

INTRODUCTION

- Rock types maps are intended to help planners and land users to:
 - i) identify the characteristics of near surface geology;
 - ii) recognise areas of existing and potential mineral resources;
 - iii) become aware of geological hazards.

ROCK TYPE DESCRIPTIONS (LITHOLOGIES)

The map unit symbols are listed alphabetically within the two major rock type categories – sedimentary and igneous. The first letter of each symbol indicates the major lithology, and the second letter (where present) a significant interbedded lithology. The numeral indicates the physical hardness (See Physical Characteristics Table) of the unweathered rock material, and the subscript numeral (where present) indicates a variation. The description for each map unit includes common name, distinctive landform, colour, hardness, grain size, bedding, fracturing and mineral composition. Major and minor lithologies are described and also the weathered material, in terms of changes in colour, hardness and grain size. The range of depths of the weathered mantle is also given. (See Definition of Descriptive Terms).

SEDIMENTARY ROCK TYPES

ALLUVIUM

Undifferentiated intertidal deposits: mud, sand, gravel and shell; unconsolidated.

Alluvium: mud, sand and gravel with minor peat, forming river beds and flood plain deposits up to 60 m thick; unconsolidated to very soft, unweathered.

Alluvium: mud, sand and gravel with minor peat, forming terrace deposits up to 10 m above stream or river beds, deposits up to 30 m thick; unconsolidated to very soft. Unweathered, or weathered to brown stained material to depths of 2 m.

GRAVEL AND CONGLOMERATE

Gravel: hard, rounded greywacke pebbles; unconsolidated. Unweathered.

Conglomerate: gravel to boulder size angular to rounded fragments of basalt and andesite in a poorly sorted fine grained matrix thickly bedded; moderately hard to hard. Weathered to moderately soft fragments in a soft brown silty clay to depths of 10m.

Conglomerate: angular to rounded gravel to cobble sized greywacke fragments in a matrix of calcareous mudstone or sandstone, medium to thickly bedded and moderately hard to hard, with minor crystalline limestone (LS₁) and greensand (GS₂). Weathered to moderately soft fragments in a silty calcareous matrix to depths of 10 m.

LIMESTONE

Crystalline limestone: medium-grained crystalline calcium carbonate containing some sand grains, with minor greensand (GS₁); thinly to medium bedded and widely fractured; moderately hard to hard. Weathered to brown clay soil to depths of 2 m.

Muddy limestone: grey, 50–75% calcium carbonate, closely fractured, in places interbedded with minor greensand (GS₁) and mudstone (MS₁); moderately hard to hard. Weathered to brown very soft slightly calcareous clay to depths of 2 m.

MUD AND MUDSTONE

Mudstone: grey, brown and green, thinly bedded and closely fractured, locally calcareous or siliceous, minor muddy limestone (LS₁) and greensand (GS₁); moderately soft to moderately hard. Weathered to soft clay to depths of 10 m, unstable in places.

Mudstone with blocks: matrix of closely fractured mudstone containing variably sized (cm – km) blocks of calcareous, non-calcareous or siliceous lithologies (MS₁, MS₂, LS₁, GS₁, GS₂, BS₁); matrix moderately soft, blocks of variable hardness. Weathered to soft clay to depths of 10 m with weathering of blocks as seen in descriptions; unstable even on gentle slopes.

Mudstone with sandstone: blue-grey, medium to thickly bedded and moderately fractured mudstone, thickly interbedded with fine sandstone in places; locally calcareous; moderately soft to moderately hard. Weathered to soft silty clay to depths of 10 m.

SAND AND SANDSTONE

Sand: feldspathic, with some quartz and minor shell fragments, forming intertidal and beach deposits; unconsolidated.

Sand: feldspathic with some quartz, forming active dunes; unconsolidated and unweathered.

Sand: feldspathic with some quartz, minor dark minerals and clay, forming fixed dunes; unconsolidated to very soft. Unweathered or weathered to brown stained very soft clayey sand to depths of 5 m.

Calcareous sandstone: grey quartz-feldspar sandstone with a calcium carbonate content up to 20%; thickly bedded and moderately fractured, with minor interbedded grey mudstone; moderately hard. Weathered to soft, brown, non-calcareous silty clay to depths of 10 m.

Interbedded sandstone and mudstone: grey quartz-feldspar sandstone: thinly to thickly interbedded with grey mudstone, moderately to widely fractured, with rare beds of medium to coarse grained volcanic breccia; moderately hard. Weathered to soft, yellowish brown silty clay to depths of 30 m.

Interbedded sandstone and mudstone (greywacke and argillite): blue-grey quartz-feldspar greywacke sandstone, thinly to thickly interbedded with dark grey argillite mudstone; closely to widely fractured and quartz veined, locally very siliceous with minor chert, quartzite and spilitic beds (outcrops of chert or quartzite are marked on the map with a Q); hard to very hard. Weathered to soft brown sandy clay with harder cores to depths of 30m.

IGNEOUS ROCK TYPES

Breccia and tuff: medium to coarse angular to sub-rounded fragments of very fine to medium grained crystalline andesite and basalt in places interbedded with fine to medium grained tuff, widely fractured; moderately hard to hard. Weathered to soft reddish clay to depths of 10 m.

EXTRUSIVE ROCK

Rhyolite and dacite: flows and domes of glassy and very fine to medium grained crystalline rhyolite and dacite, moderately fractured, moderately hard to very hard. Weathered and hydrothermally altered to soft, white or brown halloysitic clay to depths of 30 m.

Basalt: flows, cones, plugs and dikes of glassy and very fine to medium grained crystalline basalt; dense and moderately fractured, hard to very hard. Weathered to soft, brown clay to depths of 20 m.

INTRUSIVE ROCK

*Serpentine: bodies of greenish, very fine to medium grained serpentine (magnesium content up to 40%), commonly very closely fractured; moderately hard. Weathered to reddish clay to depths of 10 m.

* Not mapped separately on this sheet.

* Not mapped separately on this sheet. For description of lithology see sheet R08/09.

PHYSICAL CHARACTERISTICS OF UNWEATHERED ROCK TYPES, AND A GUIDE TO EXCAVATION METHODS			
*TERM	NUMBER & PATTERN	*DIAGNOSTIC FEATURE	GUIDE TO EXCAVATION METHODS
Very Hard	7	Not scratched with knife or hammer point.	Explosives generally required.
Hard	6	Scratched with knife or hammer point only with difficulty.	Heavy machinery generally required: explosives will be needed where rocks widely fractured.
Moderately Hard	5	Scratched with knife or hammer point.	
Moderately Soft	4	Grooved or gouged to depth of about 3mm by firm pressure on knife or hammer point.	Machinery required: explosives may be needed where rocks widely fractured.
Soft	3	Grooved or gouged readily with knife or hammer.	Machinery required.
Very Soft	2	Carved with knife or scratched with finger nail.	Can be dug with spade, light excavators suitable.
†Unconsolidated	1	Disaggregated by hand, or easily moulded.	Can be dug by hand.

*Refers to hand sized samples of fresh rock of the map unit.

†Fractures can have a significant effect on the ease of excavation; e.g. hard rocks (if closely fractured, may be excavated as readily as softer material).

†Units such as gravel or scoria are unconsolidated as a mass but consist of fragments with individual hardnesses of up to 7.

DEFINITION OF DESCRIPTIVE TERMS			
GRAIN SIZE	CRYSTALLINE ROCK	UNCONSOLIDATED SEDIMENT	CONSOLIDATED SEDIMENT
SIZE	less than 2 microns 2 to 60 microns 60 microns to 2mm 2 to 60mm more than 60mm	clay mud silt sand gravel cobbles and boulders	claystone siltstone sandstone siltstone conglomerate breccia volcanic breccia
BEDDING	The following terms denote bedding thickness ranges: thinly bedded medium bedded thickly bedded		
FRACTURING	The following terms denote fracture spacing ranges: closely fractured moderately fractured widely fractured		

COMPILATION METHODS

This map was compiled by G.S. Markham and T.F. Crippen, N.Z. Geological Survey, Otago. All available lithologic information was first plotted on to a topographic base map (NZMS 1, scale 1:63 360). Rock type unit boundaries were delineated by use of lithologic information supplemented by stereoscopic air photo interpretation of landform patterns (air photo scales 1:15 840 and 1:16 700). The main data sources were field records of H.T. Ferrar (1921–25; field sheet scale 1:15 840) and B.N. Thompson and D. Kear (1959–60; field sheet scale 1:63 360). Publications, theses in geology and unpublished N.Z.G.S. reports were also referred to (see references). * Now with Water and Soil Division, M.W.D., Auckland Science Centre, Palmerston North. † Now at Joint Centre for Environmental Sciences, University of Canterbury, Christchurch.

Refer to this map as:
Markham, G.S.† and Crippen, T.F.* 1981. 'Mangawhai-Warkworth' NZMS 290 Sheet R08/09, 1:100 000. New Zealand Land Inventory, Rock Types. Department of Lands and Survey, Wellington, New Zealand.

SHEET INDEX



COMPILATION NOTE– The base map is compiled from the NZMS 1 series (1:63360) dated 1967, 69, 71, 74

NEW ZEALAND LAND INVENTORY

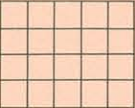
SCALE 1 : 100 000

REFERENCE

- WHANGAREI Towns
- KAIOHIO Settlements
- Houhora Homesteads
- State highways
- Other roads
- Tracks
- Railways
- Rivers and streams
- Trig stations
- Vincula (separate parcels under same ownership)
- Land holding boundaries
- Sand and mud
- Wetlands

This map is drawn on the New Zealand Map Grid Projection, a minimum-error conformal projection. The grid is the New Zealand Map Grid, showing coordinates in metres in terms of the Geodetic Datum 1949, based on the International (Hayford) Spheroid.

The smallest area mapped is generally not less than 10 hectares. Calculation of areas from this map should be within the limitations of scale. For example, individual areas should be rounded to the nearest 5 hectares. Accumulated areas should be rounded to the nearest 50 hectares.



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SYMBOLS

- Rock type boundary – known
- Rock type boundary – uncertain
- Sample site or mineral outcrop with chemical symbol (N.B. Q = quartzite or chert)
- Quarry or pit (closed)
- Quarry or pit (operating)
- Underground mine (mined material indicated e.g. Silver)
- Spring (mineral composition indicated when known e.g. Soda)
- Water bore (with sample pumping rate in litres per second (l/s), and date when known)

RELIABILITY

This is a small scale map, therefore rock type units and their boundaries are generalized. The data used in this compilation are, in many mapped area, variable in quality and quantity, in relation to the range of lithologies encountered, and their clarity of topographic expression. Small significant areas have been exaggerated.

No general field checking of original data or boundaries has been carried out. For more detailed information on selected areas write to:

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NOTE: This map should not be used for planning major engineering projects, large scale quarrying operations, or detailed work for which individual investigations are required.