			27.7	19.2	11.4	8.9	7.0	10.1	12.0	TR	--	--	38	--

Column numbers printed above the table: -1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	HZN NO.	ORCN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	DITH-CIT EXTRACTABLE AL 6G7A	DITH-CIT EXTRACTABLE MN 6D2A	(RATIO/CLAY) CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	ATTERBERG LIMITS LL 4F1	ATTERBERG LIMITS PI 4F	BULK DENSITY FIELD MOIST 4A3A	BULK DENSITY 1/3 BAR 4A1D	BULK DENSITY OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1C	WATER CONTENT 1/3 BAR 4B1C	WATER CONTENT 15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - -	- - -	-PCT OF <2MM	- - -	- - -	- - -	->			PCT <0.4MM		<- - G/CC	- -	- ->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
832246	1	12.4	1.076			3.2	1.9		3.97	3.55										36.9	
832247	2	8.61	0.668			3.8	2.3		5.37	4.98				0.70	0.81	0.050			55.5	29.4	0.18
832248	3	4.03	0.302			4.6	2.0		22.00	27.90				0.68	0.80	0.056				27.9	
832249	4	2.43				4.9	1.8							0.87	0.87					24.9	
832250	5	1.07				5.1	1.6		3.89	6.67				0.74	0.84	0.043			54.5	24.0	0.23
832251	6	0.91				4.9	1.7		2.62	4.87				0.84	0.96	0.046			54.0	22.9	0.26
832252	7	0.72				4.1	1.3		5.68	9.73				0.80	0.93	0.051			57.0	21.4	0.28
832253	8	1.69				4.6	1.7		6.57	7.08				0.90	1.09	0.066			60.8	26.2	0.31

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

SAMPLE NO.	HZN NO.	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACIDITY 6H5A	-7-- EXTR AL 6G9A	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SAT SUM 5C3	-13- BASE SAT NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
		(- NH4OAC EXTRACTABLE BASES -) <- - - -				-MEQ / 100 G - - -					- ->	<- - - - -PCT		- - - ->							
832246	1	11.4	3.0	0.8	0.6	15.8	47.5	0.3	63.3	41.3	16.1	2	25	38					10.4	5.2	5.6
832247	2	1.7	0.2	0.1	0.1	2.1	49.5	1.3	51.6	31.7	3.4	38	4	7					10.9	4.8	5.2
832248	3	0.9	0.1	0.1	--	1.1	39.7	TR	40.8	22.0			3	5					11.1	5.4	5.7
832249	4	3.4	0.4	0.1	0.1	4.0	31.2	TR	35.2	18.6			11	22					10.7	5.6	5.9
832250	5	2.5	0.7	TR	--	3.2	23.6	--	26.8	14.0			12	23					10.6	5.8	6.1
832251	6	2.9	0.8	--	--	3.7	22.4	--	26.1	12.3			14	30					10.4	5.8	6.2
832252	7	2.3	0.7	TR	--	3.0	23.7	TR	26.7	12.5			11	24					10.6	5.8	6.2
832253	8	1.5	0.3	--	--	1.8	33.2	0.1	35.0	24.3	1.9	5	5	7					10.8	5.7	5.9

(- - - -SPODIC HORIZON CRITERIA - - - - -)
(- -NA PYROPHOSPHATE EXTRACTABLE- -) INDEX OF ACCUM

(- - - - - - - - - -MINERALOGY - - - - - - - - - -)

SAMPLE NO.	HZN NO.	C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	CLAY X-RAY <2U 7A21	7A21	7A21	7A21	CLAY DTA <2U 7A3	7A3	TOTAL RES 7B1A	DOH WEATH 7B1A
		<- PCT OF <2MM->							<- RELATIVE AMOUNTS ->				<- - - - -PCT			- - - ->
832246	1		0.4	1.1	0.3	0.1		232								
832247	2		0.5	1.2	0.3	0.3		1119	VR 1	NX 6						
832248	3		0.1	0.7	0.1	0.8		484	GI 1	VR 1	NX 6		GI 1			
832249	4		0.1	0.5	0.1											
832250	5		0.1	0.4	0.1	0.1		625	GI 2	KK 1	VR 1	NX 6	GI13	KK 2		
832251	6		0.1	0.4	0.1	0.1		736								
832252	7		0.1	0.4	0.1	0.2		794								
832253	8		0.1	0.5	0.1	0.2		1326	KK 1	GI 1	NX 6		KK 4	GI 3		

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 2 PCT .1-75MM 32. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL VR VERMICULITE NX AMORPHOUS GI GIBBSITE KK KAOLINITE

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

PELCHUQUIN   S83FN-275-001

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - -	-PCT OF	<2MM- - - -	- - -	- - -	- - >	
832246	1	4	45.6	94	2.8	1.0	1.3	1.9	
832247	2	2	34.1	99	3.3	1.1	1.3	2.4	
832248	3	TR	44.1	98	4.2	1.8	1.7	2.8	
832249	4	1	51.7	98	4.4	2.0	2.0	2.3	
832250	5	TR	45.6	98	2.7	1.2	1.9	2.0	
832251	6	1	44.6	97	2.5	1.2	1.9	2.0	
832252	7	1	47.0	98	2.8	1.4	1.6	1.9	
832253	8	1	61.2	98	5.3	2.6	2.3	2.4	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

		MINERALOGY																			
		OPTICAL SAND/SILT											X-RAY CLAY					DTA		(TOT ANAL)	
SAMPLE NO.	HZN NO.	PA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
			<PCT>										<RELATIVE AMOUNTS>					<PCT>			
83P2246	1																				
83P2247	2												VR 1	NX 6						0.2	4.4
83P2248	3	VFS		OT96	GS 4	GA<1							GI 1	VR 1	NX 6			GI 1		0.0	4.0
83P2249	4																				
83P2250	5												GI 2	KK 1	VR 1	NX 6		GI13	KK 2	0.1	7.1
83P2251	6																				
83P2252	7																				
83P2253	8												KK 1	GI 1	NX 6			KK 4	GI 3	0.2	6.8

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: VR = VERMICULITE NX = NON-CRYSTALLINE GI = GIBBSITE GA = GLASS AGGREGATES GS = GLASS OT = OTHER

KK = KAOLINITE

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Series: Lanco 6/83
Pedon No: S83FN-275-002
Taxonomy: Medial, mesic, shallow Typic Durandept
Latitude: S39°42' Longitude: W 72°50'
Location:
Geomorphic Position: Terrace
Slope and Aspect: 2% planar Elevation: 50 m M.S.L
Air Temp. 13.8 C Summer: 17C Winter: 8C
Precipitation: 195 cm Aquic moisture regime.
Water Table: > 10 m Drainage: Poorly drained, impeded below 45 cm
Permeability: moderate
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash over unrelated cemented gravelly glacial outwash at 45 cm
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 7, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water:1/2.5); field moisture, 0-35 cm dry and 35-45 cm moist; a very thin mat of roots over mineral horizon.

A1 0 - 19 cm Dark reddish brown (5YR 3/3) and 2% dark reddish brown (5YR 3/4) sandy loam, strong brown (7.5YR 5/4, dry); weak fine and medium subangular blocky structure; slightly hard, friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine and fine roots, upper 1-3 cm is a dense mat of roots in the mineral soil; many very fine tubular, pores; 2% 2-5 mm gravel; pH= 5.3, strongly acid; abrupt smooth boundary.

2Bw1 19 - 35 cm Dark reddish brown (5YR 3/4) loam, strong brown (7.5YR 5/6, dry): weak medium prismatic parting to moderate fine and medium subangular blocky structure; soft, very friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine roots; many very fine tubular and interstitial pores; 1% cobble, 2% gravel; pH= 5.7, medium acid; clear smooth boundary.

3Bw2 35 - 45 cm Dark brown (7.5YR 3/4 crushed) very gravelly sandy loam; structureless; friable, slightly sticky and slightly plastic; many very fine roots; many very fine interstitial and tubular pores; coarse fragments, 55% gravel, 2% cobble mixed lithology; pH= 5.7, medium acid; abrupt wavy boundary.

4Bqlm 45 - 51 cm Dark red (2.5YR 3/6) and yellowish red (5YR 4/6) indurated duripan; very strongly cemented; coarse fragments, 60% gravel mixed lithology; pH= 5.7, medium acid; abrupt wavy boundary. Laminar cap on surface of pan.

5Bq2 51 - 65 cm Black (10YR 2/1) and very dark gray (10YR 3/1); weakly cemented; coarse fragments, 60% gravel, 3% cobble from mixed lithology; pH= 5.5, strongly acid.

*4Bslm 45 - 47 cm indurated layer, Light brownish gray (10YR 6/2, dry); 5YR 2/1 stains; very strongly cemented; 50-70% gravel. This horizon and the ones below were sampled in a quarry pit 20 m west of soil pit description.

*5Bs2 47 - 58 cm Yellowish red (5YR 5/8, 6/8 2.5YR 4/6, 2.5YR 4/8 dry); 5YR 2/1 stains; strongly cemented, pores or voids filled with Fe or clay films; 50 to 70% gravel.

*5Bs3 58 - 73 cm Strong brown (7.5YR 4/6, and 10YR 5/2 dry); weakly cemented; 50-70% gravel.

*5Bs4 73 - 79 cm Yellowish red (5YR 5/6); 5YR 2/1 stains; 50-70% gravel.

*5Bs5 79 - 90 cm Grayish brown (10YR 5/2, dry); silica coatings 10YR 8/2,dry; 10R 2.5/1, dry stains.

*These five horizons were sampled in a quarry bank 20 meters to the west of the soil pit.

LANCO

LAB CLASSIF: MEDIAL, MESIC, SHALLOW TYPIC DURANDEPT

S 83FN-275 -002

DATE 09/25/84

SAMPLE NO. 83P2262-2271
PEDON NO. 83P 483
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- CLAY LT .002	-2-- SILT .002 -.05	-3-- SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS (MM) WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM WT PCT O WHOLE SOIL
				<- - - - -	- - - -	- - - -	- - - -	- PCT OF <2MM	(3A1) - - -	- - - -	- - - -	- - - -	- - - -	- - - -	- - ->	<- PCT OF	<75MM(3B1)		->	SOIL
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832262	1S	0- 19	A	0.3	64.6	35.1			46.7	17.9	15.9	9.9	4.7	3.5	1.1	1	TR	8V	26	9
832263	2S	19- 35	2BW1	--	43.4	56.6			14.4	29.0	22.3	20.1	5.9	4.8	3.5	2	1	9V	42	16
832264	3S	35- 45	3BW2	--	45.7	54.3			29.1	16.6	14.9	8.7	6.1	10.1	14.5	5	24	61V	94	90
832265	4S	45- 51	4BQ2M	8.0	20.4	71.6			15.6	4.8	2.9	4.6	11.1	19.2	33.8	5	14	68V	96	87
832266	5S	51- 65	5BQ2	2.2	3.7	94.1			2.0	1.7	1.3	5.7	18.7	36.1	32.3	5	13	69V	99	87
832267	6S	45- 47	4BS1M													--	--	--		--
832268	7S	47- 58	5BS2													--	--	--		--
832269	8S	58- 73	5BS3													--	--	--		--
832270	9S	73- 79	5BS4													--	--	--		--
832271	10S	79- 90	5BS5													--	--	--		--

Column headings as printed: (- - -TOTAL - - -)(- -CLAY- -)(- -SILT- -)(- - - - - -SAND- - - - - -)(-COARSE FRACTIONS(MM)-)(>2MM; column numbers -1-- through -20-.

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS - LL 4F1	PI 4F	BULK DENSITY FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - -	- - - -	- -PCT OF	<2MM - -	- - -	- - -	- ->			PCT <0.4MM		<- - G/CC	- -	- ->	CM/CM	<- - -PCT OF	<2MM	- -	- ->	CM/CM
832262	1	8.33	0.516			4.1	1.9		87.33	115.00				0.64	0.73	D.044			76.3	34.5	0.26
832263	2	3.41	0.311			4.9	1.9							0.53	0.63	0.057			79.0	40.8	0.20
832264	3	4.80	0.449			3.2	1.6													35.0	
832265	4	0.61				3.7	1.0		1.59	1.68										13.4	
832266	5	0.08				0.4	0.1		1.82	2.18										4.8	
832267	6																				
832268	7																			4.3	
832269	8																			4.6	
832270	9																				
832271	10																			5.6	

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

SAMPLE NO.	HZN NO.	-1- CA 5B5A 6N2E	-2- MG 5B5A 6O2D	-3- NA 5B5A 6P2B	-4- K 5B5A 6Q2B	-5- SUM BASES	-6- ACID-ITY 6H5A	-7- EXTR AL 6G9A	-8- CEC SUM CATS 5A3A	-9- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SAT SUM 5C3	-13- BASE SAT NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
		<- - - - - - - - - - - - - -MEQ / 100 G									- - - - - - - - - - - - ->	<- - - - - -PCT		- - - ->							
832262	1	1.7	0.5	TR	0.1	2.3	48.9	0.1	51.2	26.2	2.4	4	4	9					11.2	5.3	5.8
832263	2	0.1	0.3	--	--	0.4	41.8	0.1	42.2	16.8	0.5	20	1	2					11.1	5.9	5.8
832264	3	--	0.1	--	--	0.1	41.6	TR	41.7	18.3			TR	1					11.2	5.6	5.8
832265	4	0.4	0.1	--	--	0.5	14.0	TR	14.5	12.7			3	4					10.3	5.7	5.9
832266	5	0.7	0.2	--	--	0.9	3.3	TR	4.2	4.0			21	22					8.5	5.6	6.2
832267	6																				
832268	7																				
832269	8																				
832270	9																				
832271	10																				

(- NH4OAC EXTRACTABLE BASES -) (- - - -CEC - - - -) -BASE SAT- CO3 AS CACO3; COND.(- - - -PH - - -)

SAMPLE NO.	HZN NO.	C 6A4A	FE 6C8A	AL 6G10	FE+AL DI-CI	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	CLAY X-RAY <2U 7A21	CLAY X-RAY <2U 7A21	CLAY X-RAY <2U 7A21	CLAY X-RAY <2U 7A21	CLAY DTA 7A3	CLAY DTA 7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF	<2MM->		(- -DIVIDED	BY- -)			<- RELATIVE AMOUNTS ->				<- - - - -PCT			- - - ->
832262	1		0.4	1.1	0.3	5.0		970	NX 6							
832263	2		0.1	0.6	0.1				NX 6							
832264	3		0.1	0.7	0.2				NX 6							
832265	4		0.1	0.3	0.1	TR		63								
832266	5		0.1	0.1	0.4	0.1		43								
832267	6															
832268	7															
832269	8															
832270	9															
832271	10															

(- - - -SPODIC HORIZON CRITERIA - - - - - -); (- -NA PYROPHOSPHATE EXTRACTABLE- -); (- - - - - - - - - -MINERALOGY - - - - - - - - - - -)

FAMILY CONTROL SECTION: DEPTH 25- 45 PCT CLAY 0 PCT .1-75MM 68. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES
MINERALOGY: KIND OF MINERAL NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

LANCO   S83FN-275-002

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - - -PCT OF <2MM- - - - - - - - - - >						
832262	1	TR	39.7	99	5.0	1.9	1.2	2.9	5.0
832263	2	1	56.0	98	6.7	3.2	0.6	3.0	5.5
832264	3	TR	63.7	98	5.5	2.5	0.3	3.1	5.3
832265	4	1	19.5	94	2.7	1.7	0.8	1.3	5.4
832266	5	28	4.6	38	0.8	0.7	0.7	0.3	5.0

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	MINERALOGY: OPTICAL SAND/SILT PA 7B1A	RE 7B1A (PCT)	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	X-RAY CLAY 7A2I (RELATIVE AMOUNTS)	7A2I	7A2I	7A2I	7A2I	DTA 7A3 (PCT)	7A3	(TOT ANAL) K2O 6Q3A	FE 6C7A
83P2262	1												NX 6							0.2	3.9
83P2263	2												NX 6							0.0	2.2
83P2264	3	VFS		OT96	GS 3	GC 1	GA<1						NX 6							0.0	2.9
83P2265	4																				
83P2266	5																				
83P2267	6																				
83P2268	7																				
83P2269	8																				
83P2270	9																				
83P2271	10																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: PA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: NX = NON-CRYSTALLINE GA = GLASS AGGREGATES GS = GLASS OT = OTHER GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Series: Los Ulmos 6/83
Pedon No: S83FN-275-003
Taxonomy: Clayey, halloysitic, mesic Orthoxic Pale Humult
Latitude: S39°45' Longitude: W 73°09'
Location: Cuesta Santa Elvira
Geomorphic Position: Hillslope
Slope and Aspect: 12% NW planar Elevation: 100 m M.S.L
Air Temp. 13.8 C Summer: 15.9C Winter: 7.9C
Precipitation: 210 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: moderate
Stoniness: non stony
Land Use: forest
Erosion or Deposition: none
Parent Material: volcanic ash over mica shist at depths > 2 m
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 6, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-7 cm dry and 7-202 cm slightly moist; 2cm of mixed fresh and decomposed leaves and needles over mineral horizon; vegetation composed of Pinus radiata, eucalyptus, australian sponge-tree, blackberry, and huckleberry.

A1 0 - 7 cm clay loam; Dark reddish brown (5YR 3/3, rubbed); strong medium and coarse granular structure; friable, slightly sticky; slightly plastic; weakly smeary, very moist or wet; many very fine and common coarse roots; many very fine, fine, and coarse interstitial pores; pH= 5.3, strongly acid; clear wavy boundary.

A2 7 - 27 cm Dark reddish brown (2.5YR 3/4) clay loam; moderate coarse coarse subangular blocky structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; many very fine, fine, and few coarse roots; few very fine tubular, pores; pH= 5.5, strongly acid; clear smooth boundary.

A3 27 - 66 cm Dark reddish brown (2.5YR 3/4) clay loam; weak medium and coarse subangular blocky structure; very friable, slightly sticky; slightly plastic; weakly smeary, very moist or wet; common very fine, fine and medium, few coarse roots; many very fine interstitial and tubular pores; pH= 5.5, strongly acid; clear smooth boundary.
Pieces of charcoal and cemented nodules of soil material from burned roots, size 5-40 mm.

2Bt1 66 - 115 cm Yellowish red (5YR 4/6) silty clay loam; weak medium prismatic structure parting to weak coarse subangular blocky; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; very few thin patchy clay skins in pores; few very fine, fine and medium roots; many very fine and fine tubular, discontinuous pores; pH= 5.5, strongly acid; diffuse smooth boundary.

2Bt2 115 - 166 cm Yellowish red (5YR 4/6) and reddish brown (5YR 4/4) silty clay loam; weak medium prismatic structure parting to weak coarse subangular blocky; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; few very fine and medium roots; common very fine tubular, discontinuous pores; few thin clay films in pores and on peds; pH= 5.5, strongly acid; gradual smooth boundary.

2Bt3 166 - 200 cm Reddish brown (5YR 4/4) and yellowish red (5YR 4/6) silt loam; structureless; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; few very fine and medium roots; few very fine tubular, discontinuous pores; few thin clay films in pores and on peds; pH= 5.5, strongly acid.

LOS ULMOS

LAB CLASSIF: CLAYEY, HALLOYSITIC, MESIC ORTHOXIC PALEHUMULT

S 83FN-275 -003

DATE 09/25/84

SAMPLE NO. 83P2234-2239
PEDON NO. 83P 479
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1- TOTAL CLAY LT .002	-2- TOTAL SILT .002 -.05	-3- TOTAL SAND .05 -2	-4- CLAY FINE LT .0002	-5- CLAY CO3 LT .002	-6- SILT FINE .002 -.02	-7- SILT COARSE .02 -.05	-8- SAND VF .05 -.10	-9- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75 PCT OF <75MM(3B1)	-17- >2MM WT PCT OF WHOLE SOIL
				<- - - PCT OF <2MM (3A1)											- ->					
832234	1S	0- 7	A1	52.4	36.1	11.5			22.5	13.6	5.2	3.8	1.1	0.7	0.7	TR	TR	--	6	--
832235	2S	7- 27	A2	45.4	41.2	13.4	16.0		27.2	14.0	6.1	4.0	1.2	0.9	1.2	TR	--	--	7	--
832236	3S	27- 66	A3	58.3	31.8	9.9	23.8		20.8	11.0	3.8	2.7	1.4	1.2	0.8	TR	TR	--	6	TR
832237	4S	66-115	2BT1	78.4	17.0	4.6	55.1		9.8	7.2	2.0	1.6	0.7	0.3	--	TR	TR	--	3	TR
832238	5S	115-166	2BT2	83.6	12.5	3.9	62.4		8.3	4.2	1.7	1.3	0.5	0.2	0.2	TR	--	--	2	--
832239	6S	166-200	2BT3	81.3	13.4	5.3	58.0		8.7	4.7	2.3	1.6	0.8	0.4	0.2	TR	TR	--	3	TR

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	RATIO/CLAY CEC 8D1	15 BAR 8D1	ATTERBERG LIMITS LL 4F1	PI 4F	BULK DENSITY FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - PCT OF <2MM						- ->			PCT <0.4MM		<- - G/CC		- ->	CM/CM	<- - PCT OF <2MM			- ->	CM/CM
832234	1	6.54	0.401			5.5	1.7		0.63	0.51				0.83	0.97	0.053			45.4	26.8	0.15
832235	2	4.29	0.224			6.2	1.9		0.51	0.51				0.90	1.02	0.043			41.9	23.1	0.17
832236	3	2.38	0.118			7.0	1.8		0.33	0.44				0.87	1.04	0.061			40.4	25.4	0.13
832237	4	0.60				8.1	1.9		0.17	0.35				1.14	1.41	0.073			41.1	27.1	0.16
832238	5	0.58				8.3	1.9		0.15	0.36				1.11	1.46	0.096			45.2	29.8	0.17
832239	6	0.43				8.1	1.7		0.15	0.36				1.10	1.47	0.101			44.7	29.2	0.17

SAMPLE NO.	HZN NO.	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACIDITY 6H5A	-7-- EXTR AL 6G9A	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SAT SUM 5C3	-13- BASE SAT NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
		<- - - -	- - - -	- - - -	- - -	-MEQ /	100 G - -	- - -	- - -	- - -	- ->	<- - - -	- -PCT -	- - - ->							
832234	1	4.0	1.9	0.3	0.5	6.7	34.5	1.4	41.2	33.0	8.1	17	16	20							
832235	2	--	0.5	0.2	0.2	0.9	30.8	2.4	31.7	23.1	3.3	73	3	4					9.7	4.9	5.4
832236	3	1.5	0.5	0.3	TR	2.3	27.8	1.9	30.1	19.5	4.2	45	8	12					10.1	4.9	5.0
832237	4	0.5	0.6	0.3	TR	1.4	22.3	1.2	23.7	13.2	2.6	46	6	11					9.9	4.6	5.3
832238	5	0.1	0.8	0.3	TR	1.2	24.5	1.6	25.7	12.4	2.8	57	5	10					9.7	4.7	5.2
832239	6	--	0.8	0.3	--	1.1	23.0	1.9	24.1	12.2	3.0	63	5	9					9.5	4.5	5.1
																			9.4	4.4	5.0

SAMPLE NO.	HZN NO.	SPODIC: NA PYROPHOSPHATE EXTRACTABLE C 6A4A	FE 6C8A	AL 6G10	FE+AL DIVIDED BY DI-CI FE+AL	FE+AL DIVIDED BY PCT CLAY	AL+C DIVIDED BY PCT CLAY	INDEX OF ACCUM	MINERALOGY CLAY X-RAY <2U 7A21	7A21	7A21	7A21	DTA <2U 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF	<2MM->						<- RELATIVE	AMOUNTS ->			<- - - -	-PCT -	- - ->	
832234	1		0.8	0.9	0.2	TR		105								
832235	2		0.7	0.8	0.2	TR		180	KH 2	VR 1	GE 1		KH34		87	WE13
832236	3		0.5	0.5	0.1	TR		37								
832237	4		0.2	0.2	TR	--			KH 3	GE 2	VR 1		KH59			
832238	5		0.4	0.3	0.1	--			KH 3	GE 2	VR 1		KH69			
832239	6		0.3	0.2	0.1	--										

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 67 PCT .1-75MM 5. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL KH HALLOYSITE VR VERMICULITE GE GOETHITE WE WEATH MIN

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

LOS ULMOS   S83FN-275-003

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - -	- -PCT OF <2MM-	- - - -	- - -	- - -	- - >	
832234	1	1	34.3	92	1.2	0.2	0.9	1.0	
832235	2	1	28.9	95	1.4	0.2	1.0	1.4	
832236	3	TR	31.7	94	1.2	0.2	0.9		
832237	4	1	37.0	91	0.6	0.2	0.7	0.9	
832238	5	2	44.2	91	0.6	0.2	0.7	0.8	
832239	6	1	46.4	91	0.7	0.2	0.7	0.8	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	PA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
		MINERALOGY																			
		OPTICAL											X-RAY					DTA		TOT ANAL	
		SAND/SILT											CLAY								
			PCT										RELATIVE AMOUNTS					PCT			
83P2234	1																				
83P2235	2	VPS	87	RE87	WE13								KH 2	VR 1	GE 1			KH34		0.1	9.1
83P2236	3																				
83P2237	4												KH 3	GE 2	VR 1			KH59		0.1	10.4
83P2238	5												KH 3	GE 2	VR 1			KH69		0.1	9.4
83P2239	6																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GE = GOETHITE RE = RESISTANT MINERALS VR = VERMICULITE WE = WEATHERABLE MINERALS KH = HALLOYSITE

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-004
Taxonomy: Medial, mesic Typic Durandept
Latitude: S 40°30' Longitude: W 73°02'
Location: Remehue
Geomorphic Position: Terrace
Slope and Aspect: 1% convex Elevation: 80 m M.S.L
Air Temp. 13.2 C Summer: 14.2C Winter: 6.8C
Precipitation: 145 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Moderately well drained Permeability: moderate
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash over very strongly weathered tuff at 94 cm
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 8, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-26 cm dry 26-94 cm slightly moist and 94-190 cm moist; vegetation-pasture grasses—Poa, Dactylis glomerata, Holcus lanatus, Anthoxanthum sp., Plantago lanceolata, Lolium sp., Trifolium repens, and scattered roble (Nothofagus procera); 2-3% charcoal and iron and manganese rounded concentrations from 0 to 88 cm.

O 0 - 0 cm Mat of roots with very little soil material; abrupt smooth boundary with the mineral so .

Ap 0 - 26 cm Very dark grayish brown (10YR 3/2) silt loam; weak medium and coarse structure parting to weak coarse subangular; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; many very fine mostly exped roots; common very fine interstitial and very fine tubular pores; pH= 5.5, strongly acid; clear smooth boundary.

Bw1 26 - 56 cm Dark yellowish brown (10YR 3/4) silt loam; structureless; friable, slightly sticky and slightly plastic; moderately smeary, very moist or wet; common very fine roots; many very fine, few fine tubular pores; 26-31 cm is compacted by plowing, appears to be darker in this thin layer and moist consistance is firm; pH= 5.5, strongly acid; gradual smooth boundary.

Bw2 56 - 88 cm Dark yellowish brown (10YR 4/6) silt loam; common fine distinct strong brown (7.5YR 5/6) mottles; structureless; friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; few very fine roots; many very fine, few fine and coarse tubular pores; common thin cutans (gels) in pores; pH= 5.5, strongly acid; abrupt wavy boundary.

2Bq 88 - 94 cm Black (5YR 2/1) and yellowish red (5YR 4/6) iron and silica cemented pan; extremely firm, strongly cemented with iron; few very fine roots in cracks; few very fine tubular, discontinuous pores; abrupt wavy boundary. The broken and discontinous, cracks or voids in the pan are 10-60 cm apart. Roots and water impeded by the pan but does penetrate through the cracks.

2C1 94 - 149 cm Light gray (10YR 7/2) silty clay loam; many fine and medium prominent dark red (2.5YR 3/6) mottles; structureless; friable, slightly sticky; plastic; moderatly smeary, very moist or wet; common very fine and fine interstitial and tubular pores; pH= 5.3, strongly acid; abrupt wavy boundary.

3C2 149 - 190 cm Dark gray (5Y 4/1) fine sand; structureless; friable, strongly smeary, very moist or wet; pH= 5.5, strongly acid.

OSORNO

LAB CLASSIF: MEDIAL, MESIC TYPIC DURANDEPT

S 83FN-275 -004 DATE 09/25/84

SAMPLE NO. 83P2277-2286
PEDON NO. 83P 485
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS (MM) WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM WT PCT OF WHOLE SOIL
				<- - -				PCT OF <2MM (3A1)							- ->	<- PCT OF <75MM(3B1)			->	
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832277	1S	0- 26	AP	8.0	75.3	16.7			50.4	24.9	8.3	4.4		1.2	0.8	1	TR	--	9	1
832278	2S	26- 56	2BW1	--	49.3	50.7			27.2	22.1	18.9	19.1	..5	3.3	0.9	2	TR	--	33	2
832279	3S	56- 88	2BW2	0.2	29.1	70.7			14.8	14.3	16.6	23.2	15.3	11.4	4.2	2	3	2	57	7
832280	4S	88- 94	2BQ	6.6	22.8	70.6			16.2	6.6	10.7	14.1	14.1	15.4	16.3	7	13	5	70	25
832281	5S	94-149	2C1	15.1	40.0	44.9			30.5	9.5	9.0	11.9	8.8	7.5	7.7	3	5	--	41	8
832282	6S	149-190	3C2	4.9	43.9	51.2			22.4	21.5	39.9	10.3	0.4	0.3	0.3	TR	TR	--	11	--
832283	7S	94-149	SUB1	10.6	41.5	47.9			30.5	11.0	11.5	14.8	8.7	6.5	6.4	25	22	--	66	47
832284	8S	94-149	SUB2	13.7	34.3	52.0			27.1	7.2	7.7	12.6	13.6	12.5	5.6	11	12	2	58	25
832285	9S	94-149	SUB3	20.0	65.0	15.0			50.0	15.0	7.0	2.4	1.7	2.4	1.5	4	3	--	14	7
832286	10S	94-149	SUB4	31.4	56.4	12.2			47.3	9.1	5.2	2.7	1.6	1.4	1.3	2	2	--	11	4

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	DITH-CIT EXTRACTABLE AL 6G7A	DITH-CIT EXTRACTABLE MN 6D2A	RATIO/CLAY CEC 8D1	RATIO/CLAY 15 BAR 8D1	ATTERBERG LIMITS LL 4F1	ATTERBERG LIMITS PI 4F	BULK DENSITY FIELD MOIST 4A3A	BULK DENSITY 1/3 BAR 4A1D	BULK DENSITY OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1C	WATER CONTENT 1/3 BAR 4B1C	WATER CONTENT 15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - -	- - -	-PCT OF <2MM	- - -	- - -	- - -	- ->			PCT <0.4MM		<- - G/CC	- -	- ->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
832277	1	9.38	0.756			1.7	1.0	0.1	4.38	4.16				0.69	0.80	0.050			71.1	33.3	0.26
832278	2	3.70	0.304			2.4	1.1	0.1						0.58	0.73	0.079			75.7	29.1	0.27
832279	3	2.52	0.245			3.1	1.3	0.1	115.50	156.50				0.53	0.71	0.101			95.7	31.3	0.34
832280	4	0.37				1.6	0.4	0.1	2.83	3.67										24.2	
832281	5	0.07				1.0	0.1	0.1	1.25	1.28				0.99	1.07	0.025			53.2	19.4	0.32
832282	6	0.03				0.3	TR	TR	1.59	1.41				0.89	0.92	0.011			46.5	6.9	0.35
832283	7					1.2	0.1	0.1		1.42										15.1	
832284	8					1.8	0.2	0.1		1.35										18.5	
832285	9					0.8	0.1	TR		1.02										20.4	
832286	10					1.7	0.2	TR		1.00										31.4	

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

OSORNO S 83FN-275 -004 DATE 09/25/84 PEDON NO. 83P 485 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B - - -)	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1 - - -)
		<- - - - - - - - - - - - -				-MEQ /	100 G - - -	- - - -	- - - -	- - - -	- - ->	<- - - -	- -PCT	- - - ->							
832277	1	2.1	0.2	--	0.1	2.4	50.8	0.9	53.2	35.0	3.3	27	5	7					10.9	4.8	5.2
832278	2	2.7	0.4	--	--	3.1	41.7	TR	44.8	23.0			7	13					11.0	5.6	6.1
832279	3	2.5	0.8	--	--	3.3	38.6	--	41.9	23.1			8	14					10.9	5.8	6.3
832280	4	1.4	0.8	0.1	--	2.3	20.3	TR	22.6	18.7			10	12					10.1	5.6	6.3
832281	5	5.3	5.6	1.4	--	12.3	11.4	0.1	23.7	18.8	12.4	1	52	65	--				9.0	6.0	7.0
832282	6	3.4	1.4	0.5	0.5	5.8	5.2	0.1	11.0	7.8	5.9	2	53	74					8.5	6.1	6.9
832283	7																				
832284	8																				
832285	9																				
832286	10																				

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY - - - - - -)	INDEX OF ACCUM	(- - - -MINERALOGY (- - - CLAY (- - - - X-RAY (- - - - <2U 7A2I	7A2I	7A2I	7A2I - - - -)	(- -DTA - -) (- -<2U - -) 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A - - - -)
		<- PCT OF <2MM->							<- RELATIVE AMOUNTS ->				<- - - - -PCT			- - - ->
832277	1		0.7	1.1	0.7	0.2		1279	NX 6							
832278	2		0.2	0.7	0.3				NX 6							
832279	3		0.1	0.6	0.2	3.5		1338								
832280	4		0.2	0.3	0.3	0.1		116	NX 6							
832281	5		0.1	0.1	0.2	TR		888	KH 2	FD 1	NX 6		KH29			
832282	6		0.1	TR	0.3	TR										
832283	7		0.1	TR	0.1	--			KH 3	NX 6			KH16			
832284	8		0.1	TR	0.1	--			KH 3	NX 6			KH20			
832285	9		0.1	TR	0.1	--			KH 3	NX 6			KH26			
832286	10		0.1	0.1	0.1	--			KH 3	NX 6			KH37			

FAMILY CONTROL SECTION: DEPTH 25- 88 PCT CLAY 0 PCT .1-75MM 45. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL NX AMORPHOUS KH HALLOYSITE FD FELDSPAR

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L D A T A S H E E T

OSORNO S83FN-275-004

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - - -PCT OF <2MM- - - - - - - - - - >						
832277	1	1	44.4	96	3.3	1.2	1.1	2.6	
832278	2	TR	65.8	96	5.6	2.6	1.1	3.1	
832279	3	TR	68.9	98	4.6	2.2	0.3	2.7	
832280	4	TR	38.4	94	3.6	2.7	1.8	1.4	
832281	5	3	27.0	50	0.3	0.3	0.7	0.2	
832282	6	4	7.5	10	0.1	0.1	0.2	0.1	
832283	7	4		32	0.1	0.2	0.4	0.2	
832284	8	3		32	0.3	0.2	0.8	0.2	
832285	9	1		38	0.2	0.1	0.2	0.2	
832286	10	1		53	0.3	0.2	0.4	0.3	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

		MINERALOGY																			
		OPTICAL											X-RAY					DTA		TOT ANAL	
		SAND/SILT											CLAY								
SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
			PCT										RELATIVE AMOUNTS					PCT			
83P2277	1												NX 6							0.0	3.6
83P2278	2	VFS		OT89	GS 6	GA 5	GC<1						NX 6							0.0	3.8
83P2279	3																				
83P2280	4												NX 6							0.0	5.1
83P2281	5												KH 2	FD 1	NX 6			KH29		0.1	5.8
83P2282	6																				
83P2283	7												KH 3	NX 6				KH16		0.3	4.4
83P2284	8												KH 3	NX 6				KH20		0.1	5.5
83P2285	9	VFS		OT69	GS25	GA 6	GC 1						KH 3	NX 6				KH26		0.0	4.5
83P2286	10												KH 3	NX 6				KH37		0.1	4.8

ANALYSES: S=ALL ON SIEVED < 2mm .ASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: NX = NON-CRYSTALLINE GA = GLASS AGGREGATES GS = GLASS OT = OTHER GC = GLASS COATED GRAIN

FD = FELDSPAR KH = HALLOYSITE

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-005
Taxonomy: Ashy, frigid Typic Udorthent
Latitude: S40°46' Longitude: W 72°12'
Location: Antillanca
Geomorphic Position: Hillslope
Slope and Aspect: 10% east Elevation: 1050 m M.S.L
Air Temp. 11 C Summer: 16C Winter: 7C
Precipitation: 275 cm
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid or rapid
Stoniness: non stony
Land Use: forest
Erosion or Deposition: none
Parent Material: recent volcanic ash and cinders
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 9, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-217 cm wet; vegetation-forest of stunted lenga trees (Nothofagus pumilio) and understory of Fuchsia sp., huckleberry, ferns and mosses.

O 2 - 0 cm Mat of roots and moss etc.

A1 0 - 6 cm Black (10YR 2/1) gravelly sandy loam; structureless; very friable, non-sticky and non-plastic; weakly smeary, very moist or wet; common very fine and medium roots; many very fine to medium interstitial pores; pH= 5.3, strongly acid; abrupt smooth boundary.

A2 6 - 20 cm Very dark grayish brown (10YR 3/2) and very dark brown (10YR 2/2) very gravelly coarse sand extremely gravelly coarse sand, and coarse sand strata; structureless; loose and very friable, non-sticky and non-plastic; common very fine, fine, and medium roots; many very fine, fine and medium interstitial pores; pH= 5.3, strongly acid; abrupt smooth boundary.

C1 20 - 78 cm Very dark gray (10YR 3/1) and black (10YR 2/1) very gravelly coarse sand also extremelly gravelly coarse sand, and coarse sand strata; structureless; loose and very friable, non-sticky and non-plastic; few very fine roots; many very fine, fine, and medium interstitial pores; pH= 5.5, strongly acid; abrupt wavy boundary.

C2 78 - 147 cm Black (N 2/0) and black (10YR 2/1) and very dark gray (10YR 3/1) extremely gravelly coarse sand and gravely very coarse sand; structureless; loose and very friable, non-sticky and non-plastic; few very fine roots; many very fine, fine, and medium interstitial pores; pH= 5.5, strongly acid; abrupt wavy boundary.

C3 147 - 217 cm Black (N 2/0) and black (10YR 2/1) and very dark gray (10YR 3/1) very gravelly coarse sand; structureless; loose and very friable, non-sticky and non-plastic; many very fine,fine and medium interstitial pores; pH= 5.5, strongly acid.

Notes: 1. 6-217 cm -- Each horizon consists of many strata ranging from 2-100 mm in thickness. Textures vary with each strata and are repeated throughout each horizon. Pore size and distribution varies with each strata.

2. 78-217 cm -- at the lower part of the extremely gravelly strata, thin dark brown (7.5YR 4/4) cutans or gels coat fragments and pulg voids.

3. Rock fragments vary in size from 2-20 mm and in amounts from 0 to 95 percent depending on the strata. The weighted average of the 25-100 cm control section is estimated to be > 35 percent.

ANTILLANCA

LAB CLASSIF: ASHY, FRIGID TYPIC UDORTHENT

S 83FN-275 -005

DATE 09/25/84

SAMPLE NO. 83P2303-2311
PEDON NO. 83P 489
PROJECT NO. 83P 84

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	TOTAL CLAY LT .002	TOTAL SILT .002 -.05	TOTAL SAND .05 -2	CLAY FINE LT .0002	CLAY CO3 LT .002	SILT FINE .002 -.02	SILT COARSE .02 -.05	SAND VF .05 -.10	SAND F .10 -.25	SAND M .25 -.50	SAND C .5 -1	SAND VC 1 -2	COARSE FRACTIONS(MM) WEIGHT 2 -5	5 -20	20 -75	.1- 75	>2MM WT PCT OF WHOLE SOIL
				-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				<- PCT OF <2MM (3A1)											->	<- PCT OF <75MM(3B1)			->	
832303	1S	0- 6	A1	1.0	18.7	80.3			6.3	12.4	14.5	12.7	12.3	16.7	24.1	23	17	--	79	40
832304	2S	6- 20	A2	0.6	6.1	93.3			2.4	3.7	3.6	7.3	15.4	27.9	39.1	39	18	--	96	57
832305	3S	20- 78	C1	--	1.8	98.2			0.5	1.3	2.2	8.5	21.6	34.3	31.6	15	3	--	97	18
832306	4S	78-147	C2	--	4.0	96.0			1.7	2.3	4.9	12.4	25.7	30.4	22.6	26	14	TR	95	40
832307	5S	147-217	C3	--	4.6	95.4			1.6	3.0	5.7	10.2	16.4	26.2	36.9	31	23	--	95	54
832308	6S	78-147	SUB1													--	--	--		--
832309	7S	78-147	SUB2													--	--	--		--
832310	8S	78-147	SUB3													--	--	--		--
832311	9S	78-147	SUB4													--	--	--		--

Column numbers printed across the top: -1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	RATIO/CLAY CEC 8D1	15 BAR 8D1	ATTERBERG LIMITS LL 4F1	PI 4F	BULK DENSITY FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- PCT OF <2MM						->			PCT <0.4MM		<- G/CC		->	CM/CM	<- PCT OF <2MM			->	CM/CM
832303	1	9.39	0.265			0.8	0.7		19.00	22.80											
832304	2	1.60	0.052			0.4	0.3		6.33	10.83										22.8	
832305	3	0.14				0.3	0.1													6.5	
832306	4	0.09				0.3	0.1							1.27	1.29	0.005			21.1	3.0	0.21
832307	5	0.08				0.3	0.1							1.01	1.09	0.020			39.5	2.0	0.30
832308	6																			2.4	
832309	7																				
832310	8																			5.3	
832311	9																			3.4	
																				3.6	

ANTILLANCA S 83FN-275 -005 DATE 09/25/84 PEDON NO. 83P 489 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- CEC SUM CATS 5A3A	-9-- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SAT SUM 5C3	-13- BASE SAT NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
		<- - - -	- - - -	- - - -	- - - -	-MEQ /	100 G - -	- - - -	- - - -	- - - -	- - ->	<- - - -	- -PCT -	- - - ->							
832303	1	1.0	0.5	--	0.2	1.7	20.3	1.6	22.0	19.0	3.3	48	8	9					10.6	4.6	5.6
832304	2	TR	0.1	--	--	0.1	9.0	0.1	9.1	3.8	0.2	50	1	3					10.5	5.2	5.9
832305	3	--	0.1	--	--	0.1	1.2	TR	1.3	0.7			8	14					8.6	6.2	6.5
832306	4	--	0.1	--	--	0.1	0.4	TR	0.5	0.6			20	17					9.2	6.2	6.6
832307	5	0.3	0.1	--	--	0.4	1.3	TR	1.7	0.6			24	67					8.7	6.2	6.7
832308	6																				
832309	7																				
832310	8																				
832311	9																				

SAMPLE NO.	HZN NO.	SPODIC HORIZON CRITERIA: NA PYROPHOSPHATE EXTRACTABLE C 6A4A	FE 6C8A	AL 6G10	FE+AL (DIVIDED BY) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	MINERALOGY: CLAY X-RAY <2U 7A21	7A21	7A21	7A21	DTA 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT	OF <2MM->						<- RELATIVE	AMOUNTS ->			<- - - -	-PCT -	- - ->	
832303	1		0.5	0.7	0.8	1.2		129								
832304	2		0.1	0.2	0.4	0.5		123	NX 6							
832305	3		0.1	0.1	0.5											
832306	4		--	0.1	0.3				NX 6							
832307	5		0.1	0.1	0.5											
832308	6															
832309	7															
832310	8															
832311	9															

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 0 PCT .1-75MM 96. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

ANTILLANCA   S83FN-275-005

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
		PPM	<- - - - - - - - - - -PCT OF <2MM- - - - - - - - - - - >						
832303	1	2		79	0.9	0.3	0.8	0.9	
832304	2	2		65	0.5	0.3	0.5	0.6	
832305	3	3		32	0.3	0.3	0.4	0.3	
832306	4	4		41	0.3	0.3	0.4	0.3	
832307	5	6		44	0.3	0.3	0.4	0.3	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	MINERALOGY: OPTICAL SAND/SILT FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	X-RAY CLAY 7A2I	7A2I	7A2I	7A2I	7A2I	DTA CLAY 7A3	7A3	(TOT ANAL) K2O 6Q3A	FE 6C7A
			<-- PCT									-->	<-- RELATIVE AMOUNTS				-->	<-- PCT			-->
83P2303	1																				
83P2304	2	VFS		GA78	OT10	GS 7	GC 5						NX 6							0.1	1.1
83P2305	3																				
83P2306	4												NX 6							0.1	0.4
83P2307	5																				
83P2308	6																				
83P2309	7																				
83P2310	8																				
83P2311	9																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS OT = OTHER NX = NON-CRYSTALLINE GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-006
Taxonomy: Ashy over cindery, mesic Typic Haplorthod
Latitude: S40°46' Longitude: W 72°75'
Location: Antillanca
Geomorphic Position: Hillside
Slope and Aspect: 5% SW planar Elevation: 800 m M.S.L
Microrelief: complex hummucky
Air Temp. 11 C Summer: 16C Winter: 7C
Precipitation: 250 cm
Water Table: > 10 m
Drainage: Moderately well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: forest
Erosion or Deposition: none
Parent Material: volcanic ash over cinders, depth to basalt and scoria 60-100 cm
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 9, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-22 cm moist, 22-74 cm wet; vegetation-Lenga and coique forest--Nothofagus pumilio, Nothofagus dombeyi, Fuchsia sp., huckleberry, ferns and mosses.

O 2 - 0 cm Dense carpet of moss and roots with no soil material

A1 0 - 22 cm sandy loam; Dark reddish brown (5YR 3/2, rubbed); strong very fine to fine granular structure; very friable, non-sticky and non-plastic; weakly smeary, very moist or wet; many very fine, fine, medium, and coarse roots; many very fine and fine interstitial pores; 2% fine (2-10 mm) cinders; pH= 5.3, strongly acid; clear wavy boundary.

A2 22 - 46 cm Dark brown (7.5YR 3/2) and very dark brown (10YR 2/2) sandy loam; structureless; friable, non-sticky and slightly plastic; moderatly smeary, very moist or wet; common very fine to fine roots; common very fine tubular, and common very fine interstitial pores; 2% fine (2-10 mm) cinders; pH= 5.2, strongly acid; abrupt smooth boundary. Jelly like material surrounding roots and in pores.

2C1 46 - 58 cm Brown to dark brown (10YR 4/3) dark yellowish brown (10YR 4/6) and very dark grayish brown (10YR 3/2) coarse sand; structureless; very friable, non-sticky and non-plastic; few very fine and fine roots; many very fine and fine interstitial pores; 2% fine (2-10) cinders; pH= 5.5, strongly acid; abrupt wavy boundary. Jelly like material surrounding roots and in proes.

3Bw 58 - 74 cm Very dark grayish brown (10YR 3/2) and dark brown (10YR 3/3) sandy loam; common fine distinct and prominent yellowish brown (10YR 5/6) dark yellowish brown (10YR 4/4) yellowish red (5YR 4/6),and red (2.5YR 4/6) mottles; structureless; friable, non-sticky and slightly plastic; weakly smeary, very moist or wet; few very fine and fine roots; common very fine and fine tubular, and many very fine interstitial pores; pH= 5.5, strongly acid; abrupt wavy boundary. Jelly like material surrounding roots and in pores. Material is mostly concentrated at 64-74 cm.

4C2 74 - 82 cm Vesicular cinders 5-30 cm in size; pH= 5.5, strongly acid. This horizon varies in thickness from 0 to 15 cm and is interrupted by bedrock at intervals of 0.5 to 2.5 meters.

5R 82 - cm Vesciular basalt and scoriaceous rock.

CHANLEUFU

LAB CLASSIF: ASHY OVER CINDEREY, MESIC TYPIC HAPLORTHODS

S 83FN-275 -006 DATE 09/25/84 SAMPLE NO. 83P2317-2322
PEDON NO. 83P 491
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL S^	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS (MM) WEIGHT 2 -5	-14- WEIGHT 5 -20	-15- WEIGHT 20 -75	-16- WEIGHT .1- 75	-17- (>2MM WT PCT O WHOLE SOIL
				<- PCT OF <2MM (3A1)											->	<- PCT OF <75MM(3B1)			->	
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832317	1S	0- 22	A1	1.2	23.5	75.3			12.2	11.3	9.5	12.4	24.3	22.7	6.4	2	3	--	68	5
832318	2S	22- 46	A2	0.6	19.1	80.3			8.2	10.9	9.9	10.6	20.7	31.5	7.6	1	--	--	71	1
832319	3S	46- 58	2C1	0.3	8.2	91.5			6.3	1.9	2.0	5.8	35.5	35.0	13.2	6	--	--	90	6
832320	4S	58- 74	3BW	0.7	14.0	85.3			7.8	6.2	12.0	19.6	33.1	16.9	3.7	1	TR	--	74	[illegible]
832321	5S	74- 82	4C2													--	--	--		--
832322	6S	82- 82	5R													--	--	--		--

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - - - -PCT OF <2MM - - - - - - - ->									PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
832317	1	9.29	0.259			1.2	0.7		14.58	17.08				0.37	0.53	0.126			134.3	20.5	0.42
832318	2	4.49	0.163			0.9	1.0		17.83	22.50				0.62	0.74	0.061			94.5	13.5	0.50
832319	3	2.26	0.104			0.5	0.8		20.00	62.33				0.54	0.59	0.030			77.2	18.7	0.31
832320	4	3.17				1.1	0.8		9.43	19.43				0.76	0.88	0.050			71.7	13.6	0.44
832321	5																				
832322	6																				

* PSDA SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERIATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO DESCRIPTION FOR FIELD TEXTURE.

CHANLEUFU   S 83FN-275 -006   DATE 09/25/84   PEDON NO. 83P 491   NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL - - -) 5A3B	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O - - -) 8C1F 1:1
		<- - - - - - -	- - - - - -	- - -	- - -	-MEQ /	100 G - - -	- - -	- - -	- - -	- - ->	<- - - -	- -PCT	- - - - ->							
832317	1	0.7	0.4	--	0.1	1.2	29.5	2.2	30.7	17.5	3.4	65	4	7					10.3	4.5	5.3
832318	2	--	0.2	--	TR	0.2	25.2	0.8	25.4	10.7	1.0	80	1	2					11.4	4.8	5.3
832319	3	--	TR	--	--	TR	16.1	0.2	16.1	6.0	0.2	100		TR					11.3	5.1	5.6
832320	4	0.2	0.1	--	--	0.3	19.3	0.1	19.6	6.6	0.4	25	2	5					11.0	5.9	6.1
832321	5																				
832322	6																				

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA (- -NA PYROPHOSPHATE EXTRACTABLE C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY DI-CI FE+AL	FE+AL PCT CLAY	AL+C - -) PCT CLAY	- - - - - -) INDEX OF ACCUM	(- - - MINERALOGY (- - CLAY (- - X-RAY (- - <2U 7A21	7A21	7A21	7A21 - -) - - - -)	(- -DTA 7A3	- -) 7A3	TOTAL RES 7B1A	DOM WEATH - - -) 7B1A
		<- PCT	OF	<2MM->					<- RELATIVE	AMOUNTS		->	<- - -	- -	-PCT - -	- ->
832317	1		0.9	0.7	0.8	1.3		662								
832318	2		0.6	1.0	0.8	2.7		602	NX 6							
832319	3		0.3	0.6	0.7	3.0		191								
832320	4		0.2	0.6	0.4	1.1		308	NX 6							
832321	5															
832322	6															

FAMILY CONTROL SECTION: DEPTH 25- 82 PCT CLAY 0 PCT .1-75MM 66. SPODIC HORIZON: INDEX OF ACCUMUL 1079
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L D A T A S H E E T

CHANLEUFU S83FN-275-006

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
		PPM	<- - - - - - - - - -PCT OF <2MM- - - - - - - - - - ->						
832317	1	1	36.5	81	0.8	0.2	1.2	0.8	
832318	2	1	30.9	90	1.2	0.3	1.1	1.2	
832319	3	1	24.3	78	0.9	0.4	0.5		
832320	4	TR	29.1	96	1.7	0.9	0.9		

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
		MINERALOGY: OPTICAL, SAND/SILT											MINERALOGY: X-RAY, CLAY					DTA, CLAY		TOT ANAL, CLAY	
			PCT										RELATIVE AMOUNTS					PCT			
83P2317	1																				
83P2318	2	VFS		GA67	OT14	GS13	GC 6						NX 6							0.1	2.2
83P2319	3																				
83P2320	4												NX 6							0.0	2.3
83P2321	5																				
83P2322	6																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS OT = OTHER NX = NON-CRYSTALLINE GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-007
Taxonomy: Medial, mesic Typic Dystrandept
Latitude: S 40°44'30' Longitude: W 72°79'
Location: Termas de Puyehue
Geomorphic Position: Hillside
Slope and Aspect: 30% NE Elevation: 550 m M.S.L
Air Temp. 12.5 C Summer: 16.5C Winter: 7.5C
Precipitation: 260 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: Forest
Erosion or Deposition: none
Parent Material: volcanic ash
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 8, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-112 cm moist, 112-200 cm wet; vegetation-Nothofagus forest species understory of shrubs, ferns and mosses.

O 5 - 0 cm Mat of fibrous roots, decomposed roots and some soil material; clear wavy boundary withmineral soil.

A 0 - 32 cm Black (5YR 2/1) loam; strong medium and coarse subangular blocky structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine and many medium and coarse roots; many very fine fine interstitial and tubular pores; pH= 5.3, strongly acid; clear wavy boundary.

Bw1 32 - 63 cm Dark reddish brown (5YR 3/3) silt loam; moderate medium and coarse subangular blocky structure; friable, sticky and plastic; weakly smeary, very moist or wet; common very fine, fine, medium, and coarse roots; common very fine and fine interstitial and tubular pores; pH= 5.3, strongly acid; clear wavy boundary.

2Bw2 63 - 112 cm Dark reddish brown (5YR 3/2) silt loam; strong brown and dark brown (7.5YR 4/6, 4/4, rubbed); strong medium to coarse prismatic structure parting to moderate medium to coarse subangular blocky; firm, slightly sticky and slightly plastic; moderately smeary, very moist or wet; few very fine and common fine to and medium roots; many very fine interstitial and common very fine and fine tubular pores; few moderatley thick, many thin yellowish red (5YR 5/8) cutans coating aggregates,in pores, and as bridges between aggregates; pH= 5.5, strongly acid; diffuse wavy boundary. Cutans of strongly smeary jelly-like material.

2Bw3 112 - 162 cm Dark reddish brown (5YR 3/3) silt loam; strong brown and dark brown (7.5YR 4/6, 4/4, rubbed); moderate medium and coarse prismatic structure parting to moderate medium and coarse subangular blocky; firm, slightly sticky and slightly plastic; strongly smeary, very moist or wet; few very fine and common fine and medium roots; few fine and medium tubular pores; common very fine tubular and interrsital pores; few moderatley thick, many thin yellowish red (5YR 5/8) cutans coating aggregates,in pores, and as bridges between aggregates; pH= 5.4, strongly acid; gradual wavy boundary. Cutans of strongly smeary jelly-like material.

3Bw4 162 - 200 cm Dark reddish brown (5YR 3/3) silt loam with common fine distinct and prominent dark reddish brown (2.5YR 2/4), dark gray (5YR 4/1), black (5YR 2/1), very dark gray (5YR 3/1) and yellowish red (5YR 4/6) mottles; structureless; firm, slightly sticky and slightly plastic; strongly smeary, very moist or wet: few very fine, fine, and medium roots; common very fine interstitial and tubular, and few fine and medium fine tubular pores; pH= 5.5, strongly acid. Cutans of strongly smeary jelly-like material.

PUYEHUE

LAB CLASSIF: MEDIAL, MESIC TYPIC DYSTRANDEPT

S 83FN-275 -007 DATE 09/25/84

SAMPLE NO. 83P2293-2297
PEDON NO. 83P 487
PROJECT NO. 83P 84

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-4-- (- - -TOTAL: CLAY LT .002	-5-- SILT .002 -.05	-6-- SAND .05 -2 - - -)	-7-- (- -CLAY- -) FINE LT .0002	-8-- CO3 LT .002	-9-- (- -SILT- -) FINE .002 -.02	-10- COARSE .02 -.05	-11- (- - - - -SAND- VF .05 -.10	-12- F .10 -.25	-13- M .25 -.50	-14- C .5 -1	-15- VC 1 -2 - - - -)	-16- (-COARSE FRACTIONS(MM)-) - - - - WEIGHT: 2 -5	-17- 5 -20	-18- 20 -75	-19- .1- 75	-20- (>2MM WT PCT O WHOLE SOIL
				<- - - - - - - - - - - - -	PCT OF <2MM (3A1)	- - - - - - - - - - - -										<- PCT OF <75MM(3B1)->			SOIL
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																			
832293	1S	0- 32	A	2.3	20.7	77.0			10.4	10.3	13.2	16.5	23.9	19.2	4.2	1	TR	--	64	1
832294	2S	32- 63	BW1	--	18.4	81.6			6.8	11.6	18.6	26.2	20.3	13.0	3.5	TR	--	--	63	TR
832295	3S	63-112	2BW2	0.8	23.6	75.6			9.4	14.2	32.3	34.6	6.6	1.9	0.2	TR	--	--	43	TR
832296	4S	112-162	2BW3	0.8	17.9	81.3			10.0	7.9	19.4	34.8	20.4	5.7	1.0	2	1	--	63	3
832297	5S	162-200	3BW4	0.9	14.8	84.3			9.1	5.7	12.1	23.3	24.4	20.7	3.8	TR	TR	--	72	TR

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS - LL 4F1	PI 4F)	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - -	- -PCT OF <2MM	- - - -	- - -	->					PCT <0.4MM		<- - G/CC	- - ->		CM/CM	<- - -PCT OF <2MM		- ->		CM/CM
832293	1	10.1	0.700			1.5	1.6		12.91	11.96				0.58	0.64	0.033			75.6	27.5	0.28
832294	2	6.26	0.297			2.5	1.8							0.39	0.55	0.121			133.2	21.8	0.43
832295	3	5.40				3.1	1.8		25.75	24.25				0.44	0.75	0.194			142.6	19.4	0.54
832296	4	5.27				3.9	1.8		34.00	30.88				0.36	0.85	0.329			182.4	24.7	0.57
832297	5	3.68				3.6	1.3		24.56	23.56				0.37	0.88	0.334			193.9	21.2	0.64

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

PUYEHUE S 83FN-275 -007 DATE 09/25/84 PEDON NO. 83P 487 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
		(- NH4OAC EXTRACTABLE BASES -)					ACID-	EXTR	(- - - -CEC - - -)			AL	-BASE SAT-		CO3 AS	RES.		COND.	(- - - -PH - - -)		
		CA	MG	NA	K	SUM	ITY	AL	SUM	NH4-	BASES	SAT	SUM	NH4	CACO3	OHMS		MMHOS	NAF	CACL2	H2O
		5B5A	5B5A	5B5A	5B5A	BASES			CATS	OAC	+ AL			OAC	<2MM	/CM		/CM		.01M	
		6N2E	6O2D	6P2B	6Q2B		6H5A	6G9A	5A3A	5A8B	5A3B	5G1	5C3	5C1	6E1G	8E1		8I	8C1D	8C1F	8C1F
		<- - - - - - - - - - - -				-MEQ / 100 G	- - - - - - - - - -				->	<- - - - - -PCT - - - - ->								1:2	1:1
832293	1	2.2	0.3	--	0.1	2.6	47.3	1.2	49.9	29.7	3.8	32	5	9					11.0	4.7	5.4
832294	2	0.9	0.1	--	--	1.0	43.2	0.1	44.2	24.9	1.1	9	2	4					11.1	5.2	5.9
832295	3	0.8	0.1	--	--	0.9	40.7	0.1	41.6	20.6	1.0	10	2	4					11.0	5.3	6.0
832296	4	1.0	0.2	--	--	1.2	43.0	0.1	44.2	27.2	1.3	8	3	4					10.4	5.6	6.2
832297	5	1.0	0.1	--	--	1.1	36.2	0.1	37.3	22.1	1.2	8	3	5					10.0	5.8	6.2

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -)							(- - - - - - - - - -MINERALOGY - - - - - - - - - -)							
		(- -NA PYROPHOSPHATE EXTRACTABLE- -)						INDEX	(- - - - - - - - CLAY - - - - - - - -)							
		C	FE	AL	FE+AL	FE+AL	AL+C	OF	(- - - - X-RAY - - - -)				(- -DTA - -)		TOTAL	DOM
					(- -DIVIDED BY- -)			ACCUM	(- - - - - <2U - - - -)						RES	WEATH
		6A4A	6C8A	6G10	DI-CI	PCT	PCT		7A21	7A21	7A21	7A21	7A3	7A3	7B1A	7B1A
		<- PCT OF <2MM->			FE+AL	CLAY	CLAY		<- RELATIVE AMOUNTS ->				<- - - - - -PCT - - - - ->			
832293	1		1.1	1.4	0.8	1.1		1560	NX 6							
832294	2		0.9	1.1	0.5											
832295	3		0.5	0.8	0.3	1.6		2019	NX 6							
832296	4		0.2	0.8	0.2	1.3		2190								
832297	5		0.2	0.7	0.2	1.0		1400	NX 6							

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 1 PCT .1-75MM 53. SPODIC HORIZON: INDEX OF ACCUMUL 951

ANALYSES: S= ALL ON SIEVED <2MM BASIS

MINERALOGY: KIND OF MINERAL NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

PUYEHUE S83FN-275-007

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
		PPM	<- - - - - - - - -	-PCT OF	<2MM- - - -	- - - -	- - - -	- - - >	
832293	1	1	54.8	95	1.9	0.4	1.4	1.7	
832294	2	1	65.1	98	4.0	1.6	2.5	2.9	
832295	3	TR	105.2	98	4.1	1.8	2.5	3.2	
832296	4	TR	134.2	98	6.1	2.9	3.1	4.2	
832297	5	1	135.0	99	5.8	3.0	3.0	3.4	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
		MINERALOGY																			
		OPTICAL											X-RAY					DTA		(TOT ANAL)	
		SAND/SILT											CLAY								
			<----PCT---->										<----RELATIVE AMOUNTS---->					<----PCT---->			
83P2293	1												NX 6							0.0	2.4
83P2294	2																				
83P2295	3	VFS		GA63	GS21	OT15	GC 1						NX 6							0.1	2.1
83P2296	4																				
83P2297	5												NX 6							0.1	2.7

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: NX = NON-CRYSTALLINE GA = GLASS AGGREGATES GS = GLASS OT = OTHER GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Series: Puerto Fonck 6/83
Pedon No: S83FN-275-008
Taxonomy: Medial, mesic Typic Dystrandept
Latitude: S40°42'30" Longitude: W 73°24'
Location: Nilque
Geomorphic Position: Terrace
Slope and Aspect: 5% NW Elevation: 200 m M.S.L
Microrelief: simple smooth slope
Air Temp. 12.5 C Summer: 16.5C Winter: 7.5C
Precipitation: 200 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: pasture and golf course
Erosion or Deposition: none
Parent Material: volcanic ash
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 9, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-48 cm slightly moist, 48-210 cm moist; vegetation-native pasture grass, before clearing a roble forest. Top 0-2 cm compacted by livestock; platy appearance. Golf course used for sheep pasture.

A1 0 - 17 cm Black (10YR 2/1, broken and rubbed) loam; strong medium and coarse granular structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine and few fine roots; common very fine interstitial and tubular pores; pH= 5.3, strongly acid; clear wavy boundary.

A2 17 - 48 cm Black (10YR 2/1) and very dark grayish brown (10YR 3/2) silt loam; weak coarse and very coarse subangular blocky structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; few very fine roots; common very fine tubular and many very fine interstitial pores; very dark grayish brown (10YR 3/2) root channels; pH= 5.3, strongly acid; gradual wavy boundary. 10% 4-6 cm insect nests.

AB 48 - 97 cm Black (10YR 2/1) silt loam; tructureless; friable, slightly sticky and slightly plastic; smeary, very moist or wet; few very fine roots; common very fine interstitial and tubular and few fine and coarse tubular pores; 5% (4- 6 cm) cylindrical insect nests; very dark grayish brown (10YR 3/2) root channels; pH= 5.4, strongly acid; diffuse wavy boundary.

Bw 97 - 130 cm Very dark grayish brown (10YR 3/2) and black (10YR 2/1) silt loam; structureless; friable, slightly sticky and slightly plastic; moderatly smeary, very moist or wet; few very fine roots; common very fine, fine and medium tubular, pores; 5% (4-6 cm) cylindrical insect nests; pH= 5.5, strongly acid; gradual wavy boundary.

C1 130 - 157 cm Very dark grayish brown (10YR 3/2) and black (10YR 2/1) silt loam; structureless; firm, sticky and slightly plastic; moderatly smeary, very moist or wet; few very fine roots; common very fine, fine and medium tubular, pores; pH= 5.5, strongly acid; gradual wavy boundary.

C2 157 - 210 cm Very dark grayish brown (10YR 3/2) and black (10YR 2/1) silt loam; structureless; firm, sticky and slightly plastic; moderatly smeary, very moist or wet; few very fine roots; common very fine, fine and medium tubular, pores; pH= 5.5, strongly acid.

PUERTO FONCK

LAB CLASSIF: MEDIAL, MESIC TYPIC DYSTRANDEPT

S 83FN-275 -008 DATE 09/25/84

SAMPLE NO. 83P2327-2332
PEDON NO. 83P 493
PROJECT NO. 83P 84

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	(- - -TOTAL - - -) CLAY LT .002	SILT .002 -.05	SAND .05 -2	(- -CLAY- -) FINE LT .0002	CO3 LT .002	(- -SILT- -) FINE .002 -.02	COARSE .02 -.05	(- - - - -SAND- - - - - -) VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	(-COARSE FRACTIONS(MM)-) - - - - WEIGHT - - - - 2 -5	5 -20	20 -75	.1- 75	(>2MM WT PCT O WHOLE SOIL
				<- - - - - -	- - - - -	- - - - -	- - - - -	- - PCT OF	<2MM	(3A1) - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - ->	<- PCT OF	<75MM	(3B1)->		SOIL
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832327	1S	0- 17	A1	3.6	49.0	47.4			29.4	19.6	12.4	12.8	15.3	6.1	0.8	TR	TR	--	35	TR
832328	2S	17- 48	A2	4.6	48.1	47.3			29.9	18.2	10.6	9.5	19.9	6.6	0.7	TR	TR	--	37	TR
832329	3S	48- 97	AB	1.1	45.2	53.7			21.7	23.5	29.5	18.7	4.0	1.1	0.4	--	--	--	24	--
832330	4S	97-130	BW	0.4	38.2	61.4			19.5	18.7	26.5	23.1	8.7	2.6	0.5	TR	--	--	35	--
832331	5S	130-157	C1	0.1	30.3	69.6			16.5	13.8	17.0	22.3	19.6	9.4	1.3	TR	--	--	53	--
832332	6S	157-210	C2	0.4	27.6	72.0			14.9	12.7	18.1	27.2	18.9	6.8	1.0	TR	--	--	54	TR

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG) - LIMITS - LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - -	- - -	-PCT OF	<2MM - -	- - - -	- - -	->			PCT	<0.4MM	<- -	G/CC -	- - ->	CM/CM	<- -	-PCT OF	<2MM	- ->	CM/CM
832327	1	9.18	0.705			1.9	1.3		10.00	8.14				0.75	0.85	0.043			48.1	29.3	0.14
832328	2	5.42	0.312			2.4	1.1		5.43	4.50				0.71	0.77	0.027			60.2	20.7	0.28
832329	3	7.69	0.402			3.1	1.4		31.18	24.27				0.44	0.66	0.145			135.2	26.7	0.48
832330	4	7.08				3.9	1.7		84.75	84.00				0.38	0.67	0.208			163.0	33.6	0.49
832331	5	6.04				4.1	1.6		319.00	299.00				0.43	0.72	0.187			154.3	29.9	0.54
832332	6	6.26				4.9	2.0		109.50	79.75				0.40	0.91	0.315			174.1	31.9	0.57

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR TEXTURE.

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SAT- SUM 5C3	-13- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
		<- - - - - - - - - - - - - -MEQ / 100 G									- - ->	<- - - - -PCT	- - - ->							
832327	1	8.6	1.4	--	0.2	10.2	43.8	0.3	54.0	36.0	10.5	3	19	28					10.9	5.0	5.4
832328	2	6.9	0.5	--	0.1	7.5	34.2	0.1	41.7	25.0	7.6	1	18	30					10.9	5.5	6.2
832329	3	11.4	1.1	--	--	12.5	47.5	0.1	60.0	34.3	12.6	1	21	36					11.0	5.5	6.3
832330	4	7.6	1.2	--	0.2	9.0	49.6	0.1	58.6	33.9	9.1	1	15	27					10.9	5.5	6.2
832331	5	5.8	1.2	--	--	7.0	45.1	--	52.1	31.9			13	22					10.6	5.6	5.9
832332	6	4.7	2.6	--	TR	7.3	46.4	0.1	53.7	43.8	7.4	1	14	17					10.5	5.6	6.0

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	(- - -MINERALOGY - - -) (- - CLAY - -) (- - X-RAY - -) (- - <2U - -) 7A21	7A21	7A21	7A21	(- -DTA - -) 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM->							<- RELATIVE AMOUNTS ->				<- - - - -PCT - - - ->			
832327	1		0.6	1.1	0.5	0.5		887								
832328	2		0.3	0.7	0.3	0.2		1221	NX 6							
832329	3		0.4	0.8	0.3	1.1		2913								
832330	4		0.3	0.8	0.2	2.8		1927	NX 6							
832331	5		0.2	0.7	0.2	9.0		1405								
832332	6		0.2	0.8	0.1	2.5		2835	NX 6							

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 2 PCT .1-75MM 29. SPODIC HORIZON: INDEX OF ACCUMUL 235
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

PUERTO FONICK   S83FN-275-008

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - -	-PCT OF	<2MM- - - -	- - - - -	- - - - -	- - >	
832327	1	1	37.6	95	2.4	1.0	1.5	2.2	
832328	2	TR	34.3	96	2.9	1.6	2.1	2.5	
832329	3	1	70.6	97	3.6	2.0	2.3	3.0	
832330	4	TR	95.4	99	5.0	3.0	2.8	3.4	
832331	5	TR	97.5	97	5.5	3.5	2.9	3.1	
832332	6	TR	92.9	99	7.1	3.6	2.9	3.1	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

		MINERALOGY																			
		OPTICAL											X-RAY					DTA		TOT ANAL	
		SAND/SILT											CLAY								
SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
			PCT										RELATIVE AMOUNTS					PCT			
83P2327	1																				
83P2328	2	VFS		GA69	GS17	OT12	GC 2						NX 6							0.0	4.0
83P2329	3																				
83P2330	4												NX 6							0.0	2.4
83P2331	5																				
83P2332	6												NX 6							0.0	3.3

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS OT = OTHER NX = NON-CRYSTALLINE GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Series: Frutillar 6/83
Pedon No: S83FN-275-009
Taxonomy: Medial, isomesic Histic Placaquept
Latitude: S41°08' Longitude: W 73°04'
Location: Frutillar
Geomorphic Position: Terrace
Slope and Aspect: 0% convex Elevation: 140 m M.S.L
Microrelief: slightly hummucky
Air Temp. 12 C Summer: 13.9C Winter: 6.7C
Precipitation: 170 cm Aquic moisture regime.
Water Table: > 10 m, perched on top of pan during the wet season for 5 to 6 months
Drainage: Somewhat poorly drained Permeability: moderate
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash over unrelated cemented gravelly glacial outwash at 64 cm
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 10, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-17 cm dry, 17-97 cm slightly moist; vegetation-native vegetation before clearing was a nadi forest. Present vegetation is pasture grasses and forbes of: grasses-Poa, <u>Dactylis glomerata</u>, <u>Holcus lanatus</u>, <u>Anthoxanthum sp.</u>, <u>Plantago lanceolate</u>, <u>Lolium sp.</u>, <u>Trifolium repens</u>, and scattered roble (<u>Nothofaus procera</u>). Pan at 64 cm impeds drainage.

A 0 - 17 cm Black (10YR 2/1) loam; strong medium and coarse granular structure; friable, nonsticky and slightly plastic; many very fine roots; many very fine and fine interstitial and few coarse tubular pores; 1% gravel; pH= 5.3, strongly acid; abrupt smooth boundary.

E 17 - 24 cm Dark reddish brown (5YR 2/2) loam; weak very fine and fine subangular blocky structure; very friable, nonsticky and slightly plastic; common very fine roots; common very fine tubular pores; 1% gravel; pH= 5.4, strongly acid; abrupt smooth boundary.

Bw1 24 - 38 cm Very dark brown (10YR 2/2) silt loam; many fine distinct and prominent yellowish red (5YR 4/6) mottles; moderate fine and to medium subangular blocky structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine roots; many very fine and a few tubular pores; 1% gravel; pH= 5.5, strongly acid; clear wavy boundary.

Bt1 38 - 57 cm Strong brown (7.5YR 4/6) silt loam; moderate medium prismatic structure parting to weak medium and coarse subangular blocky; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet;few very fine roots; common very fine and fine and few coarse tubular; many thin continuous clay skins in pores, few thick, and common moderatly thick dark red (2.5YR 3/6) clay skins in pores; 3% gravel; pH= 5.5, strongly acid; clear wavy boundary.

Bt2 57 - 64 cm Strong brown (7.5YR 5/6) silt loam; weak fine subangular blocky structure; friable (some parts firm), slightly sticky and slightly plastic; weakly smeary, very moist or wet; few very fine roots; few very fine tubular pores; few thin patchy clay skins in pores and few moderatly thick dark red (2.5YR 3/6) clay skins in pores; pH= 5.5, strongly acid; abrupt wavy boundary.

2Bsm 64 - 72 cm Black (N 2/0) and yellowish red (5YR 5/8) duripan; extremely firm, strongly cemented with iron; a thin mat of roots occurs on top of the pan; pH= 5.5, strongly acid; clear wavy boundary; thin black (N 2/0, 5YR 2/1) laminar cap 1-5 mm thick on top of this horizon.

2Bqm 72 - 90 cm Dark brown (10YR 3/3) dominate color of the sand grains extremely firm, strongly cemented with silica; pH= 5.5, strongly acid; gradual wavy boundary.

2C 90 - 97 cm Dark gray (10YR 4/1) and gray (10YR 5/1) gravely sand; structureless; very firm.

Note: 90 to 97 cm was sampled in a freshly dug pit; the underlying gravelly and cobbly substratum was described and sampled 8 m from the pit in a bank of a drainage ditch. The depth was measurd from the top of the pan that was assumed to be the same as the pit, i.e. 90 cm. The substratum to 255 cm is highly variable stratified with lenses and strata of sand, gravelly sand, cobbly sand and coarse sand. A composit sample to represent the substratum was taken at a depth of 115 to 155 cm. The color of the sand matrix is dark gray (10YR 4/1), gray (19YR 5/1), and light gray (10YR 6/1) colors are mostly sand grains.

FRUTILLAR

LAB CLASSIF: MEDIAL, ISOMESIC HISTIC PLACAQUEPT

S 83FN-275 -009 DATE 09/25/84

SAMPLE NO. 83P2351-2358
PEDON NO. 83P 497
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM WT PCT OF WHOLE SOIL
				<- - - - - - - - - - - - - - PCT OF <2MM (3A1)											- - - - - - - - - - - - - - ->	<- PCT OF <75MM(3B1)->				SOIL
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832351	1S	0- 17	A	4.0	44.3	51.7			26.9	17.4	10.9	10.2	10.7	13.6	6.3	1	TR	--	41	1
832352	2S	17- 24	E	1.4	39.7	58.9			26.1	13.6	18.1	21.6	12.7	4.6	1.9	1	TR	--	41	1
832353	3S	24- 38	BW1	1.0	20.8	78.2			12.8	8.0	13.9	22.0	22.6	15.0	4.7	4	TR	--	66	4
832354	4S	38- 57	BT1	1.6	17.1	81.3			11.5	5.6	9.8	18.9	22.6	19.5	10.5	2	7	4	75	13
832355	5S	57- 64	BT2	1.6	17.6	80.8			12.9	4.7	8.9	18.3	24.1	20.7	8.8	4	15	17	82	36
832356	6S	64- 72	2BSM	3.4	11.3	85.3			8.5	2.8	4.4	16.3	34.9	20.9	8.8	7	4	4	84	15
832357	7S	72- 90	2BQM	2.0	3.1	94.9			1.8	1.3	1.7	7.9	35.0	38.0	12.3	10	12	6	95	28
832358	8S	90-255	2C	0.5	1.4	98.1			0.8	0.6	1.1	8.1	25.0	38.4	25.5	7	11	41V	99	60

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - - - -PCT OF <2MM						- - - - - - - - ->			PCT <0.4MM		<- - G/CC		- - ->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
832351	1	17.5	1.168			0.7	1.1	--	15.50	12.20				0.53	0.67	0.081				48.8	
832352	2	8.77	0.476			1.7	1.2	--	29.43	25.43				0.54	0.68	0.080			92.1	35.6	0.30
832353	3	5.42	0.375			3.3	1.6	--	35.70	32.30				0.57	1.14	0.256			98.9	32.3	0.38
832354	4	3.46				2.5	1.1	--	17.94	21.69				0.59	0.98	0.176			101.9	34.7	0.38
832355	5	2.87				4.1	1.4	TR	12.69	20.19										32.3	
832356	6	0.60				1.3	0.5	0.1	2.79	4.91										16.7	
832357	7	0.15				0.3	0.1	--	3.50	4.75										9.5	
832358	8	TR				0.2	0.1	--	9.80	10.00										5.0	

* PSDA IN AQUEPTS WITH ANDIC PROPERTIES SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

FRUTILLAR S 83FN-275 -009 DATE 09/25/84 PEDON NO. 83P 497 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC - - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SAT- SUM 5C3	-13- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
		<- - - - - - - - - - - -				-MEQ /	100 G - - -				- - ->	<- - - - -	-PCT - - - - ->								
832351	1	8.3	2.6	TR	0.5	11.4	67.8	1.2	79.2	62.0	12.6	10	14	18					11.0	4.9	5.6
832352	2	1.2	0.3	--	0.1	1.6	62.1	0.3	63.7	41.2	1.9	16	3	4					11.3	5.2	5.7
832353	3	0.2	0.1	--	0.1	0.4	54.2	0.1	54.6	35.7	0.5	20	1	1					11.0	5.4	5.7
832354	4	0.4	0.2	--	0.1	0.7	37.9	0.1	38.6	28.7	0.8	12	2	2					10.6	5.7	5.8
832355	5	0.9	0.2	--	0.1	1.2	35.1	0.1	36.3	20.3	1.3	8	3	6					10.6	5.8	5.8
832356	6	--	0.1	--	TR	0.1	17.1	TR	17.2	9.5			1	1					10.5	5.9	5.9
832357	7	0.2	TR	0.1	0.2	0.5	8.2	0.1	8.7	7.0	0.6	17	6	7					9.8	5.9	6.0
832358	8	0.9	0.2	0.2	0.2	1.5	2.9	0.1	4.4	4.9	1.6	6	34	31					8.7	5.7	6.3

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	(- - - -MINERALOGY - - - -) (- - CLAY - -) (- - X-RAY - -) (- <2U -) 7A21	7A21	7A21	7A21	(- -DTA - -) 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT	OF <2MM->						<- RELATIVE	AMOUNTS ->			<- - - -	-PCT - - - ->		
832351	1		0.8	2.4	1.8	0.8		1312								
832352	2		0.4	1.4	0.6	1.3		441	NX 6							
832353	3		0.4	1.1	0.3	1.5		757								
832354	4		0.1	0.7	0.2	0.5		718	GE 1	NX 6						
832355	5		0.1	0.6	0.1	0.4		248								
832356	6		0.1	0.3	0.2	0.1		124	NX 6							
832357	7		0.1	0.2	0.8	0.2		139								
832358	8		0.1	0.1	0.7	0.4		685	NX 6							

SPODIC HORIZON: INDEX OF ACCUMULATION 1473
ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES
MINERALOGY: KIND OF MINERAL NX AMORPHOUS GE GOETHITE

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L D A T A S H E E T

FRUTILLAR S83FN-275-009

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - -	-PCT OF <2MM-	- - - - - - - - - -			>	
832351	1	3	67.5	97	3.1	0.7	0.8	2.3	4.5
832352	2	1	67.3	99	6.7	2.6	1.2	4.5	5.0
832353	3	1	73.7	99	6.8	2.8	1.4	4.1	5.2
832354	4	TR	68.1	97	6.8	3.2	1.1	2.9	5.5
832355	5	TR	55.2	99	6.2	2.9	1.4	2.9	5.6
832356	6	TR	24.7	99	3.6	2.0	1.0	2.0	5.7
832357	7	1	10.7	86	2.7	1.8	1.2	1.3	5.5
832358	8	20	6.0	47	1.0	0.8	0.8	0.3	5.0

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	PA	RE																	K2O	FE
		MINERALOGY																			
		OPTICAL											X-RAY					DTA		TOT ANAL	
		SAND/SILT											CLAY								
		7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	6Q3A	6C7A
			PCT										RELATIVE AMOUNTS					PCT			
83P2351	1																				
83P2352	2	VPS		GA86	OT12	GS 2	GC<1						NX 6							0.0	1.8
83P2353	3																				
83P2354	4												GE 1	NX 6						0.0	6.4
83P2355	5																				
83P2356	6												NX 6							0.0	4.3
83P2357	7																				
83P2358	8												NX 6							0.1	1.5

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS OT = OTHER NX = NON-CRYSTALLINE GC = GLASS COATED GRAIN

GE = GOETHITE

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-010
Taxonomy: Medial, isomesic Typic Dystrandept
Latitude: S 41°15'40" Longitude: W 73°00'30"
Location: Llanquihue
Geomorphic Position: Hillslope
Slope and Aspect: 3% SW planar Elevation: 130 m M.S.L
Microrelief: simple smooth slope
Air Temp. 11.5 C Summer: 73.9C Winter: 6.7C
Precipitation: 165 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash over hard andesite
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R.Grez
Remarks: Date described: January 12, 1983. Field reaction by Universal Indicator strips, ph 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-15 cm very slightly moist, 15-85 cm slightly moist 85-104 cm slightly moist; vegetation-native vegetation before clearing was a roble forest. Depth to hard unweathered tuff varies from 95 to 115 cm in the same pit.

Ap 0 - 15 cm Dark reddish brown (5YR 2/2) silt loam, reddish gray (5YR 5/2) dry; strong very coarse granular structure; friable, slightly sticky and slightly plastic; weakly smeary, very moist or wet; common very fine and few fine roots; many very fine and medium interstitial and common very fine tubular pores; 1% 2-20 mm gravel; pH= 5.5, strongly acid; abrupt wavy boundary. 2-3% fine charcoal fragments.

Bw1 15 - 60 cm Dark reddish brown (5YR 3/3) loam; weak medium prismatic structure parting to weak medium and coarse subangular blocky; very friable, non-sticky and slightly plastic; few very fine roots; many very fine interstitial and common very fine and fine tubular pores; few medium cylindrical insect nests; 1% 2-20 mm gravel; pH= 5.6, medium acid; diffuse wavy boundary. 2-3% fine charcoal fragments.

Bw2 60 - 85 cm Dark reddish brown (5YR 3/3) loam; weak coarse subangular blocky structure; very friable, non-sticky and slightly plastic, weakly smeary; few very fine roots; many very fine interstitial and common very fine and fine tubular pores; few medium cylindrical insect nests; 1% 2-20 mm gravel; pH= 5.6, medium acid; gradual wavy boundary. 2-3% fine charcoal fragements.

Bw3 85 - 104 cm Dark reddish brown (5YR 3/3) loam; weak medium subangular blocky structure; very friable, non-sticky and slightly plastic; few very fine roots; many very fine interstitial, few very fine and fine tubular; rock fragments, 30% gravel and 5% cobble of mixed lithology and tuff fragments; pH= 5.7, medium acid; abrupt irregular boundary. Thickness of horizon varies from 7 to 30 cm and might be discontinous.

2R 104 - 120 cm Dark gray (5YR 4/1) tuff; does not slake in water.

PUERTO OCTAY

LAB CLASSIF: MEDIAL, ISOMESIC TYPIC DYSTRANDEPT

S 83FN-275 -010 DATE 09/25/84

SAMPLE NO. 83P2391-2395
PEDON NO. 83P 503
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- (- - -TOTAL - - -) CLAY LT .002	-2-- SILT .002 -.05	-3-- SAND .05 -2	-4-- (- -CLAY- -) FINE LT .0002	-5-- CO3 LT .002	-6-- (- -SILT- -) FINE .002 -.02	-7-- COARSE .02 -.05	-8-- (- - - - - -SAND- - - - - -) VF .05 -.10	-9-- F .10 -.25	-10- M .25 -.50	-11- C .5 -1	-12- VC 1 -2	-13- (-COARSE FRACTIONS(MM)-) - - - - WEIGHT - - - - 2 -5	-14- 5 -20	-15- 20 -75	-16- .1- 75	-17- (>2MM WT PCT O WHOLE SOIL
				<- - - - - - - - - - - - - - PCT OF <2MM (3A1) - - - - - - - - - - - - - - ->												<- PCT OF <75MM(3B1)->				
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832391	1S	0- 15	AP	6.5	64.5	29.0			41.6	22.9	9.0	6.2	3.9	4.6	5.3	1	1	--	22	2
832392	2S	15- 60	BW1	--	30.6	69.4			12.9	17.7	24.1	28.1	11.2	4.3	1.7	2	5	--	49	7
832393	3S	60- 85	BW2	--	20.4	79.6			7.0	13.4	23.4	34.1	14.9	5.1	2.1	2	13	--	63	15
832394	4S	85-104	BW3	--	30.3	69.7			15.8	14.5	18.5	24.5	11.0	8.5	7.2	2	6	65V	87	76
832395	5S	104-120	2R													--	--	--		--

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	(- - DITH-CIT - -) EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - - - -PCT OF <2MM - - - - - - - ->									PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
832391	1	12.1	0.950			3.4	2.2		8.38	7.32					0.82					47.6	
832392	2	5.75	0.425			5.0	2.2							0.41	0.65	0.164			103.4	35.3	0.28
832393	3	4.61				5.3	2.3							0.38	0.94	0.337			125.8	34.8	0.34
832394	4	3.65				3.9	1.7							0.56	0.78	0.066			85.7	29.4	0.19
832395	5																				

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

PUERTO OCTAY S 83FN-275 -010 DATE 09/25/84 PEDON NO. 83P 503 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1- CA 5B5A 6N2E	-2- MG 5B5A 6O2D	-3- NA 5B5A 6P2B	-4- K 5B5A 6Q2B	-5- SUM BASES	-6- ACID-ITY 6H5A	-7- EXTR AL 6G9A	-8- CEC SUM CATS 5A3A	-9- CEC NH4-OAC 5A8B	-10- CEC BASES + AL 5A3B	-11- AL SAT 5G1	-12- BASE SAT SUM 5C3	-13- BASE SAT NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- PH NAF 8C1D	-19- PH CACL2 .01M 8C1F 1:2	-20- PH H2O 8C1F 1:1
		<- - - -	- - - -	- - - -	- - - -	-MEQ /	100 G -	- - - -	- - - -	- - - -	- - ->	<- - - -	- -PCT -	- - ->							
832391	1	13.7	2.9	--	0.4	17.0	46.2	0.2	63.2	54.5	17.2	1	27	31					10.7	5.2	5.6
832392	2	4.0	0.9	--	0.2	5.1	48.4	0.1	53.5	29.0	5.2	2	10	18					11.0	5.8	6.0
832393	3	2.4	0.9	--	0.1	3.4	44.9	0.1	48.3	26.5	3.5	3	7	13					10.8	6.0	6.1
832394	4	1.7	0.7	--	0.1	2.5	36.7	0.1	39.2	24.0	2.6	4	6	10					10.8	6.0	5.9
832395	5																				

SAMPLE NO.	HZN NO.	NA PYROPHOSPHATE EXTRACTABLE C 6A4A (PCT OF <2MM)	FE 6C8A (PCT OF <2MM)	AL 6G10 (PCT OF <2MM)	FE+AL DIVIDED BY DI-CI FE+AL	FE+AL DIVIDED BY PCT CLAY	AL+C DIVIDED BY PCT CLAY	INDEX OF ACCUM	MINERALOGY CLAY X-RAY <2U 7A21	7A21	7A21	7A21	DTA 7A3	DTA 7A3	TOTAL RES 7B1A (PCT)	DOM WEATH 7B1A (PCT)
832391	1		0.6	1.3	0.3	0.3		899								
832392	2		0.2	0.9	0.2				VR 1	NX 6						
832393	3		0.1	0.8	0.1				VR 1	NX 6						
832394	4		0.1	0.7	0.1											
832395	5															

(Spodic horizon criteria; mineralogy X-ray and DTA amounts: <- RELATIVE AMOUNTS ->)

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 0 PCT .1-75MM 61. SPODIC HORIZON: INDEX OF ACCUMUL 0
ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES
MINERALOGY: KIND OF MINERAL VR VERMICULITE NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

PUERTO OCTAY   S83FN-275-010

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
		PPM	<- - - - - - - - - -PCT OF <2MM- - - - - - - - - - >						
832391	1	3	55.0	99	3.6	1.6	1.6	2.8	
832392	2	TR	80.8	99	3.0	1.3	0.9	3.9	
832393	3	TR	84.6	99	5.8	3.2	2.4	4.0	
832394	4	TR	78.3	99	3.4	1.7	1.1	3.8	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	MINERALOGY OPTICAL SAND/SILT FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	X-RAY CLAY 7A2I	7A2I	7A2I	7A2I	7A2I	DTA 7A3	7A3	TOT ANAL K2O 6Q3A	FE 6C7A
			PCT										RELATIVE AMOUNTS					PCT			
83P2391	1																				
83P2392	2	VFS		OT96	GS 3	GA 1	GC<1						VR 1	NX 6						0.0	3.4
83P2393	3												VR 1	NX 6						0.4	4.3
83P2394	4																				
83P2395	5																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS VR = VERMICULITE OT = OTHER NX = NON-CRYSTALLINE

GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-011
Taxonomy: Medial, isomesic Typic Durandept
Latitude: S41°29' Longitude: W 73°07'
Location: Puerto Montt
Geomorphic Position: High terrace
Slope and Aspect: 5% NW Elevation: 100 m M.S.L
Microrelief: smooth simple slope
Air Temp. 12 C Summer: 14.5C Winter: 7.7C
Precipitation: 175 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: Moderately rapid
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 11, 1983. Field reaction by Universal Indicator strips,pH 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-16 cm dry, 16-92 cm slightly moist; vegetation-native vegetation befor clearing was a Roble forest. Present vegetation is pasture grasses and forbes of: grasses-Poa, Dactylis glomerata, Holcus lanatus, Anthoxanthum sp., Plantago lanceolata, Lolium sp., Trifolium repens, and scattered roble (Nothofagus procera).

A 0 - 16 cm Very dark brown (10YR 2/2) loam; strong medium and coarse granular structure; friable, non-sticky; non-plastic; many very fine roots; many fine interstitial pores; pH= 5.2, strongly acid; clear wavy boundary.

B/A 16 - 30 cm Dark brown (7.5YR 3/4) and very dark brown (10YR 2/2) loam; weak medium and coarse prismatic structure parting to weak medium and coarse subangular blocky; very friable, non-sticky and non-plastic; common very fine roots; many very fine interstitial and common very fine, fine, and medium tubular pores; few thin, moderatley thick, and thick cutans (clay films) in pores; pH= 5.5, strongly acid; gradual wavy boundary.

Bt1 30 - 70 cm Dark brown (7.5YR 3/4) and strong brown (7.5YR 4/6) silt loam; moderate coarse prismatic structure parting to moderate coarse subangular blocky; friable, slightly sticky and slightly plastic; few very fine roots; many very fine interstitial and common fine and medium tubular pores; many moderatly thiock, and common thick cutanc (clay films) on peds and in pores; pH= 5.5 strongly acid; clear wavy boundary.

Bt2 70 - 92 cm Strong brown (7.5YR 4/6) loam; weak coarse subangular blocky structure; friable, non-sticky; non-plastic; weakly smeary, very moist or wet; few very fine roots; common very fine interstitial and common fine and medium tubular pores; common thin cutans (clay films) in pores; pH= 5.5, strongly acid; abrupt wavy boundary. Gravel and cobble imbedded in first cemented C horizon and extend upwards into this horizon

2Bqs 92 - 102 cm Brown (7.5YR 5/2) strong brown (7.5YR 4/6) and pinkish white (7.5YR 8/2); strongly cemented with iron and silica; pH= 5.5, strongly acid; clear wavy boundary.

2Bs 102 - 118 cm Dark greenish gray (5GY 4/1); strongly cemented with silica; pH= 5.7, medium acid.

PUERTO MONTT

LAB CLASSIF: MEDIAL, ISOMESIC TYPIC DURANDEPT

S 83FN-275 -011 DATE 09/25/84

SAMPLE NO. 83P2367-2372
PEDON NO. 83P 499
PROJECT NO. 83P 84

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

GENERAL METHODS 1B1A, 2A1, 2B

	-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
				(- - -TOTAL	- - -	-)(	- -CLAY-	-)(	- -SILT- -)(		- - - -	- -SAND-	- -	- - -	-)(	-COARSE FRACTIONS(MM)-			-)(	>2MM
				CLAY	SILT	SAND	FINE	CO3	FINE	COARSE	VF	F	M	C	VC	- - - -	WEIGHT	- - - -		WT
SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	LT .002	.002 -.05	.05 -2	LT .0002	LT .002	.002 -.02	.02 -.05	.05 -.10	.10 -.25	.25 -.50	.5 -1	1 -2	2 -5	5 -20	20 -75	.1- 75	PCT O WHOLE SOIL
				<- - - -	- - - -	- - - -	- - - -	- - -	PCT OF <2MM	(3A1) - - -	- - - -	- - - -	- - - -	- - - -	- ->	<- PCT OF	<75MM(3B1)	->		
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832367	1S	0- 16	A	5.4	63.2	31.4			36.7	26.5	'13.3	7.5	3.7	6.6	0.3	1	TR	--	19	1
832368	2S	16- 30	B/A	1.6	27.1	71.3			11.0	'16.1	19.3	27.2	16.3	7.6	0.9	1	TR	--	52	1
832369	3S	30- 70	BT1	0.2	21.7	78.1			8.4	13.3	17.9	29.7	19.0	10.3	1.2	TR	2	--	61	2
832370	4S	70- 92	B12	--	19.9	80.1			6.4	13.5	17.2	34.8	19.8	7.5	0.8	1	TR	--	63	1
832371	5S	92-102	2BQS	3.1	30.0	66.9			16.0	14.0	13.1	18.0	15.5	13.2	7.1	9	9	8	66	26
832372	6S	102-118	2BS	3.6	30.6	65.8			18.3	12.3	10.1	14.9	12.9	13.3	14.6	5	15	6	67	26

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	DITH-CIT EXTRACTABLE AL 6G7A	DITH-CIT EXTRACTABLE MN 6D2A	RATIO/CLAY CEC 8D1	RATIO/CLAY 15 BAR 8D1	ATTERBERG LIMITS LL 4F1	ATTERBERG LIMITS PI 4F	BULK DENSITY FIELD MOIST 4A3A	BULK DENSITY 1/3 BAR 4A1D	BULK DENSITY OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1C	WATER CONTENT 1/3 BAR 4B1C	WATER CONTENT 15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - -	- - - -	-PCT OF <2MM	- - -	- - -	- - -	- ->			PCT <0.4MM		<- - G/CC	- -	- ->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
832367	1	15.8	1.172			3.8	3.6		10.17	7.96				0.59	0.74	0.078			71.9	43.0	0.17
832368	2	10.4	0.962			4.7	3.7		25.69	22.38				0.41	0.65	0.166			130.2	35.8	0.39
832369	3	5.93	0.441			4.9	2.7		157.50	155.00				0.37	1.05	0.413			163.9	31.0	0.49
832370	4	4.59				4.5	2.4							0.44	1.06	0.340			131.7	29.7	0.45
832371	5	0.41				0.9	0.4		2.00	3.81				1.48	1.51	0.005			23.4	11.8	0.14
832372	6	0.13				0.4	0.1		1.42	2.06				1.62	1.65	0.005			16.7	7.4	0.13

* PSDA IN ANDEPTS SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

PUERTO MONTT   S 83FN-275 -011   DATE 09/25/84   PEDON NO. 83P 499   NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC - - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10-- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SAT- SUM 5C3	-13- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
		<- - - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - ->										<- - - - - -PCT - - - - ->									
832367	1	5.4	0.6	--	0.3	6.3	67.5	1.7	73.8	54.9	8.0	21	9	11					11.3	4.8	5.0
832368	2	1.0	0.2	--	0.2	1.4	59.7	0.7	61.1	41.1	2.1	33	2	3					11.4	5.0	5.4
832369	3	0.5	0.1	--	0.1	0.7	49.2	0.1	49.9	31.5	0.8	12	1	2					11.0	5.6	5.7
832370	4	0.7	0.2	--	0.1	1.0	44.1	0.1	45.1	24.1	1.1	9	2	4					10.9	5.8	5.9
832371	5	0.3	TR	--	0.1	0.4	10.7	0.1	11.1	6.2	0.5	20	4	6					10.3	6.0	6.1
832372	6	0.6	0.1	--	0.1	0.8	5.0	0.1	5.8	5.1	0.9	11	14	16					9.8	6.2	6.2

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	(- - - -MINERALOGY - - - -) (- - CLAY - -) (- - X-RAY - -) <2U 7A21	7A21	7A21	7A21	(- -DTA - -) <2U 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM->			FE+AL	CLAY	CLAY		<- RELATIVE AMOUNTS ->				<- - - - -PCT - - - ->			
832367	1		1.6	2.3	0.5	0.7		1138								
832368	2		1.5	1.8	0.4	2.1		844	NX 6							
832369	3		0.3	1.0	0.2	6.5		1992	NX 6				GI			
832370	4		0.1	0.8	0.1				VR 1	GI 1	NX 6		GI 1			
832371	5		0.1	0.3	0.3	0.1		96								
832372	6		0.1	0.2	0.6	0.1		64	VR 1	FD 1	NX 6					

FAMILY CONTROL SECTION: DEPTH 25- 97 PCT CLAY 0 PCT .1-75MM 61. SPODIC HORIZON: INDEX OF ACCUMUL 249
ANALYSES: S= ALL ON SIEVED <2MM BASIS
MINERALOGY: KIND OF MINERAL NX AMORPHOUS GI GIBBSITE VR VERMICULITE FD FELDSPAR

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

PUERTO MONTT   S83FN-275-011

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8C1g
			<- - - - - - - - - -PCT OF <2MM- - - - - - - - - - >						
832367	1	4	55.1	98	4.0	1.1	2.0	3.4	4.5
832368	2	TR	107.7	99	5.6	1.9	3.2	4.0	4.9
832369	3	TR	128.2	99	3.8	1.3	1.2	4.4	5.4
832370	4	TR	104.2	99	5.0	2.1	1.0	4.2	5.6
832371	5	1	14.1	98	2.1	1.2	0.4	1.9	5.5
832372	6	5	9.2	67	1.0	0.1	0.5	0.9	5.3

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 10A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
		(MINERALOGY)																			
		(OPTICAL) SAND/SILT											(X-RAY) CLAY					(DTA)		(TOT ANAL)	
			<PCT>										<RELATIVE AMOUNTS>					<PCT>			
83P2367	1																				
83P2368	2												NX 6							0.2	3.4
83P2369	3	VFS		OT97	GS 2	GC 2	GA<1						NX 6					GI<1		0.3	4.3
83P2370	4												VR 1	GI 1	NX 6			GI 1		0.3	5.0
83P2371	5																				
83P2372	6												VR 1	FD 1	NX 6					0.3	1.9

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: NX = NON-CRYSTALLINE GI = GIBBSITE GA = GLASS AGGREGATES GS = GLASS OT = OTHER

GC = GLASS COATED GRAIN VR = VERMICULITE FD = FELDSPAR

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Pedon No: S83FN-275-012
Taxonomy: Medial, isomesic Histic Placaquept
Latitude: S41°23'30" Longitude: W 72°54'
Location: Alerce
Geomorphic Position: low terrace
Slope and Aspect: 1% planar Elevation: 120 m M.S.L
Microrelief: strongly hummucky
Air Temp. 11.8 C Summer: 14.5C Winter: 7.7C
Precipitation: 185 cm Aquic moisture regime.
Water Table: > 10 m, perched on top of pan during the wet season for 5 to 6 months
Drainage: Poorly drained Permeability: Moderately slow
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: volcanic ash over unrealated cemented gravelly glacial outwash at 55 cm
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 11, 1983. Field reaction by Universal Indicator strips, pH 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-5 cm slightly moist, 5-55 cm moist; vegetation-before clearing a native Alerce forest and dense undergrowth. Now pasture grasses and forbes and some Bacchanis sp.

O 2 - 0 cm Sphagnum moss, grass and pieces of roots, wood and leaves.

A1 0 - 5 cm Black (5YR 2/1, rubbed) loam; strong very fine granular structure; friable, non-sticky; non-plastic; many very fine, fine and medium roots; many very fine interstitial pores; this horizon is composed of mostly a dense mat of roots with some soil material; pH= 4.8, very strongly acid; clear smooth boundary.

A2 5 - 18 cm Dark reddish brown (5YR 2/2) loam; moderate very fine and fine subangular blocky structure; friable, non-sticky and slightly plastic; common very fine and few coarse roots; common very fine and fine interstitial and few very fine and fine tubular pores; many pores are coated red (2.5YR 4/8); pH= 5.1, strongly acid; clear wavy boundary.

Bw1 18 - 32 cm Brown to dark brown (7.5YR 4/4) and yellowish red (5YR 5/8) silty clay loam; weak medium and coarse angular blocky structure; friable, sticky and slightly plastic; moderatly smeary, very moist or wet; common very fine roots; many very fine and common and medium tubular, pores; common thin and moderatley thick clay films in pores and on peds, some pores are plugged with cutans; pH= 5.0, strongly acid; clear wavy boundary. Root channels filled with dark reddish brown (5YR 3/2) soil material from 0-18 cm horizon.

Bw2 32 - 55 cm Yellowish brown (10YR 5/4) and strong brown (7.5YR 5/6) silty clay loam; weak coarse prismatic structure; firm, sticky; slightly plastic; moderatly smeary, very moist or wet; few very fine roots; many very fine and common fine tubular; many thin and moderatly thick clay films on peds and in pores and few thick clay films inpores, some pores are plugged with cutans; rock fragments, 25% gravel, 2% cobble mixed lithology fragements mostly concentrated from 43 to 55 cm; ph= 5.6, medium acid; abrupt wavy boundary (in places abrupt irregular).

2Bqs 55 - 65 cm Dark brown (10YR 3/3) iron and silica strongly cemented duripan; in fractures the color is strong brown (7.5YR 5/6, brown (7.5YR 4/4) dark reddish brown (5YR 3/3), reddish brown (5YR 4/4), and yellowish red (5YR 4/6), these colors occupy 30-40% of the horizon; few thin and moderatly thick clay skins coating rock fragments; pH= 5.7, medium acid; clear wavy boundary (in some places abrupt irrigular).

2Bq 65 - 86 cm Very dark grayish brown (10YR 3/2 and 2.5YR 3/2); strongly silica cemented sand and gravel; pH= 5.7, medium acid.

ALERCE

LAB CLASSIF: MEDIAL, ISOMESIC HISTIC PLACAQUEPT

S 83FN-275 -012 DATE 09/25/84

SAMPLE NO. 83P2379-2384
PEDON NO. 83P 501
PROJECT NO. 83P 84

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1-- TOTAL CLAY LT .002	-2-- TOTAL SILT .002 -.05	-3-- TOTAL SAND .05 -2	-4-- CLAY FINE LT .0002	-5-- CLAY CO3 LT .002	-6-- SILT FINE .002 -.02	-7-- SILT COARSE .02 -.05	-8-- SAND VF .05 -.10	-9-- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS(MM) WEIGHT 2 -5	-14- WEIGHT 5 -20	-15- WEIGHT 20 -75	-16- WEIGHT .1- 75	-17- (>2MM WT PCT OF WHOLE SOIL
				<- - - PCT OF <2MM (3A1)											- - ->	<- PCT OF <75MM(3B1)->				
***** SEE FOOTNOTE REGARDING PSDA BELOW *****																				
832379	1S	0- 5	A1	0.5	21.3	78.2			8.6	12.7	11.5	16.8	10.4	11.2	28.3	TR	TR	--	67	TR
832380	2S	5- 18	A2	1.2	51.9	46.9	--		20.7	31.2	14.7	16.2	8.8	5.8	1.4	1	TR	--	33	1
832381	3S	18- 32	BS1	2.0	19.0	79.0	--		10.2	8.8	12.2	28.4	24.9	11.8	1.7	TR	TR	--	67	TR
832382	4S	32- 55	BW2	2.9	24.3	72.8	--		16.0	8.3	10.9	19.8	21.1	15.6	5.4	2	12	50V	86	65
832383	5S	55- 65	2BQS	1.6	10.0	88.4			5.7	3.3	6.2	15.7	23.3	25.0	18.2	6	35	34	96	75
832384	6S	65- 86	2BQ	1.5	5.6	92.9			3.6	2.0	2.2	9.0	23.6	33.5	24.6	6	30	41	98	77

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS - LL 4F1	PI 4F	BULK DENSITY FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - - - -PCT OF <2MM - - - - - - - ->									PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - -PCT OF <2MM - ->				CM/CM
832379	1	27.3	1.333			0.6	1.0		112.40	135.40				0.26	0.39	0.145			130.6	67.7	0.16
832380	2	16.6	0.998			0.7	2.9		48.42	35.75				0.55	0.73	0.099				42.9	
832381	3	3.67				3.3	3.6		29.00	23.90				0.64	0.87	0.108			94.4	47.8	0.30
832382	4	2.61				4.8	2.0		7.97	12.38				0.71	0.89	0.049			85.7	35.9	0.23
832383	5	0.54				1.0	0.3		4.75	7.38										11.8	
832384	6	0.39				0.6	0.2		3.53	6.40										9.6	

* PSDA IN AQUEPTS WITH ANDIC PROPERTIES SHOULD NOT BE USED FOR MAKING ENGINEERING INTERPERTATIONS BECAUSE OF INCOMPLETE DISPERSION OF AMORPHOUS MATERIAL. THEY ARE PRESENTED TO AID IN CLASSIFICATION AND ASSESSMENT OF MINERALOGY. REFER TO PEDON DESCRIPTION FOR FIELD TEXTURE.

ALERCE S 83FN-275 -012 DATE 09/25/84 PEDON NO. 83P 501 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC - - -) SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SAT- SUM 5C3	-13- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH - - -) NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- H2O 8C1F 1:1
		<- - - - - - - - - - - -MEQ / 100 G										<- - - - - -PCT - - - ->									
832379	1	3.0	1.1	--	0.8	4.9	56.6	4.1	61.5	56.2	9.0	46	8	9					8.4	4.2	5.0
832380	2	1.2	0.3	--	0.3	1.8	62.8	3.6	64.6	58.1	5.4	67	3	3					11.1	4.5	5.2
832381	3	1.1	0.2	--	0.2	1.5	65.2	1.1	66.7	58.0	2.6	42	2	3					11.2	4.9	5.4
832382	4	0.3	0.1	--	0.1	0.5	34.7	0.2	35.2	23.1	0.7	29	1	2					10.8	5.8	6.0
832383	5	0.7	0.2	--	0.1	1.0	11.6	0.2	12.6	7.6	1.2	17	8	13					10.0	6.1	6.9
832384	6	0.6	0.2	--	0.1	0.9	6.3	0.1	7.2	5.3	1.0	10	13	17					9.3	6.2	6.2

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	(- - - -MINERALOGY - - - -) (- - CLAY - -) (- - X-RAY - -) (- - - - <2U - - - -) 7A2I	7A2I	7A2I	7A2I	(- -DTA - -) (- -<2U - -) 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM->							<- RELATIVE AMOUNTS ->				<- - - - -PCT - - - ->			
832379	1		0.4	1.1	0.9	3.0		306								
832380	2		0.4	2.1	0.7	2.1		832	NX 6							
832381	3		0.4	1.8	0.3	1.1		920	NX 6							
832382	4		0.1	0.6	0.1	0.2		776								
832383	5		0.1	0.2	0.2	0.2		118	GI 1	NX 6			GI			
832384	6		0.1	0.1	0.3	0.1		135								

FAMILY CONTROL SECTION: DEPTH 25- 55 PCT CLAY 3 PCT .1-75MM 82. SPODIC HORIZON: INDEX OF ACCUMUL 352
ANALYSES: S= ALL ON SIEVED <2MM BASIS V= 75-20MM FROM VOLUME ESTIMATES
MINERALOGY: KIND OF MINERAL NX AMORPHOUS GI GIBBSITE

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

ALERCE   S83FN-275-012

SAMPLE NO.	HZN NO.	EXT P BRAY1 6S3 PPM	15 BAR MOIST 4B2b	P RETENT [1]	(- -ACID OXALATE- -) AL [1]	SI [1]	FE [1]	EXTR AL (KOH) [2]	pH KCl 8Clg
			<- - - - - - - - - - -	-PCT OF <2MM-	- - - - -	- - - - -	- - - - -	- - - - >	
832379	1	6	95.2	88	3.2	0.8	0.5		
832380	2	2	73.1	99	6.4	2.5	1.0	2.9	
832381	3	TR	93.4	99	5.6	3.4	0.3	4.8	
832382	4	1	46.2	99	5.0	2.9	0.2	3.7	
832383	5	2	17.0	92	2.0	1.3	0.3	1.6	
832384	6	17	12.1	70	1.5	1.1	0.2	0.9	

[1] Blakemore, L. C., P. L. Searle, and B. K. Daly. 1981. Soil Bureau Laboratory Methods. A. Methods for Chemical Analysis of Soils. New Zealand Soils Bureau Scientific Report 1(A. Dsiro, New Zealand.

[2] Holmgren, G. G. S. and J. M. Kimble. 1984. Field Estimation of Amorphous Aluminum with 4N KOH. Soil Sci. Soc. Amer. J. (in publication)

SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K2O 6Q3A	FE 6C7A
		MINERALOGY: OPTICAL, SAND/SILT											X-RAY, CLAY					DTA, CLAY		TOT ANAL, CLAY	
			PCT										RELATIVE AMOUNTS					PCT			
83P2379	1																				
83P2380	2												NX 6							0.2	0.9
83P2381	3	VFS		GA84	OT15	GC 1	GS<1						NX 6							0.1	4.2
83P2382	4																				
83P2383	5												GI 1	NX 6				GI<1		0.0'	2.4
83P2384	6																				

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: NX = NON-CRYSTALLINE GA = GLASS AGGREGATES GS = GLASS OT = OTHER GC = GLASS COATED GRAIN

GI = GIBBSITE

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

COMMENTS:

Series: Corte Alto 6/83
Pedon No: S83FN-275-013
Taxonomy: Fine-Loamy, mixed, mesic Andic Haplumbrept
Latitude: S 40°54' Longitude: W 73°09'
Location: Purranque
Geomorphic Position: Terrace
Slope and Aspect: 5% NW Elevation: 105 m M.S.L
Air Temp. 12.5 C Summer: 16C Winter: 7.5C
Precipitation: 145 cm Udic moisture regime.
Water Table: > 10 m
Drainage: Well drained Permeability: moderate
Stoniness: non stony
Land Use: pasture
Erosion or Deposition: none
Parent Material: multiple ash deposits
Described by: T. Cook, W. Luzio, R. Honorato, G. Galindo, W. Vera, R. Grez,
Remarks: Date described: January 10, 1983. Field reaction by Universal Indicator strips,pH 4.0-7.0 (soil/water: 1/2.5); field moisture, 0-18 cm dry, 17-194 cm slightly moist; vegetation-Present vegetation is pasture grasses and forbes of: grasses-Poa, Dactylis glomerata, Holcus lanatus, Anthozantum sp., Trifolium repens and scattered Nothofagus oblique.

O 3 - 0 cm Mat of roots and leaves.

A 0 - 18 cm Dark reddish brown (5YR 2/2) silty clay loam; strong medium and coarse granular structure; friable, slightly sticky; plastic; common very fine and fine roots; common very fine and fine and few many very fine to fine interstitial and few fine tubular pores; few medium (4-6 cm) cylindrical insect nests; 1% gravel; pH= 5.5, strongly acid; clear wavy boundary.

Bw1 18 - 47 cm Reddish brown (5YR 4/4) and dark reddish brown (5YR 3/2) silty clay loam; dark reddish brown (5YR 3/3, rubbed); strong medium and coarse subangular blocky structure; friable, slightly sticky and plastic; common very fine, few medium and coarse roots; many very fine interstitial and common very fine, fine, and medium tubular pores; few medium (4-6 cm) cylindrical insect nests; 1% gravel; pH= 5.5, strongly acid; gradual wavy boundary.

Bw2 47 - 77 cm Dark reddish brown (5YR 3/4) silt loam; weak coarse and very coarse prismatic structure parting to weak coarse subangular blocky; very friable, slightly sticky and slightly plastic; few very fine and common fine and medium roots; many very fine, common fine and medium tubular pores; few medium (4-6 cm) cylindrical insect nests; pH= 5.5, strongly acid; abrupt wavy boundary.

2C1 77 - 122 cm Brown to dark brown (7.5YR 4/4) very fine sandy loam; weak coarse angular blocky structure in upper part structruless in lower part; firm, non-sticky and slightly plastic; weakly smeary, very moist or wet; few very fine exped roots; few very fine tubular and many very fine interstitial pores; few thick clay films in pores, many thin and medium in pores and on peds, color of films are yellowish red (5YR 4/6, 5/6) and reddish brown (5YR 4/4); pH= 5.7, medium acid; abrupt smooth boundary.

2C2 122 - 170 cm Strong brown (7.5YR 4/6) fine sandy loam; weak coarse angular blocky structure in upper part in lower part structureless;friable, non-sticky and slightly plastic; few very fine and fine roots; few very fine tubular pores from 122 to 132 cm there are many very fine, fine, and medium tubular pores; at 122-132 cm few thick clay films in pores,, other parts of horizon has few thin and moderatly thick clay films, color of films in pores and fractures are yellowish red (5YR 4/6, 5/6) and reddish brown (5YR 4/4); pH= 5.7, medium acid; abrupt smooth boundary.

3C3 170 - 194 cm Brown to dark brown (7.5YR 4/4) silt loam; structureless; very friable, non-sticky and slightly plastic; few very fine, fine, and medium roots; common very fine and fine tubular pores; pH= 5.1, strongly acid.

CORTE ALTO

LAB CLASSIF: FINE-LOAMY, MIXED, MESIC ANDIC HAPLUMBREPT

S 83FN-275 -013 DATE 07/26/84

SAMPLE NO. 83P2339-2344
PEDON NO. 83P 495
PROJECT NO. 83P 84

CHILE-SMSS

GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA 68508

				-1--	-2--	-3--	-4--	-5--	-6--	-7--	-8--	-9--	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-
				(- - -TOTAL	- - -)		(- -CLAY- -)		(- -SILT- -)		(- - - - -	- -SAND-	- - - -	- -)	(-COARSE FRACTIONS(MM)-)					(>2MM)
SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	CLAY LT .002	SILT .002 -.05	SAND .05 -2	FINE LT .0002	CO3 LT .002	FINE .002 -.02	COARSE .02 -.05	VF .05 -.10	F .10 -.25	M .25 -.50	C .5 -1	VC 1 -2	WEIGHT 2 -5	5 -20	20 -75	.1- 75	WT PCT OF WHOLE SOIL
				<- - - - -	- - - - -	- - - - -	PCT OF <2MM	(3A1) - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - - - -	- - ->	<- PCT OF	<75MM(3B1)		->	
832339	1S	0- 18	A	45.8	33.8	20.4			22.7	11.1	6.0	7.6	4.9	1.4	0.5	TR	--	--	14	TR
832340	2S	18- 47	BW1	29.4	41.5	29.1			25.9	15.6	12.3	10.3	4.8	1.4	0.3	1	TR	--	18	1
832341	3S	47- 77	BW2	11.9	38.6	49.5			21.7	16.9	22.0	16.2	8.2	2.6	0.5	TR	--	--	27	TR
832342	4S	77-122	2C1	1.7	18.1	80.2			11.3	6.8	22.9	35.6	18.0	3.5	0.2	--	--	--	57	--
832343	5S	122-170	2C2	0.5	30.6	68.9			16.8	13.8	34.3	24.0	7.9	2.4	0.3	TR	--	--	35	--
832344	6S	170-194	3C3	15.5	31.0	53.5			21.3	9.7	14.7	22.2	12.4	3.8	0.4	TR	--	--	39	--

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B3A	EXTR P	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG - LIMITS -) LL 4F1	PI 4F	(- BULK DENSITY -) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(- - -WATER CONTENT - -) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2A	WRD WHOLE SOIL 4C1
		<- - - - - -	-PCT OF <2MM	- - - - -	- - ->						PCT <0.4MM		<- - G/CC	- - ->		CM/CM	<- - -PCT OF <2MM	- ->			CM/CM
832339	1	6.76	0.499			5.8	1.4		0.86	0.63				0.86	1.07	0.075			41.7	28.7	0.11
832340	2	1.26	0.104			6.5	1.6		0.77	0.83				0.88	1.03	0.054			42.7	24.4	0.16
832341	3	0.84	0.071			6.5	1.5		1.78	2.07				0.93	1.07	0.048			45.7	24.6	0.20
832342	4	0.88				4.4	1.2		11.71	13.12				0.85	0.93	0.030			55.3	22.3	0.28
832343	5	0.43				3.2	1.0		42.20	65.00				0.66	0.74	0.039			75.6	32.5	0.28
832344	6	0.50				5.1	0.7		1.66	1.73				0.76	0.85	0.038			61.1	26.8	0.26

*** C O N T I N U A T I O N O N N E X T P A G E ***

CORTE ALTO S 83FN-275 -013 DATE 07/26/84 PEDON NO. 83P 495 NATIONAL SOIL SURVEY LABORATORY

SAMPLE NO.	HZN NO.	-1-- (- NH4OAC EXTRACTABLE BASES -) CA 5B5A 6N2E	-2-- MG 5B5A 6O2D	-3-- NA 5B5A 6P2B	-4-- K 5B5A 6Q2B	-5-- SUM BASES	-6-- ACID-ITY 6H5A	-7-- EXTR AL 6G9A	-8-- (- - - -CEC SUM CATS 5A3A	-9-- NH4-OAC 5A8B	-10- BASES + AL 5A3B - - -)	-11- AL SAT 5G1	-12- -BASE SUM 5C3	-13- SAT- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1G	-15- RES. OHMS /CM 8E1	-16-	-17- COND. MMHOS /CM 8I	-18- (- - - -PH NAF 8C1D	-19- CACL2 .01M 8C1F 1:2	-20- - - -) H2O 8C1F 1:1
		<- - - - - - - - - - - - - -MEQ / 100 G - - - - - - - - - - - - - ->										<- - - - - -PCT - - - - ->									
832339	1	9.4	2.4	0.1	1.6	13.5	33.3	0.7	46.8	39.6	14.2	5	29	34					9.0	4.7	5.6
832340	2	3.1	1.0	0.2	1.2	5.5	28.7	1.1	34.2	22.6	6.6	17	16	24					9.9	5.0	5.3
832341	3	4.8	1.2	0.7	0.1	6.8	26.1	0.2	32.9	21.2	7.0	3	21	32					10.3	5.5	5.8
832342	4	2.0	0.4	0.3	0.1	2.8	26.7	0.1	29.5	19.9	2.9	3	9	14					10.7	6.2	6.2
832343	5	1.7	0.2	0.2	0.2	2.3	31.4	0.1	33.7	21.1	2.4	4	7	11					10.7	6.1	6.2
832344	6	6.0	1.6	1.8	0.2	9.6	21.3	0.2	30.9	25.7	9.8	2	31	37					9.7	5.4	6.3

SAMPLE NO.	HZN NO.	(- - - -SPODIC HORIZON CRITERIA - - - - - -) (- -NA PYROPHOSPHATE EXTRACTABLE- -) C 6A4A	FE 6C8A	AL 6G10	FE+AL (- -DIVIDED BY- -) DI-CI FE+AL	FE+AL PCT CLAY	AL+C PCT CLAY	INDEX OF ACCUM	(- - - -MINERALOGY - - - -) (- - CLAY - -) (- - X-RAY - -) <2U 7A21	7A21	7A21	7A21	(- -DTA - -) <2U 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM->							<- RELATIVE AMOUNTS ->				<- - - - -PCT - - - ->			
832339	1		0.7	0.6	0.2	TR		430								
832340	2		0.4	0.4	0.1	TR		565	KH 2	NX 6			KH49			
832341	3		0.2	0.3	0.1	TR		808								
832342	4		0.1	0.6	0.1	0.4		1289	KH 1	NX 6			KH13			
832343	5		0.1	0.5	0.1	1.2		1606								
832344	6		0.2	0.3	0.1	TR		556	KH 2	NX 6			KH48			

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 14 PCT .1-75MM 34. SPODIC HORIZON: INDEX OF ACCUMUL 0

ANALYSES: S= ALL ON SIEVED <2MM BASIS

MINERALOGY: KIND OF MINERAL KH HALLOYSITE NX AMORPHOUS

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

N S S L

S U P P L E M E N T A L   D A T A   S H E E T

		EXT P BRAY1	15 BAR MOIST	P RETENT	(- -ACID OXALATE- -) AL	SI	FE	EXTR AL (KOH)	pH KCl
SAMPLE NO.	HZN NO.	6S3 PPM	4B2b	*	*	*	*		8C1g
			<- - - - - - - - - -PCT OF <2MM-	- - - -	- - - -	- - - -	- - - -	- - - >	
832339	1	3	30.9	89	1.2	0.3	1.4	0.8	4.3
832340	2	1		96	1.4	0.4	1.6	1.3	4.3
832341	3	TR	33.1	99	1.5	0.5	1.3	1.3	4.8
832342	4	TR	34.8	99	4.5	2.3	1.6	2.5	5.4
832343	5	TR	38.5	99	6.1	3.8	1.8	2.4	5.2
832344	6	TR	40.8	91	1.0	0.7	2.2	0.9	4.5

* NEW ZEALAND PROCEDURE

CP83FN129

		MINERALOGY																			
		OPTICAL											X-RAY					DTA		TOT ANAL	
		SAND/SILT											CLAY								
SAMPLE NO.	HZN NO.	FA 7B1A	RE 7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7B1A	7A2I	7A2I	7A2I	7A2I	7A2I	7A3	7A3	K20 6Q3A	FE 6C7A
			PCT										RELATIVE AMOUNTS					PCT			
83P2339	1																				
83P2340	2	VFS		OT99	GS 1	EC<1	GA<1						KH 2	NX 6				KH49		0.2	7.9
83P2341	3																				
83P2342	4												KH 1	NX 6				KH13		0.0	4.6
83P2343	5																				
83P2344	6												KH 2	NX 6				KH48		0.0	5.3

ANALYSES: S=ALL ON SIEVED < 2mm BASIS

MINERALOGY: FA = FRACTION ANALYZED RE = RESISTANT

KIND OF MINERAL: GA = GLASS AGGREGATES GS = GLASS OT = OTHER KH = HALLOYSITE NX = NON-CRYSTALLINE

GC = GLASS COATED GRAIN

RELATIVE AMOUNT: 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

MINERALOGY BASED ON SAND/SILT:

MINERALOGY BASED ON CLAY:

FAMILY PLACEMENT:

Appendix I

Summary of micromorphological descriptions of soils for the Sixth International Soil Classification Workshop.

R. Honorato

Facultad de Agronomía
Pontificia Universidad Católica de Chile

CHI-1 PELCHUQUIN

Typical isotic fabric throughout the profile, with regard to the SRDP is congelic in every horizon, with the exception of the Ap in which it is congelic grading to agglutinic. The plasma and skeleton grains are of silt size and they form peds in between the coarser sand sized skeleton grains.

The voids are mainly of compound packing type and secondly channels and skew planes in the agglutinic areas.

The skeleton grains composed of quartz plagioclases and traces of amphibol-pyroxenes, have a random distribution.

In the Bs_2 horizon wedge shape crystals of quartz of less than 0.1 mm are rather common.

There is a well-expressed microstructure composed of rounded aggregates most of them probably fecal pellets from 0.02 to 0.5 mm in diameter. These biological features are described throughout the profile although they are concentrated in the A horizons. The fabric of these pellets is similar to those of the matrix of soil.

Highly decomposed organic remains as skeleton are common all through the profile will the wall cells still recognizable.

Sesquioxidic glaebules and scarce lithorelicts are described everywhere in the profile.

CHI-2 LANCO

Isotic soil plasmic fabric. The NRDP is porphyric in the A_1 and 2Bs horizons and dominantly granic in the others. The SRDP is congelic in the A_1 and 2Bs horizons. In the 3BC and $4Bs_{1m}$ horizons is quite heterogenous grading between agglutinic and intertextic type.

In the $4Bs_{1m}$ horizon the matrix is fine volcanic siliceous-vitric material which acts as cementing agent of coarse skeleton grains.

The skeleton is relatively scarce up to 35 cm, the mineral grain are mainly lithorelicts of many different types of volcanic rocks; quartz and other minerals are present only as traces. No pumice fragments were described.

A biological microstructure variable in size is well expressed in the A_1 and 2Bs horizons. Numerous fecal pellets and organic remains are observed too. Fecal pellets have a fabric like the soil fabric.

In the $4Bs_{1m}$ (duripan) horizon, diffusion argillans not birefringent are developed in the vitric material. Also, diffusion ferrans are described as cementing agent between the coarse skeleton grains. In addition, sesquioxidic glaebules are abundant.

CHI-3 LOS ULMOS

Soil plasmic fabric is dominantly isotic as it is described in Andisols, but slightly in vosepic in the base of the Bs horizon. The dominant SRDP is agglutinic with some areas of congelic type due to the biological activity. The NRDP is plasmi-porphyric all through the profile.

Soil plasma is abundant and has a very strong reddish brown color.

Skeleton is rather scarce, mainly quartz and traces of other minerals like plagioclases and amphibol-pyroxenes. Some scarce lithorelicts of volcanic rocks are observed too, all through the profile.

The biological activity is intense resulting in a microstructure, with rounded aggregates. Pedotubules, are filled with fecal pellets in the A horizons.

Organic skeleton formed by somewhat decomposed organic remains as cell tissues and altered roots are abundant.

The system of voids is mainly formed by vughs channels, skew planes and by compound packing voids in some areas of a higher biological activity.

Some thin discontinuous argillans, with a continuous extinction, can be observed in the Bs_3 horizon. These cutans probably stress cutans recover the normal voids wells and around some skeleton grains.

CHI-4 OSORNO

Isotic soil fabric and congelic SRDP are dominant throughout the profile; in the Ap horizon congelic SRDP grades to agglutinic in some areas. According to Brewer's nomenclature RDP is porphyroskelic in the $2C_1$ and $3C_2$ horizons.

The NRDP is porphyric in the Ap, Bw and Bs horizons, it is plasmi-porphyric in the $2C_1$ and grani-porphyric in the $3C_2$ horizon.

In the Bq horizon soil fabric is quite heterogenous, it consists of a ground mass of vitric material with skeleton grains enclosed. The plasma is of a yellow-brown color with yellow or reddish areas depending on the degree of weathering and segregation of iron.

Microstructure is well developed specially in the Bw and Bs horizons. Numerous pedotubules filled with pellets of the same fabric as the soil are the result of intense biological activity.

Compound packing voids are the most important accompanied in some more dense areas by channels, chambers, vughes, and skew-planes.

The skeleton grains are scarce in the profile with the exception of the $3C_2$ horizon. The most important is quartz and less frequent plagioclases and amphibol-pyroxenes. Plagioclases and amphibol-pyroxenes increase in the 2Bq, $2C_1$ and $3C_2$horizons. Volcanic rock fragments are infrequent in the first two horizons and common in the remainders. Besides, pumice fragments are described in Bs and 2Bq horizons showing its characteristic vesicular structure. Some of these fragments show patches of yellow color concerning with the first state of weathering.

Normally, the skeleton grains are well preserved amphibol-pyroxenes crystals are often cracked with iron deposits inside. In the $3C_2$ horizon some grains are covered with plasma.

Somewhat decomposed organic remains as skeleton are abundant in the form of cell tissues and fusiform root remains.

Small sesquioxidic glaebules are common throughout the profile, and abundant in the 2Bq. The cementing agents of this last horizon are iron and silica, and it is possible to observe some diffusion ferrans.

CHI-5 ANTILLANCA

The Antillanca soil series is characterized by the scarce quantity of plasma. The soil plasmic fabric is isotic, the NRDP granic and the SRDP can be classified as dermatic. Most of the skeleton grains are coated with a dark brownish film of volcanic plasma.

The skeleton grains are quite dominant with the exception of the A_1 horizon where the organic skeleton is higher.

The skeleton is composed of all kinds of volcanic aphanitic and pumice sand size fragments, increasing with depth. Some isolated mineral grains of plagioclases, quartz and amphibol-pyroxenes are also observed. Normally mineral grains are part of volcanic rocks. The skeleton grains are slightly weathered in the first two horizons.

CHI-6 CHANLEUFU

Isotic plasmic fabric is dominant all through the profile. The NRDP is porphyri-granic in the A_1, A_2 and C_2 horizons. In the C_1 horizons it is considered as granic due to the presence of vesicular-basaltic cinder.

This cinder includes a part of microcrystals and phenocrysts both composed of plagioclases.

The SRDP is congelic in the A_1, A_2 and C_2 horizons. The C_1 horizon is composed mainly of pumice fragments of vesicular type ( ).

Soil fabric is very loose as a consequence of the intense biological activity. In the A_1 and A_2 horizons fecal pellets and organic debris in combination with roots in different stages of weathering were described.

Skeleton grains of sand size are frequent mainly of pumice, quartz and scarce plagioclases and amphibol-pyroxenes crystals.

The skeletal grains are well preserved although some amphibol-pyroxenes crystals show a surface with cracks. Basaltic cinders are not altered. Sesquioxidic glaebules are common all over the profile.

CHI-7 PUYEHUE

Typical isotic fabric, the NRDP is porphyric and the SRFDP congulic throughout the profile. The soil plasma hnas a strong dark reddish brown color, being yellowish in some areas influenced by altered vitric pumice.

Voids are mainly of compound packing type, microstructure made up of rounded aggregates from 0.02 to 0.5 mm in diameter is well expressed, numerous fecal pellets filling voids are observed.

The skeleton grains are rather scarce in the soil profile, increasing with depth. They are mainly volcanic and vitric pumice fragments and quartz, plagioclases and amphibol-pyroxene association. Some of quartz crystals show a wedge shape. In the Bs_1 horizon skeleton grains are very scarce Normally skeleton grains are well preserved but some volcanic rock fragments are very cracked and partially incorporated to the plasma.

Organic remains are common all through the profile, but are predominant in the A horizons.

CHI-8 PUERTO FONCK

Isotic fabric throughout the profile. The NRDP is porphyric and the SRDP congelic in every horizon, the plasma has a dark brown color.

The biological activity is intense mainly in the A_1 and A_2 horizons. Numerous pedotubules filled with fecal pellets can be observed. The organic skeleton composed by tissues debris and roots somewhat decomposed is abundant all through the profile.

The skeleton grains are scarce, the most important are volcanic rock fragments including pumice, with the exception of the C_2 horizon. Less frequent are quartz, plagioclases and amphibol-pyroxenes. Some of the volcanic fragments are often fragmented and partially incorporated into the soil plasma. Pumice fragments show the typical yellowish weathering state.

Small sesquioxidic glaebules are common throughout the profile.

CHI-9 **FRUTILLAR**

Typical isotic plasmic fabric. The NRDP is porphyric in the A and E horizons, porphyric-phyric in the Bs_1, Bs_2 and Bs_3 and phyri-granic in the C horizons. The SRDP is an intergrade congelic-agglutinic in the A and Bs_3 horizons and congelic in the C, Bs_1 and Bs_2 horizons. The plasma is of dark brown color.

The mineral skeleton grains are scarce in the A, E and Bs_1 horizons. The organic skeleton represented by roots debris and organic tissues are abundant.

The skeleton grains are mainly quartz, plagioclases, amphibol-pyroxenes and some volcanic rock fragments. Only in the $2Bs_m$ horizon, the last fragments are moderately weathered. With regard to the vitric volcanic materials, are also weathered showing a yellowish color.

In the Bs_m there are diffusion ferrans and discontinuous argillans, both developed in voids.

In the top of the 2Bs (duripan) a thin iron discontinuous film, thin iron pan, of around 0.1 mm can be observed. The iron is diffused into the subcutanic area.

Sesquioxidic glaebules are common in the whole profile increasing from the Bs_3 horizon.

CHI-10 PUERTO OCTAY

Isotic fabric dominant all throughout the profile. The NRDP is porphyhri-phyric in the A horizon and porphyric in the others with the exception of the 2R horizon. The SRDP is congelic grading to agglutinic in some areas of the A horizon.

In the 2R horizon ("tuff") fabric is quite heterogenous, it consists of a ground mass of vitric yellowish vesicular altered pumice, and a grayish fine siliceous cemented volcanic material, enclosing grains. This grain is mainly volcanic rock fragments, plagioclases and quartz.

Compound packing voids are the most important, accompanied by channels, vughs and skew planes in the agglutinic areas.

Organic remains as skeleton are common all through the profile, the higher biological activity is evidenced by the presence of numerous fecal pellets filling voids.

Skeleton grains are scarce being quartz plagioclases followed by amphibol-pyroxene association in the first horizon. The skeleton is generally well preserved, although in the Bw_2 horizon plagioclases grains are cracked and corroded. Some of the quartz crystals are on a wedge shape. Besides in the AB horizon can be observed volcanic aphanitic rock fragments.

Fine sesquioxidic glaebules are described everywhere in the profile.

CHI-11 PUERTO MONTT

Typical isotic fabric throughout the profile with the exception of the duripan layers. The NRDP is generally porphyric and the SRDP congelic grading to agglutinic in some areas of the horizon.

The skeleton grains are rather scarce, compound mainly by quartz, plagioclases, amphybol-pyroxenes and traces of volcanic rock fragments in the A and B horizons. In the C horizon aphanitic and andesitic volcanic rock fragments are common. Some vitric volcanic yellowish patches are also present.

Intense biological activity is observed in the A and B/A horizons. Numerous pedotubules filled with fecal pellets that have an internal fabric similar to the soil fabric.

Highly decomposed organic remains as skeleton are common all through the profile.

Sesquioxidic glaebules and scarce lithorelicts arfe described everywhere in the profile.

CHI-12 ALERCE

The mineralogical characteristics of the Alerce soil series is very similar to Frutillar soil series. Soil plasmic fabric is isotic, the NRDP is porphyric in the A horizons and plasmi-porphyric in the B horizons. The SRDP is a congelic-agglutinic intergrade. Voids are composed of compound packing voids, channels, vughs and some skew planes.

The skeleton is scarce in the A and Bs_1 horizons increasing with depth. The skeleton grains are quartz, plagioclases, amphibol-pyroxenes and volcanic rock fragments including andesitic rocks.

The intense biological activity is evidenced by the numerouspedotubules filled of fecal pellets specially in the A and Bs_1 horizons.

The 2Cgs horizon has yellowish plasma, surrounding the skeleton formed of coarsed grains. This characteristic has been related to some weathering state of vitric volcanic materials. Some of the volcanic fragments are also altered presenting a cracked and corroded surface showing iron deposits.

CHI-13 CORTE ALTO

The micromorphological characteristics of this soil are similar to that of the Los Ulmos soil series. Soil plasmic fabaric is dominantly isotic. The NRDP is plasmi-porphyric in the A and B horizons and porphyric in the C. The SRDP is primarily agglutinic and secondary congelic where the biological activity is intense.

Skeleton grains are scarce in the A and B horizons increasing with depth. The grains are made up of quartz, plagioclases, amphibol-pyroxenes, and volcanic rock fragments in decreasing order of quantity. The last one incrfeases in the C horizons. Fine quartz crystals are of wedge shape.

Organic skeleton formed by roots remains and tissues debris are abundant in the A and B horizons.

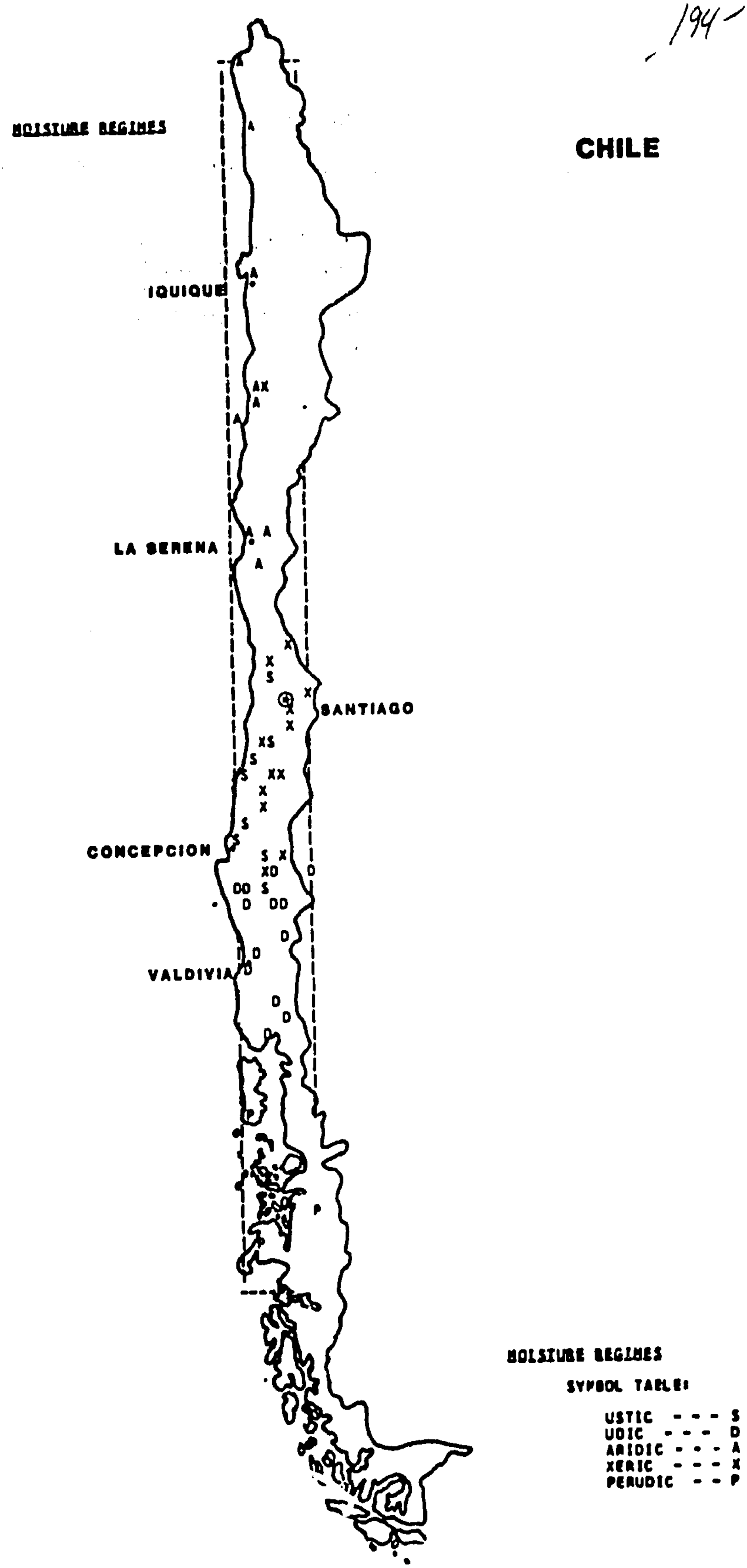
The system of voids is composed of channels, and skew planes dominantly and of compound packing voids in the first two horizons. In the B horizon are observed few thin cutans coating glaebules, coarse grains and void walls. These cutans have a continuous extinction and have the same fabric as the soil fabric.

Fine sesquioxidic glaebules of less than 0.2 mm are common in the soil profile.

Appendix II

Soil Moisture and Temperature Regimes

The following five pages show the determination of soil moisture and temperature regimes according to Franklin Newhall system of computation for selected stations in the Chile (Newhall, 1972). This information was taken from SMSS Technical Monograph No. 2, 1981 (Van Wambeke, 1981).


MOISTURE REGIMES
CHILE
IQUIQUE
LA SERENA
SANTIAGO
CONCEPCION
VALDIVIA
MOISTURE REGIMES
SYMBOL TABLE:
USTIC - - - S
UDIC - - - D
ARIDIC - - - A
XERIC - - - X
PERUDIC - - P

DETERMINATION OF SOIL MOISTURE REGIME ACCORDING TO FRANKLIN NEWHALL SYSTEM OF COMPUTATION

FOR CHIL

PAGE 1

NAME OF STATION	MEAN SOIL TEMPERATURE ANN	SUMM	WINT	TEMPERATURE REGIME	CUMULATIVE DAYS MSC IN ONE YEAR IS DRY	M/D	MOI	WHEN SOIL TEMP >5 DRY	M/D	MOI	MAX. CONSECUTIVE DAYS THAT MCS IS MOIST IN SOME PARTS IN ONE YEAR	WHEN SOIL TEMP > 8	DRY AFTER SUMMER SOLST.	MOIST AFTER WINTER SOLST.	MOISTURE REGIME
ANCUD	12.6	14.7	10.6	ISOMESIC	0	0	360	0	0	360	360	257	0	120	PERUDIC
ANGOL	15.4	18.9	12.4	THERMIC	54	76	230	54	76	230	306	222	54	120	XERIC
ANTOFAGASTA	18.9	21.1	17.1	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
ARICA	21.0	23.0	19.2	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
CABILDO	17.1	19.9	13.9	THERMIC	152	86	122	152	86	122	208	208	120	105	XERIC
CABORAPER	11.5	12.9	10.1	ISOMESIC	0	0	360	0	0	360	360	225	0	120	PERUDIC
CALDERA	18.8	21.0	16.8	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
CATAPILCO	17.1	19.9	13.9	THERMIC	130	65	165	130	65	165	230	230	115	120	XERIC
CAUQUENES	17.3	21.4	13.8	THERMIC	116	31	213	116	31	213	244	244	101	120	XERIC
CHANARAL	18.1	20.3	16.2	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
CHILLAN	15.5	19.3	12.1	THERMIC	53	76	231	53	76	231	307	173	53	120	XERIC
CONCEPCION	14.9	17.6	12.6	ISOMESIC	0	98	262	0	98	262	360	360	0	120	USTIC
CONSTITUCION	15.9	18.5	13.6	ISOTHERMIC	57	75	228	57	75	228	303	303	57	120	USTIC
CONTULMO	15.5	18.2	13.2	ISOTHERMIC	0	0	360	0	0	360	360	360	0	120	UDIC
COPIAPO	18.2	21.1	15.5	THERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
COQUIMBO	17.0	18.7	15.5	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
CURICO	16.2	20.3	12.6	THERMIC	114	31	215	114	31	215	246	160	99	120	XERIC
ELTENIENTE	12.6	16.1	9.1	MESIC	64	58	238	64	58	163	296	140	56	120	XERIC
FLORDELLAGO	14.0	16.9	11.4	MESIC	0	0	360	0	0	360	360	284	0	120	UDIC
FRUTILLAR	12.9	15.5	10.6	ISOMESIC	0	0	360	0	0	360	360	250	0	120	UDIC
IQUIQUE	20.3	21.9	18.7	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
ISANTAMARIA	15.5	17.1	13.9	ISOTHERMIC	18	98	244	18	98	244	342	342	18	120	USTIC
ISLAGUAFO	12.2	13.8	11.0	ISOMESIC	0	0	360	0	0	360	360	264	0	120	PERUDIC
ISLAMOCHA	15.2	17.2	13.6	ISOTHERMIC	0	14	346	0	14	346	360	360	0	120	UDIC
LACALERA	16.3	19.0	13.4	THERMIC	132	62	166	132	62	166	228	228	117	120	XERIC
LASERENA	16.6	18.7	14.8	ISOTHERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
LINARES	16.3	20.5	12.7	THERMIC	72	64	224	72	64	224	288	174	72	120	XERIC
LOLOL	22.1	26.5	17.7	HYPERTH.	142	24	194	142	24	194	218	218	120	120	USTIC
LONQUIMAY	10.8	14.5	6.9	MESIC	0	0	360	0	0	242	360	189	0	120	UDIC
LOSANGELES	15.8	19.7	12.5	THERMIC	9	113	238	9	113	238	351	207	9	120	USTIC
LOSANDES	18.3	22.3	14.3	THERMIC	151	51	158	151	51	158	209	209	120	120	XERIC
MAULLIN	12.2	14.3	10.4	ISOMESIC	0	0	360	0	0	360	360	249	0	120	UDIC
OVALLE	17.4	20.2	14.9	THERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
PANGUIPULLI	14.2	17.3	11.2	MESIC	0	0	360	0	0	360	360	280	0	120	UDIC
PENABLANCA	17.1	19.9	13.9	THERMIC	136	59	165	136	59	165	224	224	120	120	XERIC
PLENGUAVACA	19.3	22.1	16.6	THERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC
PUERTOAYSEN	11.4	14.0	8.4	MESIC	0	0	360	0	0	282	360	209	0	120	PERUDIC
PUERTOMONTT	13.5	15.9	11.3	ISOMESIC	0	0	360	0	0	360	360	288	0	120	UDIC
PUERTOSAAVED	14.4	16.5	12.9	ISOMESIC	0	3	357	0	3	357	360	360	0	120	UDIC
PUNTAGALERA	13.6	15.1	12.3	ISOMESIC	0	0	360	0	0	360	360	360	0	120	UDIC
PUNTATUMBES	14.5	16.3	13.3	ISOMESIC	69	57	234	69	57	234	291	291	54	120	USTIC
PUNTACARRANZ	14.9	16.5	13.6	ISOMESIC	78	51	231	78	51	231	282	282	63	120	USTIC
PUQUILLAY	16.7	19.7	13.8	THERMIC	110	44	206	110	44	206	250	250	95	120	XERIC
QUELLON	12.6	14.7	10.6	ISOMESIC	0	0	360	0	0	360	360	257	0	120	UDIC
QUILPUE	15.9	18.6	13.4	THERMIC	116	68	176	116	68	176	244	244	101	120	XERIC

COMPUTED BY FORTRAN PROGRAM VW08, APR 1981

DATE 04/29/81

DETERMINATION OF SOIL MOISTURE REGIME ACCORDING TO FRANKLIN NEWHALL SYSTEM OF COMPUTATION

FOR CHIL

NAME OF STATION	MEAN SOIL TEMPERATURE ANN	SUMM	WINT	TEMPERATURE REGIME	CUMULATIVE DAYS MSC IN ONE YEAR IS DRY	M/D	MOI	WHEN SOIL TEMP >5 DRY	M/D	MOI	MAX.CONSECUTIVE DAYS THAT MCS IS MOIST IN SOME PARTS IN ONE YEAR	WHEN SOIL TEMP > 8	DRY AFTER SUMMER SOLST.	MOIST AFTER WINTER SOLST.	MOISTURE REGIME
QUILLOTA	18.0	20.7	15.2	THERMIC	129	63	168	129	63	168	231	231	114	120	XERIC
RANCAGUA	15.5	19.4	11.7	THERMIC	121	63	176	121	63	176	239	133	106	120	XERIC
RENGO	16.6	20.4	12.7	THERMIC	118	35	207	118	35	207	242	183	103	120	XERIC
SANFERNANDO	15.9	19.7	12.3	THERMIC	110	33	217	110	33	217	250	158	95	120	XERIC
SANJOSEMAIPO	15.5	19.0	12.1	THERMIC	113	34	213	113	34	213	247	143	98	120	XERIC
SANPEDRO	11.1	13.2	9.2	ISOMESIC	0	0	360	0	0	360	360	196	0	120	PERUDIC
SANPABLO	12.4	14.9	10.0	ISOMESIC	0	0	360	0	0	360	360	239	0	120	UDIC
SANTIAGO	17.0	20.9	13.2	THERMIC	134	57	169	134	57	169	226	226	119	120	XERIC
TALCAHUANO	15.0	17.4	13.0	ISOMESIC	10	103	247	10	103	247	350	350	10	120	USTIC
TALCA	17.2	21.5	13.4	THERMIC	118	33	209	118	33	209	242	242	103	120	XERIC
TEMUCO	14.6	17.5	11.9	MESIC	0	3	357	0	3	357	360	322	0	120	UDIC
TRAIGUEN	14.9	18.2	12.1	MESIC	0	92	268	0	92	268	360	316	0	120	USTIC
VALDIVIA	14.4	17.4	11.9	MESIC	0	0	360	0	0	360	360	311	0	120	UDIC
VALPARAISO	16.9	19.0	15.2	ISOTHERMIC	117	69	174	117	69	174	243	243	102	120	USTIC
VICTORIA	12.9	15.8	10.2	MESIC	0	0	360	0	0	360	360	239	0	120	UDIC
VICUNA	18.1	20.7	15.5	THERMIC	360	0	0	360	0	0	0	0	120	0	ARIDIC

COMPUTED BY FORTRAN PROGRAM VWO8, APR 1981 DATE 04/29/81

DETERMINATION OF SOIL MOISTURE REGIME ACCORDING TO FRANKLIN NEWHALL SYSTEM OF COMPUTATION
FOR CHIL

NAME OF STATION	MOISTURE REGIME	CON.D. M/D T>8	TEMPERATURE REGIME	TENTATIVE SUBDIVISION OF MOISTURE REGIME		CONS DAYS MOIST(2+3) SUM.	CONS DAYS MOIST(2+3) WINT	CUM.DAYS MOIST(2+3) SUM.	CUM.DAYS MOIST(2+3) WINT	CONS.DAYS COMP.MOIST SUM.	CONS.DAYS COMP.MOIST WINT	CUM.DAYS COMP.MOI. SUM.	CUM.DAYS COMP.MOI. WINT
ANCUD	PERUDIC	257	ISOMESIC		PERUDIC					180	180	180	180
ANGOL	XERIC	222	THERMIC	TYPIC	XERIC	75	180	126	180				
ANTOFAGASTA	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
ARICA	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
CABILDO	XERIC	208	THERMIC	DRY	XERIC	45	163	45	163				
CABORAPER	PERUDIC	225	ISOMESIC		PERUDIC					180	180	180	180
CALDERA	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
CATAPILCO	XERIC	230	THERMIC	DRY	XERIC	45	180	50	180				
CAUQUENES	XERIC	244	THERMIC	DRY	XERIC	45	180	64	180				
CHANARAL	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
CHILLAN	XERIC	173	THERMIC	TYPIC	XERIC	75	180	127	180				
CONCEPCION	USTIC	360	ISOMESIC	UDIC	TROPUST.					56	180	82	180
CONSTITUCION	USTIC	303	ISOTHERMIC	UDIC	TROPUST.	75	180	123	180				
CONTULMO	UDIC	360	ISOTHERMIC	TYPIC	UDIC					180	180	180	180
COPIAPO	ARIDIC	0	THERMIC	EXTREME	ARIDIC	0	0	0	0				
COQUIMBO	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
CURICO	XERIC	160	THERMIC	DRY	XERIC	45	180	66	180				
ELTENIENTE	XERIC	140	MESIC	TYPIC	XERIC	64	180	116	180				
FLORDELLAGO	UDIC	234	MESIC	TYPIC	UDIC					180	180	180	180
FRUTILLAR	UDIC	250	ISOMESIC	TYPIC	UDIC					180	180	180	180
IQUIQUE	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
ISANTAMARIA	USTIC	342	ISOTHERMIC	UDIC	TROPUST.	87	180	162	180				
ISLAGUAFO	PERUDIC	264	ISOMESIC		PERUDIC					180	180	180	180
ISLAMOCHA	UDIC	360	ISOTHERMIC	TYPIC	UDIC					105	180	166	180
LACALERA	XERIC	228	THERMIC	DRY	XERIC	45	180	48	180				
LASERENA	ARIDIC	0	ISOTHERMIC	EXTREME	ARIDIC	0	0	0	0				
LINARES	XERIC	174	THERMIC	TYPIC	XERIC	75	180	108	180				
LOLOL	USTIC	218	HYPERTH.	XERIC	TEMPUST.	45	173	45	173				
LONQUIMAY	UDIC	189	MESIC	TYPIC	UDIC					180	180	180	180
LOSANGELES	USTIC	207	THERMIC	WET	TEMPUST.	105	180	171	180				
LOSANDES	XERIC	209	THERMIC	DRY	XERIC	45	164	45	164				
MAULLIN	UDIC	249	ISOMESIC	TYPIC	UDIC					180	180	180	180
OVALLE	ARIDIC	0	THERMIC	EXTREME	ARIDIC	0	0	0	0				
PANGUIPULLI	UDIC	280	MESIC	TYPIC	UDIC					180	180	180	180
PENABLANCA	XERIC	224	THERMIC	DRY	XERIC	45	179	45	179				
PLENGUAVACA	ARIDIC	0	THERMIC	EXTREME	ARIDIC	0	0	0	0				
PUERTOAYSEN	PERUDIC	209	MESIC		PERUDIC					180	180	180	180
PUERTOMONTT	UDIC	288	ISOMESIC	TYPIC	UDIC					180	180	180	180
PUERTOSAAVEC	UDIC	360	ISOMESIC	TYPIC	UDIC					105	180	177	180
PUNTAGALERA	UDIC	360	ISOMESIC	TYPIC	UDIC					180	180	180	180
PUNTATUMBES	USTIC	291	ISOMESIC	UDIC	TROPUST.	66	180	111	180				
PUNTACARRANZ	USTIC	282	ISOMESIC	UDIC	TROPUST.	57	180	102	180				
PUQUILLAY	XERIC	250	THERMIC	DRY	XERIC	45	180	70	180				
QUELLON	UDIC	257	ISOMESIC	TYPIC	UDIC					180	180	180	180
QUILPUE	XERIC	244	THERMIC	DRY	XERIC	45	180	64	180				

COMPUTED BY FORTRAN PROGRAM VN08, APR 1981

DATE 04/29/81

DETERMINATION OF SOIL MOISTURE REGIME ACCORDING TO FRANKLIN NEWHALL SYSTEM OF COMPUTATION

FOR CHIL

NAME OF STATION	MOISTURE REGIME	CON.D. M/D T>8	TEMPERATURE REGIME	TENTATIVE SUBDIVISION OF MOISTURE REGIME		CONS DAYS MOIST(2+3) SUM.	CONS DAYS MOIST(2+3) WINT	CUM.DAYS MOIST(2+3) SUM.	CUM.DAYS MOIST(2+3) WINT	CONS.DAYS COMP.MOIST SUM.	CONS.DAYS COMP.MOIST WINT	CUM.DAYS COMP.MOI. SUM.	CUM.DAYS COMP.MOI. WINT
QUILLOTA	XERIC	231	THERMIC	DRY	XERIC	45	180	51	180				
RANCAGUA	XERIC	133	THERMIC	DRY	XERIC	45	180	59	180				
RENGO	XERIC	183	THERMIC	DRY	XERIC	45	180	62	180				
SANFERNANDO	XERIC	158	THERMIC	DRY	XERIC	45	180	70	180				
SANJOSEMAIPO	XERIC	143	THERMIC	DRY	XERIC	45	180	67	180				
SANPEDRO	PERUDIC	196	ISOMESIC		PERUDIC					180	180	180	180
SANPABLO	UDIC	239	ISOMESIC	TYPIC	UDIC					180	180	180	180
SANTIAGO	XERIC	226	THERMIC	DRY	XERIC	45	180	46	180				
TALCAHUANO	USTIC	350	ISOMESIC	UDIC	TROPUST.	95	180	170	180				
TALCA	XERIC	242	THERMIC	DRY	XERIC	45	180	62	180				
TEMUCO	UDIC	322	MESIC	TYPIC	UDIC					105	180	177	180
TRAIGUEN	USTIC	316	MESIC	WET	TEMPUST.					54	180	88	180
VALDIVIA	UDIC	311	MESIC	TYPIC	UDIC					180	180	180	180
VALPARAISO	USTIC	243	ISOTHERMIC	TYPIC	TROPUST.	45	180	63	180				
VICTORIA	UDIC	239	MESIC	TYPIC	UDIC					180	180	180	180
VICUNA	ARIDIC	0	THERMIC	EXTREME	ARIDIC	0	0	0	0				

COMPUTED BY FORTRAN PROGRAM VW08, APR 1981

DATE 04/29/81

Appendix III

In this appendix, eleven pages called a data sheet packet--an explanation is included. If you have any questions concerning the data sheet, these pages should be reviewed.

DATA SHEET PACKET - AN EXPLANATION

WARWICK

SAMPLED AS: LOAMY-SKELETAL, MIXED, MESIC TYPIC DYSTROCHREPT

S 78VT-025 -002 SAMPLE NOS. 78P1791 - 1796 DATE 6/ 5/79

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SPODOSOL STUDY WINDHAM COUNTY

GENERAL METHODS 1B1A, 2A1, 2B

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1- TOTAL CLAY LT .002	-2- TOTAL SILT .002 -.05	-3- TOTAL SAND .05 -2	-4- CLAY FINE LT .0002	-5- CLAY CO3 LT .002	-6- SILT FINE .002 -.02	-7- SILT COARSE .02 -.05	-8- SAND VF .05 -.10	-9- SAND F .10 -.25	-10- SAND M .25 -.50	-11- SAND C .5 -1	-12- SAND VC 1 -2	-13- COARSE FRACTIONS (MM) WEIGHT 2 -5	-14- WEIGHT 5 -20	-15- WEIGHT 20 -75	-16- .1- 75	-17- (>2MM) WT PCT OF WHOLE SOIL
				<- PCT OF <2MM (3A1)											->	<- PCT OF <75MM (3B1)			->	SOIL
781791	1S	0- 5	A1	11.9	38.5	49.6			22.4	16.1	12.8	11.7	5.4	8.1	11.6	7	13	5	53	25
781792	2S	5- 23	B21IR	10.4	39.0	50.6			21.2	17.4	12.1	10.4	5.5	7.8	14.8	5	27	48	88	93
781793	3S	23- 35	B22	11.3	42.6	46.1			23.4	19.2	12.4	11.4	4.6	6.9	10.8	6	11	19	56	56
781794	4S	35- 50	B23	10.4	38.9	50.7			20.3	18.6	11.4	9.8	5.5	9.0	15.0	7	20	37	78	78
781795	5S	50- 61	B3	7.4	23.8	68.8			12.7	11.1	6.4	8.7	7.3	15.9	30.5	10	29	35	90	79
781796	6S	61-117	2C	5.7	7.8	86.5			4.5	3.3	3.4	10.0	12.4	27.4	33.3	10	30	37	96	85

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B1B	EXTR P 6S1A	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	DITH-CIT EXTRACTABLE AL 6G7A	DITH-CIT EXTRACTABLE MN 6D2A	(RATIO/CLAY) CEC 8D1	(RATIO/CLAY) 15 BAR 8D1	(ATTERBERG) LIMITS LL 4F1	(ATTERBERG) LIMITS PI 4F	BULK DENSITY FIELD MOIST 4A3A	BULK DENSITY 1/3 BAR 4A1D	BULK DENSITY OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	WATER CONTENT FIELD MOIST 4B4	WATER CONTENT 1/10 BAR 4B1C	WATER CONTENT 1/3 BAR 4B1C	WATER CONTENT 15 BAR 4B2	WRD WHOLE SOIL 4C1
		<- PCT OF <2MM						->			PCT <0.4MM		<- G/CC		->	CM/CM	<- PCT OF <2MM			->	CM/CM
781791	1	5.59	0.208			1.8	0.3		2.81	1.32				0.90						15.7	
781792	2	2.41	0.113			1.9	0.7		1.26	0.92				0.98	1.01	0.010			34.7	9.6	0.25
781793	3	1.33	0.064			1.8	0.5		0.61	0.60	31	1		1.17	1.20	0.008			30.0	6.8	0.27
781794	4	0.91	0.053			1.7	0.4		0.55	0.53				1.20						5.5	
781795	5	0.58				1.1	0.3		0.62	0.58				1.50						4.0	
781796	6	0.41				0.7	0.2		0.63	0.93				1.60						5.3	

SAMPLE NO.	HZN NO.	NH4OAC EXTRACTABLE BASES CA 5B4A 6N2E	MG 5B4A 6O2D	NA 5B4A 6P2B	K 5B4A 6Q2B	SUM BASES	ACIDITY 6H2B	EXTR AL 6G1E	CEC SUM CATS 5A3A	CEC NH4-OAC 5A8A	CEC BASES + AL 5A3B	AL SAT 5G1	BASE SAT SUM 5C3	BASE SAT NH4 OAC 5C1	CO3 AS CACO3 <2MM 6E1D	RES. OHMS /CM 8E1	PH CACL2 .01M 8C1E 1:2	PH H2O 8C1A 1:1
		<- MEQ / 100 G									->	<- PCT		->				
781791	1	0.3	0.2	--	--	0.5	38.9	7.5	39.4	33.4	8.0	94	1	1			3.2	3.5
781792	2	0.1	--	--	--	0.1	22.0	3.5	22.1	13.1	3.6	97	TR	1			4.0	4.1
781793	3	TR	--	--	--	TR	11.7	2.2	11.7	6.9	2.2	100	TR	TR		23000	4.2	4.3
781794	4	TR	--	--	--	TR	10.2	2.0	10.2	5.7	2.0	100	TR	TR			4.2	4.3
781795	5	--	--	--	--	--	7.6	1.1	7.6	4.6	1.1	100	TR	TR			4.4	4.4
781796	6	TR	--	--	--	TR	5.2	0.6	5.2	3.6	0.6	100	TR	1			4.4	4.5

SAMPLE NO.	HZN NO.	SPODIC HORIZON CRITERIA NA PYROPHOSPHATE EXTRACTABLE C 6A4A	FE 6C5A	AL 6G5A	FE+AL (DIVIDED BY) DI-CI FE+AL	FE+AL (DIVIDED BY) PCT CLAY	AL+C (DIVIDED BY) PCT CLAY	INDEX OF ACCUM	MINERALOGY CLAY X-RAY 7A2B	7A2B	7A2B	7A2B	DTA 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM		->					<- RELATIVE AMOUNTS			->	<- PCT			->
781791	1		1.1	0.2	0.6	0.1		167								
781792	2	1.8	0.6	0.5	0.8	0.1	0.2	304								
781793	3		0.2	0.3	0.2	TR		73								
781794	4		0.2	0.2	0.2	TR		75								
781795	5		0.2	0.2	0.3	0.1		43								
781796	6		0.1	0.2	0.3	0.1		132								

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 7.6 PCT .1-75MM 86.4. SPODIC HORIZON: INDEX OF ACCUMUL 0

ESTIMATED BULK DENSITY FOR LAYER 1, 4, 5, 6,

ANALYSES: S= ALL ON SIEVED <2MM BASIS

DATA SHEET HEADING

WARWICK

SAMPLED AS: LOAMY-SKELETAL, MIXED, MESIC TYPIC DYSTROCHREPT

S 78VT-025 -002 SAMPLE NOS. 78P1791 - 1796 DATE NOVEMBER, 1979

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

SPODOSOL STUDY WINDHAM COUNTY

GENERAL METHODS 1B1A, 2A1, 2B

Warwick
Name of the soil series, pedon sampled to represent.

Sampled As
Classification (field) of pedon at time of sampling.

Pedon number S78 VT-025-002
- S = special sample
- 78 = calendar year sampled
- VT = state where sampled - 2-letter FIPS code for state where sampled
- 025 = FIPS county code
- 002 = consecutive pedon number for calendar year for county

Sample numbers--NSSL assigned numbers.
- 78 = year (FY)
- P = permanent storage of data on NSSL computer disk (T = temporary storage)
- 1791 = last four digits is consecutive sample number (NSSL)

Date-date of printout

Project name and/or county sampled.

General methods for soil preparation--see SSIR No. 1.

General conventions. Unless otherwise specified analyses are calculated to an oven dry weight base. Therefore, if analyses are reported on a < 2 mm base, it means that analyses are on all particles < 2 mm in size and results are calculated using an oven dry sample weight. Conversely, if the analyses are reported on a whole soil base, it means that the analyses are for all particles with coarse fragments included, and are calculated using an oven dry sample weight.

Footnotes

FAMILY CONTROL SECTION: DEPTH 25- 71 PCT CLAY 51 PCT .1-75MM 2

ANALYSES: S= ALL ON SIEVED <2MM BASIS

MINERALOGY: KIND OF MINERAL MI MICA MT MONTMORILL KK KAOLINITE CL CHLORITE QZ QUARTZ

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

Family control section: Depth limits of control section; calculated weighted average % clay of control section; and calculated weighted average % 0.1-75 mm fraction for use in determining loamy vs. silty particle size class.

Estimated bulk densities for layer: . . . self explanatory.

Analyses: Tier 1, column 1 provides explanation of soil preparation code.

Mineralogy: Identifies clay mineralogy codes and relative amount codes.

Tier 1

	-1-	-2-	-3-	-4-	-5-	-6-	-7-	-8-	-9-	-10-	-11-	-12-	-13-	-14-	-15-	-16-	-17-	-18-	-19-	-20-
				(- - -TOTAL	- - -	-)	(- -CLAY-	-)	(- -SILT-	-)	(- - - -	- -SAND-	-	- - - - -)	(-COARSE	FRACTIONS(MM)	-)			(>2MM)
				CLAY	SILT	SAND	FINE	CO3	FINE	COARSE	VF	F	M	C	VC	- - - -	WEIGHT	- - - -		WT
SAMPLE	HZN	DEPTH	HORIZON	LT	.002	.05	LT	LT	.002	.02	.05	.10	.25	.5	1	2	5	20	.1-	PCT OF
NO.	NO.	(CM)		.002	-.05	-2	.0002	.002	-.02	-.05	-.10	-.25	-.50	-1	-2	-5	-20	-75	75	WHOLE
				<- - - - - - -	- - - - - - -	PCT OF <2MM	(3A1)	- - - -	- - - -	- - - -	- - - -	- - - -	- - ->	<- PCT OF	<75MM(3B1)	->		SOIL
781791	15	0- 5	A1	11.9	38.5	49.6			22.4	16.1	12.8	11.7	5.4	8.1	11.6	7	13	5	53	25

General: First two columns (unnumbered columns) are the same for each tier. The first column on the left is the NSSL sample number, the second number is the horizon number. Except for columns 1-3, tier 1 is entirely particle size and coarse fragment data. Particle size distribution (columns 4-15) is reported on the < 2 mm fraction and is determined after destruction of organic matter, washing free of soluble salts, drying the sample, and obtaining a base weight, and dispersion with sodium hexametaphosphate.

Column 1. Space after horizon number for two letter preparation code.
S = standard preparation. Coarse fragments > 2 mm weighed and discarded from sample shipped to lab.
SP = same as "S" but clod parameters (tier 2, columns 12-14 and 16-18) reported on a whole soil base. Often used in soils with soft shale, tuft, or other water holding coarse fragments.
SK = same as "S" except 2-20 mm fractions are ground to < 2 mm and kept. Analysis of 2-20 mm fraction is combined with analysis of < 2 mm and reported as < 20 mm base. Often used for calcium carbonate and for gypsum; i.e., calcic horizon with hard concretions, see Soil Taxonomy, p. 387.
SR = same as "SK" except 2-20 mm fractions recombined with < 2 mm fraction. Results reported on < 20 mm base.
GP = entire sample ground. Results reported on whole soil base.
WP = same as "GP" except > 2 mm fractions sieved and weighed before grinding to < 2 mm and recombining with < 2 mm material. Results reported on whole soil base.

Column 2. Depth in cm.

Column 3. Horizon notation. Arabic numbers are used instead of Roman Numerals. Printed horizon designation may be truncated since only six spaces available for notation. The entire notation is stored in computer.

Column 4. % total clay. Particles < 0.002 mm. Sedimentation and pipette analysis.

Column 5. % total silt. Particles 0.002 mm to 0.05 mm. Sedimentation and pipette analysis.

Column 6. % total sand. Particles 0.05 mm to 2.0 mm. Sieve analysis.

Column 7. % fine clay. Particles < 0.0002 mm. Centrifugation and pipette analysis.

Column 8. % carbonate clay. Carbonate < 0.002 mm. Sedimentation and pipette analysis, HCl treatment, and CO_2 evolution. Subtracted from col. 4 to obtain % noncarbonate clay when determining taxonomic particle size class. See Soil Taxonomy, p. 384, footnote 1.

Column 9. % fine silt. Particles 0.002 mm to 0.02 mm. Sedimentation and pipette analysis.

Column 10. % coarse silt. Particles 0.02 mm to 0.05 mm. By difference--coarse silt = [100-(% clay + % fine silt + % sand)].

Column 11. % very fine sand (VFS). Particles 0.05 mm to 0.1 mm. Sieve analysis. Treated as silt to distinguish loamy and silty particle size classes. See Soil Taxonomy, p. 383.

Column 12. % fine sand (FS). Particles 0.1 mm to 0.25 mm. Sieve analysis.

Column 13. % medium sand (MS). Particles 0.25 mm to 0.5 mm. Sieve analysis.

Column 14. % coarse sand (CS). Particles 0.5 to 1.0 mm. Sieve analysis.

Column 15. % very coarse sand (VCS). Particles 1 mm to 2 mm. Sieve analysis.

Column 16. Weight % coarse fragments 2 mm to 5 mm. Reported on < 75 mm base. Sieve analysis.

Column 17. Weight % coarse fragments 5 mm to 20 mm. Reported on < 75 mm base. Sieve analysis.

Column 18. Weight % coarse fragments 20 mm to 75 mm. Reported on < 75 mm base. Sieve analysis in field (at least 20 kg sampled needed) or calculated from volume estimates.

Column 19. Weight % particles and fragments 0.1 mm to 75 mm. Reported on < 75 mm base. Sieve analysis and/or estimates of > 20 mm fraction. Used to distinguish loamy and silty particle size classes (see p. 384, Soil Taxonomy).

Column 20. Weight % fragments > 2 mm. Reported on whole soil base. Includes fragments from 2 mm to 250 mm in size. Calculated from sieve analysis and volume estimates. Used to convert analysis on < 2 mm base to whole soil base by formula:

datum whole soil = datum < 2 mm x [1-(col. 20/100)].

Coarse fragments assumed diluents in this equation.

Tier 2

SAMPLE NO.	NSS NO.	-1- ORGN C 6A1C	-2- TOTAL N 6B1B	-3- EXTR P 6S1A	-4- TOTAL S 6R3A	-5- DITH-CIT EXTRACTABLE FE 6C2B	-6- DITH-CIT EXTRACTABLE AL 6G7A	-7- DITH-CIT EXTRACTABLE MN 6D2A	-8- (RATIO/CLAY) CEC 8D1	-9- (RATIO/CLAY) 15 BAR 8D1	-10- (ATTERBERG LIMITS) LL 4F1	-11- (ATTERBERG LIMITS) PI 4F	-12- BULK DENSITY FIELD MOIST 4A3A	-13- BULK DENSITY 1/3 BAR 4A1D	-14- BULK DENSITY OVEN DRY 4A1H	-15- COLE WHOLE SOIL 4D1	-16- WATER CONTENT FIELD MOIST 4B4	-17- WATER CONTENT 1/10 BAR 4B1C	-18- WATER CONTENT 1/3 BAR 4B1C	-19- WATER CONTENT 15 BAR 4B2	-20- WRD WHOLE SOIL 4C1
		<- - - - - - -PCT OF <2MM	-	-	-	-	-	- - ->			PCT <0.4MM		<- - G/CC	- -	->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
78 781	1	1.57	0.143						0.71	0.33	49	25		1.29	1.55	0.063			25.8	16.2	0.12

General: Unless otherwise noted, analyses are reported on < 2 mm base.

Column 1. % organic carbon. Wet combustion analysis (Walkley-Black). Multiply % organic carbon by 1.7 to estimate organic matter.

Column 2. % total nitrogen. Kjeldahl digestion analysis. Carbon/nitrogen ratios ≈ 10-12 in mollic epipedons. Higher ratios may indicate a nitrogen immobilization problem.

Column 3. % total extractable phosphorous. Perchloric acid digestion. Presently not determined at NSSL.

Column 4. % total sulfur. Leco ignition, KIO_3 titration. Used to assess potential acidity in sulfidic soils or mine spoils.

Column 5. % iron. Dithionite-citrate extractable (Fe DI-CI). Commonly called "free iron." Used in spodic horizon criteria.

Column 6. % aluminum. Dithionite-citrate extractable (Al DI-CI). Used in spodic horizon criteria.

Column 7. % manganese. Dithionite-citrate extractable.

Column 8. CEC-7/clay ratio. Ratio of CEC-7 (Tier 3, col. 9) to total clay (Tier 1, col. 4). Related to activity of clay fraction.

Column 9. 15-bar/clay ratio. Ratio of 15-bar water (Tier 2, col. 19) to total clay (Tier 1, col. 4). If clay > 10% and if organic carbon/clay (Tier 2, col. 1/Tier 1, col. 4) is < 0.1, ratio should be between 0.3 and 0.5. Ratios > 0.6 may indicate a dispersion problem. See p. 384, footnote 1, Soil Taxonomy.

Column 10. Liquid limit reported on < 0.4 mm base. Used in Unified and AASHO engineering classifications.

Column 11. Plasticity index reported on < 0.4 mm base. Calculated by liquid limit (col. 10) minus plastic limit. Used in Unified and AASHO engineering classifications.

Column 12. Bulk density at field moisture content g/cc (dry wt./moist vol.). Measured on natural fabric clod.

Column 13. Bulk density at 1/3-bar or 1/10-bar moisture content g/cc (dry wt./moist vol.) Measured on natural fabric clod. Used on SCS-SOILS-5. 1/10 bar run on sandy soils that have 15-bar moisture (tier 2, col 19) < 5% throughout

Column 14. Ovendry bulk density g/cc (dry wt/dry vol.). Measured on natural fabric clod.

Column 15. COLE. Coefficient Of Linear Extensibility whole soil base. Calculated from increase in bulk density between moist (tier 2, col. 13) and ovendry conditions (tier 2, col. 14). Used in determining shrink-swell potential for SCS-SOILS-5 or total potential linear extensibility for vertic subgroups. Total potential extensibility equals horizon thickness in cm x COLE; summed for each horizon to the depth in question (assumes no large cracks between air-dryness and 1/3-bar moisture and that coarse fragments are diluents)

Column 16. Weight % field moisture content (wt. H_2O/dry wt. soil x 100).

Column 17. Weight % moisture content at 1/10-bar tension. Calculated from water retained in natural fabric clods for loamy and clayey soils and from water in < 2 mm sample for sandy soils. Used to represent field capacity for sandy soils.

Column 18. Weight % moisture content at 1/3-bar tension. Calculated from water retained in natural fabric clods. Used to represent field capacity for loamy and clayey soils.

Column 19. Weight % moisture content at 15-bar tension. Calculated from water retained in < 2 mm soil sample. Represents the wilting point.

Column 20. Water Retention Difference (WRD) Reported as cm of water per cm depth of soil. Volume fraction for whole soil of water between 15 bar and an upper limit, usually 1/3 bar but 1/10 bar for sandy soils. After adjustment for salts (tier 4, col. 11 salt sheet) and root exfoliation, WRD provides estimate of Available Water Capacity (AWC)

Tier 3

ACID

SAMPLE NO.	HZN NO.	-1- (- NH4OAC EXTRACTABLE BASES -) CA 5B4A 6N2E	-2- MG 5B4A 6O2D	-3- NA 5B4A 6P2B	-4- K 5B4A 6Q2B	-5- SUM BASES	-6- ACIDITY 6H2B	-7- EXTR AL 6G1E	-8- (- CEC -) SUM CATS 5A3A	-9- NH4-OAC 5A8B	-10- BASES + AL 5A3B	-11- AL SAT 5G1	-12- -BASE SAT- SUM 5C3	-13- NH4 OAC 5C1	-14- CO3 AS CACO3 <2MM 6E1B	-15- RES. OHMS /CM 8E1	-16-	-17-	-18-	-19- (- PH -) CACL2 .01M 8C1E 1:2	-20- H2O 8C1A 1:1
		<- - - - - - - - - - - - - MEQ / 100 G									- - - ->	<- - - - PCT - - - ->									
781793	3	TR	—	—	—	TR	11.7	2.2	11.7	6.9	2.2	100	TR	TR		23000				4.2	4.3

SALT

SAMPLE NO.	HZN NO.	-1- (- NH4OAC EXTRACTABLE BASES -) CA 5B4A 6N2E	-2- MG 5B4A 6O2D	-3- NA 5B4A 6P2B	-4- K 5B4A 6Q2B	-5- SUM BASES	-6- ACIDITY 6H2B	-7-	-8- (- CEC -) SUM CATS 5A3A	-9- NH4-OAC 5A6A	-10- EXCH NA 5D2 PCT	-11- SAR 5E	-12- BASE SATURATION SUM 5C3	-13- NH4OAC 5C1	-14- CARBONATE AS CACO3 <2MM 6E1D	-15- <20MM	-16- CASO4 AS GYPSUM <2MM 6F1C	-17- <20MM 6F1C	-18- (- PH -) SAT PASTE 8C1B	-19- CACL2 .01M 8C1E 1:2	-20-
		<- - - - - - - - - - MEQ / 100 G								- - - ->			<- -PCT- >		<- -PCT ->		<- -PCT ->				
78781	1		5.3	0.1	1.1					35.3	TR	TR			1				7.7		

General: The NSSL has acid and salt data sheet formats. The first two tiers are the same for each format, but tiers 3 and 4 differ. All analysis on tier 3 are reported on the < 2 mm base. Columns 1 through 4 are bases extractable in normal ammonium acetate (N NH_4OAc) at pH 7 (CEC-7).

Column 1. NH_4OAc extractable calcium (Ca) meq/100 g. Note that Ca is not reported for horizon 1 salt sheet because the sample is calcareous. NH_4OAc dissolves and extracts Ca from carbonates, gypsum, and other soluble salts. Commonly used as soil test for Ca. Convert to Kg/Ha = Ca meq/100/g x 20 x thickness in cm x bulk density (tier 2, col. 13) x [1-(Vol. > 2 mm/100)].

Column 2. NH_4OAc extractable magnesium (Mg) meq/100 g. Commonly used as soil test for Mg. Convert to kg/ha = Mg meq/100g x 12 x thickness (cm) x bulk density (tier 2, col. 13) x [1-(Vol. > 2 mm/100)].

Column 3. NH_4OAc extractable sodium (Na) meq/100 g.

Column 4. NH_4OAc extractable potassium (K) meq/100 g. Common soil test for K. Convert to kg/ha = K meq/100 g x 39 x thickness (cm) x bulk density (tier 2, col. 13) x [1-(Vol. > 2 mm/100)].

Column 5. Sum of bases (Ca + Mg + Na + K) extractable by N NH_4OAc (Cols. 1+2+3+4).

Column 6. Extractable acidity measured at pH 8.2 meq/100 g.

Column 7. Normal potassium chloride (KCl) extractable aluminum (Al) meq/100 g (acid sheet only; blank on salt sheet). Normally little present if pH > 5 (col. 20).

Column 8. Cation Exchange Capacity at pH 8.2 (CEC-8.2). Calculated by summing NH_4OAc extractable bases (col. 5) and extractable acidity (col. 6). Not reported on salt sheet for horizons with carbonates or soluble salts.

Column 9. CEC at pH 7 (CEC-7). Measured by retention of ammonium by soil at pH 7.

Column 10. Acid sheet. Bases plus Al (CEC-unbuffered). Calculated by summing NH_4OAc extractable bases (col. 5) and KCl extractable Al (col. 7). Commonly called effective CEC of acid soils.

Column 10. Salt sheet. Exchangeable Sodium Percentage (ESP). Calculated by dividing extractable Na (col. 3) by CEC-7 (col. 9) and multiplying by 100. Extractable Na is adjusted for soluble Na (Tier 4, col. 3) if present, NH_4OAc will extract both exchangeable and soluble Na. Calculated, Exchangeable Na = Extractable Na meq/100g - [(soluble Na meq/l)(SP-Tier 4, col. 10 salt sheet)÷1000]. Used as natric horizon criteria.

Column 11. Acid sheet. % aluminum saturation. Calculated by dividing KCl extractable Al (col. 7) by bases plus Al (col. 10) and multiplying by 100. Considered root limiting if ≥ 60%.

Column 11. Salt sheet. Sodium Absorption Ratio (SAR). SAR = Na (Tier 4, col. 3)/$\sqrt{(Ca + Mg)/2}$ (Tier 4, cols. 1+2). Criteria for natric horizon and used in assessing salinity problems. Set up to assess quality of irrigation water.

Column 12. % base saturation, sum of cations. Calculated by dividing sum of bases (col. 5) by CEC-8.2 (col. 8) and multiplying by 100. Used in most alfic-ultic separations in Soil Taxonomy

Column 13. % base saturation, NH_4OAc. Calculated by dividing sum of bases (col. 5) by CEC-7 (col. 9) and multiplying by 100. Used in mollic, umbric, and eutro-dystro breaks in Soil Taxonomy.

Column 14. % calcium carbonate equivalent. Carbonates of Ca + Mg analyzed. Expressed as $CaCO_3$ equivalent. Used to assess calcic horizons and mineralogy class.

Column 15. Resistivity ohms/cm. Determined on saturated paste. Used to determine potential hazard for corrosion of uncoated steel.

Column 16. Salt sheet. % $CaSO_4$ as gypsum < 2 mm base. Used to determine potential hazard for corrosion of concrete, also to assess gypsic horizons and mineralogy class.

Column 17. Salt sheet. % $CaSO_4$ as gypsum < 20 mm base. Used in mineralogy class--see Taxonomy p. 387.

Column 18. Acid sheet. pH 1:1 N KCl or NaF pH. KCl pH used as indicator of net negative charge. Commonly 1 unit less than pH in 1:1 soil-water suspension. NaF pH > 10 indicates presence of structually weak Al associated with allophane, organic matter, or halloysite.

Column 18. Salt sheet. pH of saturated paste.

Column 19. pH in 1:2 soil-0.01 M calcium chloride ($CaCl_2$) suspension. Used to eliminate possible seasonable variations in pH. Normally about 0.5 units below the 1:1 soil-water pH (col. 20) but may be greater for acid soils. Relates somewhat with base saturation when BS > 60%; ie, if $CaCl_2$ pH is 6.0, NH_4OAc base saturation is commonly > 75%; if pH is > 7.5, the soil is normally saturated with bases. Used in reaction classes--see Soil Taxonomy pp. 388, 390.

Column 20. pH in 1:1 soil-water suspension. Normally varies according to season of the year.

Tier 4

-1-- -2-- -3-- -4-- -5-- -6-- -7-- -8-- -9-- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

ACID

SAMPLE NO.	HZN NO.	SPODIC HORIZON CRITERIA: NA PYROPHOSPHATE EXTRACTABLE C 6A4A (PCT OF <2MM)	FE 6C5A	AL 6G5A	FE+AL DIVIDED BY DI-CI FE+AL	FE+AL DIVIDED BY PCT CLAY	AL+C DIVIDED BY PCT CLAY	INDEX OF ACCUM	MINERALOGY: CLAY X-RAY 7A2B (RELATIVE AMOUNTS)	7A2B	7A2B	7A2B	CLAY DTA 7A3 (PCT)	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
781791	1		1.1	0.2	0.6	0.1	.	167								
781792	2	1.8	0.6	0.5	0.4	0.1	0.2	304								

SALT

SAMPLE NO.	HZN NO.	WATER EXTRACTED FROM SATURATED PASTE: CA 6N1B (MEQ / LITER)	MG 6O1b	NA 6P1B	K 6Q1B	CO3 6I1B	HCO3 6J1B	CL 6K1C	SO4 6L1C	NO3 6M1C	H2O 8A (PCT)	TOTAL SALTS EST. 8D5 (PCT)	ELEC. COND. 8A1A (MMHOS /CM)	MINERALOGY: CLAY X-RAY <2U 7A2B (RELATIVE AMOUNTS)	7A2B	7A2B	7A2B	CLAY DTA <2U 7A3 (PCT)	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
78 784	4	24.0	14.5	0.7	0.3		1.2	TR	41.4		58.0	0.1	2.80	MT 3	MI 3	KK 3	CL 1	KK18 '			

General: The first 12 columns of the acid and salt data sheets differ and are discussed separately. All analyses in tier 4 except mineralogy are reported on the < 2 mm base. Clay mineralogy is reported on total clay base unless otherwise noted. Grain counts are on base of fraction(s) specified in heading.

ACID

Column 1. % sodium pyrophosphate (0.1 M $Na_4P_2O_7$) extractable carbon (C-pyro). Used in spodic horizon criteria with < 0.1% Fe-Pyro (col. 2).

Column 2. % sodium pyrophosphate extractable iron (Fe-pyro). Used in spodic horizon criteria. Usually considered to be iron associated with organic matter.

Column 3 Sodium pyrophosphate extractable aluminum (Al-pyro). Used in spodic horizon criteria.

Column 4. Pyrophosphate Fe+Al/dithionite citrate Fe+Al ratio. Calculated by dividing Fe-Pyro + Al-pyro (cols. 2+3) by Fe DI-CI + Al DI-CI (tier 2, cols. 5+6). Used in spodic horizon criteria.

Column 5. Pyrophosphate Fe+Al/clay ratio. Calculated by dividing Fe-pyro + Al-pyro (cols. 2+3) by % clay (tier 1, col. 4) Used in spodic horizon criteria.

Column 6. Pyrophosphate Al plus carbon/clay ratio. Calculated by dividing C-pyro + Al-pyro (cols. 1+3) by % clay (tier 1, col. 4). Used when column 2 < 0.1.

Column 7. Index of accumulation of spodic horizon. Calculated by subtracting 1/2 clay % (tier 1, col. 4) from CEC-8.2 (tier 3, col. 8) and multiplying by thickness (cm) of subhorizon. Total index is sum of all subhorizons of spodic horizon. See Soil Taxonomy p. 32 for limits of spodic horizon.

SALT

Column 1-9 are soluble cations and anions (salts) in a water extract from a saturated soil paste.

Column 1 Water soluble Ca meq/1.

Column 2. Water soluble Mg meq/1.

Column 3. Water soluble Na meq/1.

Column 4 Water soluble K meq/1.

Column 5. Water soluble carbonate (CO_3) meq/1. pH (Tier 3, col. 20) must be $\geq$ 9 in order to have carbonate anion.

Column 6. Water soluble bicarbonate (HCO_3) meq/1.

Column 7. Water soluble chloride (Cl) meq/1.

Column 8. Water soluble sulfate (SO_4) meq/1. Used along with gypsum (Tier 3, cols. 16 & 17 salt sheet) in estimating potential corrosivity of concrete.

Column 9. Water soluble nitrate (NO_3) meq/1.

Column 10. Weight % water content of saturated paste (Saturation Percentage--SP). Used to convert from meq/1 (cols. 1-9 salt sheet) to meq/100g. Datum meq/100g = (Datum meq/1)(SP)/1000.

Column 11. % total estimated soluble salts in soil. Calculated from conductivity (EC, col. 12 salt sheet) of saturation extract. Total salt meq/1 = -4.2333 + 12.2347 (EC, col. 12 salt sheet) + 0.0580 $(EC)^2$ - 0.0003 $(EC)^3$. Total salt % = total salt meq/1 x 0.00064 SP (col. 10 salt sheet).

Column 12. Electrical conductivity (EC) of saturation extract mmho/cm. Used as a measure of salinity.

BOTH ACID AND SALT DATA SHEETS

Columns 13-16. Relative amounts of clay minerals. 1--trace, 2--small, 3--moderate, 4--abundant, 5--dominant, 6--indeterminate.

Columns 17-18. Quantitative amounts of clay minerals in percent (Differential Thermal Analysis--DTA).

Column 19. % total resistant minerals. Optical count of minerals in dominant fraction (silt or sand). Is used to assess family mineralogy class.

Column 20. % dominant weatherable mineral in fraction(s) indicated.

(1)

U.S. DEPARTMENT OF AGRICULTURE SOIL CONSERVATION SERVICE

SOIL INTERPRETATIONS RECORD

A	B	C	D	E	F	G	H	I	J	K
FOOTNOTE	ESTIMATED SOIL PROPERTIES									
DEPTH (IN)	USDA TEXTURE	UNIFIED	AASHO	FRACT. > 3 IN. (PCT)	PERCENT OF MATERIAL LESS THAN 3 IN. PASSING SIEVE NO.				LIQUID LIMIT	PLASTICITY INDEX
					4	10	40	200		

L	M	N	O	P	Q	R	S	T	U	V	W	X	Y
DEPTH (IN)	CLAY (PCT OF < 2MM)	MOIST BULK DENSITY (G/CM³)	PERMEABILITY (IN/HR)	AVAILABLE WATER CAPACITY (IN/IN)	SOIL REACTION (pH)	SALINITY (MMHOS/CM)	SHRINK-SWELL POTENTIAL	EROSION FACTORS		WIND EROD. GROUP	ORGANIC MATTER (PCT)	CORROSIVITY	
								K	T			STEEL	CONCRETE
SAME DEPTH AS ABOVE													

*Column A. Thickness in in--layer or zone. See tier 1, col. 1. Convert cm to in-in = cm/2.54.
Example--pedon 2, Ap, 0-10 cm = 0-4 in.

Column B. USDA texture. See tier 1, cols. 4-6 and 11-15 and vol. estimates of coarse fragments in description.
Example--pedon 2, 0-10 cm, silty clay.

Column C. Unified engineering classification. See "Guide for Interpreting Engineering Uses of Soils" (GIEUS)
See cols. F, G, H, I, J, K.
Example--pedon 2, 0-10 cm = CH.

Column D. AASHO engineering classification. See GIEUS and Cols. F, G, H, I, J, K.
Example--pedon 2, 0-10 cm = A-7-6.

Column E. Fraction > 3 inches (75 mm) calculated from data in tier 1.
% > 3 inches = col. 20 - [(cols. 16 + 17 + 18)(100 - col. 20)/100 - (cols. 16 + 17 + 18)]
Example--pedon 1, 10-23 cm.
% > 3 inches = 61 - [(6 + 16 + 31)(100 - 61)/100 - (6 + 16 + 31)] = 61 - [(53)(39)/(100-53)] = 61 - [2067/47] = 61 - 44 = __17%__

Column F. Percent passing #4 sieve (material < ~5 mm) calculate from data in tier 1.
% passing #4 = [100 - (col. 17 + 18)].
Example--pedon 1, 0-10 cm.
% passing #4 = [100 - (2 + 35)] = [100 - 37] = __63%__

Column G. % passing #10 sieve (material < 2 mm). Calculate from data in tier 1.
% passing #10 = [100 - (cols. 16 + 17 + 18)].
Example--pedon 1, 0-10 cm.
% passing #10 = [100 - (1 + 2 + 35)] = [100 - 38] = __62%__.

Column H. % passing #40 sieve (material < 0.42 mm) estimate using data in tier 1.
% passing #40 = col. G - [(cols. 14 + 15)(col. G/100)]
Example--pedon 1, 0-10 cm.
% passing #40 = 62 - [(4.7 + 4.0)(62/100)] = [(8.7)(0.62)] = 62-5 = __57%__

Column I. % passing #200 sieve (material < 0.074 mm) calculate using data in tier 1.
% passing #200 sieve = (col. G/100) [(col. 4 + 5) + (col. 11/2)]
Example--pedon 1, 0-10 cm
% passing #200 sieve = (62/100) [(13.2 + 54.2) + (9.6/2)] = (0.62) [(67.4) + (4.8)] = 0.62 (72.2) = __45%__

Column J. Liquid limit (LL). See tier 2, col. 10.
Example--pedon 2, 0-10 cm, LL = 52

Column K. Plasticity index (PI). See tier 2, col. 11.
Example--pedon 2, 0-10 cm, PI = 27

Column L. Same as col. A.

Column M. Percent clay. See tier 1, col. 4.
Example--pedon 2, 0-10 cm % clay = 45.8%

Column N. Moist bulk density. See tier 2, col. 13.
Example--pedon 2, 0-10 cm, bulk density = 1.13 g/cc

Column O. Permeability in inches/hour of layer.

Column P. Available Water Capacity (AWC). Estimate from WRD (tier 2, col. 20). WRD must be adjusted to rooting depth and restrictions and for salts. If no root restrictions or salts WRD minimum estimater of AWC.
Example--pedon 2, 0-10 cm layer minimum AWC = 0.13.

Column Q. Soil reaction (pH). See tier 3, col. 20.
Example--pedon 1, 0-10 cm reaction = 5.1.

Column R. Salinity. Based on EC (tier 4, col. 12, salt sheet). See GIEUS for classes.
Example--pedon 2, 23-46 cm EC = 2.8 rating = __low__.

Column S. Shrink-swell potential. Based on COLE (tier 2, col. 15) See GIEUS for classes.
Example--pedon 2, 0-10 cm COLE = 0.077 rating = high.

Column T. K factor--values assigned by series. Can estimate from Wischmeier nomograph.

Column U. T factor--values assigned by series.

Column V. Wind erodibility group. See Technical Guide.

Column W. Organic matter. Calculate by multiplying % organic carbon (tier 2, col. 1) x 1.7.
Example--pedon 1, 0-10 cm % organic matter = 4.35 x 1.7 = 7.4%.

Column X. Corrosivity uncoated steel. Based on Resistivity (tier 3, col. 15) or acidity (tier 3, col. 6). See GIEUS for classes.
Example--pedon 1, 63-122 cm zone acidity = 7.8 meq/100 g. Resistivity = 29,000. Rating = __low__.

Column Y. Corrosivity concrete. Based on soluble sulfate (tier 4, col. 8, salt sheet) or % gypsum (tier 3, col. 16 + 17, salt sheet), and pH (tier 3, col. 20). See GIEUS for classes.
SO_4 ppm = SO_4 meq/l x sp (tier 4, col. 10, salt sheet) x 0.48.
Example--pedon 2, 81-140 cm. SO_4 ppm = 90 x 79 x 0.48 = 3412 __ppm__ or moderate rating.
Gypsum is partially soluble in water and contributes 30 meq/l SO_4. If the soil contains > 1% gypsum, it has a potential source of > 7,000 ppm SO_4. Therefore, rating may have to be adjusted for presence of gypsum.

* Form 5 will most likely be converted to metric system within 1980. For purpose of comparison to data sheet, depths are listed in cm.

Example Pedon 1 ACID SHEET

SAMPLED AS: LOAMY-SKELETAL, MIXED, FRIGID FRAGIOCHREPT

S 77MN-031 -001 SAMPLE NOS. 78P 552 - 556 DATE JULY 1979

COOK AND ST. LOUIS COUNTIES

GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

-1- -2- -3- -4- -5- -6- -7- -8- -9- -10- -11- -12- -13- -14- -15- -16- -17- -18- -19- -20-

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	TOTAL CLAY LT .002	TOTAL SILT .002-.05	TOTAL SAND .05-2	CLAY FINE LT .0002	CLAY CO3 LT .002	SILT FINE .002-.02	SILT COARSE .02-.05	SAND VF .05-.10	SAND F .10-.25	SAND M .25-.50	SAND C .5-1	SAND VC 1-2	COARSE FRACTIONS (MM) WEIGHT 2-5	WEIGHT 5-20	WEIGHT 20-75	.1-75 PCT OF <75MM (3B1)	(>2MM) WT PCT OF WHOLE SOIL
				<- - - PCT OF <2MM (3A1)											- - ->	<- PCT OF <75MM(3B1)			->	
78 552	1S	0- 10	A1	13.2	54.2	32.6			36.4	17.8	9.6	9.5	4.8	4.7	4.0	1	2	35	52	50
78 553	2S	10- 23	B21HI	19.5	42.6	37.9			28.2	14.4	7.1	8.8	4.9	7.3	9.8	6	16	31	67	61
78 554	3S	23- 38	B22HI	12.2	23.2	64.6			15.5	7.7	6.0	7.2	5.3	11.3	34.8	8	8	29	77	54
78 555	4S	38- 63	B3	8.8	40.5	50.7			25.9	14.6	12.0	11.9	6.3	8.9	11.6	5	9	30	66	52
78 556	5S	63-122	CX	12.7	41.4	45.9			31.1	10.3	10.3	10.0	5.8	8.6	11.2	8	12	27	66	61

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B1B	EXTR P 6S1A	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG) LIMITS LL 4F1	PI 4F	(BULK DENSITY) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(WATER CONTENT) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2	WRD WHOLE SOIL 4C1
		<- - - - - - - PCT OF <2MM						- - ->			PCT <0.4MM		<- - G/CC		- - ->	CM/CM	<- - -PCT OF <2MM			- ->	CM/CM
78 552	1	4.35	0.260			1.3	0.2		1.76	1.26				0.90						16.6	
78 553	2	2.27	0.150			0.9	0.7		1.05	0.72				1.04	1.18	0.026			35.3	14.1	0.14
78 554	3	1.21	0.077			2.0	0.7		0.98	0.74				1.20						9.0	
78 555	4	1.24	0.069			2.0	0.7		1.16	0.95				1.47	1.50	0.004			22.1	8.4	0.13
78 556	5	0.26	0.017			1.6	0.2		0.86	0.51				1.55	1.61	0.007			22.3	6.5	0.13

SAMPLE NO.	HZN NO.	(NH4OAC EXTRACTABLE BASES) CA 5B4A 6N2E	MG 5B4A 6O2D	NA 5B4A 6P2B	K 5B4A 6Q2B	SUM BASES	ACIDITY 6H2B	EXTR AL 6G1E	(CEC) SUM CATS 5A3A	NH4-OAC 5A8A	BASES + AL 5A3B	AL SAT 5G1	(BASE SAT) SUM 5C3	NH4 OAC 5C1	CO3 AS CACO3 <2MM 6E1B	RES. OHMS /CM 8E1	(PH) CACL2 .01M 8C1E 1:2	H2O 8C1A 1:1
		<- - - - - - - - - - - - - MEQ / 100 G									- - ->	<- - - - - PCT		- - - ->				
78 552	1	8.3	2.2	--	0.5	11.0	19.7	1.3	30.7	23.2	12.3	11	36	47			4.3	5.1
78 553	2	2.9	0.8	--	0.2	3.9	25.5	3.2	29.4	20.4	7.1	45	13	19			4.4	5.1
78 554	3	0.6	0.1	--	TR	0.7	16.4	1.2	17.1	12.0	1.9	63	4	6			4.7	5.3
78 555	4	0.6	0.1	--	TR	0.7	17.4	1.4	18.1	10.2	2.1	67	4	7			4.8	5.3
78 556	5	4.7	1.3	TR	TR	6.0	7.6		13.6	10.9			44	55		29000	4.9	5.9

SAMPLE NO.	HZN NO.	(SPODIC HORIZON CRITERIA) (NA PYROPHOSPHATE EXTRACTABLE) C 6A4A	FE 6C5A	AL 6G5A	FE+AL (DIVIDED BY) DI-CI FE+AL	FE+AL (DIVIDED BY) PCT CLAY	AL+C (DIVIDED BY) PCT CLAY	INDEX OF ACCUM	(MINERALOGY) CLAY X-RAY <2U 7A2B	7A2B	7A2B	7A2B	DTA <2U 7A3	7A3	TOTAL RES 7B1A	DOM WEATH 7B1A
		<- PCT OF <2MM		->					<- RELATIVE AMOUNTS			->	<- - - - -PCT			- - - ->
78 552	1		0.2	0.1	0.2	TR		241								
78 553	2		0.9	0.4	0.8	0.1		255	VR 2	KK 1			KK15			
78 554	3		0.3	0.4	0.3	0.1		166								
78 555	4		0.2	0.4	0.2	0.1		382								
78 556	5		0.1	0.1	0.1	TR		440	VR 2	MI 1						

FAMILY CONTROL SECTION: DEPTH 25-100 PCT CLAY 11.3 PCT .1-75MM 67.6. SPODIC HORIZON: INDEX OF ACCUMUL 0

ESTIMATED BULK DENSITY FOR LAYER 1, 3,

ANALYSES: S= ALL ON SIEVED <2MM BASIS

MINERALOGY: KIND OF MINERAL VR VERMICULITE KK KAOLINITE MI MICA

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

Example Pedon 2 SALT SHEET

VAYDAN

SAMPLED AS: CLAYEY, MONTMORILLONITIC, (CALCAREOUS), FRIGID, SHALLOW TYPIC USTORTHENT

S 77ND-001 -006 SAMPLE NOS. 78P 775 - 780 DATE 6/29/78 79

UNSATURATED HYDRAULIC CONDUCTIVITY STUDY

GENERAL METHODS 1B1A, 2A1, 2B

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA, AND
NORTH DAKOTA AGRI. EXP. STA., FARGO, ND

SAMPLE NO.	HZN NO.	DEPTH (CM)	HORIZON	-1- TOTAL CLAY LT .002	-2- TOTAL SILT .002-.05	-3- TOTAL SAND .05-2	-4- CLAY FINE LT .0002	-5- CLAY CO3 LT .002	-6- SILT FINE .002-.02	-7- SILT COARSE .02-.05	-8- SAND VF .05-.10	-9- SAND F .10-.25	-10- SAND M .25-.50	-11- SAND C .5-1	-12- SAND VC 1-2	-13- COARSE FRACTIONS (MM) WEIGHT 2-5	-14- WEIGHT 5-20	-15- WEIGHT 20-75	-16- WEIGHT .1-75	-17- (>2MM) WT PCT OF WHOLE SOIL
				<- - - PCT OF <2MM (3A1) - - -												<- PCT OF <75MM (3B1) ->				
78 775	1S	0- 10	AP	45.8	46.6	5.6			33.9	14.7	2.8	1.4	0.5	0.7	0.9	TR	—	—	3	TR
78 776	2S	10- 23	AC	52.4	45.9	1.7			35.2	10.7	0.7	0.3	0.3	0.3	--	TR	--	--	1	TR
78 777	3S	23- 46	C1	48.1	51.0	0.9			37.8	13.2	0.2	0.2	--	0.2	--	TR	--	--	TR	TR
78 778	4S	46- 56	CR1	49.9	50.0	0.1			41.8	8.2	—	0.1	—	—	—	TR	--	--	TR	TR
78 779	5S	56- 81	CR2	45.2	54.7	0.1			42.1	42.6	0.1	0.1	--	--	--	TR	--	--	TR	TR
78 780	6S	81-140	CR3	56.3	43.5	0.2			12.6	0.9	0.1	0.1	--	--	--	--	--	--	TR	--

SAMPLE NO.	HZN NO.	ORGN C 6A1C	TOTAL N 6B1B	EXTR P 6S1A	TOTAL S 6R3A	DITH-CIT EXTRACTABLE FE 6C2B	AL 6G7A	MN 6D2A	(RATIO/CLAY) CEC 8D1	15 BAR 8D1	(ATTERBERG LIMITS) LL 4F1	PI 4F	(BULK DENSITY) FIELD MOIST 4A3A	1/3 BAR 4A1D	OVEN DRY 4A1H	COLE WHOLE SOIL 4D1	(WATER CONTENT) FIELD MOIST 4B4	1/10 BAR 4B1C	1/3 BAR 4B1C	15 BAR 4B2	WRD WHOLE SOIL 4C1
		<- - - PCT OF <2MM - - ->									PCT <0.4MM		<- - G/CC - - ->			CM/CM	<- - PCT OF <2MM - ->				CM/CM
78 775	1	1.42	0.144						0.82	0.37	52	27		1.17	1.46	0.077			27.9	17.1	0.13
78 776	2	0.58	0.068						0.73	0.38				1.48	1.83	0.073			26.9	17.7	0.14
78 777	3	0.22	0.038						0.76	0.36	60	36		1.47	1.76	0.062			24.9	17.4	0.11
78 778	4	0.16	0.034						0.73	0.37				1.53	1.85	0.065			24.3	18.6	0.09
78 779	5	0.13	0.025						0.74	0.37				1.59	1.86	0.054			23.4	16.9	0.10
78 780	6	0.12	0.030						0.49	0.35	58	34		1.55	1.73	0.037			25.6	19.8	0.09

SAMPLE NO.	HZN NO.	NH4OAC EXTRACTABLE BASES CA 5B4A 6N2E	MG 5B4A 6O2D	NA 5B4A 6P2B	K 5B4A 6Q2B	SUM BASES	ACIDITY 6H2B	(CEC) SUM CATS 5A3A	NH4-OAC 5A6A	EXCH NA 5D2 PCT	SAR 5E	BASE SATURATION SUM 5C3	NH4OAC 5C1	CARBONATE AS CACO3 <2MM 6E1B	<20MM	CASO4 AS GYPSUM <2MM 6F1C	<20MM 6F1C	(PH) SAT PASTE 8C1B	CACL2 .01M 8C1E 1:2
		<- - - MEQ / 100 G - - -										<- -PCT- >		<- -PCT ->		<- -PCT ->			
78 775	1		6.5	0.1	1.3				37.5	TR	TR			2				7.7	
78 776	2		6.6	0.1	0.7				38.4	TR	TR			2				7.5	
78 777	3	28.0	7.6	0.1	0.6	36.3			36.6	TR	TR		99					7.5	
78 778	4	19.0	12.0	0.3	0.6	31.9			36.5	1	TR		87					7.7	
78 779	5	10.3	17.0	0.4	0.6	28.3			33.5		2		84					7.8	
78 780	6	5.0	15.3	0.5	0.5	21.3			27.5		5		77					7.5	

SAMPLE NO.	HZN NO.	WATER EXTRACTED FROM SATURATED PASTE: CA 6N1B	MG 6O1B	NA 6P1B	K 6Q1B	CO3 6I1B	HCO3 6J1B	CL 6K1C	SO4 6L1C	NO3 6M1C	H2O 8A	TOTAL SALTS EST. 8D5	ELEC. COND. 8A1A MMHOS/CM	MINERALOGY CLAY X-RAY <20 7A2B	7A2B	7A2B	7A2B	DTA <20 7A3	7A3	TOTL. ANALYSIS <20 5Q3A	FE 6C7A
		<- - - MEQ / LITER - - -									<- -PCT ->			<- RELATIVE AMOUNTS ->				<- - - PCT - - ->			
78 775	1	4.4	1.5	0.8	0.8		3.1	TR	3.1		60.0	TR	0.60	MT 4	MI 3	KK 3	CL 2			2.0	4.6
78 776	2	25:9	7.3	0.5	0.3		1.6	TR	30.0		--61.0	0.1	2.60								
78 777	3	34.4	9.3	0.7	0.4		1.4	0.1	34.2		57.0	0.1	2.80	MT 5	MI 3	KK 2	QZ 2			1.5	4.1
78 778	4	21.0	15.0	1.5	0.5		1.2	TR	47.6		68.0	0.1	3.00								
78 779	5	21.0	30.0	9.7	0.4		1.0	TR	61.2		71.0	0.2	4.20								
78 780	6	18.0	35.5	23.6	0.8		0.7	TR	90.0		79.0	0.3	5.50	MT 4	MI 3	KK 2	CL 2	KK13		2.7	4.6

FAMILY CONTROL SECTION: DEPTH 25- 46 PCT CLAY 48.1 PCT .1-75MM 0.7

ANALYSES: S= ALL ON SIEVED <2MM BASIS

MINERALOGY: KIND OF MINERAL MT MONTMORILL MI MICA KK KAOLINITE CL CHLORITE QZ QUARTZ

RELATIVE AMOUNT 6 INDETERMINATE 5 DOMINANT 4 ABUNDANT 3 MODERATE 2 SMALL 1 TRACE

Example Pedon 1

Pedon Classification: Fragiochrept; loamy-skeletal, mixed, frigid
Series Classification: Same
Soil: Series not designated
Soil No.: S77MN-031-001
Location: Cook County, Minnesota SW¼, NE¼, NW¼, Sec. 7, T. 62 N., R. 2 E. about 50 feet north of curve in road, 1,190 feet south and 2,100 feet east of northwest section corner, about 9 miles north of Grand Marais.
Climate: Some characteristics of temperatures are: annual normal 36° F (2° C), winter normal 11° F (- 12° C), summer normal 63° F (16° C); some characteristics of precipitation are: mean annual 29 inches (74 cm.), June to September 12 inches (30 cm.), mean snowfall 65 inches (165 cm.)
Parent Material: Grayish brown loamy-skeletal till of the Rainy Lobe of the Late Wisconsin glaciation.
Physiography: Moraine.
Landscape Setting: Sampling site is on the upper part of a 3 percent southwest facing convex slope that is on the side of a ridge about 1,000 feet long and 150 feet wide. The elevation is about 1,600 feet. The local relief in this section is about 200 feet.
Vegetation: Mainly white spruce 3 to 14 inches d.b.h. with few aspen 2 to 3 inches d.b.h. Understory is mainly hazel.
Drainage: Well drained.
Erosion: None
Permeability: Slow to moderately slow.
Ground water: Water table is probably perched above the fragipan for short periods.
Described by: R. Lewis October 13, 1977.
Sampled by: S. Holzhey, M. Mausbach, R. Turner, H. Finney, D. Grigal and J. Engen.

A1 78P552 0 to 10 cm. (0 to 4 inches). Black (10YR 2/1) cobbly loam; strong fine granular structure; very friable, slightly sticky, and nonplastic; few worm casts; many fine and very fine continuous pores; many very fine to coarse roots; about 15 percent coarse fragments; about 5-10 percent larger than 8 cm.; clear smooth boundary. (3 to 13 cm. thick)

A2 10 to 13 cm. (not sampled) (4 to 5 inches). Discontinuous horizon occupies about 10 percent of pedon; reddish gray (5YR 4/2) loam; moderate very fine and fine granular structure; friable, slightly sticky, and nonplastic; abrupt broken boundary. (2 to 5 cm. thick)

B21hir 78P553 10 to 23 cm. (4 to 9 inches). Dark reddish brown (5YR 3/3) cobbly loam; brown (7.5YR 5/4) dry; moderate very fine and fine granular structure; very friable, slightly sticky, nonplastic, and smeary; many fine and very fine discontinuous pores; many very fine to coarse roots; about 15 percent coarse fragments; about 5 to 10 percent are larger than 8 cm.; gradual wavy boundary. (10 to 20 cm. thick)

B22hir 78P554 23 to 38 cm. (9 to 15 inches). Dark reddish brown (5YR 3/4) cobbly loam; moderate fine granular; very friable, slightly sticky, nonplastic, and smeary; many fine and very fine discontinuous pores; many very fine to coarse roots; about 10 percent coarse fragments; about 5 to 10 percent are larger than 8 cm.; gradual wavy boundary. (10 to 20 cm. thick)

B3 78P555 38 to 63 cm. (15 to 25 inches). Discontinuous horizon occupying about 15 percent of pedon; brown (7.5YR 4/4) cobbly loam; moderate fine subangular blocky structure parting to moderate fine granular structure; friable, slightly sticky, nonplastic, and slightly smeary; common fine and very discontinuous pores; common fine and very fine vertical roots; about 15 percent coarse fragments; about 5 to 10 percent are larger than 8 cm.; clear wavy boundary. (0 to 25 cm. thick)

Cx 78P556 63 to 122 cm. (25 to 48 inches). Dark grayish brown (10YR 4/2) cobbly loam; weak medium and coarse platy structure; firm, and brittle; few very fine horizontal pores; few very fine and fine roots in upper part, dominantly between plates; about 45 percent coarse fragments; about 35 percent greater than 8 cm.

Remarks: Colors are for moist soil. Backhoe was used for the sampling pit. Lithology of rock fragments is mainly gabbro and basalt. Few "red rock" fragments.

Example Pedon 2

Soil Type: Wayden silty clay.
Sample No.: S77ND001-4 (FIPS)
Date: September 12, 1977.
Sampled by: M. Mausbach, F. Schroer, M. Meyer.
Described by: F. Wilhelm, G. Muckel, S. Ekart, E. Gamble.
Area: About 2 miles east and 2½ miles north of Reeder, Adams County.
Location: 300 feet east and 330 feet north of the southwest corner of the NW¼, Sec. 30, T131N, R98W.
Classification: Clayey, montmorillonitic (calcareous), frigid, shallow Typic Ustorthent.
Vegetation: Summerfallow (spring wheat in 76).
Parent Material: Clayey shales of the Ft. Union (Tongue River) formation.
Physiography: Hilltop.
Relief: Convex, simple.
Slope: 2 percent.
Permeability: Slow (0.06 - 0.2 in./hr.).
Moisture: Moist throughout.
Drainage: Well drained.
Ground Water: >5 feet.
Erosion: Slight.
Aspect: Northeast.
Elevation: Approximately 2,900 feet.
Pedon Description: Wayden silty clay.

(Colors are for dry soil unless otherwise stated.)

Ap 0 to 10 cm. Grayish brown (2.5Y 5/2) silty clay, dark grayish brown (2.5Y 4/2) moist; strong very fine granular structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; slight effervescence; abrupt smooth boundary.

AC 10 to 23 cm. Light brownish gray (2.5Y 6/2) silty clay, grayish brown (2.5Y 5/2) moist; moderate very fine subangular blocky structure; very hard, firm, very sticky and very plastic; common very fine roots; many very fine pores; tongues of Ap less than 5 mm thick; common irregularly shaped soft lime masses; slight effervescence; clear wavy boundary.

C1 23 to 46 cm. Pale yellow (5Y 7/3) silty clay with 30 percent shale fragments, olive (5Y 5/3) moist; moderate very fine subangular blocky and rock structure; very hard, very firm, very sticky and very plastic; common very fine roots; common very fine pores; common medium yellowish brown (10YR 5/8 moist) iron stains; common gypsum crystals; common pressure faces; tongues of Ap less than 5 cm thick; clear wavy boundary.

Cr1 46 to 56 cm. Pale yellow (5Y 7/3) clay shales, olive (5Y 5/3) moist; rock (fissile) structure; extremely hard, very firm, very sticky and very plastic; common very fine roots with most following fissures and cleavage planes; few very fine pores; common medium yellowish brown (10YR 5/8 moist) iron stains; few tongues less than 5 mm wide; common pressure faces; common gypsum crystals; clear wavy boundary.

Cr2 56 to 81 cm. Pale yellow (5Y 7/3) clay shales, olive (5Y 5/3) moist; rock (fissile) structure; extremely hard, very firm, very sticky and very plastic; few very fine roots following fissures and cleavage planes; few very fine pores; common medium dark brown (7.5Y 4/4 moist) iron stains; common gypsum crystals; common fine paleoroots;common pressure faces; gradual wavy boundary.

Cr3 81 to 140 cm. Light gray (5Y 7/1) clay shales, gray (5Y 5/1) moist; rock (fissile) structure; extremely hard, very firm, very sticky and very plastic; few very fine roots following fissures and cleavage planes; very few fine pores; common gypsum crystals; common fine paleoroots; few pressure faces.

Additional Notes

Large horizontal and vertical cleavage planes extend through the shales. Some are as large as 18 inches by 24 inches. These are coated with brown (10YR 4/3 moist) and some have up to 2 inches of weathered material along these planes. The rock structure size increases with depth. Lignite was encountered at a depth of 35 inches. Also, an Unsatruated Hydraulic conductivity study is being conducted at this site.

Appendix IV

In this appendix, data that was produced by the Comision Chilena de Energia Nuclear and by the Centro de Estudios de la Cuenca del Maule is included. This work was done to support the work done by the NSSL and to be part of an interlaboratory cross check.

Series: Pelchuquín

Pedon Nº S83 FN - 275 - 001

Horizon	CCHEN 1/ pH NaF	P^{31} Ret(%)	P^{32} Ret(%)	U. Chile (Talca) 2/ pH (1:2.5) H_2O	K(ppm)
Ap1	11.3	88	97	5.5	235
Ap2	11.7	100	98	4.5	47
2BA	11.6	99	99	5.1	18
2Bs1	10.6	98	98	5.2	16
2Bs2	11.4	98	97	5.4	27
2C1	11.5	98	98	5.4	22
3C2	11.7	99	98	5.1	29

Series: Lanco

Pedon Nº S83 FN - 275 - 002

Horizon	pH NaF	P^{31} Ret(%)	P^{32} Ret(%)
A1	11.8	98	99
2Bs	11.7	99	99
3BC	11.7	99	99
4Bs1m	--	--	--
5Bs2	9.9	--	35

1/ Comisión Chilena de Energía Nuclear
pH (NaF): Soil Survey Investigations Report Nº 1: 8C1d
P^{31}(retained): Nitric Vanadomolybdate acid method
P^{32}(retained): Nitric Vanadomolybdate acid method

2/ Centro de Estudios de la Cuenca del Maule
pH (H_2O) (1:2.5): CG 811 Schott Gerate pH-meter.
K : Ammonium acetate, 1N pH7. Flame fotometry.

Series: Los Ulmos

Pedon Nº: S83 FN - 275 - 003

CCHEN

Horizon	pH NaF	P^{31} Ret(%)	P^{32} Ret(%)
A1	11.0	89	94
A2	11.1	94	97
A3	10.9	89	93
Bs1	11.6	84	88
Bs2	10.5	80	86
Bs3	10.3	82	81

Series: Osorno

Pedon Nº S83 FN - 275 - 004

0	--	--	--
Ap	11.4	97	98
Bw	11.7	100	99
Bs	11.6	99	98
2Bq	11.0	92	93
2C1	9.2	32	34
3C2	8.6	13	5

Series: Antillanca

Pedon Nº S83 FN - 275 - 005

0	--	--	--
A1	10.8	65	77
A2	11.4	56	64
C1	10.8	28	19
C2	10.4	27	31
C3	10.5	27	32

Series: Chanleufú

Pedon Nº S83 FN - 275 - 006

Horizon	CCHEN pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)	U. Chile (Talca) pH(1:2.5) H_2O	U. Chile (Talca) K(ppm)
0	--	--	--		
A1	11.4	78	90		
A2	11.7	92	93		
C1	11.6	84	89		
C2	11.8	99	95		
2C3	--	--	--		
3R	--	--	--		

Series: Puyehue

Pedon Nº S83 FN - 275 - 007

Horizon	CCHEN pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)	U. Chile (Talca) pH(1:2.5) H_2O	U. Chile (Talca) K(ppm)
0	--	--	--	--	--
A	11.6	96	96	4.9	53
B	11.8	100	99	5.3	27
Bs1	11.7	97	97	5.4	10
Bs2	11.5	100	99	5.4	10
BCs	11.8	100	99	5.5	12

Series: Puerto Fonck

Pedon Nº S83 FN - 275 - 008

Horizon	CCHEN pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)	U. Chile (Talca) pH(1:2.5) H_2O	U. Chile (Talca) K(ppm)
A1	11.5	94	96	5.2	88
A2	11.6	98	96	5.7	43
AB	11.6	95	96	5.8	18
Bs	11.7	97	97	5.7	16
C1	11.6	98	97	5.6	29
C2	11.6	99	99	5.6	49

Series: Frutillar

Pedon Nº S83 FN - 275 - 009

Horizon	pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)	U. de Chile (Talca) pH(1:2.5) H_2O	U. de Chile (Talca) K(ppm)
A	11.6	96	99		
E	11.8	100	99		
Bs1	11.8	100	99		
Bs2	11.7	100	99		
Bs3	11.7	--	99		
2Bsm	11.5	98	97		
2Cqm	11.3	81	82		
2C	10.1	34	--		

Series: Puerto Octay

Pedon Nº S83 FN - 275 - 010

Horizon	pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)	U. de Chile (Talca) pH(1:2.5) H_2O	U. de Chile (Talca) K(ppm)
A	11.6	98	98	5.3	82
AB	11.7	99	99	5.6	22
Bw1	11.8	99	99	5.7	22
Bw2	11.8	99	99	5.7	20
2R	--	--	--	--	--

Series: Puerto Montt

Pedon Nº S83 FN - 275 - 011

Horizon	pH NaF	CCHEN P^{31} Ret(%)	CCHEN P^{32} Ret(%)
A	11.8	98	99
B/A	11.7	100	99
Bt1	11.3	100	99
Bt2	11.5	100	98
2Cqs	--	--	--
2Cs	10.8	66	56

Series: Alerce

Pedon Nº S83 FN - 275 - 012

Horizon	pH NaF	CCHEN P^{31} Ret(%)	P^{32} Ret(%)
O	--	--	--
A1	9.0	--	--
A2	11.5	99	98
Bs1	11.7	98	99
Bs2	11.7	98	98
2Cqs	--	--	--
2Cq	--	--	--

Series: Corte Alto

Pedon Nº S83 FN - 275 - 013

O	--	--	--
A	10.5	79	88
Bs1	10.9	89	94
Bs2	11.2	95	96
2C1	11.5	99	97
2C2	11.1	100	97
2C3	10.3	74	79

Appendix V

This appendix contains supplement data for the pedons produced by Dr. K. Wada of Japan.

Summary of Clay Mineral Analyses of Chile Soil Samples for Sixth International Soil Classification Workshop

Koji Wada and Yasuko Kakuto

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Fukuoka 812, Japan

Table 1.

Sample No.	Soil[1] pH$_{NaF}$	Soil[1] T.B. test	A+Im+Fh[2] (%)	Layer silicates[3]	Oxides[3]	Primary minerals[3]
1-2	10.7	-	42	Ch, Vt-Ch/Ch	Gb	Cb
4	10.6	-	43	Ch, Vt-Ch/Ch	Gb	Cb
6(1)	10.0	-	28	Ch, Vt-Ch/Ch	Gb	Cb
7	10.1	-	59	Ch, Vt-Ch/Ch	Gb	Cb(?)
2-2	11.1	-	70	Ch, Vt-Ch	Gb, Go	Cb
3	11.3	-	71	Ch, Vt-Ch	Gb, Go	Cb
3-1	9.1	+	10*	Vt-Ch/Ch, Ht(7), Ch	Go, Gb	Cb
3	9.0	+	9*	Vt-Ch/Ch, Ht(7), Ch	Go, Cb	-
5	8.1	+	6*	Ht(7, 10), Vt-Ch/Ch	Go, Gb	-
4-1	10.8	-	47	Vt-Ch/Ch, Ch, Ht(7)(?)	Go, Gb	-
3	10.2	- (+)	67	Vt-Ch/Ch, Ch, Ht(7)	Go, Gb	-
5-1	10.3	-				
2	9.0	-	81	-	-	Fd
6-1	9.5	-				
3	11.1	-	82	Sm	-	Fd
7-1	10.6	-	76	Sm, Sm-Ch	-	Cb, Fd
3	10.7	-	93	Sm, Sm-Ch	-	Cb, Fd
5	10.8	-	97	Sm, Sm-Ch	-	Fd
8-1	10.5	-	72	Sm(?)	-	Fd, Cb(?)
3	10.6	-	84	Sm(?)	-	Fd, Cb(?)
5	10.4	- (+)	92	Sm(?)	-	Fd
9-1	11.1	-	50	Vt-Ch, Ch	Go	Cb
3	11.2	-	77	Vt-Ch, Ch	Go	Cb
5	10.3	-	70	Vt-Ch, Ch	Go, Gb	Cb
10-1	10.5	-	75	Vt-Ch/Ch, Ch, Sm	Gb, Go(?)	Cb, Ho
3	11.1	-	81	Vt-Ch/Ch, Ch, Sm	Gb	Cb, Ho
11-1	11.5	-	68	Ch, Vt-Ch/Ch, Sm	Gb, Go	Cb
3	11.0	-	79	Ch, Vt-Ch/Ch, Sm	Gb, Go	Cb
12-2	10.8	-	36	Ch, Vt-Ch/Ch	Go(?)	Cb, Qz, Ho
4	10.4	- (+)	73	Ch, Vt-Ch/Ch	Gb, Go	Cb, Ho
13-1	8.0	+	13*	Vt-Ch/Ch, Ht(7, 10), Ch	Gb	Cb
3	9.9	+	16*	Vt-Ch/Ch, Ht(10, 7), Ch	Gb	Cb, Ho
5	10.5	- (+)	71	Ht(10), Sm, Sm-Ch/Ch	-	Fd, Cb

1) pH$_{NaF}$: Add 50 ml 1 M NaF to 1 g soil. Stir for 2 minutes and measure pH of the soil suspension with a glass electrode.
T.B. test: Add about 10 to 30 mg air-dry or undried soil into 0.3 to 0.4 ml 0.02 % toluidine blue solution and stir for 1 minute. + metachromasis occurred (reddish purple). - no metachromasis occurred (blue).

2) The sum of A (=allophane), Im (=imogolite) and Fh (=ferrihydrite and other noncrystalline iron oxide) estimated from the oxalate-soluble SiO_2+Al_2O_3+Fe_2O_3 (%) assuming a $H_2O(+)/SiO_2+Al_2O_3+Fe_2O_3$ weight ratio of 0.45.

* Identified to be halloysite by difference infrared spectroscopy.

3) Layer silicates, oxides and primary minerals identified by X-ray diffraction and infrared spectroscopy for the clay remaining after oxalate-oxalic acid treatment.

Layer silicates: Ch=chlorite; Ht(7)=halloysite (7Å); Ht(10)=halloysite (10Å); Sm=smectite; Sm-Ch=smectite-chlorite intergrades; Vt-Ch=vermiculite-chlorite intergrades; / denotes a random interstratification.

Oxides: Gb=gibbsite; Go=goethite.

Primary minerals: Cb=cristobalite; Fd=feldspar; Ho=hornblende; Qz=quartz.

Table 2.

Sample No.	Clay (< 2μm)[1] %	pH_{dis}	Oxalate soluble[2] SiO_2	Al_2O_3 (%)	Fe_2O_3	Total	Si/2Al ratio	Im[3] content
1-2	35	4	5.8	16.3	7.2	29.2	0.61	+
4	52	4	6.9	16.1	6.4	29.5	0.73	++
6(1)	51	4	3.8	10.0	5.8	19.6	0.64	+
7	51	4	9.7	22.6	8.5	40.9	0.73	+
2-2	49	4	12.5	31.9	3.9	48.3	0.67	+++
3	46	4	12.8	32.4	4.1	49.3	0.67	+++
3-1	54	10	0.4	3.6	2.7	6.7	0.18	-
3	68	10	0.3	3.5	2.2	6.0	0.15	-
5	86	10	0.3	2.1	1.4	3.8	0.25	-
4-1	32	4	6.6	18.8	6.7	32.1	0.60	+
3	50	4	11.7	29.0	5.2	45.9	0.68	+++
5-1	2	4	—	—	—	—	—	++
2	1	4	13.1	31.4	11.7	56.1	0.71	++
6-1	5	4	—	—	—	—	—	++
3	4	4	12.2	34.3	10.0	56.5	0.60	++
7-1	9	4	5.9	25.4	20.7	52.2	0.40	++
3	24	4	14.1	35.5	14.5	64.1	0.67	+
5	34	4	17.4	36.7	13.0	67.2	0.81	++
8-1	17	4	9.6	28.0	12.1	49.8	0.58	+
3	27	4	13.8	31.0	13.3	57.9	0.76	++
5	41	4	17.0	33.8	12.7	63.7	0.86	++
9-1	24	4	7.4	22.1	4.8	34.3	0.60	+
3	54	4	11.5	31.8	10.0	53.2	0.61	++
5	42	4	12.2	28.3	7.8	48.3	0.73	+++
10-1	28	4	11.1	30.4	10.1	51.7	0.62	++
3	53	4	13.5	32.6	9.9	55.9	0.70	+++
11-1	31	4	7.2	26.9	13.0	47.1	0.46	+
3	49	4	11.6	31.0	12.1	54.6	0.64	+++
12-2	16	4	5.2	15.6	3.8	24.6	0.56	+
4	42	4	14.6	30.5	4.9	50.1	0.81	++
13-1	56	10	0.7	4.4	3.9	9.0	0.27	-
3	60	10	1.7	5.6	3.4	10.7	0.51	-
5	35	4	15.3	26.6	6.9	48.8	0.98	++

1) Treat 10 g air-dry or fresh soil sample with H_2O_2 and wash with water. Disperse the sample at pH 4 or 10 after treatment with sonic wave (28 kHz; 125 W; 10-15 min). Collect clay (< 2μm) by sedimentation. Repeat dispersion and sedimentation for 5 to 10 times. Determine the weight of the collected clay. pH_{dis}=pH for dispersion.

2) Shake 20 mg clay in 30 ml 0.2 M NH_4 oxalate-oxalic acid mixture (pH 3.0) in the dark at 25°C for 4 hours and centrifuge at 2500 rpm. Add 1 drop 0.1 % superfloc to the supernatant and centrifuge again. Analyse Fe, Al and Si in the supernatant by atomic absorption spectroscopy. Report on the oven-dry basis of the clay.

3) The content of Im (=imogolite) estimated by visual inspection of electron micrographs of the clay.

Appendix VI

This appendix contains a supplemental data sheet for all of the pedons sampled.

S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A

PELCHUGOIN

SAMPLED AS:

S 83FN-275 -001   SAMPLE NOS. 83P2246 - 2253   DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	ENGINEERING PERCENTAGES PASSING SIEVE 3 (INCHES) 1	2 2	3/2 3	1 4	3/4 5	3/8 6	NUMBER 4 7	10 8	40 9	200 10	PSDA 20 (MICRONS) 11	5 12	2 13	CUMULATIVE CURVE USDA LESS THAN (MM) 1. 14	.5 15	.25 16	.10 17	.05 18	FRACTIONS(<76MM) DIAMETERS(MM) AT PERCENTILE 60 19	50 20	10 21	ATTERBERG LL (PCT) 22	PI 23	GRADUATION UNIFORMITY CU 24	CURVATURE CC 25
832246	1S	0- 2	AP1	100	100	100	100	100	100	100	100	96	35	55	28	10	100	97	95	90	79	0.02	0.016	0.002			13.3	0.7
832247	2S	2- 11	AP2	100	100	100	100	100	100	100	100	99	36	51	24	6	100	99	98	92	79	0.03	0.019	0.002			10.9	0.7
832248	3S	11- 15	2BA	100	100	100	100	100	100	100	100	96	70	31	13	1	99	97	93	79	57	0.06	0.039	0.004			13.9	1.5
832249	4S	15- 29	2BB1	FRACTIONS NOT DETERMINED																								
832250	5S	29- 39	2BB2	100	100	100	100	100	100	100	100	91	53	21	11	4	99	93	83	61	40	0.10	0.069	0.005			20.6	2.1
832251	6S	39- 51	2C1	100	100	100	100	100	100	100	100	90	53	21	11	5	99	93	82	61	40	0.10	0.069	0.004			23.0	2.4
832252	7S	51- 63	2C2	100	100	100	100	100	100	100	100	89	46	16	8	2	99	92	80	56	31	0.12	0.084	0.008			15.3	2.5
832253	8S	63- 79	3C3	100	100	100	100	100	100	100	100	76	57	31	15	4	88	78	71	62	51	0.09	0.049	0.003			26.2	1.1

SAMPLE NO	HZ NO	WEIGHT FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2 26	250 -UP 27	250 -75 28	75 -2 29	75 -20 30	20 -5 31	5 -2 32	<2 33	<75 MM FRACTION, PCT OF <75 MM: 75 -2 34	75 -20 35	20 -5 36	5 -2 37	<2 38	39	WEIGHT PER UNIT VOLUME G/CC, WHOLE SOIL: SOIL SURVEY 1/3 BAR 40	OVEN -DRY 41	ENGINEERING MOIST 42	SATURATED 43	<2 MM FRACTION: SOIL SURVEY 1/3 BAR 44	15 BAR 45	OVEN -DRY 46	ENGINEERING MOIST 47	SATURATED 48	VOID RATIOS AT 1/3 BAR: WHOLE SOIL 49	<2 MM 50
832246	1	--	--	--	--	--	--	--	100	--	--	--	--	100		1.45										
832247	2	--	--	--	--	--	--	--	100	--	--	--	--	100		0.70	0.81	1.09	1.44	0.70	0.76	0.81	1.09	1.44	2.79	2.79
832248	3	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.66	0.50									
832249	4	--	--	--	--	--	--	--	100	--	--	--	--	100		0.87	0.37									
832250	5	--	--	--	--	--	--	--	100	--	--	--	--	100		0.74	0.84	1.15	1.46	0.74	0.80	0.84	1.14	1.46	2.58	2.58
832251	6	--	--	--	--	--	--	--	100	--	--	--	--	100		0.84	0.96	1.29	1.52	0.84	0.92	0.96	1.29	1.52	2.15	2.15
832252	7	--	--	--	--	--	--	--	100	--	--	--	--	100		0.80	0.93	1.26	1.50	0.80	0.89	0.93	1.26	1.50	2.31	2.31
832253	8	--	--	--	--	--	--	--	100	--	--	--	--	100		0.90	1.09	1.45	1.56	0.90	1.03	1.09	1.45	1.56	1.94	1.94

SAMPLE NO	HZ NO	VOLUME FRACTIONS, WHOLE SOIL (MM), PCT OF WHOLE SOIL: >2 51	250 -UP 52	250 -75 53	75 -2 54	75 -20 55	20 -5 56	5 -2 57	<2 58	AT 1/3 BAR: 2- .05 59	.05- .002 60	LT .002 61	PORES D 62	PORES F 63	(C/) (/N) RAT -IO 64	RATIOS TO CLAY, <2 MM FRACTION: FINE CLAY 65	CEC SUM CATS 66	CEC NH4-OAC 67	15 BAR H2O 68	LE 1/3 BAR 69	LINEAR EXTENSIBILITY (IN/IN), 1/3 BAR TO WHOLE SOIL 15 BAR 70	WHOLE SOIL OVEN -DRY 71	<2 MM 15 BAR 72	<2 MM OVEN -DRY 73	W R D (IN/IN) WHOLE SOIL 74	<2 MM 75
832246	1	--	--	--	--	--	--	--	100	11	33	0	45		12		6.09	3.97								
832247	2	--	--	--	--	--	--	--	100	6	19	2	35	39	13		9.75	5.37	4.74	0.947	2.8	5.0	2.8	5.0	0.18	0.18
832248	3	TR	--	--	--	--	--	TR	100	11	14		73		13		40.90	22.30		5.600						
832249	4	--	--	--	--	--	--	--	100	19	14		67													
832250	5	--	--	--	--	--	--	--	100	17	10	1	31	41			7.44	3.39	4.67	1.198	2.6	4.3	2.6	4.3	0.23	0.23
832251	6	--	--	--	--	--	--	--	100	19	11	1	23	45			5.35	2.62	1.97	0.979	3.1	4.6	3.1	4.6	0.26	0.26
832252	7	--	--	--	--	--	--	--	100	21	9	1	24	45			12.19	5.51	4.73	2.318	3.6	5.1	3.6	5.1	0.28	0.28
832253	8	--	--	--	--	--	--	--	100	17	16	1	11	53			9.46	6.37	7.03	1.784	4.6	6.6	4.6	6.6	0.31	0.31

SAMPLE NO	HZ NO	WEIGHT FRACTIONS - CLAY FREE, WHOLE SOIL, PCT OF >2MM+SAND+SILT: >2 76	75 -2 77	20 -2 78	2- .05 79	.05- .002 80	LT .002 81	<2 MM FRACTION, PCT OF SAND+SILT: SANDS VC 82	C 83	M 84	F 85	VF 86	SILTS C 87	F 88	CL AY 89	TEXTURE (<2 MM): DETERMINED IN FIELD 90	OF PSDA 91	PSDA (MM), PCT OF <2MM: SAND 2- .05 92	SILT .05- .002 93	CLAY LT .002 94	PH CACL2 .01M 95	ELECTRICAL (<2 MM): RES. OHMS 96	COND. MMHOS 97	CONSULT. AMOUNTS SALT MG/KG 98	IN. OF H2O 1/3 BAR TO 15BAR AIRDRY (WHL SOIL) 99	100
832246	1				23	77	12	TR	3	2	6	12	27	50	12		SIL	20.8	68.8	10.4	5.2					
832247	2				23	77	6	TR	1	1	6	15	27	49	6		SIL	21.4	72.7	5.9	4.3					
832248	3				43	57	1	1	2	5	14	22	25	31	1		SIL	42.9	56.1	1.0	5.4					
832249	4				57	43		1	3	7	22	25	25	10			*FSL	57.3	42.7	—	5.6					
832250	5				62	38	4	1	6	11	22	22	20	18	4		FSL	59.7	36.7	3.6	5.9					
832251	6				63	37	5	1	7	11	22	23	19	18	5		FSL	60.3	35.0	4.7	5.8					
832252	7				70	30	2	1	7	12	25	25	15	18	2		FSL	68.1	29.7	2.2	5.8					
832253	8				51	49	4	12	10	7	9	12	20	29	4		FSL	49.4	46.9	3.7	5.7					

SAMPLE	UP LOW	LOW	DIF	CLAY	SAND	OC	S/C	W S/C	W OC	UP LOW	LOW	DIF	S/C	W S/C	W OC
832246	0- 4	4	4	10.9	20.8	12.396	2.0	2.0	12.4	0- 4	4	4	2.0	2.0	12.4
832247	4- 27	27	23	5.9	21.4	8.615	3.6	3.4	9.2	4- 27	17	14	3.6	3.1	9.5
832248	27- 39	39	12	1.0	42.9	4.035	42.9	15.5	7.6						
832249	39- 73	40	1	0.0	57.3	2.432	42.9	15.5	7.5						

SUPPLEMENTARY CHARACTERIZATION DATA

LANCO

SAMPLED AS:

S 83FN-275 -002 SAMPLE NOS. 83P2262 - 2271 DATE 11/30/83

CHILR-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	1 (3 in)	2 (2 in)	3 (3/2 in)	4 (1 in)	5 (3/4 in)	6 (3/8 in)	7 (No. 4)	8 (No. 10)	9 (No. 40)	10 (No. 200)	11 (20 µ)	12 (5 µ)	13 (2 µ)	14 (1.)	15 (.5)	16 (.25)	17 (.10)	18 (.05)	19 (60)	20 (50)	21 (10)	22 (LL)	23 (PI)	24 (CU)	25 (CC)
				ENGINEERING PERCENTAGE PASSING <—INCHES—>						<—NUMBER—>				PSDA SIEVE <—MICRONS—>			CUMULATIVE CURVE FRACTIONS(<76MM) USDA LESS THAN <—MM—>					DIAMETERS(MM) AT <—PERCENTILE—>			ATTERBERG <—PCT—>		GRADATION UNIFMTY	CURVTUR
832262	1S	0- 7	A	100	98	96	94	92	92	92	91	86	68	43	17	TR	90	87	83	74	59	0.05	0.030	0.003			15.4	0.6
832263	2S	7- 14	2BS	FRACTIONS				NOT				DETERMINED																
832264	3S	14- 18	3BC	FRACTIONS				NOT				DETERMINED																
832265	4S	18- 20	4BS1M	100	80	66	46	32	25	18	13	6	4	3	2	1	9	6	5	4		433.44	27.327	1.246			26.0	5.8
832266	5S	20- 26	5BS2	100	80	66	45	31	25	18	13	3	1	1	TR	TR	9	4	2	1		133.84	27.730	1.219			27.8	7.1
832267	6S	18- 18	4BS1S	FRACTIONS				NOT				DETERMINED																
832268	7S	18- 23	5BS2	FRACTIONS				NOT				DETERMINED																
832269	8S	23- 29	5BS3	FRACTIONS				NOT				DETERMINED																
832270	9S	29- 31	5BS4	FRACTIONS				NOT				DETERMINED																
832271	10S	31- 35	5BS5	FRACTIONS				NOT				DETERMINED																

(WEIGHT FRACTIONS) —WHOLE SOIL (MM)— <——PCT OF WHOLE SOIL——> ; —<75 MM FRACTION— <—PCT OF <75 MM—> ; (WEIGHT PER UNIT VOLUME G/CC) ; (VOID) —RATIOS— AT 1/3 BAR

SAMPLE	HZ NO	26 (>2)	27 (250-UP)	28 (250-75)	29 (75-2)	30 (75-20)	31 (20-5)	32 (5-2)	33 (<2)	34 (75-2)	35 (75-20)	36 (20-5)	37 (5-2)	38 (<2)	39	40 (Whole soil, soil survey 1/3 BAR)	41 (Soil survey OVEN-DRY)	42 (Engineering MOIST)	43 (Engineering SATURATED)	44 (<2 mm soil survey 1/3 BAR)	45 (15 BAR)	46 (OVEN-DRY)	47 (Engineering MOIST)	48 (SATURATED)	49 (WHOLE SOIL)	50 (<2 MM)
832262	1	3	--	--	4	3	TR	1	91	4	3	TR	1	91		0.66	0.76	1.15	1.42	0.64	0.70	0.73	1.13	1.40	2.90	3.14
832263	2	15	--	4	12	9	1	2	85	12	9	1	2	00		0.60	0.71	1.00	1.37	0.53	0.59	0.63	0.95	1.33	3.42	4.00
832264	3	90	--	2	88	60	24	5	10	90	61	24	5	10		2.45										
832265	4	87	--	2	85	67	14	5	13	87	68	14	5	13		2.39										
832266	5	87	--	1	84	67	13	5	13	87	69	13	5	13		2.39										

(VOLUME FRACTIONS) —WHOLE SOIL (MM)— AT 1/3 BAR <——PCT OF WHOLE SOIL——> ; (C/N) ; (RATIOS TO CLAY) —<2 MM FRACTION— ; (LINEAR EXTENSIBILITY) ; (WRD) <—IN/IN—>

SAMPLE	HZ NO	51 (>2)	52 (250-UP)	53 (250-75)	54 (75-2)	55 (75-20)	56 (20-5)	57 (5-2)	58 (<2)	59 (2-.05)	60 (.05-.002)	61 (LT .002)	62 (PORES D)	63 (PORES P)	64 (C/N)	65 (FINE CLAY)	66 (CEC SUM CATS)	67 (CEC NH4-OAC)	68 (15 BAR H2O)	69 (LE 1/3 BAR)	70 (Whole soil 1/3 BAR to 15 BAR)	71 (to OVEN-DRY)	72 (<2 mm to 15 BAR)	73 (to OVEN-DRY)	74 (WHOLE SOIL)	75 (<2 MM)
832262	1	2	--	--	2	2	TR	1	98	8	15		27	47	16		170.67	97.33	115.00	15.000	2.9	4.7	3.0	4.5	0.26	0.27
832263	2	3	--	1	3	2	1	2	97	11	3		37	40	11						3.2	5.8	3.6	5.9	0.20	0.20
832264	3	43	--	2	41	55	22	5	17	5	4		3		11											
832265	4	78	--	2	76	60	13	5	22	8	2	1	10				1.81	1.59								
832266	5	78	--	3	75	60	12	5	22	11			10				1.91	1.82								

(WEIGHT FRACTIONS-CLAY FREE) —WHOLE SOIL— PCT OF >2MM+SAND+SILT> ; —<2 MM FRACTION— (——PCT OF SAND+SILT——) ; (-TEXTURE--) (DETERMINED IN FIELD / BY PSDA) (--<2 MM-) ; (--PSDA (MM)--) (--PCT OF <2MM-) ; (PH) ; (-ELECTRICAL) (- - - <2 MM- - -) ; (CUMULT. AMOUNTS) IN. OF H2O 1/3 BAR TO 15BAR AIRDRY (WHL SOIL)

SAMPLE NO	HZ NO	76 (>2 -75)	77 (75 -2)	78 (20 -2)	79 (2-.05)	80 (.05-.002)	81 (LT .002)	82 (VC)	83 (C)	84 (M)	85 (F)	86 (VF)	87 (Silt C)	88 (Silt F)	89 (CL AT)	90 (Texture in field)	91 (Texture by PSDA)	92 (Sand 2-.05)	93 (Silt .05-.002)	94 (Clay LT .002)	95 (pH CaCl2 .01M)	96 (RES- IST. OHMS)	97 (CON- DUCT. MMHOS)	98 (SALT MG/KG)	99 (1/3 BAR TO 15BAR)	100 (AIRDRY)
832262	1	9	9	1	32	59	TR	1	4	5	10	16	18	47	TR		SIL	35.1	64.6	0.3	5.4					
832263	2	15	12	3	48	37		3	5	6	20	22	29	14			VFSL	56.6	43.4	—	6.2					
832264	3	90	39	29	5	5		14	10	6	9	15	17	29			SL	54.3	45.7	—	5.6					
832265	4	33	35	19	9	3	1	37	21	12	5	3	5	17	9		COSL	71.6	20.4	8.0	6.2					
832266	5	87	84	18	12	TR	TR	33	37	19	6	1	2	2	2		COS	94.1	3.7	2.2	5.6					
832267	6																									
832268	7																									
832269	8																									
832270	9																									
832271	10																									

SAMPLE	UP LOW	LOW DIF		CLAY	SAND	OC	S/C	W S/C	W OC
832262	0- 19	19	19	0.3	35.1	8.325	117.0	117.0	8.3
832263	19- 35	35	16	0.0	56.6	3.406	117.0	117.0	6.1
832264	35- 45	40	5	0.0	54.3	4.797	117.0	117.0	5.9

UP LOW	LOW DIF		S/C	W S/C	W OC
0- 19	19	18	****	****	8.3

SUPPLEMENTARY CHARACTERIZATION DATA

LOS ULMOS

SAMPLED AS:

S 83FN-275 -003 SAMPLE NOS. 83P2234 - 2239 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HOR-IZON	ENGINEERING PERCENTAGE PASSING 3 (INCHES) 1	2 2	3/2 3	1 4	3/4 5	3/8 6	4 (NUMBER) 7	10 8	40 9	200 10	PSDA SIEVE 20 (MICRONS) 11	5 12	2 13	CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN 1. (MM) 14	.5 15	.25 16	.10 17	.05 18	DIAMETERS (MM) AT 60 (PERCENTILE) 19	50 20	10 21	ATTERBERG LL (PCT) 22	PI 23	GRADATION UNIFORMITY CU 24	CURVATURE CC 25
832234	15	0- 3	A1	100	100	100	100	100	100	100	100	98	91	75	61	52	99	99	97	94	88	--	0.002	--			14.0	0.4
832235	25	3- 11	A2	100	100	100	100	100	100	100	100	98	90	73	56	45	99	98	97	93	87	0.01	0.003	--			20.7	0.4
832236	35	11- 26	A3	100	100	100	100	100	100	100	100	99	92	79	67	58	99	98	97	94	90	--	0.001	--			8.1	0.6
832237	45	26- 45	BS1	100	100	100	100	100	100	100	100	100	97	88	82	78	100	100	99	97	95	--	0.001	--			4.3	0.7
832238	55	45- 65	BS2	100	100	100	100	100	100	100	100	99	97	92	87	84	100	100	99	98	96	--	0.001	--			4.0	0.8
832239	65	65- 79	BS3	100	100	100	100	100	100	100	100	99	96	90	85	81	100	99	99	97	95	--	0.001	--			4.1	0.8

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS) WHOLE SOIL (MM) >2 (PCT OF WHOLE SOIL) 26	250-UP 27	250-75 28	75-2 29	75-20 30	20-5 31	5-2 32	<2 33	<75 MM FRACTION 75-2 (PCT OF <75 MM) 34	75-20 35	20-5 36	5-2 37	<2 38	39	(WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL SOIL SURVEY 1/3 BAR 40	OVEN-DRY 41	ENGINEERING MOIST 42	SATURATED 43	<2 MM FRACTION SOIL SURVEY 1/3 BAR 44	15 BAR 45	OVEN-DRY 46	ENGINEERING MOIST 47	SATURATED 48	(VOID RATIOS) AT 1/3 BAR WHOLE SOIL 49	<2 MM 50
832234	1	TR	--	--	--	--	--	TR	100	—	--	--	TR	100		0.83	0.97	1.20	1.52	0.83	0.90	0.97	1.21	1.52	2.19	2.19
832235	2	--	--	--	--	--	--	--	100	—	--	--	--	100		0.90	1.02	1.28	1.56	0.90	0.96	1.02	1.26	1.56	1.94	1.94
832236	3	TR	--	--	—	--	TR	TR	100	—	—	TR	TR	100		0.87	1.04	1.22	1.54	0.87	0.94	1.04	1.22	1.54	2.05	2.05
832237	4	TR	—	--	—	--	TR	TR	100	—	—	TR	TR	100		1.14	1.41	1.61	1.71	1.14	1.24	1.41	1.61	1.71	1.32	1.32
832238	5	--	--	--	--	--	--	--	100	--	--	--	--	100		1.11	1.46	1.61	1.69	1.11	1.24	1.46	1.61	1.69	1.39	1.39
832239	6	TR	--	--	--	--	TR	TR	100	—	--	TR	TR	100		1.11	1.48	1.61	1.69	1.10	1.24	1.47	1.59	1.69	1.39	1.41

SAMPLE NO	HZ NO	(VOLUME FRACTIONS) WHOLE SOIL (MM) AT 1/3 BAR >2 (PCT OF WHOLE SOIL) 51	250-UP 52	250-75 53	75-2 54	75-20 55	20-5 56	5-2 57	<2 58	2-.05 59	.05-.002 60	LT .002 61	PORES D 62	PORES F 63	(C/N) RATIO 64	(RATIOS TO CLAY) <2 MM FRACTION FINE CLAY 65	CEC SUM CATS 66	CEC NH4-OAC 67	15 BAR H2O 68	LE 1/3 BAR 69	(LINEAR EXTENSIBILITY) WHOLE SOIL 1/3 BAR TO 15 BAR 70	OVEN-DRY 71	<2 MM (IN/IN) 15 BAR 72	OVEN-DRY 73	(W R D) WHOLE SOIL (IN/IN) 74	<2 MM 75
832234	1	TR	--	--	--	--	--	TR	100	4	11	16	32	37	16		0.79	0.63	0.51	0.101	2.7	5.3	2.7	5.3	0.15	0.15
832235	2	—	--	--	--	--	--	--	100	5	14	15	29	38	19	0.35	0.70	0.51	0.51	0.095	2.2	4.3	2.2	4.3	0.17	0.17
832236	3	TR	--	--	--	--	TR	TR	100	3	10	19	32	35	20	0.41	0.52	0.33	0.44	0.105	2.6	6.1	2.6	6.1	0.13	0.13
832237	4	TR	--	--	--	--	TR	TR	100	2	7	33	10	47		0.70	0.30	0.17	0.35	0.093	2.8	7.3	2.8	7.3	0.16	0.16
832238	5	--	--	--	--	--	--	--	100	2	5	35	8	50		0.75	0.31	0.15	0.36	0.115	3.8	9.6	3.8	9.6	0.17	0.17
832239	6	TR	—	--	--	--	TR	TR	100	2	6	34	9	50		0.71	0.30	0.15	0.36	0.124	4.0	10.1	4.1	10.1	0.17	0.17

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS-CLAY FREE) WHOLE SOIL >2 (PCT OF >2MM+SAND+SILT) 76	75-2 77	20-2 78	<2 MM FRACTION 2-.05 79	.05-.002 80	LT .002 81	SANDS VC (PCT OF SAND+SILT) 82	C 83	M 84	F 85	VF 86	SILTS C 87	F 88	CL VI 89	(TEXTURE) (DETERMINED IN FIELD) 90	BY PSDA (<2 MM) 91	(PSDA (MM)) SAND 2-.05 (PCT OF .2MM) 92	SILT .05-.002 93	CLAY LT .002 94	(PH) CACL2 .01M 95	(ELECTRICAL) RES-IST. OHMS (<2 MM) 96	CON-DUCT. MMHOS 97	SALT MG/KG 98	(CUMULT. AMOUNTS) IN. OF H2O 1/3 BAR TO 15BAR (WHL SOIL) 99	AIRDRY 100
832234	1				24	76	110	1	1	2	8	11	29	47	110		C	11.5	36.1	52.4	4.9					
832235	2				25	75	93	2	2	2	7	11	26	50	93		SIC	13.4	41.2	45.4	4.9					
832236	3				24	76	140	2	3	3	6	9	26	50	140		C	9.9	31.8	58.3	4.6					
832237	4				21	79	363		1	3	7	9	33	43	363		C	4.6	17.0	78.4	4.7					
832238	5				24	76	510	1	1	3	8	10	26	31	510		C	3.9	12.5	83.6	4.5					
832239	5				28	72	435	1	2	4	9	12	25	47	435		C	5.3	13.4	81.3	4.4					

SAMPLE	UP LOW	LOW DIF		CLAY	SAND	OC	S/C	W S/C	W OC	UP LOW	LOW DIF		S/C	W S/C	W OC
832234	0- 7	7	7	52.4	11.5	6.544	0.2	0.2	6.5	0- 7	7	7	0.2	0.2	6.5
832235	7- 27	27	20	45.4	13.4	4.292	0.3	0.3	4.9	7- 27	18	11	0.3	0.3	5.2
832236	27- 66	40	13	58.3	7.9	2.375	0.2	0.2	4.1						

SUPPLEMENTARY CHARACTERIZATION DATA

OSORNO

SAMPLED AS:

S 83FN-275 -004 SAMPLE NOS. 83P2277 - 2286 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	ENGINEERING PERCENTAGE PASSING — INCHES 3 (1)	2 (2)	3/2 (3)	1 (4)	3/4 (5)	3/8 (6)	NUMBER 4 (7)	10 (8)	40 (9)	200 (10)	PSDA SIEVE MICRONS 20 (11)	5 (12)	2 (13)	CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN (MM) 1. (14)	.5 (15)	.25 (16)	.10 (17)	.05 (18)	DIAMETERS (MM) AT PERCENTILE 60 (19)	50 (20)	10 (21)	ATTERBERG (PCT) LL (22)	PI (23)	GRADATION UNIFORMITY CU (24)	CURVATURE CC (25)
832277	1S	0- 10	AP	100	100	100	100	100	100	100	99	97	87	58	23	8	98	97	95	91	82	0.02	0.014	0.002			9.9	0.6
832278	2S	10- 22	B2	FRACTIONS NOT DETERMINED																								
832279	3S	22- 35	B3	100	99	99	99	93	97	96	94	76	36	14	6	TR	90	79	65	43	28	0.20	0.133	0.010			20.0	1.5
832280	4S	35- 37	2B2	100	99	93	96	95	99	82	75	49	27	17	10	5	63	51	41	30	22	0.85	0.461	0.005			>100	2.2
832281	5S	37- 59	2C1	100	100	100	100	100	98	95	92	76	55	42	25	14	85	78	70	59	51	0.11	0.047	0.001			>100	0.5
832282	6S	59- 75	3C2	100	100	100	100	100	100	100	100	99	75	27	14	5	100	99	99	89	49	0.06	0.051	0.003			18.0	2.5
832283	7S	37- 59	SUB1	100	100	100	100	100	99	79	53	45	31	22	12	6	50	46	42	34	28	2.54	1.083	0.004			>100	0.5
832284	8S	37- 59	SUB2	100	99	99	99	98	92	96	75	59	39	31	18	10	71	61	51	42	36	0.45	0.222	0.002			>100	0.4
832285	9S	37- 59	SUB3	100	100	100	100	100	99	97	93	89	53	65	37	19	92	89	88	86	79	0.02	0.009	0.001			22.5	1.2
832286	10S	37- 59	SUB4	100	100	100	100	100	99	98	96	93	87	76	49	30	95	93	92	89	84	0.01	0.005	--			21.2	1.0

SAMPLE NO	HZ NO	WEIGHT FRACTIONS — WHOLE SOIL (MM) PCT OF WHOLE SOIL >2 (26)	250-UP (27)	250-75 (28)	75-2 (29)	75-20 (30)	20-5 (31)	5-2 (32)	<2 (33)	<75 MM FRACTION PCT OF <75 MM 75-2 (34)	75-20 (35)	20-5 (36)	5-2 (37)	<2 (38)	(39)	WEIGHT PER UNIT VOLUME G/CC — WHOLE SOIL: SOIL SURVEY 1/3 BAR (40)	OVEN-DRY (41)	ENGINEERING MOIST (42)	SATURATED (43)	<2 MM FRACTION: SOIL SURVEY 1/3 BAR (44)	15 BAR (45)	OVEN-DRY (46)	ENGINEERING MOIST (47)	SATURATED (48)	VOID RATIOS AT 1/3 BAR WHOLE SOIL (49)	<2 MM (50)
832277	1	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.70	0.81	1.19	1.44	0.69	0.76	0.80	1.18	1.43	2.79	2.84
832278	2	2	--	--	2	--	TR	2	98	2	--	TR	2	98		0.59	0.74	1.03	1.37	0.58	0.69	0.73	1.02	1.36	3.49	3.57
832279	3	6	--	--	6	2	2	2	94	6	2	2	2	94		0.56	0.75	1.06	1.35	0.53	0.67	0.71	1.04	1.33	3.73	4.00
832280	4	25	--	--	25	5	13	7	75	25	5	13	7	75		1.64										
832281	5	8	--	--	8	--	5	3	92	8	--	5	3	92		1.05	1.13	1.56	1.65	0.99	1.04	1.07	1.52	1.62	1.52	1.68
832282	6	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.84	0.92	1.31	1.55	0.89	0.92	0.92	1.30	1.55	1.98	1.98
832283	7	47	--	--	47	--	22	25	53	47	--	22	25	53		1.64										
832284	8	25	--	--	25	2	12	11	75	25	2	12	11	75		1.64										
832285	9	7	--	--	7	--	3	4	93	7	--	3	4	93		1.50										
832286	10	4	--	--	4	--	2	2	96	4	--	2	2	96		1.47										

SAMPLE NO	HZ NO	VOLUME FRACTIONS — WHOLE SOIL (MM) PCT OF WHOLE SOIL >2 (51)	250-UP (52)	250-75 (53)	75-2 (54)	75-20 (55)	20-5 (56)	5-2 (57)	<2 (58)	AT 1/3 BAR 2-.05 (59)	.05-.002 (60)	LT .002 (61)	PORES (62)	SAT P-10 (63)	(C/N) (64)	RATIOS TO CLAY FINE CLAY (65)	<2 MM FRACTION CEC SUM CATS (66)	CEC NH4-OAC (67)	15 BAR H2O (68)	LE 1/3 BAR (69)	LINEAR EXTENSIBILITY WHOLE SOIL 1/3 BAR TO 15 BAR (70)	OVEN-DRY (71)	<2 MM 15 BAR (72)	OVEN-DRY (73)	W R D (IN/IN) WHOLE SOIL (74)	<2 MM (75)
832277	1	1	--	--	1	--	TR	1	100	4	20	2	25	49	12		6.65	4.39	4.16	0.638	3.2	5.0	3.3	5.1	0.26	0.26
832278	2	2	--	--	2	--	TR	2	100	11	11		34	44	12						5.9	7.9	6.0	8.0	0.27	0.27
832279	3	1	--	--	1	2	2	2	99	14	6		29	50	10		209.50	115.50	156.505	1.000	7.7	10.2	8.1	10.2	0.34	0.34
832280	4	15	--	--	15	3	8	4	85	33	11	3	38				3.42	2.83								
832281	5	3	--	--	3	--	2	1	97	16	15	5	9	51			1.57	1.25	1.29	0.172	1.6	2.5	1.7	2.6	0.33	0.33
832282	6	TR	--	--	--	--	--	TR	100	17	15	2	24	42			2.24	1.59	1.91	0.224	1.1	1.1	1.1	1.1	0.35	0.35
832283	7	32	--	--	32	--	15	17	68	19	15	4	31													
832284	8	15	--	--	15	1	7	7	85	24	16	6	30													
832285	9	4	--	--	4	--	2	2	96	8	34	10	43													
832286	10	2	--	--	2	--	1	1	98	7	30	17	45													

SAMPLE NO	HZ NO	WEIGHT FRACTIONS - CLAY FREE — WHOLE SOIL PCT OF >2MM+SAND+SILT >2 (76)	75-2 (77)	20-2 (78)	2-.05 (79)	.05-.002 (80)	LT .002 (81)	<2 MM FRACTION PCT OF SAND+SILT SANDS VC (82)	C (83)	M (84)	F (85)	VF (86)	SILTS C (87)	F (88)	CLAY (89)	TEXTURE DETERMINED IN FIELD (90)	BY PSDA (91)	PSDA (MM) PCT OF <2MM SAND 2-.05 (92)	SILT .05-.002 (93)	CLAY LT .002 (94)	(PH) CACL2 .01M (95)	ELECTRICAL <2 MM RES. OHMS (96)	COND. MMHOS (97)	SALT MG/KG (98)	CUMULT. AMOUNTS IN. OF H2O 1/3 BAR TO 15BAR (WHL SOIL) (99)	AIRDRY (100)
832277	1	1	1	1	18	81	9	1	1	2	5	4	27	55	4		SIL	16.7	75.3	8.0	4.8					
832278	2	2	2	2	50	48		1	3	9	19	19	22	27			VFSL	50.7	49.3	--	5.6					
832279	3	6	6	4	67	27	TR	4	11	13	23	17	14	15	TR		LS	70.7	29.1	0.2	5.9					
832280	4	26	26	21	56	19	5	17	16	15	15	11	7	17	7		COSL	70.6	22.9	6.6	5.6					
832281	5	9	9	9	48	43	16	9	9	10	14	11	11	36	10		L	44.9	40.0	15.1	6.0					
832282	6				54	46	5	TR	TR	TR	11	42	23	24	5		VFSL	51.2	43.9	4.9	6.1					
832283	7	50	50	50	27	23	6	7	7	10	17	13	12	34	12		L	47.9	41.5	10.6						
832284	8	28	28	26	43	29	11	6	14	16	15	9	8	31	16		L	52.0	34.3	13.7						
832285	9	9	9	9	17	74	23	2	3	2	3	9	19	63	25		SIL	15.0	55.0	20.0						
832286	10	6	6	6	17	77	43	2	2	2	4	8	13	69	46		SICL	12.2	56.4	31.4						

SAMPLE	UP LOW	LOW DIF	CLAY	SAND	OC	S/C	W S/C	W OC
832277	0- 26	26 26	8.0	16.7	9.379	2.1	2.1	9.4
832278	26- 56	40 14	0.0	50.7	3.696	2.1	2.1	7.4

UP LOW	LOW DIF	S/C	W S/C	W OC
0- 26	18 18	2.1	2.1	9.4

SUPPLEMENTARY CHARACTERIZATION DATA

ANTILLANCA

SAMPLED AS:

S 83FN-275 -005 SAMPLE NOS. 83P2303 - 2311 DATE 11/30/83

CHILE-SBSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

Columns: ENGINEERING PERCENTAGE PASSING SIEVE — INCHES: 1 = 3, 2 = 2, 3 = 3/2, 4 = 1, 5 = 3/4, 6 = 3/8; NUMBER: 7 = 4, 8 = 10, 9 = 40, 10 = 200; PSDA MICRONS: 11 = 20, 12 = 5, 13 = 2. CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN (MM): 14 = 1., 15 = .5, 16 = .25, 17 = .10, 18 = .05; DIAMETERS (MM) AT PERCENTILE: 19 = 60, 20 = 50, 21 = 10; ATTERBERG (PCT): 22 = LL, 23 = PI; GRADATION: 24 = UNIFMTY CU, 25 = CURVTUR CC.

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
832303	1S	0- 2	A1	100	100	100	100	100	92	93	60	34	17	4	2	1	46	36	28	21	12	2.00	1.238	0.040			50.1	1.1
832304	2S	2- 3	A2	100	100	100	100	100	91	32	43	13	4	1	1	TR	26	14	8	4	3	2.90	2.331	0.322			9.0	1.5
832305	3S	8- 31	C1	FRACTIONS NOT DETERMINED																								
832306	4S	31- 58	C2	FRACTIONS NOT DETERMINED																								
832307	5S	59- 35	C3	FRACTIONS NOT DETERMINED																								
832308	6S	31- 58	SUB1	FRACTIONS NOT DETERMINED																								
832309	7S	31- 58	SUB2	FRACTIONS NOT DETERMINED																								
832310	8S	31- 58	SUB3	FRACTIONS NOT DETERMINED																								
832311	9S	31- 58	SUB4	FRACTIONS NOT DETERMINED																								

Columns: (WEIGHT FRACTIONS) WHOLE SOIL (MM), PCT OF WHOLE SOIL: 26 = >2, 27 = 250-UP, 28 = 250-75, 29 = 75-2, 30 = 75-20, 31 = 20-5, 32 = 5-2, 33 = <2; <75 MM FRACTION, PCT OF <75 MM: 34 = 75-2, 35 = 75-20, 36 = 20-5, 37 = 5-2, 38 = <2; 39. (WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL: SOIL SURVEY 40 = 1/3 BAR, 41 = OVEN-DRY; ENGINEERING 42 = MOIST, 43 = SATURATED; <2 MM FRACTION: SOIL SURVEY 44 = 1/3 BAR, 45 = 15 BAR, 46 = OVEN-DRY; ENGINEERING 47 = MOIST, 48 = SATURATED; (VOID RATIOS AT 1/3 BAR): 49 = WHOLE SOIL, 50 = <2 MM.

SAMPLE NO.	HZ NO	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
832303	1	40	--	--	40	--	17	23	60	40	--	17	23	60		1.77										
832304	2	57	--	--	57	--	18	39	43	57	--	18	39	43		1.95										
832305	3	18	--	--	18	--	3	15	82	18	--	3	15	82		1.41	1.43	1.65	1.88	1.27	1.29	1.29	1.54	1.79	0.88	1.09
832306	4	40	--	--	40	TR	14	26	60	40	TR	14	26	60		1.34	1.43	1.66	1.83	1.01	1.09	1.09	1.41	1.63	0.98	1.62
832307	5	54	--	--	54	--	23	31	46	54	--	23	31	46		1.91										

Columns: (VOLUME FRACTIONS AT 1/3 BAR) WHOLE SOIL (MM), PCT OF WHOLE SOIL: 51 = >2, 52 = 250-UP, 53 = 250-75, 54 = 75-2, 55 = 75-20, 56 = 20-5, 57 = 5-2, 58 = <2, 59 = 2-.05, 60 = .05-.002, 61 = LT .002, 62 = PORES D, 63 = PORES P; 64 = (C/N) RATIO; (RATIOS TO CLAY) <2 MM FRACTION: 65 = FINE CLAY, 66 = CEC SUM CATS, 67 = CEC NH4-OAC, 68 = 15 BAR H2O, 69 = LE 1/3 BAR; (LINEAR EXTENSIBILITY) WHOLE SOIL <-1/3 BAR TO (IN/IN)->: 70 = 15 BAR, 71 = OVEN-DRY; <2 MM: 72 = 15 BAR, 73 = OVEN-DRY; (W & D) <--IN/IN->: 74 = WHOLE SOIL, 75 = <2 MM.

SAMPLE NO	HZ NO	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
832303	1	27	--	--	27	--	11	16	73	32	4		13		35		22.00	19.00								
832304	2	41	--	--	41	--	13	28	59	21	2		26		31		15.17	6.33								
832305	3	10	--	--	10	--	2	8	90	42	1		23	24							0.5	0.5	0.5	0.5	0.22	0.24
832306	4	20	--	--	20	TR	7	13	80	21	1		17	32							2.0	2.2	2.6	2.6	0.30	0.30
832307	5	39	--	--	39	--	17	23	61	32	2		20													

Columns: (WEIGHT FRACTIONS - CLAY FREE) WHOLE SOIL, PCT OF >2MM+SAND+SILT: 76 = >2, 77 = 75-2, 78 = 20-2, 79 = 2-.05, 80 = .05-.002, 81 = LT .002; <2 MM FRACTION, PCT OF SAND+SILT: SANDS 82 = VC, 83 = C, 84 = M, 85 = F, 86 = VF; SILTS 87 = C, 88 = F; 89 = CL AY; (TEXTURE) (<2 MM): 90 = DETERMINED IN FIELD, 91 = AT PSDA; (PSDA (MM)) PCT OF <2MM: 92 = SAND 2-.05, 93 = SILT .05-.002, 94 = CLAY LT .002; (PH): 95 = CACL2 .01M; (ELECTRICAL) <2 MM: 96 = RESIST. OHMS, 97 = CONDUCT. MMHOS; (CUMULT. AMOUNTS): 98 = SALT MG/KG, 99 = IN. OF H2O 1/3 BAR TO 15BAR, 100 = AIRDRY (WHL SOIL).

SAMPLE NO	HZ NO	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
832303	1	40	40	40	48	11	1	24	17	12	13	15	13	6	1		LCOS	80.3	18.7	1.0	4.6					
832304	2	57	57	57	40	3	TR	39	28	15	7	4	4	2	1		COS	93.3	6.1	0.6	5.2					
832305	3	18	18	18	81	1		32	34	22	8	2	1	TR			COS	98.2	1.8	—	6.2					
832306	4	40	40	40	58	2		23	30	26	12	5	2	2			COS	96.0	4.0	—	6.2					
832307	5	54	54	54	44	2		37	26	16	10	6	3	2			COS	95.4	4.6	—	6.2					
832308	6																									
832309	7																									
832310	8																									
832311	9																									

SAMPLE	UP LOW	LOW DIF	CLAY	SAND	OC	S/C	W S/C	W OC
832303	0- 6	6 6	1.0	80.3	9.386	80.3	80.3	9.4
832304	6- 20	20 14	0.6	93.3	1.599	155.5	132.9	3.9
832305	20- 78	40 20	0.0	98.2	0.137	155.5	132.9	2.0

UP LOW	LOW DIF	S/C	W S/C	W OC
0- 6	6 6	80.3	80.3	9.4
6- 20	18 12	****	****	4.2

SUPPLEMENTARY CHARACTERIZATION DATA

CHANLEUFU

SAMPLED AS:

S 83FN-275 -006 — SAMPLE NOS. 83P2317 - 2322 — DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	ENGINEERING PERCENTAGE PASSING SIEVE 3 INCHES (1)	2 (2)	3/2 (3)	1 (4)	3/4 (5)	3/8 INCHES (6)	4 NUMBER (7)	10 (8)	40 (9)	200 NUMBER (10)	PSDA SIEVE 20 MICRONS (11)	5 (12)	2 (13)	CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN 1. MM (14)	.5 (15)	.25 (16)	.10 (17)	.05 (18)	DIAMETERS (MM) AT 60 PERCENTILE (19)	50 (20)	10 (21)	ATTERBERG LL PCT (22)	PI (23)	GRADATION UNIFORMITY CU (24)	CURVATURE CC (25)
832317	15	0- 9	A1	100	100	100	100	100	99	98	96	62	29	13	6	1	90	68	45	33	24	0.39	0.292	0.011			34.5	1.5
832318	25	9- 18	A2	100	100	100	100	100	100	100	99	55	25	9	4	1	91	60	40	29	20	0.50	0.353	0.022			22.2	1.0
832319	35	18- 23	C1	100	100	100	100	100	100	100	94	40	9	6	3	TR	82	49	15	10	8	0.63	0.514	0.102			6.2	1.8
832320	45	23- 29	C2	100	100	100	100	100	100	100	99	70	21	8	4	1	95	79	46	26	15	0.34	0.273	0.025			13.3	1.6
832321	55	29- 32	2C3	FRACTIONS NOT DETERMINED																								
832322	65	32- 32	3R	FRACTIONS NOT DETERMINED																								

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS) WHOLE SOIL (MM) PCT OF WHOLE SOIL >2 (26)	250-UP (27)	250-75 (28)	75-2 (29)	75-20 (30)	20-5 (31)	5-2 (32)	<2 (33)	<75 MM FRACTION PCT OF <75 MM 75-2 (34)	75-20 (35)	20-5 (36)	5-2 (37)	<2 (38)	(39)	(WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL SOIL SURVEY 1/3 BAR (40)	OVEN-DRY (41)	ENGINEERING MOIST (42)	SATURATED (43)	<2 MM FRACTION SOIL SURVEY 1/3 BAR (44)	15 BAR (45)	OVEN-DRY (46)	ENGINEERING MOIST (47)	SATURATED (48)	(VOID RATIOS) AT 1/3 BAR WHOLE SOIL (49)	<2 MM (50)
832317	1	4	--	--	4	--	2	2	96	4	--	2	2	96		0.38	0.55	0.87	1.24	0.37	0.51	0.53	0.87	1.23	5.97	6.16
832318	2	1	--	--	1	--	--	1	99	1	--	--	1	99		0.62	0.75	1.20	1.39	0.62	0.73	0.74	1.21	1.39	3.27	3.27
832319	3	6	--	--	6	--	--	6	94	6	--	--	6	94		0.57	0.62	0.99	1.36	0.54	0.58	0.59	0.96	1.34	3.65	3.91
832320	4	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.77	0.89	1.32	1.48	0.76	0.86	0.88	1.31	1.47	2.44	2.49

SAMPLE NO	HZ NO	(VOLUME FRACTIONS) WHOLE SOIL (MM) AT 1/3 BAR PCT OF WHOLE SOIL >2 (51)	250-UP (52)	250-75 (53)	75-2 (54)	75-20 (55)	20-5 (56)	5-2 (57)	<2 (58)	2-.05 (59)	.05-.002 (60)	LT .002 (61)	PORES D (62)	PORES F (63)	(C/N) RATIO (64)	FINE CLAY (65)	(RATIOS TO CLAY) <2 MM FRACTION CEC SUM CATS (66)	CEC NH4-OAC (67)	15 BAR H2O (68)	LE 1/3 BAR (69)	(LINEAR EXTENSIBILITY) WHOLE SOIL (IN/IN) 1/3 BAR TO 15 BAR (70)	OVEN-DRY (71)	<2 MM 15 BAR (72)	OVEN-DRY (73)	(W R D) WHOLE SOIL IN/IN (74)	<2 MM (75)
832317	1	1	--	--	1	--	2	2	99	10	3		37	49	36		25.58	14.58	17.08	10.583	11.7	13.1	11.3	12.7	0.42	0.42
832318	2	1	--	--	1	--	--	1	100	19	4		19	58	29		42.33	17.83	22.50	10.167	5.6	6.6	5.6	6.1	0.50	0.50
832319	3	1	--	--	1	--	--	1	99	18	2		36	42	22		53.67	20.00	62.33	10.000	2.3	2.8	2.4	3.0	0.31	0.32
832320	4	1	--	--	1	--	TR	1	100	24	4		16	55			28.00	9.43	19.43	7.143	4.2	4.9	4.2	5.0	0.44	0.44

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS-CLAY FREE) WHOLE SOIL PCT OF >2MM+SAND+SILT >2 (76)	75-2 (77)	20-2 (78)	2-.05 (79)	.05-.002 (80)	LT .002 (81)	<2 MM FRACTION SANDS PCT OF SAND+SILT VC (82)	C (83)	M (84)	F (85)	VF (86)	SILTS C (87)	F (88)	CL AT (89)	(TEXTURE) DETERMINED IN FIELD (90)	BY PSDA (91)	(PSDA (MM)) SAND 2-.05 PCT OF 2MM (92)	SILT .05-.002 (93)	CLAY LT .002 (94)	(PH) CACL2 .01M (95)	(ELECTRICAL) RES-IST. OHMS (96)	CONDUCT. MMHOS (97)	SALT MG/KG (98)	(CUMULT. AMOUNTS) IN. OF H2O 1/3 BAR TO 15BAR AIRDRY (WHL SOIL) (99)	(100)
832317	1	4	4	4	73	23	1	6	23	25	13	10	11	12	1		LCOS	75.3	23.5	1.2	4.5					
832318	2	1	1	1	80	19	1	8	32	21	11	10	11	9	1		LCOS	80.3	19.1	0.6	4.8					
832319	3	6	6	6	96	8	TR	13	35	36	6	2	2	6	TR		COS	91.3	[illegible]	0.3	5.1					
832320	4	1	1	1	85	14	1	4	17	33	20	12	6	9	1		LS	85.3	14.0	0.7	5.9					
832321	5																									
832322	6																									

SAMPLE	UP LOW	LOW DIF		CLAY	SAND	OC	S/C	W S/C	W OC
832317	0- 22	22	22	1.2	75.3	9.294	62.7	62.7	9.3
832318	22- 46	40	18	0.6	80.3	4.491	133.8	94.7	7.1

UP LOW	LOW DIF		S/C	W S/C	W OC
0- 22	18	18	62.7	62.7	9.3

SUPPLEMENTARY CHARACTERIZATION DATA

PUYEHUE

SAMPLED AS:

S 83PN-275 -007 SAMPLE NOS. 83P2293 - 2297 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	ENGINEERING PERCENTAGE PASSING 3 IN 1	2 IN 2	3/2 IN 3	1 IN 4	3/4 IN 5	3/8 IN 6	NUMBER 4 7	NUMBER 10 8	NUMBER 40 9	NUMBER 200 10	PSDA SIEVE 20 MICRONS 11	5 MICRONS 12	2 MICRONS 13	CUMULATIVE CURVE USDA LESS THAN 1. MM 14	.5 MM 15	.25 MM 16	.10 MM 17	.05 MM 18	FRACTIONS (<76MM) DIAMETERS (MM) AT PERCENTILE 60 19	50 20	10 21	ATTERBERG LL (PCT) 22	PI (PCT) 23	GRADATION UNIFMTY CU 24	CURVTUR CC 25
832293	1S	0- 13	A	100	100	100	100	100	100	100	99	70	30	13	6	2	95	76	52	36	23	0.31	0.221	0.011			28.0	1.5
832294	2S	13- 25	BA	FRACTIONS NOT DETERMINED																								
832295	3S	25- 44	BS1	100	100	100	100	100	100	100	100	96	43	10	5	1	100	98	91	57	24	0.11	0.087	0.019			5.7	1.5
832296	4S	44- 64	BS2	100	100	100	100	100	100	99	97	86	28	10	5	1	96	91	71	37	18	0.19	0.142	0.018			10.5	1.6
832297	5S	64- 79	2CS	100	100	100	100	100	100	100	100	69	23	10	5	1	96	76	51	28	16	0.32	0.239	0.020			16.1	1.8

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS) WHOLE SOIL (MM) PCT OF WHOLE SOIL >2 26	250-UP 27	250-75 28	75-2 29	75-20 30	20-5 31	5-2 32	<2 33	<75 MM FRACTION PCT OF <75 MM 75-2 34	75-20 35	20-5 36	5-2 37	<2 38	39	(WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL SOIL SURVEY 1/3 BAR 40	SOIL SURVEY OVEN-DRY 41	ENGINEERING MOIST 42	ENGINEERING SATURATED 43	<2 MM FRACTION SOIL SURVEY 1/3 BAR 44	SOIL SURVEY 15 BAR 45	SOIL SURVEY OVEN-DRY 46	ENGINEERING MOIST 47	ENGINEERING SATURATED 48	(VOID) RATIOS AT 1/3 BAR WHOLE SOIL 49	<2 MM 50
832293	1	1	--	--	1	--	--	1	99	1	--	--	1	99		0.58	0.64	1.02	1.36	0.58	0.62	0.64	1.02	1.36	3.57	3.57
832294	2	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.39	0.55	0.91	1.24	0.39	0.53	0.55	0.91	1.24	5.79	5.79
832295	3	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.44	0.75	1.07	1.27	0.44	0.72	0.75	1.07	1.27	5.02	5.02
832296	4	3	--	--	3	--	1	2	97	3	--	1	2	97		0.37	0.87	1.02	1.23	0.36	0.81	0.85	1.02	1.22	6.16	6.36
832297	5	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.37	0.88	1.09	1.23	0.37	0.85	0.88	1.09	1.23	6.16	6.16

SAMPLE NO	HZ NO	(VOLUME FRACTIONS) WHOLE SOIL (MM) AT 1/3 BAR PCT OF WHOLE SOIL >2 51	250-UP 52	250-75 53	75-2 54	75-20 55	20-5 56	5-2 57	<2 58	2-.05 59	.05-.002 60	LT .002 61	PORES D 62	PORES F 63	(C/N) RAT-IO 64	(RATIOS TO CLAY) <2 MM FRACTION FINE CLAY 65	CEC SUM CATS 66	CEC NH4-OAC 67	15 BAR H2O 68	LE 1/3 BAR 69	(LINEAR EXTENSIBILITY) WHOLE SOIL <-1/5 BAR TO (IN/IN)-> 15 BAR 70	OVEN-DRY 71	<2 MM 15 BAR 72	<2 MM OVEN-DRY 73	(WRD) WHOLE SOIL <-IN/IN-> 74	<2 MM 75
832293	1	1	--	--	1	--	--	1	100	17	5	1	35	43	14		21.70	12.91	11.96	1.435	2.2	3.3	2.2	3.3	0.28	0.28
832294	2	TR	--	--	--	--	--	TR	100	12	3		33	52	21						10.8	12.1	10.8	12.1	0.43	0.43
832295	3	TR	--	--	--	--	--	TR	100	13	4		20	63			52.00	25.75	24.25	24.375	17.8	19.5	17.8	19.5	0.54	0.54
832296	4	3	--	--	3	--	1	2	100	11	2		21	65			55.25	34.00	30.88	41.500	30.9	33.0	31.0	33.2	0.57	0.57
832297	5	TR	--	--	--	--	TR	TR	100	12	2		14	72			41.44	24.56	23.56	37.222	31.9	33.5	31.9	33.5	0.64	0.64

SAMPLE NO	HZ NO	(WEIGHT FRACTIONS-CLAY FREE) WHOLE SOIL PCT OF >2MM+SAND+SILT >2 76	75-2 77	20-2 78	<2 MM FRACTION 2-.05 79	.05-.002 80	LT .002 81	SANDS PCT OF SAND+SILT VC 82	C 83	M 84	F 85	VF 86	SILTS C 87	F 88	CL AT 89	(TEXTURE) (DETERMINED IN FIELD) (<2 MM) 90	BY PSDA 91	(PSDA (MM)) PCT OF <2MM SAND 2-.05 92	SILT .05-.002 93	CLAY LT .002 94	(PH) CACL2 .01M 95	(ELECTRICAL) <2 MM RES-IST. OHMS 96	CON-DUCT. MMHOS 97	SALT MG/KG 98	(CUMULT. AMOUNTS) IN. OF H2O (WHL SOIL) 1/3 BAR TO 15BAR 99	AIRDRY 100
832293	1	1	1	1	78	21	2	4	20	24	17	14	11	11	2		LS	77.0	20.7	2.3	4.7					
832294	2				82	18		3	13	20	26	19	12	7			LS	81.6	13.4	--	5.2					
832295	3				76	24	1	TR	2	7	35	33	14	3	1		LFS	75.6	23.6	0.8	5.3					
832296	4	3	3	3	79	18	1	1	6	21	35	20	8	10	1		LS	81.3	17.9	0.8	5.6					
832297	5				85	15	1	4	21	25	24	12	6	9	1		LS	84.3	14.8	0.9	5.8					

SAMPLE	UP LOW	LOW	DIF	CLAY	SAND	OC	S/C	W S/C	W OC	UP LOW	LOW	DIF	S/C	W S/C	W OC
832293	0- 32	32	32	2.3	77.0	10.107	33.5	33.5	10.1	0- 32	18	18	33.5	33.5	10.1
832294	32- 63	40	8	0.0	81.6	6.256	33.5	33.5	9.3						

SUPPLEMENTARY CHARACTERIZATION DATA

PUERTO FONCK

SAMPLED AS:

S 83FN-275 -008 SAMPLE NOS. 83P2327 - 2332 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	1 (3 IN)	2 (2 IN)	3 (3/2 IN)	4 (1 IN)	5 (3/4 IN)	6 (3/8 IN)	7 (NO. 4)	8 (NO. 10)	9 (NO. 40)	10 (NO. 200)	11 (20 µ)	12 (5 µ)	13 (2 µ)	14 (1. mm)	15 (.5)	16 (.25)	17 (.10)	18 (.05)	19 (60 pctl)	20 (50 pctl)	21 (10 pctl)	22 LL	23 PI	24 CU	25 CC
832327	1S	0- 7	A1	100	100	100	100	100	100	100	100	89	60	33	15	4	99	93	78	65	53	0.08	0.044	0.003			22.9	1.0
832328	2S	7- 19	A2	100	100	100	100	100	100	100	100	88	59	34	16	5	99	93	73	63	53	0.08	0.044	0.003			26.6	0.8
832329	3S	19- 39	AB	100	100	100	100	100	100	100	100	97	65	23	10	1	100	98	94	76	46	0.07	0.055	0.005			13.4	2.0
832330	4S	39- 51	BS	100	100	100	100	100	100	100	100	95	55	20	8	TR	100	97	88	65	39	0.09	0.067	0.006			14.1	2.0
832331	5S	51- 62	C1	FRACTIONS NOT DETERMINED																								
832332	6S	62- 83	C2	100	100	100	100	100	100	100	100	87	38	15	6	TR	99	92	73	46	28	0.16	0.114	0.009			18.1	2.1

(ENGINEERING PERCENTAGE PASSING: 1–6 INCHES, 7–10 NUMBER; PSDA SIEVE: 11–13 MICRONS; CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN (MM): 14–18; DIAMETERS (MM) AT PERCENTILE: 19–21; ATTERBERG (PCT): 22–23; GRADATION UNIFORMITY CU, CURVATURE CC: 24–25)

SAMPLE NO.	HZ NO	26 (>2)	27 (250-UP)	28 (250-75)	29 (75-2)	30 (75-20)	31 (20-5)	32 (5-2)	33 (<2)	34 (75-2)	35 (75-20)	36 (20-5)	37 (5-2)	38 (<2)	39	40 SOIL SURVEY 1/3 BAR	41 OVEN-DRY	42 ENG. MOIST	43 SATURATED	44 <2MM 1/3 BAR	45 15 BAR	46 OVEN-DRY	47 ENG. MOIST	48 SATURATED	49 VOID RATIO WHOLE SOIL	50 <2 MM
832327	1	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.75	0.85	1.11	1.47	0.75	0.80	0.85	1.11	1.47	2.53	2.53
832328	2	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.71	0.77	1.14	1.44	0.71	0.75	0.77	1.14	1.44	2.73	2.73
832329	3	--	--	--	--	--	--	--	100	--	--	--	--	100		0.44	0.66	1.03	1.27	0.44	0.63	0.66	1.03	1.27	5.02	5.02
832330	4	--	--	--	--	--	--	--	100	--	--	--	--	100		0.38	0.67	1.00	1.24	0.39	0.63	0.67	1.00	1.24	5.97	5.97
832331	5	--	--	--	--	--	--	--	100	--	--	--	--	100		0.43	0.72	1.09	1.27	0.43	0.69	0.72	1.09	1.27	5.16	5.16
832332	6	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.40	0.91	1.10	1.25	0.40	0.86	0.91	1.10	1.25	5.63	5.63

(WEIGHT FRACTIONS: 26–33 PCT OF WHOLE SOIL (MM); 34–38 PCT OF <75 MM FRACTION; WEIGHT PER UNIT VOLUME G/CC: 40–43 WHOLE SOIL, 44–48 <2 MM FRACTION; VOID RATIOS AT 1/3 BAR: 49–50)

SAMPLE NO.	HZ NO	51 (>2)	52 (250-UP)	53 (250-75)	54 (75-2)	55 (75-20)	56 (20-5)	57 (5-2)	58 (<2)	59 (2-.05)	60 (.05-.002)	61 (LT .002)	62 PORES D	63 PORES F	64 C/N RATIO	65 FINE CLAY	66 CEC SUM CATS	67 CEC NH4-OAC	68 15 BAR H2O	69 LE 1/3 BAR	70 WHOLE SOIL 15 BAR	71 OVEN-DRY	72 <2 MM 15 BAR	73 OVEN-DRY	74 WRD WHOLE SOIL	75 WRD <2 MM
832327	1	TR	--	--	--	--	TR	TR	100	13	14	1	16	36	13		15.00	10.00	8.14	1.194	2.2	4.3	2.2	4.3	0.14	0.14
832328	2	TR	--	--	--	--	TR	TR	100	13	13	1	30	43	17		9.07	5.43	4.50	0.587	1.8	2.7	1.8	2.7	0.28	0.28
832329	3	--	--	--	--	--	--	--	100	4	3		24	59	19		54.55	31.18	24.27	13.162	12.7	14.5	12.7	14.5	0.48	0.48
832330	4	--	--	--	--	--	--	--	100	9	3		24	62			146.30	84.75	84.00	52.000	18.4	20.8	18.4	20.8	0.49	0.49
832331	5	--	--	--	--	--	--	--	100	11	5		18	66			521.00	319.00	299.00	******	17.1	18.7	17.1	18.7	0.54	0.54
832332	6	TR	--	--	--	--	--	TR	100	11	4		15	70			134.25	104.50	79.75	79.750	29.1	31.5	29.1	31.5	0.57	0.57

(VOLUME FRACTIONS: 51–63 PCT OF WHOLE SOIL; RATIOS TO CLAY: 65–69 <2 MM FRACTION; LINEAR EXTENSIBILITY (IN/IN) 70–73: WHOLE SOIL, <2 MM, <-1/3 BAR TO; WRD: 74–75 (IN/IN))

SAMPLE NO	HZ NO	76 (>2)	77 (75-2)	78 (20-2)	79 (2-.05)	80 (.05-.002)	81 (LT .002)	82 VC	83 C	84 M	85 F	86 VF	87 SILT C	88 SILT F	89 CLAY	90 TEXTURE IN FIELD	91 BY PSDA	92 SAND 2-.05	93 SILT .05-.002	94 CLAY LT .002	95 PH CACL2 .01M	96 RES. OHMS	97 COND. MMHOS	98 SALT MG/KG	99 1/3 BAR TO 15BAR	100 AIRDRY
832327	1				49	51	4	1	6	16	13	13	20	30	4		FSL	47.4	49.0	3.6	5.0					
832328	2				50	50	5	1	7	21	10	11	19	31	5		FSL	47.3	48.1	4.6	5.5					
832329	3				54	46	1	TR	1	4	19	30	29	22	1		VFSL	53.7	45.2	1.1	5.5					
832330	4				62	38	TR	1	3	9	23	27	19	20	TR		VFSL	61.4	38.2	0.4	5.5					
832331	5				70	30	TR	1	9	20	22	17	14	17	TR		SL	69.6	30.3	0.1	5.6					
832332	6				72	28	TR	1	7	19	27	18	13	15	TR	-	LS	72.0	27.6	0.4	5.6					

(WEIGHT FRACTIONS - CLAY FREE: 76–81 WHOLE SOIL, PCT OF >2MM+SAND+SILT; 82–89 <2 MM FRACTION, PCT OF SAND+SILT; TEXTURE DETERMINED 90–91 (<2 MM); PSDA (MM) 92–94 PCT OF <2MM; ELECTRICAL 95–98 (<2 MM); CUMULT. AMOUNTS IN. OF H2O 99–100 (WHL SOIL))

SAMPLE	UP LOW	LOW DIF	CLAY	SAND	OC	S/C	W S/C	W OC	UP LOW	LOW DIF	S/C	W S/C	W OC
832327	0- 17	17 17	3.6	47.4	9.179	13.2	13.2	9.2	0- 17	17 17	13.2	13.2	9.2
832328	17- 48	40 23	4.6	47.3	5.421	10.3	11.5	7.0	17- 48	19 1	10.3	13.0	9.0

SUPPLEMENTARY CHARACTERIZATION DATA

FRUTILLAR

SAMPLED AS:

S 83FN-275 -009 SAMPLE NOS. 83P2351 - 2358 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	DEPTH (IN)	HORIZON	1 (3 in)	2 (2 in)	3 (3/2 in)	4 (1 in)	5 (3/4 in)	6 (3/8 in)	7 (No. 4)	8 (No. 10)	9 (No. 40)	10 (No. 200)	11 (20 µ)	12 (5 µ)	13 (2 µ)	14 (1.)	15 (.5)	16 (.25)	17 (.10)	18 (.05)	19 (60)	20 (50)	21 (10)	22 LL	23 PI	24 CU	25 CC
832351	1S	0- 7	A	100	100	100	100	100	100	100	99	77	54	31	15	4	93	79	69	59	48	0.11	0.058	0.003			33.7	0.9
832352	2S	7- 9	E	100	100	100	100	100	100	100	99	89	51	27	12	1	97	93	80	59	41	0.11	0.072	0.004			24.6	1.3
832353	3S	9- 15	BS1	100	100	100	100	100	100	100	96	72	28	13	6	1	91	77	55	34	21	0.29	0.198	0.011			26.6	2.0
832354	4S	15- 22	BS2	100	99	98	97	96	93	89	87	56	21	11	5	1	78	61	41	25	16	0.48	0.340	0.015			33.4	2.5
832355	5S	22- 25	BS3	100	95	92	87	83	76	68	64	41	16	9	4	1	58	45	30	18	12	1.22	0.645	0.025			49.1	2.1
832356	6S	25- 28	2BS4	100	99	98	97	96	94	92	85	52	15	10	6	3	78	60	30	16	12	0.50	0.398	0.019			26.2	6.3
832357	7S	28- 35	2CCS	100	98	97	95	94	83	82	72	29	4	3	2	1	63	36	11	5	4	0.92	0.717	0.228			4.1	0.9
832358	8S	35- 92	2C	100	88	80	63	59	54	49	41	12	1	1	TR	TR	31	15	5	1	1	19.65	6.059	0.361			54.4	0.1

SAMPLE NO	HZ NO	26 (>2)	27 (250-UP)	28 (250-75)	29 (75-2)	30 (75-20)	31 (20-5)	32 (5-2)	33 (<2)	34 (75-2)	35 (75-20)	36 (20-5)	37 (5-2)	38 (<2)	39	40 (1/3 BAR)	41 (OVEN-DRY)	42 (MOIST)	43 (SATURATED)	44 (1/3 BAR)	45 (15 BAR)	46 (OVEN-DRY)	47 (MOIST)	48 (SATURATED)	49 (WHOLE SOIL)	50 (<2 MM)
832351	1	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.53	0.68									
832352	2	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.54	0.69	1.03	1.34	0.54	0.64	0.68	1.04	1.34	3.91	3.91
832353	3	4	--	--	4	--	TR	4	96	4	--	TR	4	96		0.59	1.17	1.15	1.37	0.57	1.01	1.14	1.13	1.36	3.49	3.65
832354	4	13	--	--	13	4	7	2	87	13	4	7	2	87		0.66	1.07	1.25	1.41	0.59	0.88	0.98	1.19	1.37	3.02	3.49
832355	5	36	--	--	36	17	15	4	64	36	17	15	4	64		1.73										
832356	6	15	--	--	15	4	4	7	85	15	4	4	7	85		1.56										
832357	7	28	--	--	28	6	12	10	72	28	6	12	10	72		1.67										
832358	8	60	1	1	58	40	11	7	40	59	41	11	7	41		1.49										

SAMPLE NO	HZ NO	51 (>2)	52 (250-UP)	53 (250-75)	54 (75-2)	55 (75-20)	56 (20-5)	57 (5-2)	58 (<2)	59 (2-.05)	60 (.05-.002)	61 (LT .002)	62 (PORES)	63 (BAR F -10)	64	65 (FINE CLAY)	66 (SUM CATS)	67 (NH4-OAC)	68 (15 BAR H2O)	69 (LE 1/3 BAR)	70 (15 BAR)	71 (OVEN-DRY)	72 (15 BAR)	73 (OVEN-DRY)	74 (WHOLE SOIL)	75 (<2 MM)
832351	1	1	--	--	1	--	TR	1	100	13	1	1	30		15		19.30	15.50		2.025						
832352	2	1	--	--	1	--	TR	1	100	12	1		31	49	14		45.50	23.43	25.43	5.714	6.4	8.5	5.8	8.0	0.30	0.31
832353	3	1	--	--	1	--	TR	1	99	17	4		22	56	14		54.00	35.70	32.30	26.000	20.9	25.6	21.0	26.0	0.38	0.38
832354	4	3	--	--	3	1	2	1	97	13	4		16	59			18.13	17.14	21.69	11.500	13.3	17.5	14.3	18.4	0.39	0.40
832355	5	23	--	--	23	11	10	3	77	33	7	1	35				22.63	12.64								
832356	6	9	--	--	9	2	2	4	91	42	6	2	41				5.06	2.71								
832357	7	18	--	--	18	4	8	6	82	43	1	1	17				4.35	3.50								
832358	8	44	1	1	43	30	8	5	56	29			25				6.80	9.30								

SAMPLE NO	HZ NO	76 (>2)	77 (75-2)	78 (20-2)	79 (2-.05)	80 (.05-.002)	81 (LT .002)	82 (VC)	83 (C)	84 (M)	85 (F)	86 (VF)	87 (C SILT)	88 (F SILT)	89 (CLAY)	90 (TEXTURE IN FIELD)	91 (TEXTURE BY PSDA)	92 (SAND 2-.05)	93 (SILT .05-.002)	94 (CLAY LT .002)	95 (PH CACL2 .01M)	96 (RES. OHMS)	97 (COND. MMHOS)	98 (SALT MG/KG)	99 (1/3 BAR TO 15BAR)	100 (AIRDRY)
832351	1	1	1	1	53	46	4	7	14	11	11	11	11	29	4		SL	51.7	44.3	4.0	4.7					
832352	2	1	1	1	59	40	1	2	5	13	22	13	13	26	1		FSL	58.9	39.7	1.4	5.5					
832353	3	4	4	4	76	20	1	5	15	23	22	[illegible]	8	13	1		LS	79.2	20.3	1.0	5.5					
832354	4	13	13	9	72	15	1	11	20	23	19	10	6	12	2		LCOS	81.3	17.1	1.6	5.9					
832355	5	36	36	17	52	11	1	3	21	24	19	3	5	13	2		LCOS	80.9	17.5	1.6	6.0					
832356	6	15	15	11	75	10	3	9	22	36	17	5	1	9	4		LCOS	85.3	11.3	3.4	6.2					
832357	7	28	28	22	69	2	1	13	39	36	8	2	1	2	2		COS	94.9	3.1	2.0	5.9					
832358	8	60	58	19	39	1	TR	26	39	25	8	1	1	1	1		COS	98.1	1.4	0.5	5.7					

SAMPLE	UP LOW	LOW DIF	CLAY	SAND	OC	S/C	W S/C	W OC
832351	0- 17	17 17	4.0	51.7	17.451	12.9	12.9	17.5
832352	17- 24	24 7	1.4	58.9	3.769	42.1	21.4	14.9
832353	24- 38	38 14	1.0	79.2	5.425	78.2	42.3	11.4
832354	38- 57	40 2	1.6	81.3	3.459	50.8	42.3	11.0

UP LOW	LOW DIF	S/C	W S/C	W OC
0- 17	17 17	12.9	12.9	17.5
17- 24	18 1	42.1	14.5	17.0

SUPPLEMENTARY CHARACTERIZATION DATA

PUERTO OCTAY

SAMPLED AS:

S 83FN-275 -010 | SAMPLE NOS. 83P2391 - 2395 | DATE 11/30/83

CHILE-SNSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

ENGINEERING PERCENTAGE PASSING: INCHES 3, 2, 3/2, 1, 3/4, 3/8 (cols 1–6); NUMBER 4, 10, 40, 200 (cols 7–10); PSDA SIEVE MICRONS 20, 5, 2 (cols 11–13); CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN 1., .5, .25, .10, .05 MM (cols 14–18); DIAMETERS (MM) AT 60, 50, 10 PERCENTILE (cols 19–21); ATTERBERG LL, PI (<-PCT>) (cols 22–23); GRADATION UNIFORMITY CU (col 24), CURVATURE CC (col 25)

SAMPLE NO.	HZN NO.	DEPTH (IN)	HORIZON	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	25
832391	1S	0- 6	A	100	100	100	100	100	100	99	98	87	75	47	23	6	93	80	84	78	70	0.03	0.022	0.002			13.8	0.7
832392	2S	6- 24	AB	FRACTIONS NOT DETERMINED																								
832393	3S	24- 33	BW1	FRACTIONS NOT DETERMINED																								
832394	4S	33- 41	BW2	FRACTIONS NOT DETERMINED																								
832395	5S	41- 47	2C	FRACTIONS NOT DETERMINED																								

(WEIGHT FRACTIONS) WHOLE SOIL (MM): >2, 250-UP, 250-75, 75-2, 75-20, 20-5, 5-2, <2 — PCT OF WHOLE SOIL (cols 26–33); <75 MM FRACTION: 75-2, 75-20, 20-5, 5-2, <2 — PCT OF <75 MM (cols 34–38); col 39; (WEIGHT PER UNIT VOLUME G/CC) WHOLE SOIL: SOIL SURVEY 1/3 BAR, OVEN-DRY; ENGINEERING MOIST, SATURATED (cols 40–43); <2 MM FRACTION: SOIL SURVEY 1/3 BAR, 15 BAR, OVEN-DRY; ENGINEERING MOIST, SATURATED (cols 44–48); (VOID RATIOS) AT 1/3 BAR WHOLE SOIL, <2 MM (cols 49–50)

SAMPLE NO.	HZ NO	26	27	28	29	30	31	32	33	34	35	36	37	38	39	40	41	42	43	44	45	46	47	48	49	50
832391	1	2	--	--	2	--	1	1	98	2	--	1	1	98		1.46	0.83									
832392	2	7	--	--	7	--	5	2	93	7	--	5	2	93		0.44	0.69	0.86	1.27	0.41	0.60	0.65	0.83	1.26	5.02	5.46
832393	3	14	--	--	14	--	12	2	86	14	--	12	2	86		0.43	1.03	0.89	1.27	0.38	0.85	0.94	0.86	1.24	5.16	5.97
832394	4	75	--	10	65	58	5	1	25	72	65	6	1	28		1.37	1.66	1.66	1.05	0.56	0.73	0.78	1.04	1.35	0.93	3.73

(VOLUME FRACTIONS) WHOLE SOIL (MM): >2, 250-UP, 250-75, 75-2, 75-20, 20-5, 5-2, <2, 2-.05, .05-.002, LT .002 AT 1/3 BAR, PORES D, P — PCT OF WHOLE SOIL (cols 51–64); (C/N) RATIO (col 65); (RATIOS TO CLAY) <2 MM FRACTION: FINE CLAY, CEC SUM CATS, NH4-OAC, 15 BAR H2O, LE 1/3 BAR (cols 66–69); (LINEAR EXTENSIBILITY) WHOLE SOIL 1/3 BAR TO 15 BAR, OVEN-DRY; <2 MM 15 BAR, OVEN-DRY (<-1/5 BAR TO (IN/IN)->) (cols 70–73); (W R D) WHOLE SOIL, <2 MM (<--IN/IN->) (cols 74–75)

SAMPLE NO.	HZ NO	51	52	53	54	55	56	57	58	59	60	61	62	63	64	65	66	67	68	69	70	71	72	73	74	75
832391	1	1	--	--	1	--	1	1	99	16	35	4	45		13		9.72	8.39								
832392	2	1	--	--	1	--	1	2	99	11	5		41	42	14						12.7	16.2	13.5	16.6	0.28	0.28
832393	3	2	--	--	2	--	2	2	98	11	3		38	46							29.3	33.8	30.8	35.2	0.34	0.35
832394	4	34	--	5	34	31	3	1	61	9	4		19	29							5.1	6.6	9.2	11.7	0.19	0.32

(WEIGHT FRACTIONS-CLAY FREE) WHOLE SOIL: >2, 75-2, 20-2, 2-.05, .05-.002, LT .002 — PCT OF >2MM+SAND+SILT (cols 76–81); <2 MM FRACTION SANDS VC, C, M, F, VF; SILTS C, F — PCT OF SAND+SILT (cols 82–88); CLAY (col 89); (TEXTURE) DETERMINED IN FIELD, BY PSDA (<2 MM) (cols 90–91); (PSDA (MM)) SAND 2-.05, SILT .05-.002, CLAY LT .002 — PCT OF <2MM (cols 92–94); (PH) CACL2 .01M (col 95); (ELECTRICAL) RES. OHMS, COND. MMHOS (cols 96–97); (CONSULT. AMOUNTS) SALT MG/KG (col 98); IN. OF H2O 1/3 BAR TO 15BAR, AIRDRY (WHL SOIL) (cols 99–100)

SAMPLE NO	HZ NO	76	77	78	79	80	81	82	83	84	85	86	87	88	89	90	91	92	93	94	95	96	97	98	99	100
832391	1	2	2	2	30	68	7	6	5	4	7	10	24	44	7		SIL	29.0	64.5	6.5	5.4					
832392	2	7	7	7	65	28		2	4	11	29	24	10	13			FSL	69.4	30.6	—	5.8					
832393	3	14	14	14	68	18		2	5	15	34	23	13	7			LFS	79.6	20.4	—	6.1					
832394	4	75	65	6	17	8		7	8	11	24	19	14	16			FSL	69.7	30.3	—	6.1					
832395	5																									

SAMPLE	UP LOW	LOW DIF	CLAY	SAND	OC	S/C	W S/C	W OC	UP LOW	LOW DIF	S/C	W S/C	W OC
832391	0- 15	15 15	6.5	29.0	12.090	4.5	4.5	12.1	0- 15	15 15	4.5	4.5	12.1
832392	15- 60	40 25	0.0	69.4	5.746	4.5	4.5	0.1	15- 60	18 3	4.5	4.5	11.0

SUPPLEMENTARY CHARACTERIZATION DATA

PUERTO MONTT

SAMPLED AS:

S 83FN-275 -011 SAMPLE NOS. 83P2367 - 2372 DATE 11/30/83

CHILE-SMSS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	1 (3 in)	2 (2 in)	3 (3/2 in)	4 (1 in)	5 (3/4 in)	6 (3/8 in)	7 (No. 4)	8 (No. 10)	9 (No. 40)	10 (No. 200)	11 (20 µ)	12 (5 µ)	13 (2 µ)	14 (1. mm)	15 (.5 mm)	16 (.25 mm)	17 (.10 mm)	18 (.05 mm)	19 (60 pctl)	20 (50 pctl)	21 (10 pctl)	22 LL	23 PI	24 CU	25 CC
				ENGINEERING PERCENTAGE PASSING <-INCHES->						<-NUMBER->				PSDA SIEVE <-MICRONS->			CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN <-MM->					DIAMETERS (MM) AT <--PERCENTILE-->			ATTERBERG <-PCT->		GRADATION UNIFORMITY	CURVATURE
832367	1S	0- 6	A	100	100	100	100	100	100	100	99	91	75	42	20	5	99	92	89	81	68	0.04	0.027	0.003			14.1	0.9
832368	2S	6- 12	B/A	100	100	100	100	100	100	100	99	87	39	12	6	2	98	91	74	48	28	0.15	0.109	0.012			12.9	1.5
832369	3S	12- 28	BT1	100	100	100	100	100	99	98	98	62	31	8	3	TR	97	87	68	39	21	0.19	0.141	0.022			8.7	1.1
832370	4S	28- 36	BT2	FRACTIONS NOT DETERMINED																								
832371	5S	36- 40	2COS	100	98	96	94	92	88	83	74	56	30	14	7	2	69	59	48	34	24	0.54	0.291	0.009			60.1	1.1
832372	6S	40- 46	2CS	100	99	98	96	95	88	80	75	52	30	16	9	3	64	54	44	33	26	0.75	0.373	0.007			>100	1.1

SAMPLE NO.	HZ NO	26 (>2)	27 (250-UP)	28 (250-75)	29 (75-2)	30 (75-20)	31 (20-5)	32 (5-2)	33 (<2)	34 (75-2)	35 (75-20)	36 (20-5)	37 (5-2)	38 (<2)	39	40 (1/3 BAR)	41 (OVEN-DRY)	42 (MOIST)	43 (SATURATED)	44 (1/3 BAR)	45 (15 BAR)	46 (OVEN-DRY)	47 (MOIST)	48 (SATURATED)	49 (WHOLE SOIL)	50 (<2 MM)
		(WEIGHT FRACTIONS) ---WHOLE SOIL (MM)- <-------PCT OF WHOLE SOIL----->								-<75 MM FRACTION-- <--PCT OF <75 MM->						(WEIGHT PER UNIT VOLUME G/CC) ------WHOLE SOIL------ SOIL SURVEY / ENGINEERING				-------<2 MM FRACTION------- --SOIL SURVEY-- ENGINEERING					(VOID) --RATIOS-- AT 1/3 BAR	
832367	1	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.59	0.75	1.01	1.37	0.59	0.66	0.74	1.01	1.37	3.49	3.49
832368	2	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.41	0.66	0.94	1.26	0.41	0.60	0.65	0.94	1.26	5.46	5.56
832369	3	2	--	--	2	--	2	TR	98	2	--	2	TR	98		0.38	1.06	0.99	1.24	0.37	0.97	1.05	0.98	1.23	5.97	6.16
832370	4	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.44	1.07	1.02	1.27	0.44	0.97	1.06	1.02	1.27	5.02	5.02
832371	5	26	--	--	26	8	9	9	74	26	8	9	9	74		1.66	1.69	1.44	2.03	1.48	1.50	1.51	1.83	1.92	0.60	0.79
832372	6	25	--	--	25	5	15	5	75	25	5	15	5	75		1.79	1.82	2.02	2.11	1.62	1.64	1.65	1.89	2.01	0.48	0.64

SAMPLE NO	HZ NO	51 (>2)	52 (250-UP)	53 (250-75)	54 (75-2)	55 (75-20)	56 (20-5)	57 (5-2)	58 (<2)	59 (2-.05)	60 (.05-.002)	61 (LT .002)	62 (PORES D)	63 (PORES F)	64 (NAT -10)	65 (FINE CLAY)	66 (CEC SUM CATS)	67 (CEC NH4-OAC)	68 (15 BAR H2O)	69 (LE 1/3 BAR)	70 (WHOLE SOIL 1/3 BAR TO 15 BAR)	71 (WHOLE SOIL TO OVEN-DRY)	72 (<2 MM 15 BAR)	73 (<2 MM OVEN-DRY)	74 (WRD WHOLE SOIL)	75 (WRD <2 MM)
		(VOLUME FRACTIONS) ---WHOLE SOIL (MM) AT 1/3 BAR--- <-------PCT OF WHOLE SOIL------->													(C/N)	(RATIOS TO CLAY) -------<2 MM FRACTION-------					(LINEAR EXTENSIBILITY) WHOLE SOIL / ---<2 MM--- <-1/5 BAR TO (IN/IN)->				(W R D) <--IN/IN-->	
832367	1	1	--	--	1	--	TR	1	100	7	14	1	36	42	19		13.67	10.17	7.96	1.444	4.3	8.3	3.8	7.8	0.17	0.17
832368	2	1	--	--	1	--	TR	1	100	11	4		32	53	11		38.19	25.69	22.38	10.375	14.2	17.2	13.5	16.6	0.38	0.39
832369	3	2	--	--	2	--	2	TR	100	11	3		25	61	13		249.50	157.50	155.00	******	37.1	40.8	37.9	41.6	0.49	0.49
832370	4	TR	--	--	--	--	TR	TR	100	13	3		25	58							30.6	34.5	30.1	34.1	0.45	0.45
832371	5	16	--	--	16	5	6	6	84	31	14	1	9	28			3.58	2.00	3.81	0.226	0.4	0.6	0.4	0.7	0.14	0.17
832372	6	17	--	--	17	3	10	3	83	34	16	2	9	23			1.61	1.42	2.06	0.167	0.4	0.6	0.4	0.6	0.13	0.15

SAMPLE NO	HZ NO	76 (>2 PCT)	77 (75-2 UP)	78 (20-2)	79 (2-.05)	80 (.05-.002)	81 (LT .002)	82 (VC)	83 (C)	84 (M)	85 (F)	86 (VF)	87 (SILT C)	88 (SILT F)	89 (CL AT)	90 (TEXTURE DETERMINED IN FIELD)	91 (BY PSDA)	92 (SAND 2-.05)	93 (SILT .05-.002)	94 (CLAY LT .002)	95 (PH CACL2 .01M)	96 (RESIST. OHMS)	97 (CONDUCT. MMHOS)	98 (SALT MG/KG)	99 (H2O 1/3 BAR TO 15BAR)	100 (AIRDRY (WHL SOIL))
		(WEIGHT FRACTIONS-CLAY FREE) --WHOLE SOIL-- PCT UP >2MM+SAND+SILT>						---<2 MM FRACTION--- ------SANDS------ (-------PCT OF SAND+SILT-------)					SILTS			(-TEXTURE--) (--<2 MM-)		(--PSDA (MM)---) (---PCT OF <2MM-)			(PH)	(-ELECTRICAL) (- - - <2 MM- - - -)			(CUMULT. AMOUNTS) IN. OF H2O	
832367	1	1	1	1	33	66	6	TR	7	4	8	19	28	39	6		SIL	31.4	63.2	5.4	4.8					
832368	2	1	1	1	72	27	2	1	8	17	20	20	16	11	2		FSL	71.3	27.1	1.6	5.0					
832369	3	2	2	2	77	21	TR	1	10	19	30	18	13	8	TR		LR	78.1	21.7	0.2	5.6					
832370	4				80	20		1	7	20	35	17	13	6			LS	80.1	19.9	—	5.8					
832371	5	27	27	18	51	23	2	7	14	16	19	14	14	17	3		SL	66.9	30.0	3.1	6.0					
832372	6	26	26	21	51	24	3	15	14	13	13	10	13	19	4		COSL	65.8	30.6	3.6	6.2					

SAMPLE	UP LOW	LOW	DIF	CLAY	SAND	OC	S/C	W S/C	W OC
832367	0- 16	16	16	5.4	31.4	15.824	5.8	5.8	15.0
832368	16- 30	30	14	1.6	71.3	10.416	44.6	23.3	13.3
832369	30- 70	40	10	0.2	78.1	5.925	390.5	115.5	11.5

UP LOW	LOW	DIF	S/C	W S/C	W OC
0- 16	16	16	5.8	5.8	15.8
16- 30	18	2	44.6	10.1	15.2

S U P P L E M E N T A R Y   C H A R A C T E R I Z A T I O N   D A T A

ALMACE

SAMPLED AS:

S 82FN-275 -012 SAMPLE NOS. 83P2379 - 2384 DATE 11/30/83

CHILE-SASS

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

ENGINEERING: PERCENTAGE PASSING (<--INCHES--> 1–6; <-NUMBER-> 7–10); PSDA SIEVES (<-MICRONS->) 11–13; CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN (<--MM-->) 14–18; DIAMETERS (MM) AT (<--PERCENTILE-->) 19–21; ATTERBERG (<-PCT>) 22–23; GRADATION 24–25

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	1 (3)	2 (2)	3 (3/2)	4 (1)	5 (3/4)	6 (3/8)	7 (4)	8 (10)	9 (40)	10 (200)	11 (20)	12 (5)	13 (2)	14 (1.)	15 (.5)	16 (.25)	17 (.10)	18 (.05)	19 (60)	20 (50)	21 (10)	22 (LL)	23 (PI)	24 (UNIFMTY CU)	25 (CURVTUR CC)
832379	1S	0- 2	A1	100	100	100	100	100	100	100	100	58	28	9	4	1	72	61	50	33	22	0.48	0.249	0.021			22.7	0.7
832380	2S	2- 7	A2	100	100	100	100	100	100	100	99	90	61	22	9	1	98	92	83	67	53	0.07	0.046	0.005			13.2	1.7
832381	3S	7- 13	5S1	100	100	100	100	100	100	100	100	80	28	12	6	2	98	86	62	33	21	0.24	0.172	0.012			19.5	2.4
832382	4S	13- 22	US2	100	95	75	60	50	44	38	36	27	12	7	3	1	34	28	21	14	10	25.00	19.000	0.052			>100	0.3
832383	5S	22- 26	2COS	100	90	83	73	66	49	31	25	13	4	2	1	TR	20	14	8	4	3	14.95	10.033	0.303			49.3	3.7
832384	6S	26- 34	2CO	100	88	80	68	59	44	29	23	8	2	1	1	TR	17	10	4	2	2	19.65	12.496	0.517			38.0	2.4

(W E I G H T   F R A C T I O N S) ---WHOLE SOIL (MM)- (<--PCT OF WHOLE SOIL--->) 26–33; -<75 MM FRACTION-- (<--PCT OF <75 MM->) 34–38; (W E I G H T   P E R   U N I T   V O L U M E   G/CC) ------WHOLE SOIL------ 40–43; -------<2 MM FRACTION------- 44–48; (VOID) ---RATIOS-- AT 1/3 BAR 49–50

SAMPLE NO	HZ NO	26 (>2)	27 (250-UP)	28 (250-75)	29 (75-2)	30 (75-20)	31 (20-5)	32 (5-2)	33 (<2)	34 (75-2)	35 (75-20)	36 (20-5)	37 (5-2)	38 (<2)	39	40 (SOIL SURVEY 1/3 BAR)	41 (OVEN-DRY)	42 (ENGINEERING MOIST)	43 (SATURATED)	44 (SOIL SURVEY 1/3 BAR)	45 (15 BAR)	46 (OVEN-DRY)	47 (ENGINEERING MOIST)	48 (SATURATED)	49 (WHOLE SOIL)	50 (<2 MM)
832379	1	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.26	0.39	0.60	1.16	0.26	0.33	0.39	0.60	1.16	9.19	9.19
832380	2	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.55	0.74									
832381	3	TR	--	--	--	--	TR	TR	100	--	--	TR	TR	100		0.64	0.88	1.24	1.40	0.64	0.78	0.87	1.24	1.40	3.14	3.14
832382	4	66	--	4	61	48	12	2	34	64	50	12	2	36		1.37	1.58	1.77	1.35	0.71	0.83	0.89	1.32	1.44	0.93	2.73
832383	5	75	--	--	75	34	35	6	25	75	34	35	6	25		2.20										
832384	6	77	--	--	77	41	30	6	23	77	41	30	6	23		2.23										

(V O L U M E   F R A C T I O N S) ----WHOLE SOIL (MM) AT 1/3 BAR--- (<-----PCT OF WHOLE SOIL----->) 51–63; (C/N) 64; (R A T I O S   T O   C L A Y) -------<2 MM FRACTION------- 65–69; (LINEAR EXTENSIBILITY) WHOLE SOIL ---<2 MM-- <-1/5 BAR TO (IN/IN)-> 70–73; (W R D) (<--IN/IN->) 74–75

SAMPLE NO	HZ NO	51 (>2)	52 (250-UP)	53 (250-75)	54 (75-2)	55 (75-20)	56 (20-5)	57 (5-2)	58 (<2)	59 (2-.05)	60 (.05-.002)	61 (LT .002)	62 (PORES D)	63 (PORES F)	64 (RAT -TO)	65 (FINE CLAY)	66 (CEC SUM CATS)	67 (CEC NH4-OAC)	68 (15 BAR H2O)	69 (LE 1/3 BAR)	70 (WHOLE SOIL 15 BAR)	71 (WHOLE SOIL OVEN-DRY)	72 (<2 MM 15 BAR)	73 (<2 MM OVEN-DRY)	74 (WHOLE SOIL)	75 (<2 MM)
832379	1	TR	--	--	--	--	TR	TR	100	8	2		56	34	20		123.00	112.40	135.40	29.000	3.3	14.5	6.3	14.5	0.16	0.16
832380	2	1	--	--	1	--	TR	1	100	10	11		79		18		53.03	44.42		5.250						
832381	3	TR	--	--	--	--	TR	TR	100	14	5		16	60			33.35	24.00	23.30	5.400	7.3	11.2	6.8	10.8	0.30	0.30
832382	4	34	--	2	32	25	6	1	66	13	4	1	3	40			12.14	7.97	12.30	2.690	3.3	4.9	5.3	7.8	0.23	0.35
832383	5	63	--	--	63	29	29	5	37	13	2		17				7.39	4.75								
832384	6	65	--	--	65	34	25	5	35	18	1		16				4.80	3.53								

(W E I G H T   F R A C T I O N S - C L A Y   F R E E) --WHOLE SOIL-- PCT OF >2MM+SAND+SILT> 76–81; ---<2 MM FRACTION---- (-------PCT OF SAND+SILT-------) 82–89; (-TEXTURE--) (DETERMINED) (--<2 MM-) 90–91; (--P S D A (MM)---) (--PCT OF .2MM-) 92–94; (PH) 95; (-ELECTRICAL) (- - - - <2 MM- - - -) 96–98; (CUMULT. AMOUNTS) 99–100

SAMPLE NO	HZ NO	76 (>2)	77 (75-2)	78 (20-2)	79 (2-.05)	80 (.05-.002)	81 (LT .002)	82 (SANDS VC)	83 (SANDS C)	84 (SANDS M)	85 (SANDS F)	86 (SANDS VF)	87 (SILTS C)	88 (SILTS F)	89 (CL AY)	90 (IN FIELD)	91 (BY PSDA)	92 (SAND 2-.05)	93 (SILT .05-.002)	94 (CLAY LT .002)	95 (CA-CL2 .01M)	96 (RES-IST. OHMS)	97 (CON-DUCT. MMHOS)	98 (SALT MG/KG)	99 (IN. OF H2O 1/3 BAR TO 15BAR)	100 (AIRDRY (WHL SOIL))
832379	1				79	21	1	28	11	10	17	12	13	9	1		LCOS	70.2	21.3	0.5	4.2					
832380	2	1	1	1	87	52	1	1	6	9	16	15	32	21	1		SIL	46.9	51.9	1.2	4.5					
832381	3				81	19	2	2	12	25	29	12	9	10	2		LS	79.0	19.0	2.0	4.9					
832382	4	67	62	14	25	8	1	6	16	22	20	11	9	16	1		SL	72.8	24.3	2.9	5.8					
832383	5	75	75	41	22	3	TR	18	25	24	16	6	1	7	2		COS	88.4	10.0	1.6	6.1					
832384	6	77	77	36	21	1	TR	25	34	24	9	2	2	4	2		COS	92.3	5.6	1.5	6.2					

SAMPLE	UP LOW	LOW	DIF	CLAY	SAND	OC	S/C	W S/C	W OC
832379	0- 5	5	5	0.5	78.2	27.295	156.4	156.4	27.3
832380	5- 18	18	13	1.2	46.9	16.598	39.1	71.7	19.6
832381	18- 32	32	14	2.0	79.0	3.670	39.5	57.6	12.6
832382	32- 55	40	8	2.9	72.8	2.614	25.1	51.1	10.6

UP LOW	LOW	DIF	S/C	W S/C	W OC
0- 5	5	5	****	****	27.3
5- 18	18	13	39.1	71.7	19.6

SUPPLEMENTARY CHARACTERIZATION DATA

CORTE ALTO

SAMPLED AS:

S 33FN-275 -013

CHILE-S8SS

SAMPLE NOS. 83P2339 - 2344 DATE 11/30/83

U. S. DEPARTMENT OF AGRICULTURE
SOIL CONSERVATION SERVICE
NATIONAL SOIL SURVEY LABORATORY
LINCOLN, NEBRASKA

GENERAL METHODS: ENGINEERING FRACTIONS WERE CALCULATED FROM USDA FRACTION SIZES

SAMPLE NO.	HZN NO.	(IN) DEPTH	HORIZON	3 (1)	2 (2)	3/2 (3)	1 (4)	3/4 (5)	3/8 (6)	4 (7)	10 (8)	40 (9)	200 (10)	20 (11)	5 (12)	2 (13)	1. (14)	.5 (15)	.25 (16)	.10 (17)	.05 (18)	60 (19)	50 (20)	10 (21)	LL (22)	PI (23)	CU (24)	CC (25)
				ENGINEERING PERCENTAGE PASSING — INCHES						NUMBER				PSDA SIEVE <-MICRONS->			CUMULATIVE CURVE FRACTIONS (<76MM) USDA LESS THAN <-MM->					DIAMETERS (MM) AT <--PERCENTILE-->			ATTERBERG <-PCT->		GRADATION UNIFORMITY	CURVATURE
332339	15	0- 7	A	100	100	100	100	100	100	100	100	97	83	68	55	46	100	98	93	86	80	0.01	0.003	--			25.5	0.3
332340	25	7- 18	BS1	100	100	100	100	100	100	100	99	96	77	55	39	29	99	97	93	82	70	0.03	0.013	--			61.9	0.4
332341	35	18- 30	BS2	100	100	100	100	100	100	100	100	95	64	34	21	12	100	97	89	72	50	0.07	0.049	0.001			48.7	2.0
332342	45	30- 48	2C1	100	100	100	100	100	100	100	100	92	32	13	6	2	100	96	78	43	20	0.16	0.121	0.011			14.4	2.7
332343	55	48- 67	2C2	100	100	100	100	100	100	100	100	95	52	17	7	1	100	97	89	65	31	0.09	0.073	0.007			12.2	3.3
332344	65	67- 76	3C3	100	100	100	100	100	100	100	100	93	55	37	24	16	100	96	83	61	46	0.09	0.059	0.001			>100	1.1

SAMPLE NO.	HZ NO	>2 (26)	250 -UP (27)	250 -75 (28)	75 -2 (29)	75 -20 (30)	20 -5 (31)	5 -2 (32)	<2 (33)	75 -2 (34)	75 -20 (35)	20 -5 (36)	5 -2 (37)	<2 (38)	(39)	1/3 BAR (40)	OVEN -DRY (41)	MOIST (42)	SATURATED (43)	1/3 BAR (44)	15 BAR (45)	OVEN -DRY (46)	MOIST (47)	SATURATED (48)	WHOLE SOIL (49)	<2 MM (50)
		(WEIGHT FRACTIONS) ---WHOLE SOIL (MM)- <------PCT OF WHOLE SOIL------>								--<75 MM FRACTION-- <--PCT OF <75 MM-->						(WEIGHT PER UNIT VOLUME G/CC) ------WHOLE SOIL------ SOIL SURVEY		ENGINEERING		------<2 MM FRACTION------ --SOIL SURVEY--		ENGINEERING			(VOID RATIOS) --AT 1/3 BAR--	
332339	1	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.86	1.07	1.22	1.54	0.86	0.94	1.07	1.22	1.54	2.08	2.08
332340	2	1	--	--	1	--	TR	1	99	1	--	TR	1	99		0.39	1.04	1.26	1.55	0.88	0.95	1.03	1.26	1.55	1.98	2.01
332341	3	TR	--	--	--	--	--	TR	100	--	--	--	TR	100		0.93	1.07	1.36	1.58	0.93	1.01	1.07	1.36	1.58	1.85	1.85
332342	4	--	--	--	--	--	--	--	100	--	--	--	--	100		0.85	0.93	1.32	1.53	0.85	0.91	0.93	1.32	1.53	2.12	2.12
332343	5	--	--	--	--	--	--	--	100	--	--	--	--	100		0.66	0.74	1.16	1.41	0.66	0.71	0.74	1.16	1.41	3.02	3.02
332344	6	--	--	--	--	--	--	--	100	--	--	--	--	100		0.76	0.85	1.22	1.47	0.76	0.82	0.85	1.22	1.47	2.49	2.49

SAMPLE NO.	HZ NO	>2 (51)	250 -UP (52)	250 -75 (53)	75 -2 (54)	75 -20 (55)	20 -5 (56)	5 -2 (57)	<2 (58)	2- .05 (59)	.05- .002 (60)	LT .002 (61)	PORES D (62)	PORES F (63)	(C/M) -20 (64)	FINE CLAY (65)	SUM CATS (66)	NH4- OAC (67)	15 BAR H2O (68)	LE 1/3 BAR (69)	15 BAR (70)	OVEN -DRY (71)	15 BAR (72)	OVEN -DRY (73)	WHOLE SOIL (74)	<2 MM (75)
		(VOLUME FRACTIONS) ----WHOLE SOIL (MM) <------PCT OF WHOLE SOIL------>								<2 1/3 BAR--- (/M)						(RATIOS TO CLAY) ---<2 MM FRACTION--- ---C E C---				(LINEAR EXTENSIBILITY) WHOLE SOIL <-1/3 BAR TO (IN/IN)->		<2 MM		(W R D) <--IN/IN-->	
332339	1	TR	--	--	--	--	--	TR	100	7	11	15	12	36	14		1.02	0.86	0.63	0.166	3.0	7.6	3.0	7.6	0.11	0.11
332340	2	1	--	--	1	--	TR	1	100	11	11	10	29	37	12		1.16	0.77	0.86	0.184	2.6	5.3	2.6	5.4	0.15	0.15
332341	3	TR	--	--	--	--	--	TR	100	17	11	4	32	43	12		2.76	1.78	2.07	0.403	2.8	4.8	2.8	4.8	0.20	0.20
332342	4	--	--	--	--	--	--	--	100	[illegible]	[illegible]	1	21	47			17.13	11.71	13.12	1.765	2.3	3.0	2.3	3.0	0.28	0.28
332343	5	--	--	--	--	--	--	--	100	17	[illegible]	[illegible]	25	50			57.40	42.20	65.00	7.800	2.5	3.9	2.5	3.9	0.28	0.28
332344	6	--	--	--	--	--	--	--	100	[illegible]	4	4	25	46			[illegible]	1.06	1.73	0.245	2.6	3.8	2.6	3.8	0.26	0.26

SAMPLE NO	HZ NO	>2 (76)	75 -2 (77)	20 -2 (78)	2- .05 (79)	.05- .002 (80)	LT .002 (81)	VC (82)	C (83)	M (84)	F (85)	VF (86)	SILTS C (87)	SILTS F (88)	CLAY (89)	TEX FIELD (90)	PSDA (91)	SAND 2- .05 (92)	SILT .05- .002 (93)	CLAY LT .002 (94)	PH CACL2 .01M (95)	RES. OHMS (96)	COND. MMHOS (97)	SALT G/KG (98)	1/3 BAR (99)	15BAR AIRDRY (100)
		(WEIGHT FRACTIONS - CLAY FREE) --WHOLE SOIL-- PCT OF >2MM+SAND+SILT>			---<2 MM FRACTION----			------SANDS------- (------PCT OF SAND+SILT------)								(-TEXTURE-)		(--PSDA (MM)---) (--PCT OF <2MM--)			(PH)	(-ELECTRICAL) (<2 MM)			(CUMULT. AMOUNTS) IN. OF H2O (WHL SOIL)	
332339	1				38	62	35	1	3	3	14	11	29	42	15		C	20.4	[illegible]	45.8	4.7					
332340	2	1	1	1	41	59	41	TR	2	7	15	17	22	37	42		CL	[illegible]	[illegible]	29.4	5.0					
332341	3				56	44	14	1	3	7	18	25	19	25	14		L	[illegible]	[illegible]	11.9	5.5					
332342	4				82	16	2	TR	4	18	36	23	7	11	2		LFS	[illegible]	[illegible]	1.7	6.2					
332343	5				69	31	1	TR	2	1	24	33	10	17	1		VFSL	[illegible]	[illegible]	0.5	6.1					
332344	6				63	37	13	TR	4	15	26	17	11	25	13		FSL	[illegible]	[illegible]	15.5	5.4					

SAMPLE	UP LOW	LOW DIF		CLAY	SAND	OC	S/C	W S/C	W OC
332339	0- 18	18	18	45.3	20.4	6.759	0.4	0.4	6.0
332340	18- 47	40	22	29.4	29.1	1.260	1.0	0.7	3.7

UP LOW	LOW DIF		S/C	W S/C	W OC
0- 19	10	10	0.4	0.4	6.3

CHILEAN NITRATES FERTILIZERS

Produced by Sociedad Química y Minera de Chile S.A. – S.Q.M.

* 16–0–0 : Nitrate of Soda (natural sodium nitrate)
* 15–0–14 : Nitrate of Soda-Potash (potassium sodium nitrate)

Outstanding Properties

– Quick action, because all its nitrogen is in nitrate form, being highly soluble and having rapid access and availability to plant roots.

– Chilean Nitrates are optimum for timely nutrition of plants, and for supplemental applications to promptly replenish nitrogen, or nitrogen and potassium, leached by heavy rains especially in sandy soils.

– Nitrate nitrogen is a requisite to produce maximum yields and optimum quality flue - cured and burley types of tobacco.

– They supply sodium, an essential element for maximum yields in sugarbeets and some vegetable crops. In addition, sodium replaces part of the potassium requirements of these and several other crops, thus reducing fertilization costs.

– Chilean Nitrates do not acidify. They help to prevent a decrease in soil pH and loss of fertility. They save important amounts of lime.

– Nitrate of Soda-Potash (15–0–14) is virtually free of chloride. Excess chloride is harmful particularly to crops such as tobacco, orchards, vineyards, vegetables and potatoes.

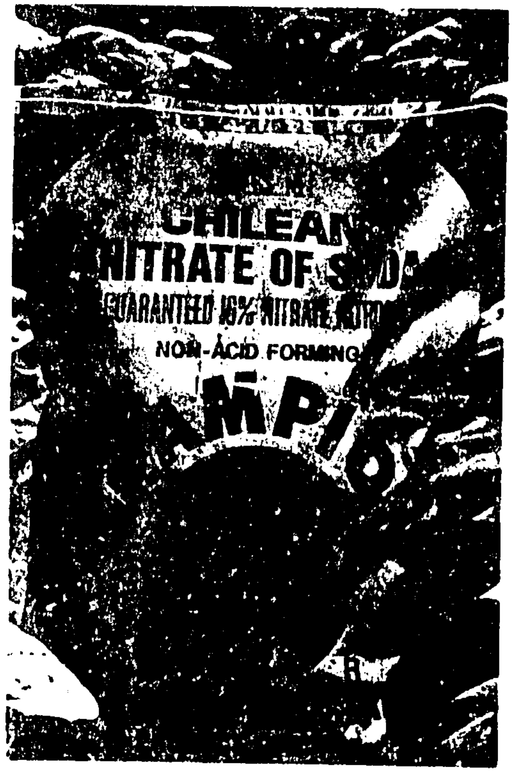
– They are not subject to volatilization losses as ammonia. Even remaining on the soil surface they keep 100 o/o efficiency.

– They supply small quantities of boron, an essential micronutrient for plants.

New Product

Beside these two traditional nitrate fertilizers, S.Q.M. will start producing a third one in 1986:

* 13–0–45: Potassium Nitrate.



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