GEOLOGY AND ITS RELATIONSHIP TO EROSION IN THE SOUTHERN RUAHINE RANGE, NORTH ISLAND, NEW ZEALAND

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ABSTRACT

The structure and lithology of a sequence of Mesozoic greywackes comprising the Torlesse terrane within the southern Ruahine Range has been mapped. At a scale of 1:25 000 the sequence was subdivided into informal lithozones with one or more lithozones constituting a higher order lithostratigraphic unit here referred to as a Lithotype. Each of three recognised Lithotypes occupies a consistent stratigraphic position throughout a 40 km long mapped area. From east to west the three Lithotypes are: (1) the Tamaki Lithotype; (2) the Wharite Lithotype; and (3) the Western Lithotype. The easternmost Tamaki Lithotype and the westernmost Western Lithotype consist of a relatively undeformed flysch-type sequence of distal turbidites. The centrally located Wharite Lithotype structurally underlies the Tamaki Lithotype but overlies the Western Lithotype. It comprises a complex sequence of predominantly flysch-type sedimentary rocks, together with lithologically diverse, argillite-dominated, clast-bearing debris flow deposits; large sheet-like bodies of massive volcanics (and associated cherts) that have been emplaced by gravitational sliding; and intact pillow lava accumulations and horizons of red and green argillite of syndepositional origin.

Major and trace element analyses of volcanic lithologies indicate that most samples were erupted in a mid-ocean ridge or intraplate setting. None appear to have been derived from an island arc setting.

The bulk of the clastic sediments consist of reworked materials derived by the erosion of a mixed volcano-plutonic source and redeposited in a distal deep-water submarine fan environment. Blocks of allochthonous fossiliferous shallow-water lithologies indicate that the source terrane, in part, comprised rocks of Late Triassic age. Autochthonous fossils indicate that sedimentation continued until at least Late Jurassic time.

Part of the stratigraphic sequence was severely deformed along a low angle thrust zone in Early Cretaceous time at the onset of the Rangitata Orogeny. An early phase of ductile deformation resulted in plastically and permanently deformed rocks. Ductile deformation is restricted to strata comprising the Wharite Lithotype which, with its allochthonous debris, in part, constitutes an olistostrome that has undergone tectonic deformation and hence also constitutes a melange. Thus it may be regarded as a tectonised olistostrome. Ductile deformation was succeeded by the development of shear fractures during subsequent phases of brittle deformation that affected strata comprising all three Lithotypes. Brittle deformation occurred in conjunction with episodes of faulting and folding during the second orogeny - the Kaikoura Orogeny in Pliocene to Recent times.

Active faults that were initiated during the early phase of ductile deformation continued to be sites of active fault displacement throughout Quaternary and Holocene time. Late Quaternary tectonic features along these major active faults have been mapped. Minimum rates of vertical fault displacements since Ohakean time approximate 1 mm/yr in this area.

Several phases of folding were recognised, including: (1) an early phase of syndepositional, highly asymmetric folds with well developed axial plane cleavage; and (2) three post-lithification phases of folding - *e.g.* (a) steeply plunging isoclinal folds; (b) subhorizontal, open asymmetric folds; and (c) steeply plunging open folds.

Contacts between the three Lithotypes are not thought to be major tectonic breaks but are instead of primary depositional origin and have become sites of subsequent fault movement in Quaternary time. The three Lithotypes may therefore represent a near complete eastward dipping, westward younging overturned stratigraphic sequence. They are not fault-bound terranes.

Metamorphism to prehnite pumpellyite grade, folding and rotation of the strata to its present steep attitude predates Late Cretaceous sedimentation. The westward rotation and imbrication of thrust sheets that are internally westward younging but form part of a regionally eastward younging succession of thrust sheets was the result of underthrusting at a convergent plate margin.

The relationship between structural and lithological characteristics of the Torlesse bedrock and the magnitude of valley slope erosion in the southern Ruahine Range is investigated. Comparison of aerial photographs spanning a 28 year period between 1946 and 1974 indicate that erosion has increased by 91%. The greatest proportion of this eroded area occurs on the steeper north- and west-facing slopes. Saturation of colluvium during major storm events is the prime triggering mechanism for the majority of shallow translational slope movements. Debris slides and debris avalanches predominate and result from failure at less than 1m depth at the colluvium-bedrock contact. Rock slides are few in number and are structurally controlled, failing along bedding plane surfaces at greater than 1m depth. Rock falls and rock topples are least numerous and only involve small quantities of material.

An erosion rate of 1215m^3/ha/yr for the southern Ruahine Range is of the same order of magnitude as other New Zealand and overseas studies and although considered to be severe it is not unduly excessive.

Much of the forest deterioration in this area is due to the opening of the canopy by the successive removal of large tracts of forest vegetation through mass movement processes during episodes of increased rainfall.

Large-scale rotational and translational mass movement features including rock slumps, earth slumps, earth slides and ridge-top features (involving bedrock only), have been documented from 109 localities. A relationship between the incidence of rock slumps and major fault breccia zones has been established in this area. The majority of large-scale mass movement features failed in pre-historic time but two failed in historic time. The consequences of future mass movements upon lowland areas adjacent to the base of the Range is discussed.

A map showing the relative stability of slopes and the predominant forms of slope movement most likely to occur under the present seismic, climatic, physiographic and human conditions is presented.

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