A MINERALOGICAL AND TEXTURAL STUDY OF THE CENTRAL NORTH ISLAND TEPHRA, OKAREKA ASH AND ITS OVERLYING TEPHRIC LOESS DEPOSITS

A Thesis Presented as Partial Fulfillment for the Degree of Master of Science in Soil Science

by

Lynette Anne Benny

Massey University,
New Zealand

1982

ACKNOWLEDGEMENTS

I wish to thank my supervisors Dr. J.H. Kirkman, and Mr. R.B. Stewart for their guidance, encouragement and advice during my thesis work.

I wish also to extend my thanks to Dr. W.A. Pullar and Mr N.M. Kennedy, Soil Bureau, Rotorua, for their invaluable assistance in collecting soil samples for this study, and worthwhile discussion in the field.

I am grateful to Mr. D. Hopcroft and Mr. R.J. Bennett of the Electron Microscope Lab. D.S.I.R., for their technical assistance in the electron optical work, and printing of the electron micrographs.

To Miss. J.S. Rowarth and Mr. R.C. Wallace, my thanks for your critical reading of, and helpful comments about the manuscript.

I would also like to thank my mother, Mrs. A.F. Benny, who typed this thesis, and finally, both my parents for their continuing support.

ABSTRACT

In Central North Island, New Zealand, Post-Okareka tephric loess rests upon Okareka Ash (c.17,000 years B.P.). Tephric loess accumulation occurred under semi-arid conditions which coincided with glacial advances in southern areas of New Zealand.

Morphological and grain-size evidence indicates the tephric loess has been derived from a localised source, most probably that of Okareka Ash material, reworked and redeposited by aeolian processes. Optical and electron optical evidence reveals that Okareka Ash particles are angular and relatively unweathered, whereas tephric loess grains are subangular and more weathered.

The sand and clay mineralogy of the tephra and tephric loess are similar. Sand fractions contain mainly rhyolitic volcanic glass, quartz, plagioclase feldspar, biotite, hypersthene, hornblende, titanomagnetite and traces of cristobalite, tridymite and augite, whereas clay fractions contain halloysite, allophane, imogolite and gibbsite in varying amounts.

Grain-size analysis reveals Okareka Ash deposits show decreasing mean grain-size with increasing distance from source, are poorly-sorted, fine-skewed, and lepto/platykurtic. In contrast to tephra, tephric loess samples exhibit a narrow mean grain-size range, and are better sorted, but show similar skewness and kurtosis values to ash. Grain-size results also indicate that due to minimal weathering of Okareka Ash and Post-Okareka loess, the distinction between the two deposits is less well-defined than data from similar deposits reported by Fisher (1966). Furthermore, where ash deposits are thin, in distal areas from source, and under certain environmental conditions, textural and morphological characteristics of the tephra are similar to those of the tephric loess. Nevertheless, grain-size parameters may be used to differentiate airfall tephra and tephric loess deposits, although this

differentiation is enhanced by post-depositional weathering.

The contrasting clay mineralogies of tephra and tephric loess samples from sections of similar topography, altitude, drainage and rainfall, illustrates the problems of field sampling in weathering studies.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

NOMENCLATURE

Sections: (except for Trunk Rd, sections sampled are given a letter symbol, listed below, with increasing distance from Okareka Ash source)

G Gavin Rd
A Okareka Quarry
I Lynmore
H Te Ngae
B Pukehangi Rd
J Ngongotaha
C Tarukenga
D Dalbeth Rd
E Highland Hill
K Kuhatahi

At Trunk Rd section, due to the thickness of Okareka Ash, samples were labelled according to -

firstly, the predominance of

R rhyolitic (pale grey)

or B basaltic (dark grey-black) material

and secondly, the grain-size by a letter subscript -

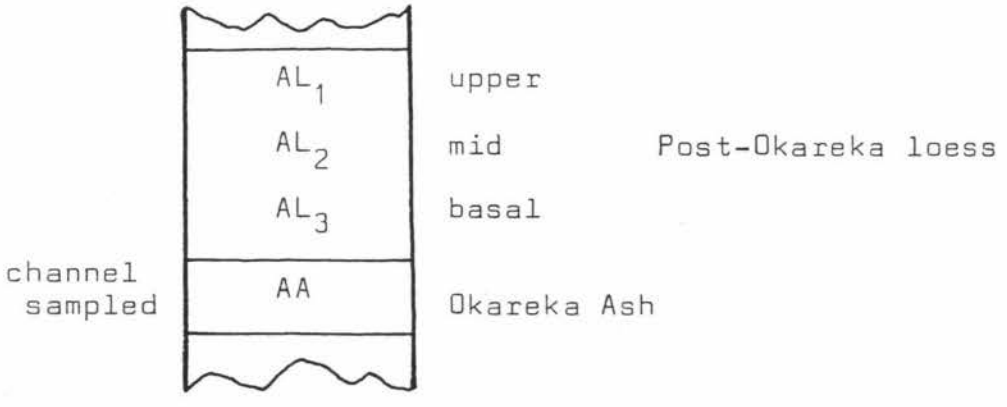
A ash
L lapilli
c coarse
f fine

Ash and Loess: loess samples were labelled -

L loess
A Ash

and given a number subscript, from top to base, depending upon the number of samples taken -

e.g. Okareka Quarry - section A



ABBREVIATIONS

Al	Aluminium
Å	angstrom (10^{-7} m)
An	anorthite
Cpx	augite
Bt	biotite mica
cm	centimetre (10^{-2}m)
^{o}C	degrees celsius
DTA	differential thermal analysis
Fds	feldspar (includes alkali and plagioclase)
g	gram
>	greater than
Hb	hornblende
H	hydrogen
Opx	hypersthene
IR	infra-red spectroscopy
kHz	kilohertz
km	kilometre
Kw	kilowatt
K_G	kurtosis
<	less than
Mz	mean grain-size
m	metre
µm	micrometre (10^{-6}m)
mg	milligram (10^{-3}g)
mm	millimetre (10^{-3}m)
O	oxygen
%	percent
Qz	quartz
Ø	phi scale
(v)ps	(very) poorly-sorted
RI	refractive index
SEM	scanning electron microscope
Si	silica
SK_I	skewness
(s)fs	(strongly) fine-skewed
sym	symmetrical
σ_I	sorting
θ	theta

FeO	titanomagnetite
TEM	transmission electron microscope
VG	volcanic glass (rhyolitic)
XRD	X-ray diffraction

N.B. for consistency all grain-size calculations were carried out at μm sizes to equal Ø (phi-scale) divisions (e.g. 63μm = 4.5Ø)