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**THE NATURE OF SENSITIVITY IN RHYOLITIC PYROCLASTIC SOILS FROM  
NEW ZEALAND**

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## ABSTRACT

Sensitive soils with a high ratio of peak to remoulded strength are frequently involved in large, damaging landslides around the world. In New Zealand, sensitive soils are derived from *in situ* weathering of fine-grain pyroclastic deposits; elsewhere they are typically deposits of glacial derived "rock flour". This research describes the nature of sensitive pyroclastic deposits and proposes a possible process to their formation. Investigations focused on the ~1 Ma Kidnappers tephra due to its widespread nature and typical exposure at the base of cliffs where it is typically saturated and contributes to landslides.

Field observations found that these soils are generally syn-eruptively reworked pyroclastic deposits of variable grain-size and plasticity, with typical deposits being high to extremely high plasticity silts. These soils are often the basal shear plane of landslides in the Auckland and Tauranga regions. X-ray diffraction studies found a typical mineralogy of quartz and plagioclase together with the clay minerals halloysite and kaolinite. Scanning electron microscopy observations showed these soils have a quasi-matrix microstructure inherited from the original vesicular texture that has been modified by weathering into clay minerals without a significant change in porosity. Geotechnical testing determined the physical and material properties of the soils to be: dry density, 0.9 – 1.1 g/cm<sup>3</sup>; moisture content, 49% - 104% by mass; peak friction angle, 15° - 32°; peak cohesion, 10 – 80 kPa; residual friction angle, 14° - 30°; residual cohesion, 0 – 13 kPa; sensitivity, 6 to 24.

Key factors in the genesis of sensitive pyroclastic deposits are: i.) an original low density deposit composed of vesicular glass and pumice fragments, ii.) weathering of primary material to form halloysite and kaolinite, iii.) a delicate microstructure dominated by clay mineral microaggregates in a high-porosity fabric, and iv.) high natural water content that promotes fluid behaviour during shearing. Of these four conditions original vesicular texture and weathering that promotes the formation of kaolin group minerals are the most important factors in the generation of sensitivity. The results of this research will help practitioners to recognize and respond to sensitive pyroclastic soils and contributes to the understanding of these soils in a global context.



## **DEDICATION**

To Crystal:

Your love and support gave me the perseverance needed to complete this thesis.



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