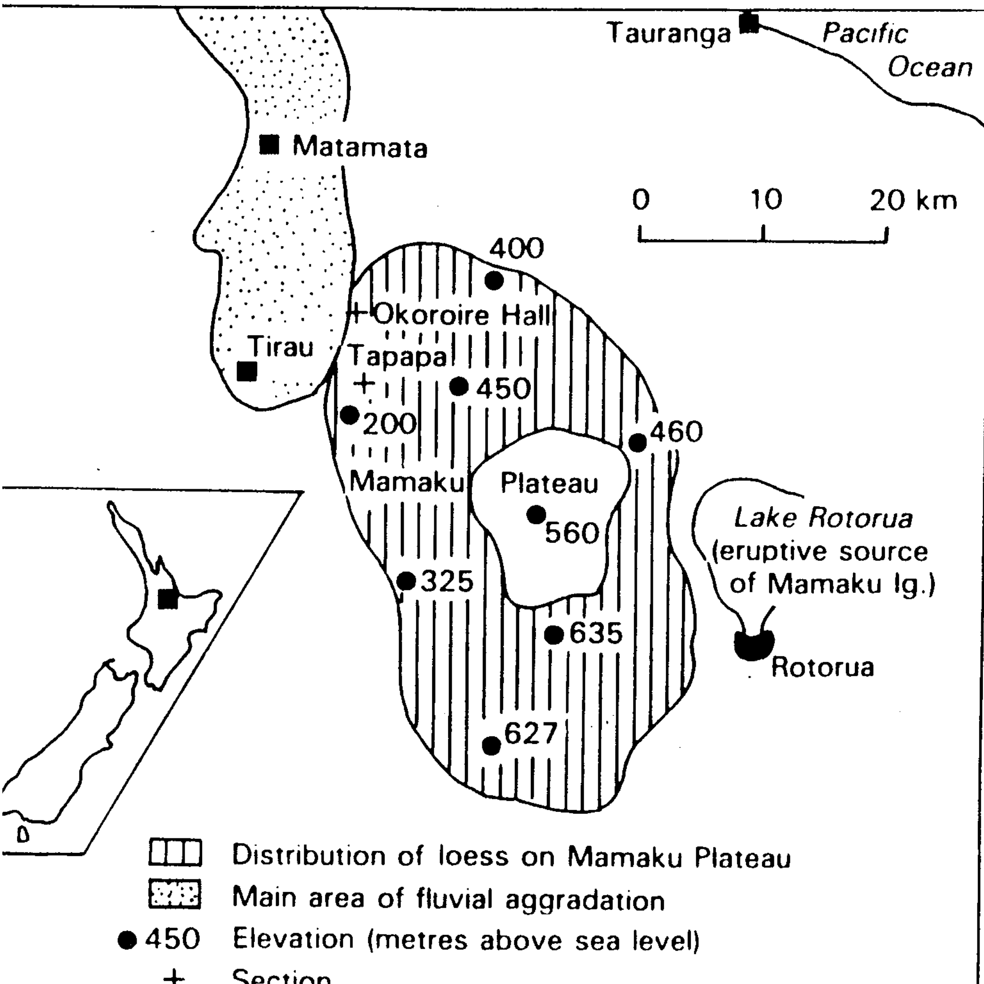
TEN YEARS OF LOESS LETTER

LL21

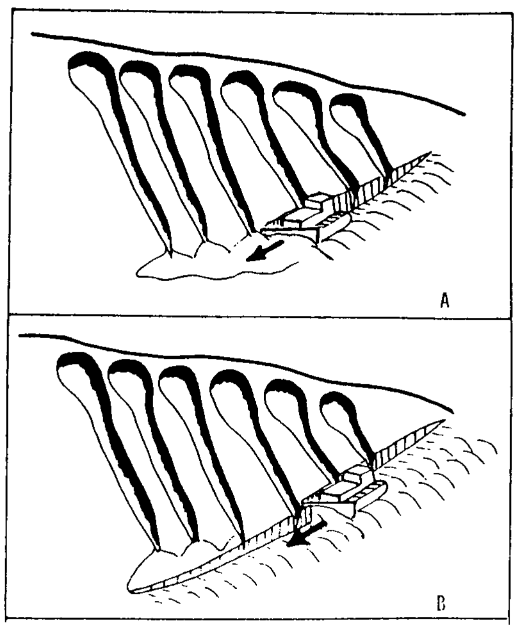


PROCEEDINGS OF AN INTERNATIONAL SYMPOSIUM ON LOESS
NEW ZEALAND / 14-21 FEBRUARY 1987

LOESS

Its distribution, geology and soils

Edited by
D.N.EDEN & R.J.FURKERT
New Zealand Soil Bureau, Department of Scientific and Industrial Research



A.A.BALKEMA / ROTTERDAM / BROOKFIELD / 1988

ISSN 0110-7658

This is Loess Letter 21, which is also the 10th anniversary issue, and we celebrate by featuring an amazingly timely publication. This issue of LL is devoted to the new book on 'Loess: Its Distribution, Geology and Soils' edited by D.J. Eden and R.J. Furkert, and published by A.A. Balkema of Rotterdam.

In January 1979, in a bar in Auckland N.Z., Jim Bowler and Ian Smalley discussed ways of initiating the activity of the newly-formed Western Pacific Working Group of the Loess Commission. It was decided that Bowler would organise a conference in Australia, essentially to discuss loess and related 'dust mantle' materials in China, New Zealand and Australia, and that Smalley would produce a newsletter, to disseminate relevant information and to promote the interests of the WPWG. The whole scheme has worked out remarkably well; three very successful conferences were held, and 'Loess Letter' has appeared to thrive. So, here we are ten years later, looking at the fruits of a remarkable achievement. Each conference was followed by a volume of papers, and the Balkema volume which we celebrate in particular makes a magnificent climax. The three volumes are:

Quaternary Dust Mantles in China, New Zealand and Australia, ed. R.J. Wasson: Australian National University 1982 (see LL5 for a report on the meeting)

Aspects of Loess Research, Editor-in-Chief Liu Tung-Sheng: China Ocean Press 1987 (see LL18 for contents lists and digests)

Loess: Its Distribution, Geology and Soils, ed. D.J. Eden and R.J. Furkert: Balkema Rotterdam 1988.

LL21 is devoted to an appreciation of the Eden/Furkert volume, the climax of the WPWG programme. We reproduce the contents list, the preface, and some of the abstracts. Since this was the N.Z. volume for the N.Z. conference we have concentrated on N.Z. abstracts, and N.Z. illustrations. The cover picture is from the paper by Neall Kennedy of N.Z.-D.S.I.R. Division of Land and Soil Sciences. Balkema have made a superb job of the actual production, the book looks very good, and it is readily available. The first two volumes in the WPWG series had somewhat restricted circulations and availabilities, the Balkema volume can be ordered through any bookshop. Be sure to order one for your library.

The compendium volume of LL1-10 Reprints is still available from Geobooks (now part of Elsevier) and can be consulted for the early history of the WPWG. LL has changed in the ten years, it is noticeable now that all the available space is taken up with reviews and digests and abstracts of published works: the number of books and papers published on loess has increased dramatically in the last ten years. In LL18 six major books on loess were noted, in LL19 there were three, LL20 was totally devoted to the EG Loess Special and LL21 is wholly concerned with the 3rd WPWG volume. We expect continued expansion of loess activity over the next ten years; LL25 will be the special issue for the Beijing 1991 INQUA Congress. The fifteenth INQUA Congress could be in 1999 or 2000. Now, and at the Beijing Congress, we should be thinking of the requirements of the 'Loess 2000' project - the setting of aims and targets for the next ten years of loess research.

LL21. Loess Letter is produced at Leicester University in the Centre for Loess Research and Documentation; it is the newsletter of the Loess Commission of INQUA the International Union for Quaternary Research. The production of LL is part of the programme of the Documentation Working Group. Editorial address: Loess Letter, Geography Department, Leicester University, Leicester LE1 7RH, England.

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Contents

Preface

The papers in this volume were contributions to an International Symposium on Loess held in New Zealand from 14-21 February, 1987. The symposium was the third meeting held by the Western Pacific Working Group of the International Union for Quaternary Research (INQUA) Loess Commission. The Western Pacific Working Group was formed during 1977 to foster research into loess and related deposits in China, Australia and New Zealand. It was convened by Dr Jim Bowler of Australia.

The first meeting was held in Canberra, Australia during December 1980. The meeting took the form of a three-day workshop and field trip led by Jim Bowler. The second meeting led by Prof. Liu Tungsheng was held in Xian, China during October 1985 where for the first time the immense loess deposits which form the Loess Plateau in northern China came under the international microscope.

The third meeting of the Western Pacific Working Group, held in New Zealand was organised by Drs Dennis Eden and Derek Milne of NZ Soil Bureau, DSIR. The symposium involved a two-day conference and six-day field trip encompassing the central part of New Zealand, led by Derek Milne. The field trip started at Christchurch in South Island where participants examined deposits somewhat similar to classical loess, though largely non-calcareous. The group then moved to North Island and examined deposits containing a greater volcanic component and having vastly different morphologies. The field trip concentrated on the stratigraphy and chronology of the loess and highlighted the importance of tephras in dating and correlating the loess. Between 30 and 40 scientists participated at the two-day conference at Palmerston North which dealt with all aspects of loess. The high cost of international travel to New Zealand prevented many intending overseas scientists from coming though participants from North America, Europe and Asia were present.

All the papers presented at the Symposium appear in this volume either as full papers or in abstract form. The production of the proceedings was carried out at NZ Soil Bureau, DSIR, Lower Hutt.

The proceedings were typed by Tessa Roach and Jayne Hilleard; many of the diagrams were drawn by Carolyn Powell and photographically prepared by Quentin Christie.

D.N. Eden and R.J. Furkert

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Localised volcanic loess deposits in North Taranaki, North Island, New Zealand

B.V.Alloway, V.E.Neall & C.G.Vucetich
Department of Soil Science, Massey University, Palmerston North, New Zealand

ABSTRACT

Over much of the North Taranaki coast extensive and thick sheet-like late Pleistocene lahar deposits overlie uplifted marine benches to form prominent platforms that have restricted both stream incision and coastal erosion. Overlying the laharic deposits is a sequence (up to 4 m thick) of conformable, uniform thickness, clay-rich beds and many proportionately thinner coarse ash interbeds. A succession of five Pleistocene clay-rich loesses, (Onaero, Rimutauteka, Puketotara, Huirangi and Kaimata) are identified beneath a thin (0.8 m) Holocene mantle of allophanic fine ash. The upper part of each loess is marked by a clear downward transition from strongly to weakly developed soil morphological properties (expressed notably through colour and structure). Ages for the various loesses and interbedded andesitic tephras were estimated from the presence of two interbedded rhyolitic tephras, and by matching the loess episodes, plus peaks in interregional quartz accumulation with the cold climate intervals recognised in the marine $\delta^{18}O$ record. On this basis the uppermost three loesses at Onaero are correlated with the southern North Island chronostratigraphic units identified as Ohakean, Ratan and Porewan substages. The two older loess deposts are here considered to correlate with the Last Interglacial - $\delta^{18}O$ stages 5b and 5d.

1 INTRODUCTION

Until recently it was presumed that the 30 m thick sequence of highly allophanic cover beds in North Taranaki was entirely tephra of varying ash and lapilli grade, with intervening episodes of soil formation (Neall 1972). The present study began as a detailed investigation into the northward distribution of tephra marker beds erupted from Mt Egmont, a 2518 m high andesitic strato-volcano situated in the centre of Taranaki region, New Zealand (Fig. 1). This study set out to determine whether the material of fine ash grade occurring between tephra marker beds is of tephric or aeolian origin.

2 STRATIGRAPHY

A well dated Holocene sequence of tephra marker beds and interbeds of fine ash grade material forms the present day soils. The sequence is

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Relationships between loess deposition and mineral weathering in some soils in Southland, New Zealand

G.J.Churchman & J.G.Bruce
NZ Soil Bureau, DSIR, Lower Hutt, New Zealand

ABSTRACT

Four soils formed in loess deposits derived from tuffaceous greywacke in Southland, New Zealand show differences in the nature and relative proportions of micas and chlorites and their weathering products down the profiles. Differences were more easily seen when clay minerals were determined both before and after chemical pretreatments for the removal of organic matter and oxides of iron and aluminium.

There is usually a close correspondence between the depths at which distinct changes occur, and the boundaries between loess layers. In two of the shallowest soils, the extent of clay mineral development tends to increase with depth. The shallowest soil shows little or no change in mineral weathering with depth. The deepest soil shows distinctly different extents of mineral development in different parts of the profile. Current soil development has not affected the lower buried layers.

1 INTRODUCTION

Loess deposits of variable thickness are widespread on downlands and terraces in Southland and south and west Otago, in the southern part of the South Island (Bruce 1973). The stratigraphy of the loess is similar throughout the whole region though the thickness of individual loess layers is greater in eastern districts than in western districts. The full stratigraphic sequence comprises at least four loess layers. Each buried layer is capped by a paleosol which, in most places, is considered to be a former fragipan, the overlying solum having been removed by a process called pedosphere stripping (Bruce 1973). In western districts, where individual loess layers are relatively thin, current soil development may traverse two or more loess layers. Soils developed in such situations are considered to be polygenetic since current soil-forming processes are being superimposed on soil horizons from previous cycles of soil formation. This tenet is reflected in the morphology of the soils.

In eastern districts, where the loess layers are thicker, soil development has taken place within individual layers when each was uppermost. The state of development of these soils has been preserved by subsequent burial by a younger loess layer. Such soils are considered to be monogenetic as they have undergone only one cycle of soil formation.

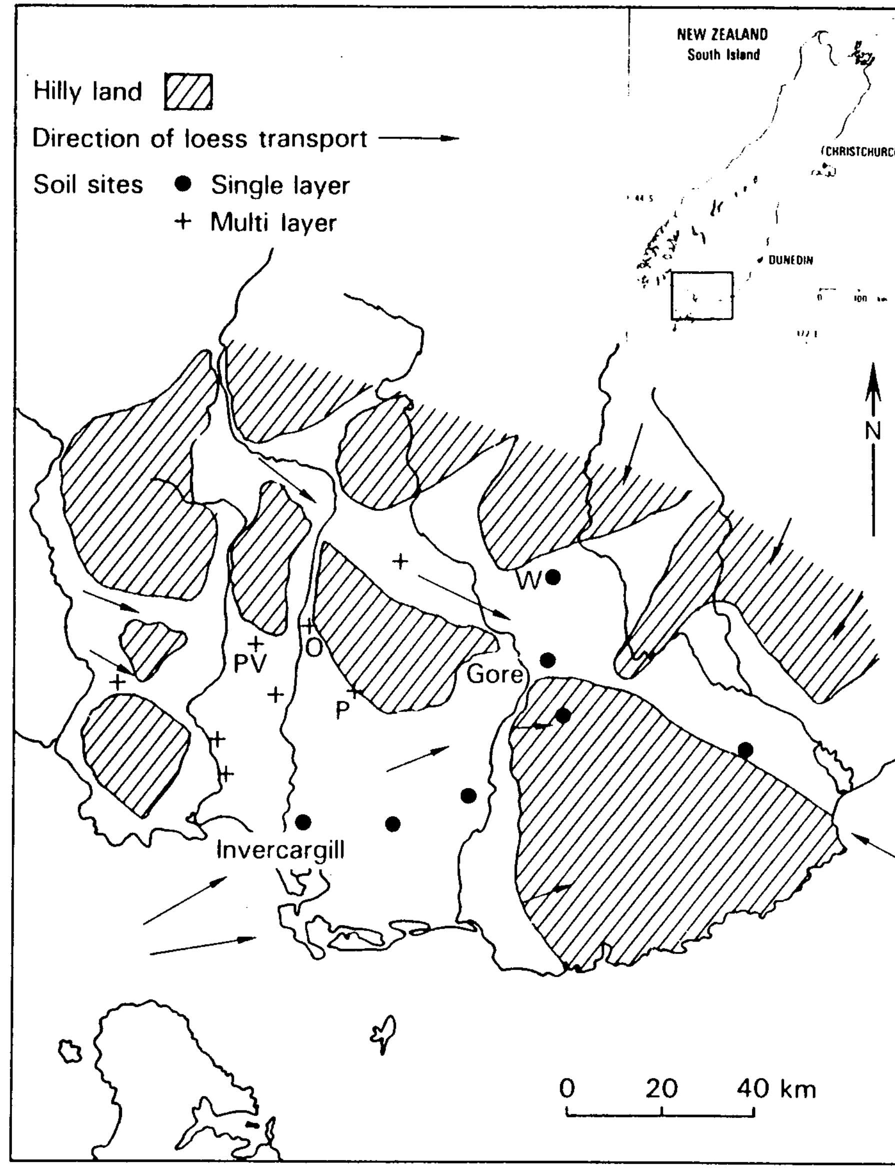


Fig. 1. Map of southern part of South Island, New Zealand showing main physiographic features and sites of multi-layered and single-layered loess soils. (O = Otapiri soil; P = Pukemutu soil; PV = Pukemutu soil (variant); W = Waikoikoi soil).

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Identification and stratigraphic significance of distal Aokautere Ash in three loess cores from eastern South Island, New Zealand

D.N.Eden
NZ Soil Bureau, DSIR, Lower Hutt, New Zealand
P.C.Froggatt
Department of Geology, Research School of Earth Sciences, Victoria University of Wellington, New Zealand

ABSTRACT

The Aokautere Ash which is derived from a central North Island eruption that occurred approximately 21 000 yrs B.P., forms a widespread marker bed within the uppermost loess layer (loess 1) in southern North Island. Aokautere Ash generally does not occur as a visible layer in South Island where it is more than 300 km from source. Cores from three widely separated loess columns in eastern South Island were continuously channel-sampled over 5 or 10 cm intervals and a stratigraphic zone containing volcanic glass shards was located in loess 1 of each core. The volcanic glass was correlated with Aokautere Ash on the basis of similar stratigraphic position and similar chemical compositions of the glass shards.

The stratigraphic position of Aokautere Ash in South Canterbury loess indicates that some previous radiocarbon dates for the upper part of the loess sequence are erroneous. The loess chronology for South Canterbury has been reviewed as a consequence.

Loess 1 in the three cores is correlated with loess 1 in southern North Island loess sequences by the presence of Aokautere Ash in similar stratigraphic positions. This indicates there was a major loess depositional episode throughout the central part of New Zealand during $\delta^{18}O$ stage 2 between about 25 000 and 10 000 yrs B.P.

1 INTRODUCTION

During soil mapping on river terraces in the Manawatu district of south-west North Island, Cowie (1964) discovered the widespread occurrence of a volcanic ash (tephra) layer which he called Aokautere Ash. This layer is generally found within the top metre of the loessial cover beds. Further mapping has shown that Aokautere Ash is also present in the Wellington district (Atkinson 1973) and in Wairarapa (Palmer 1982). The acidic composition and northward thickening of the tephra indicated that it was probably derived from the central North Island volcanic region. Radiocarbon dating of wood samples extracted from peat immediately above and below the tephra at Taita, Lower Hutt indicated its age to be approximately 21 000 yrs B.P. (Atkinson 1973).

Aokautere Ash has since been correlated by Vucetich and Howorth (1976) with a sequence of lapilli and ash on the northern shores of Lake Taupo and a new formation, the Kawakawa Tephra, defined.

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Paleomagnetism of Last Glacial loess from two sections in New Zealand

P.C.Froggatt
Department of Geology, Research School of Earth Sciences, Victoria University of Wellington, New Zealand

ABSTRACT

Loess containing an identifiable marker horizon (Kawakawa Tephra) was sampled from two localities (Tapapa near Rotorua and Clifford Bay in Marlborough) for the measurement of bulk magnetic susceptibility and natural remanent magnetism. Magnetic susceptibility varies widely through each loess layer, with peaks corresponding to paleosols. Regardless of the absolute value of magnetic susceptibility, the peaks are about twice the value of those from the intervening loess.

NRM values on Kawakawa Tephra from 3 sites within loess and from samples near source agree well, suggesting the NRM values reflect the magnetic field at the time of deposition. Loess adjacent to the tephra generally has similar NRM values. At Tapapa, a full reversal of the magnetic field is recorded, at about 70 000 to 80 000 yrs BP, but its significance and regional extent is still to be tested. The curves of declination and inclination with depth show regular small-scale fluctuations, presumably secular variation, broken into segments by intervals of rapid change. These intervals probably indicate periods of non-deposition, as they coincide with the susceptibility peaks and with the paleosols.

At Tapapa the age of the loess is constrained by Kawakawa Tephra at c. 21 000 yrs BP and by the Mamaku Ignimbrite beneath the loess at c. 140 000 yrs BP. The magnetic susceptibility curve is remarkably similar to the $\delta^{18}O$ curve for the same time, suggesting the magnetic susceptibility signal reflects climatic change. On this basis the paleosols at Tapapa correspond to $\delta^{18}O$ stages 3, 5a and 5e. For Clifford the only chronology point is Kawakawa Tephra at a depth of 180 cm. Two chronology models are possible, but the more favoured model places the oldest loess sampled into stage 6.

Measurements of magnetic properties on the loess record in New Zealand have considerable potential to aid both the recognition of paleosols and breaks in deposition and may ultimately provide a chronology for loess via the dated oxygen isotope record.

1 INTRODUCTION

Loess is one of the most widespread Quaternary deposits in New Zealand (e.g. McCraw 1973). In addition to its implication for past climate, it has the potential for stratigraphic and chronologic correlation throughout New Zealand. Important aids in the correlation are

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Late Quaternary loess associated with the Mamaku Plateau, North Island, New Zealand

N.M.Kennedy
NZ Soil Bureau, DSIR, Rotorua, New Zealand

ABSTRACT

The Mamaku Plateau, west of Rotorua, is largely composed of ignimbrite erupted c. 140 000 yrs B.P. The ignimbrite is mantled by loess and tephra cover beds up to 7 m thick. The cover beds contain up to nine loess layers. Five dated rhyolitic tephra layers with ages ranging from 13 000 years to 140 000 years are interbedded within the loess and these have been used to establish a chronology. The loess layers have been matched with cold climate intervals in the marine $\delta^{18}O$ record and correlated with a loess sequence in the Rangitikei Valley, southern North Island.

The loess is rhyolitic in composition and was derived from fluvial aggradation surfaces to the north-west of the Plateau and from erosion of pre-existing loess and tephra cover beds on the Plateau.

Major erosion of cover beds occurred prior to the deposition of Rotoehu Ash c. 50 000 yrs B.P. and during cold climate conditions following deposition of Kawakawa Tephra (Aokautere Ash) c. 21 000 yrs B.P.

1 INTRODUCTION

The Mamaku Plateau and environs are important to Quaternary studies because they appear to contain a complete chronological record of loess deposition for the last 200 000 years.

The Plateau is approximately 1250 km^2 and lies immediately west of Rotorua (Fig. 1) at an elevation of between 150 and 650 m, but mostly at about 500 m elevation. The surface of the Plateau slopes mainly from east to west. It is largely composed of welded and partly welded Mamaku Ignimbrite which erupted c. 140 000 yrs B.P. (Murphy and Seward 1981). The ignimbrite erupted from what is now Lake Rotorua and is up to 180 m thick near the highest parts of the Plateau (Nathan 1976). It is generally unconformably capped by tephra and loess.

The topography is generally flat to rolling with some deeply dissected valleys and gullies, particularly on the western side of the Plateau. Eroded hillocks or tors occur on the central loess-free parts of the Plateau (Fig. 1) above about 450 m elevation.

2 LOESS DISTRIBUTION, MORPHOLOGY AND GEOMORPHOLOGY

Loess is widespread on the Plateau and covers much of the flat and rolling land (Fig. 1). In places it is up to 7 m thick. It was first

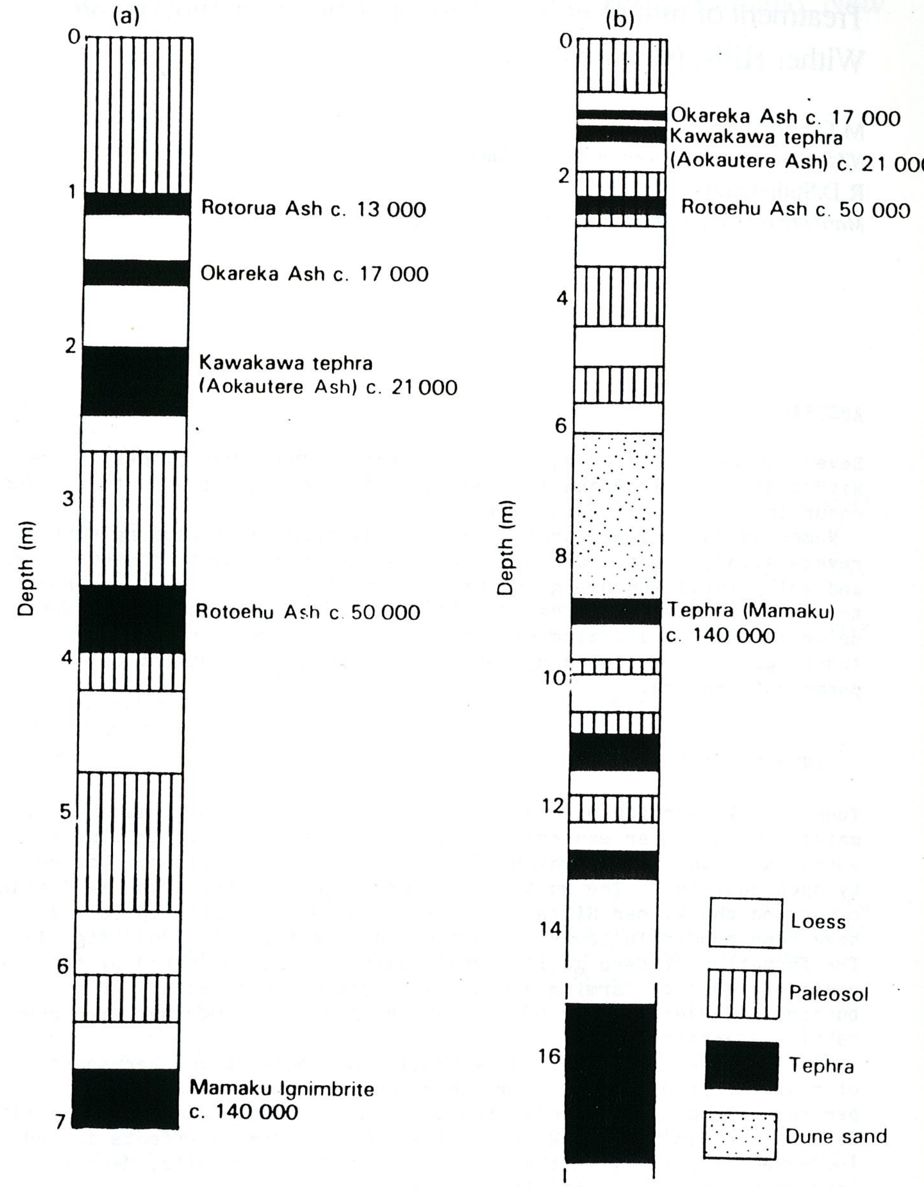


Fig. 2. Stratigraphy of Tapapa (a) and Okoroire Hall (b) sections.

e. c. 140 000 yrs-c. 200 000 yrs B.P. Up to four layers of loess totalling about 2-2.5 m accumulated during this period before being buried by Mamaku Ignimbrite. Consequently, they are only seen adjacent to the western margins of the Plateau where Mamaku Ignimbrite is either very thin or absent.

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Treatment of tunnel-gully erosion in loess colluvium on the Wither Hills, New Zealand

M.D.Laffan
NZ Soil Bureau, DSIR, Nelson, New Zealand
R.D.Sutherland
Marlborough Catchment Board, Blenheim, New Zealand

ABSTRACT

Severe tunnel-gully erosion is prevalent on the lower slopes of the Wither Hills, near Blenheim, New Zealand, where gullies up to 7 m deep occur in thick loess colluvium.

Numerous control measures have been investigated including natural revegetation, plantation forestry, pasture improvement, contour works and gully infilling using earthmoving machinery. The most successful treatment is the mechanical reshaping of severely eroded hillslopes using an angle-bulldozing method to erase all traces of the tunnel-gullies, followed by contour cultivation and sowing to permanent pasture.

1 INTRODUCTION

Tunnel-gully erosion occurs on more than 130 000 ha of loessial soils, mainly on the drier eastern side of New Zealand. It is initiated by subsurface tunnelling, which often causes surface collapse, followed by open gullying. The most severe tunnel-gully erosion in New Zealand occurs on the Wither Hills, near Blenheim where gullies up to 7 m deep have been eroded in loess colluvium mantling the hillsides (Fig. 1). The formation of deep gullies was dramatically accelerated by the onset of pastoral farming about the middle of last century with burning and over-grazing of the native grassland, together with severe rabbit infestations.

Untreated severe tunnel-gully erosion not only causes permanent loss of pastoral productivity from the eroded sites, but also causes periodic flooding and sedimentation on nearly 1400 ha of valuable flat land at the foot of the Wither Hills. Other adverse effects include increased difficulty in the control of weeds and rabbits, depressed land values and low aesthetic values.

Experimental work to control tunnel-gullying and improve pastoral production on the Wither Hills began in 1944 with the purchase by the Government of a small farm, now called the Wither Soil Conservation Reserve (National Water and Soil Conservation Organisation 1973). Further trials and the application of erosion control measures have been extended to other farms on the Wither Hills by the Marlborough Catchment Board, as part of the Wither Hills Catchment Control Schemes, which began in the late 1950s. Various treatments have been used including natural revegetation, plantation forestry, spaced tree

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Four distinct loess sources in northern and eastern Southland, New Zealand

P.D.McIntosh
NZ Soil Bureau, DSIR, Dunedin, New Zealand
D.N.Eden
NZ Soil Bureau, DSIR, Lower Hutt, New Zealand

ABSTRACT

Four sources of loess are recognised in northern and eastern Southland: (1) alluvium from schist and greywacke on the Mataura River flood plain; (2) alluvium and possibly colluvium from tuffaceous greywacke in the Kaiwera-Mimihau district; (3) alluvium derived from erosion of weathered schist and greywacke gravels in the central Waimea Plains; (4) alluvium derived from Permian tuffaceous argillite in the southern Waimea Plains. Loess from sources (1) and (2) is regionally widespread, but loess from sources (3) and (4) extends only a few hundred metres from source.

From the position of loess deposits in relation to source areas, textural and mineralogical trends, and loess thickness, the winds depositing the loess are concluded to have been from the westerly quarter.

1 INTRODUCTION

Loess more than 1 metre thick is widespread in Southland (Bruce et al. 1973). The main areas of accumulation are below 300 m altitude, where flood plains of the Waiau, Aparima, Oreti and Mataura Rivers have been loess sources (Bruce 1973). Bruce described the two main regional loess provinces: loess deposits were derived from, firstly, metamorphic rocks, and secondly, tuffaceous greywacke rocks. He also noted that some of the loess was of local origin and that Wood (1956) had found minerals from local outcrops in the loess deposits. Both Wood (1956) and Bruce (1973) concluded that the loess had been deposited by westerly winds.

This paper extends the work of Bruce (1973) and summarises recent published and unpublished research in four districts in northern and eastern Southland (Fig. 1), in which the provenance of the loess deposits has been examined by mapping of the loess deposits, by examining their textural variation, and by mineralogical and chemical analyses (Eden et al. 1987; McIntosh and Lee, unpublished data; McIntosh, unpublished data).

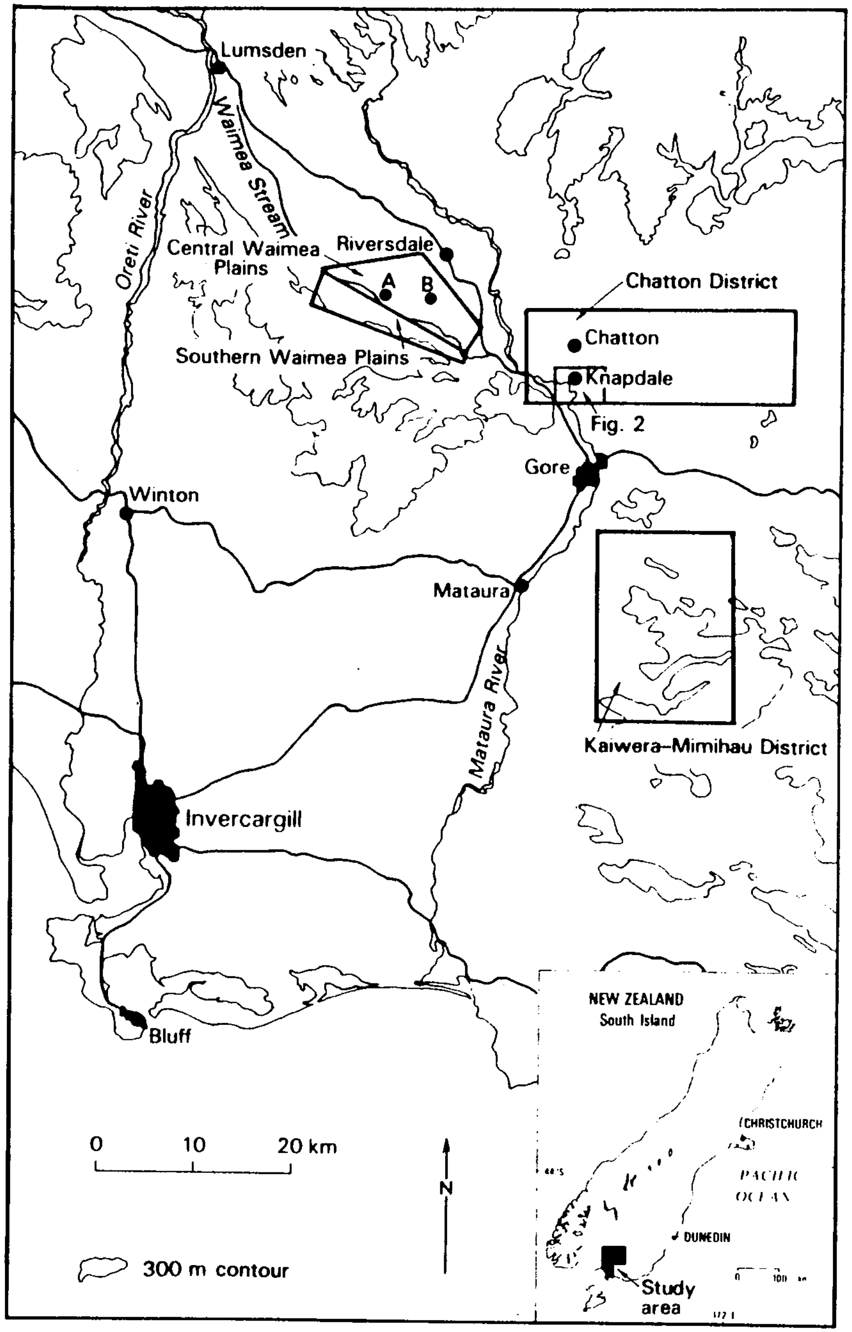


Fig. 1. Location map. A and B show locations of loess deposits described in Figs. 2 and 3 respectively.

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Review of loess studies on the West Coast, South Island, New Zealand

G.Mew, R.F.Thomas & D.N.Eden
NZ Soil Bureau, DSIR, Lower Hutt, New Zealand

ABSTRACT

West Coast loess deposits are generally <1 m thick and occur on alluvial terraces and adjacent rolling country. The West Coast is a high rainfall (> 2500 mm/year) region and the loess is saturated with water for most of the year. Waterlogging and leaching have altered most West Coast loesses with the result that no unequivocal paleosols have been recognised. However, pollen is preserved allowing the past vegetation to be traced. The presence of the c 20 000 yrs B.P. Kawakawa Tephra (Aokautere Ash) both as a layer and as a glass concentration has been useful in establishing a time plane within the loess. The stratigraphic position of the glass has been used to calculate the ages of glacial outwash surfaces. Investigations of loess source areas and transport directions have suggested that loess-bearing winds may have come from north-westerly and south-easterly directions.

1 INTRODUCTION

Modern scientific studies of loess on the West Coast commenced with the work of Raeside (1964) but it was Young (1967) who recognised the general distribution of the material. Young also identified the major characteristics of West Coast loesses in terms of particle size distribution, variable thickness related to age of surface and influence on soil drainage. A map of loess deposits on the South Island at a scale of 1:1 000 000 was published by Bruce et al. (1973). Loess thickness was shown in two categories, 1 m to about 20 m and thin, mainly < 50 cm. The greater thicknesses were mapped from the mid-Grey Valley south to the Waiho River and the lesser thicknesses north from near Greymouth to Westport. Subsequent soil surveys at 1:50 000 (e.g. Mew et al. 1975, Mew 1980a,b) have led to a better knowledge of the distribution of loess as a soil parent material in most areas between Hokitika, Reefton and Westport. Moar and Suggate (1973, 1979) have elucidated some loess stratigraphy around Hokitika and Westport using a combination of pollen analysis and ^{14}C dating.

West Coast loess differs in several ways from loess in other parts of New Zealand. It occurs in a high rainfall region (> 2500 mm/year). Deposits are usually thinner (< 100 cm) than at main east coast, South Island type sites, and in most places, small in extent. Also, some of the deposits are very strongly leached. As in other parts of New

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Loess, river aggradation terraces and marine benches at Otaki, southern North Island, New Zealand

A.S.Palmer
Department of Soil Science, Massey University, Palmerston North, New Zealand
R.Barnett & B.J.Pillans
Department of Geology, Research School of Earth Sciences, Victoria University of Wellington, New Zealand
R.H.Wilde
NZ Soil Bureau, DSIR, Palmerston North, New Zealand

ABSTRACT

Despite the excellent record of river aggradation terraces in Rangitikei Valley, and the equally impressive marine benches along the Wanganui Coast, the stratigraphic relationships between river aggradation terraces and marine benches are seldom seen. Near Otaki, in southern Horowhenua, marine cliffing during the Last Interglacial ($\delta^{18}O$ stage 5e) truncated the Marton river aggradation gravels deposited during the Penultimate Glacial ($\delta^{18}O$ stage 6). Beach sands abut the sea cliff, while sand dunes blew up and over the scarp to form dunes which mantle the Marton gravels. The dunes were subsequently mantled by at least three loess units, the youngest of which contains Aokautere Ash. This sequence has a close parallel in the Holocene when Ohakean gravels ($\delta^{18}O$ stage 2) were truncated during the postglacial rise in sea level.
Ohakean and Martonan aggradation gravels are thicker and more extensive than Ratan and Porewan gravels, suggesting the former were deposited during major glacial periods ($\delta^{18}O$ stages 2 and 6) and the latter during intervening, less-severe stadial periods ($\delta^{18}O$ stages 3 and 4). Pollen evidence is consistent with these interpretations. Each of these episodes of river aggradation was accompanied by loess deposition.

1 INTRODUCTION

River aggradation and degradation terraces are a common feature of the New Zealand landscape (Milne 1973a,b, Kaewyana 1980, Palmer 1982). The best developed are those mapped by Milne on the Rangitikei River in the south-west of the North Island about 60 km north of Otaki. Aggradation terraces are characterised by thick accumulations of spheroidal water-worn gravels in a sandy matrix, while degradation terraces feature a complex array of sands, silts and gravels. Seven major periods of river aggradation were recognised in the last 230 000 years (Milne 1973a), each presumed to represent increased erosion during glacial or stadial periods. The seven terraces formed as a result of aggradation phases were named: Ohakea, Rata, Porewa (Last Glacial), Cliff (Last Interglacial), Greatford, Marton and Burnand (Penultimate Glacial). Milne (1973b) recognised loess and river aggradation deposits from six cold substages, each followed by weathering and river degradation in six alternating warm substages.

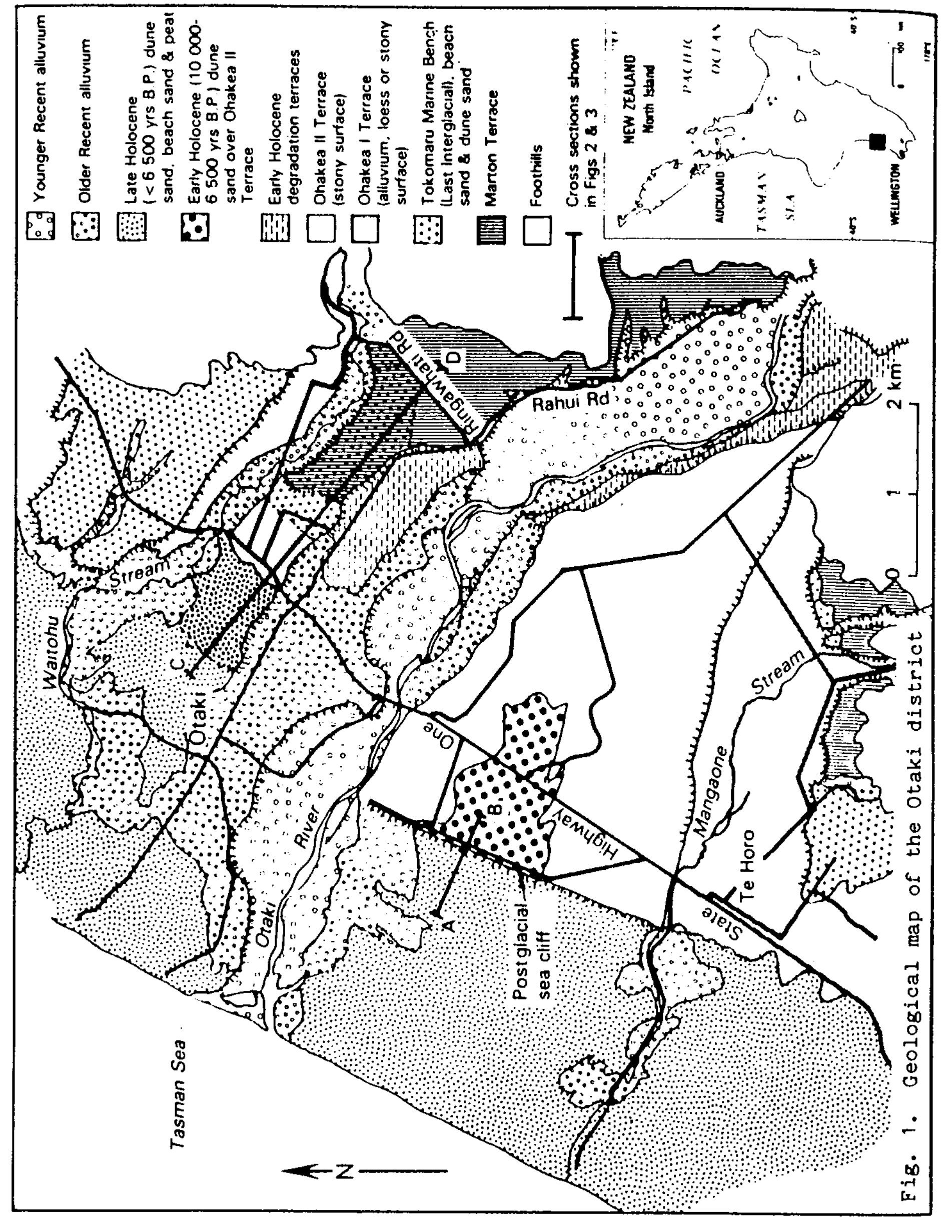


Fig. 1. Geological map of the Otaki district

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Loess chronology in Wanganui Basin, New Zealand

B.J.Pillans
Department of Geology, Research School of Earth Sciences, Victoria University of Wellington, New Zealand

ABSTRACT

Since the seminal work of Milne in 1973, which established a c. 300 000 year loess chronology for Rangitikei Valley in eastern Wanganui Basin, much attention has focussed on correlation of Milne's loess stratigraphic units to other parts of the basin, and elsewhere in New Zealand. In western Wanganui Basin, stratigraphic relationships between loess sheets and marine terraces are well established, but correlation to Rangitikei Valley is not straightforward. Correlation is hindered by change in weathering regimes across the basin and by lack of materials for radiometric dating.

Fission-track dating and correlation of interbedded rhyolitic tephra are critical to the loess chronology in eastern and western parts of the basin. These tephra include Mt Curl Tephra (c. 240 000 years) in the east and Rangitawa Pumice (c. 370 000 years) in the west, although there is some dispute over interpretation of fission-track ages. The c. 20 000 year Kawakawa Tephra (Aokautere Ash Member) and several tephra in the age range c. 160-240 000 years are interbedded with loess and tephra in the basin, but the older tephra have yet to be identified with confidence in some critical sections. Similarly, the distinctive, but as yet undated, Fordell Ash occupies an important stratigraphic position in the central basin area, but correlation to the east and west is not yet possible. Based on currently available fission-track ages, loess chronology in western Wanganui Basin can be extended back to c. 500 000 years.

1 INTRODUCTION

The Wanganui Basin in the south-western part of North Island, New Zealand (Fig. 1), has long been of importance in New Zealand Quaternary studies (e.g. Te Punga 1952, Fleming 1953, Cowie 1964, Milne 1973a, b, c, Seward 1976, Pillans 1983, Beu and Edwards 1984). The major reason for this importance lies in the emergent shallow marine sediments of the basin and their intimate association with coastal deposits which include tephra, loess, dune sand and lignite. The marine sediments and their fossils facilitate correlation with deep ocean records (principally the oxygen isotope stratigraphy in deep sea cores), and provide a direct record of sea level changes. The tephra are valuable for correlation and radiometric dating, while the lignites are important for palynology and chemical dating.

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

A preliminary investigation of the physical and chemical properties of the Pahiatua Terrace loess beds, north-west Wairarapa, New Zealand

K.F.Stevens
Department of Geology, Research School of Earth Sciences, Victoria University of Wellington, New Zealand

ABSTRACT

The Pahiatua terrace in north-west Wairarapa has a cover bed sequence of loesses, paleosols, and tephra more than 15 m thick, representing a Quaternary record extending back about 300 000 years. So far the only study of the sequence has been a field description supported by some grain size analyses and optical determinations of minerals in grain mounts. Sequential changes of the physical and chemical properties in the sequence are now being examined in a continuous 15 cm core drilled through the sequence. Water content, bulk density, nitrogen content and magnetic susceptibility have been measured.

The results from the measurements suggest that there are more paleosols in the sequence than previously recognised.

1 INTRODUCTION

Vella et al. 1988 (in press) have described terrace cover bed sequences on a series of alluvial terraces in north-west Wairarapa (Fig. 1). The thickest sequence and greatest number of cover beds is on the Pahiatua Terrace (Fig. 2), 2 km west of Pahiatua. It includes nine loess beds considered to represent cold climate phases correlated with stadials of the last, penultimate, and antipenultimate glaciations. Strongly developed paleosols represent the last and penultimate interglacial phases. Less strongly developed paleosols represent interstadials.

The sequence is dated by tephra at three horizons. The two best dated are the Aokautere Ash or Kawakawa Tephra, mean age 20 560 ± 410 yrs B.P. (Vucetich and Howorth 1976) and the Mt Curl Tephra (230 000 ± 30 000 yrs B.P. Milne 1973; 254 000 ± 2000 yrs B.P. Froggatt et al. 1986). The third horizon is the Makakahi tephric paleosol, equivalent to the Middle Tongariro tephra of the Rangitikei district to the north-west, considered to have an age of about 60 000 yrs B.P. (Milne 1973). The complete cover bed sequence (Fig. 2) is considered to represent approximately 300 000 years, the longest time represented by any cover bed sequence known in the North Island south of the Manawatu Gorge.

Vella et al. (in press 1988) nominated a type section for Pahiatua cover beds at grid ref. NZMS1 N149/298249 on the ridge immediately west of Ridge Road Central 2 km west of Pahiatua. A cutting on Ridge Road Central 300 m east of the type locality, and adjacent to the

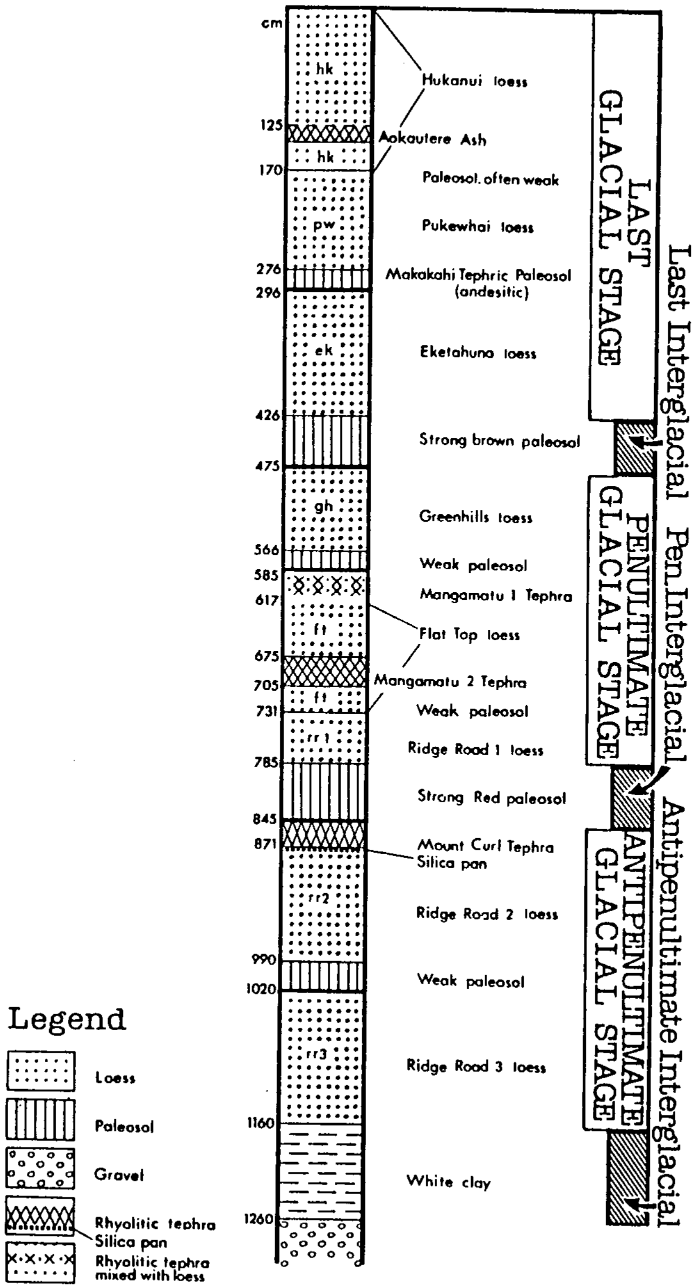


Fig. 2. The sequence of cover beds on the Pahiatua Terrace according to Vella et al. 1988 (in press).

Loess, Eden & Furkert (eds), © 1988 Balkema, Rotterdam. ISBN 90 6191 851 0

Aeolian cover beds of marine terraces in the western Wanganui district, North Island, New Zealand

R.H.Wilde
NZ Soil Bureau, DSIR, Palmerston North, New Zealand
C.G.Vucetich
Department of Soil Science, Massey University, Palmerston North, New Zealand

ABSTRACT

Weathered aeolian cover beds, ranging in thickness from c. 0.5 to 2 m, mantle uplifted marine terraces in the western Wanganui district, south-west North Island, New Zealand. The cover beds comprise basal marine sand, interbedded dune sands, loess and tephra.

The cover beds have several sources. The main source for loess is considered to be an area now seaward of the present shoreline. A rhyolitic tephra (Aokautere Ash) present within the cover bed sequence originated from the central North Island and an andesitic tephra, also present, from Taranaki. Interbedded aeolian sands were derived from a coastal source, and from an inland source after erosion and redeposition of older cover beds.

The soils and paleosols developed within the cover beds are briefly described.

Depositional histories of the cover beds are outlined. This paper establishes a c. 250 000 year chronology for cover beds on the three best defined marine terraces that form major features of the western Wanganui landscape, and reviews ages of the underlying marine benches. Glacial stages and substages are assigned to the cover beds. There is good agreement between these and the ages assigned here to the terraces (Rapanui c. 120 000 yrs B.P.; Ngarino c. 210 000 yrs B.P. and Brunswick c. 310 000 yrs B.P.) from the New Guinea sea level curve.

1 INTRODUCTION

This paper establishes a c. 250 000 year old chronology for the cover beds of the western Wanganui district in the south-western part of North Island, New Zealand (Fig. 1). The stratigraphy of aeolian cover beds on uplifted marine terraces is described and interpreted and the ages of the underlying marine benches are reviewed.

The investigation was confined to the three best-defined, gently sloping marine terraces (Rapanui, Ngarino and Brunswick Terraces) that are major features of the western Wanganui landscape (Wilde 1979). Cover beds on older terraces were not examined in detail because there were few undisturbed sections of them exposed when fieldwork was carried out.

The most comprehensive description of the geology of the Wanganui district and the first account of the coastal marine terraces and their cover beds is given by Fleming (1953). Dickson et al. (1974)

INQUA Loess Commission

Documentation Working Group

ISSN 0110-7658

Loess Letter 21 : April 1989