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THE MINERALOGY OF THE TOKOMARU SILT LOAM AND THE OCCURRENCE OF CRISTOBALITE AND TRIDYMITE IN SELECTED NORTH ISLAND SOILS

A thesis presented in partial fulfilment of
the requirements for the degree of
Doctor of Philosophy in Soil Science
at Massey University

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1987

ABSTRACT

The origin of cristobalite has been investigated in a selection of soils from North Island. These include Tokomaru silt loam in the Manawatu, and Hamilton clay loam, Naike clay and Te Kowhai silt loam in the Hamilton basin. The occurrence of cristobalite, in conjunction with associated sand and silt mineralogy, has been used to interpret both the provenance of soil parent materials and aspects of soil genesis.

Cristobalite isolated from the soils is α-cristobalite (opal-C) and is invariably accompanied by tridymite (tridymite-M structure). SEM data suggest that rather than discrete phases, cristobalite and tridymite usually occur intergrown with each other. Together they constitute up to 15% of the soils examined and usually occur in higher concentrations in upper soil horizons. Oxygen isotope abundances for cristobalite and tridymite range from 7.5-8.4 $^{o}/_{oo}$ and are independent of grain size and relative proportions of cristobalite and tridymite. These data, together with the highly ordered crystal structure and subhedral morphologies of grains, indicate that cristobalite and tridymite formed at high temperature. Both are shown to occur in a number of the rhyolitic tephras from the Taupo Volcanic Zone (e.g. Aokautere and Okareka ashes) and leucocratic lavas from the Egmont centre. Cristobalite and tridymite in the soils therefore probably originated from volcanic sources.

Various forms of amorphous silica were also identified in the soils of the Hamilton basin. In upper soil horizons, microfossils and phytoliths dominate but at depth the Naike clay and Hamilton clay loam contain two inorganic forms of amorphous silica. These comprise

microspheres similar to those described in precious opal. Oxygen isotope data (26.6-26.9 $^{o}/_{oo}$) are consistent with their being of low temperature origin.

In the Tokomaru silt loam, although the mineralogy is dominantly quartzofeldspathic, variations in sand mineralogy and sand chemistry identify tephric additions at specific depths in the loess. Microprobe data on pyroxenes, amphiboles, glasses and titanomagnetites at these depths and in reference tephras from the Egmont centre and the Taupo Volcanic Zone demonstrate that it is possible to identify the sources of the tephras in the soil and so place some time constraints on the age of the loess:

0-50 cm	Mixed rhyolitic and andesitic tephras from the Egmont centre and the Taupo Volcanic Zone. These have accumulated during the last 11 ka.
1.1-1.2 m	Rhyolitic ash, tentatively correlated with the Rerewhakaaitu Ash (14.7 ka B.P.) from the Okataina centre.
1.2-1.3 m	Andesitic tephra from the Egmont centre.
c. 1.6 m	Andesitic tephra from the Egmont centre.
c. 2.0 m	Andesitic tephra from the Egmont centre.
2.21-2.34 m	Aokautere Ash (20 ka B.P.) from the Taupo centre.

The distribution of phytolith types in this soil demonstrate a change at c. 50 cm depth which is interpreted as resulting from post-glacial afforestation. This is inferred to have occurred at 11-12 ka B.P.

Quartz accumulation rates demonstrate that there are markedly increased rates of loess accumulation from 14.7 ka to 12 ka, after which time there was a dramatic reduction. The loess that accumulated between these dates may not be so directly related to cold climate conditions as to an increased supply of suitable material from local sources.

ACKNOWLEDGEMENTS

During the course of this research project I have received support and encouragement from many people and I would like to express my gratitude to the following for this assistance.

Dr. V.E. Neall, my principal supervisor, for his enthusiasm, patience and wise counsel when I drifted into areas with which I was unfamiliar and who allowed new and interesting avenues of inquiry to be freely pursued.

To the "Quaternary team" in the Department of Soil Science, Drs. R.B. Stewart (latterly also as co-supervisor) and A.S. Palmer, and Messrs C.G. Vucetich and B.V. Alloway for helpful discussion during the course of the project.

Members of the Department of Soil Science, particularly Drs. J.A. Pollok, M. A. Turner, A.N. Macgregor and J.H. Kirkman encouraged and assisted me in resolving minor problems or in learning new techniques.

To Drs. C.M. Lees, J.P. Skipworth, R.N. Patel and Mr. A.G. Robertson for initial assistance with the inquiry into phytoliths.

Drs. H.S. Gibbs and D.J. Lowe, Waikato University provided informative assistance and guidance when collecting the soils from the Hamilton Basin.

Messrs D.H. Hopcroft and R. Bennet, Applied Biochemistry Division, D.S.I.R. and Dr. J.D. Collen, Victoria University, are thanked for supplying their technical skills and assistance in producing the electron micrographs.

Dr. P. Blattner and Miss C. Houston, Geological Survey, introduced me to oxygen isotope analysis techniques and supplied the oxygen isotope data.

Mr. K. Palmer, Victoria University, assisted with the XRF analyses and facilitated ready access to the electron microprobe.

Dr. C.W. Childs undertook some preliminary mossbauer studies and, together with Dr. J.D.G. Milne, made unpublished chemical data available.

To the "production team", particularly Glenys, Martin Eggels and Anne Rouse for giving of their time and expertise so freely.

Finally to my main support team (Glenys, Kerry, Heather and Cleland) for encouragement, support and patience during all phases of the project. For sharing the "highs" with me and helping me through the "lows" - Thank you.

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