# PETROGRAPHY AND MINERALIZATION OF KARAMEA (RED ISLAND) SOUTHERN HAWKES BAY

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## INTRODUCTION

In May, 1973, Karamea, Grid reference N142/393944 (N.Z.M.S. 1 Sheet N142 Waimarama, 2nd Edition, 1969) was visited briefly in order to get a first impression of the environmental relationships of deposition of the manganese-oxide concentrations noted in a Cretaceous volcanic sequence by Kingma (1971). It was then found that the sedimentary and volcanic formations did not correspond well with the profile given by Kingma (redrawn as Fig. 1 below), nor could Red Island simply be called "a mass of volcanic agglomerate" (Mason 1955). Therefore in May, 1975 Karamea was revisited and its topography and geology mapped with rangefinder methods at a scale of 1:1000. The results of these investigations up to date are summarized below, while a more comprehensive account, including the detailed map and petrographic descriptions, is in preparation.

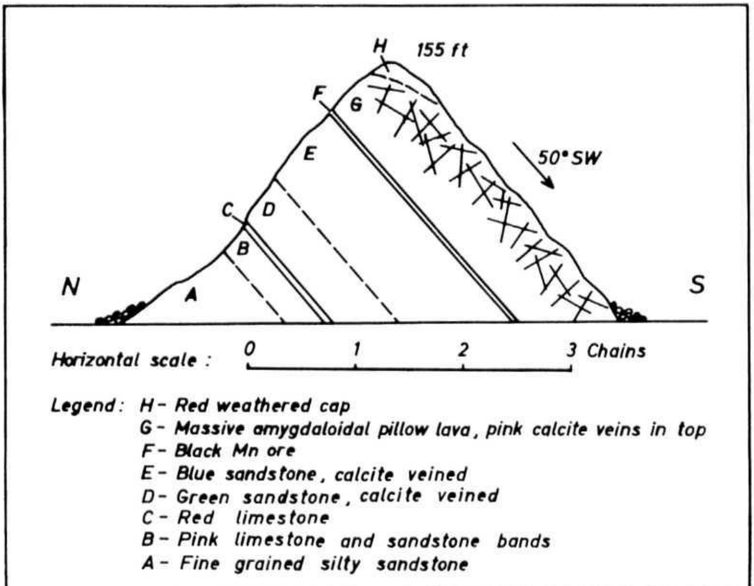


**Fig. 1. Section through the western portion of Red Island (N142/392945) after Kingma (1971, Fig. 37). Grid reference of Kingma (1971) adjusted to the position on N.Z.M.S. 1 Sheet N142 Waimarama, 2nd Edition, 1969.**

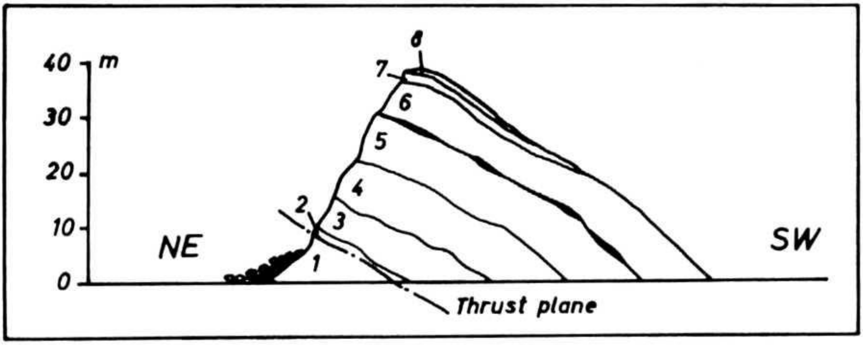


**Fig.2. Profile through Karamea, eastern portion (N142/393944); see text for legend.**

## PETROGRAPHY OF FORMATIONS

The general NE-SW profile representing the most complete sequence of strata (strike N90-120E, dip 30-50S to SW) in the E of the island contains the following petrographic units (from bottom to top in Fig. 2), disregarding talus.

1. In the N and NW of the island its base is formed by a whitish-grey bentonitic, partly glauconitic, calcareous shale or fine sandstone containing large (1m diameter) calcareous concretions in the W. By analogy with the similar lithologic formations along the coast of the adjacent mainland (Kingma 1971, fig. 8), and although no fossils have been found in this formation on the Island, I would consider these to be Raukumara beds (mid-Upper Cretaceous). They are severely sheared near their top. Maximal exposed thickness is 15m.

2. Pink to dusky-red, also partly strongly sheared, argillaceous limestones and shales containing some lenses of greenish, tuffaceous friable sediment, consisting of chloritic, devitrified glass shards and flattened lapilli. Little, elliptical nodules (up to mm diameter) of Mn-oxides (psilomelane) lie parallel to the bedding, and dark, fine ferri-manganiferous matter forms laminae in the richly microfossiliferous beds. Some prismatic fragments of large *Inoceramus* are present too. From these beds *Aucellina* had been described (Wellman 1959 quoted in Kingma 1971), thus suggesting an age no younger than Motuan (early Upper Cretaceous) for these beds. Nowhere on the Island is this unit thicker than 3-4m.

3. The first lava appears, baking the underlying and intercalated sediment brick-red along the contact. It is a pale olive-greenish fine-grained mafic lava with units less than half a metre across, which do not appear to be actual pillows, but are characterized by a concentric – also radiating and irregular – network ("spiderweb") of fine calcite-zeolite-filled fractures and pale orange coloured alteration rims. Often thin ledges of the red calcareous sediment form interstitial and fracture fillings. This lava unit, about 8m thick in the E, appears to pinch out towards the W.

4. A greenish-black basaltic pillow lava follows with individual rather spherical pillows well preserved, though partly broken (or "exploded"). These

have a black scoriaceous, glassy crust and are fractured thoroughly, the network of fractures being filled with coarse calcite. Abundant irregular, elongated patches of pink-red calcareous sediment continue to occur among the pillows. This unit is 8-10m thick.

5. Then a bluish-green patchy, fine-grained lava follows, again with polygonal "pseudopillows" the margins of which are marked by a brown weathered zone and white calcite-filled veins. This basaltic lava contains globular segregations (up to several cm diameter) of apparently the same composition. Some portions of this lava are spotted with white and also greenish calcite-chlorite-filled vesicles (up to several mm diameter). Sedimentary inclusions are much less abundant here. At the top of this lava, pink to dusky-red calcareous sediments, partly brick-red baked, hematitic and brecciated, contain nodules, lenses and layers of solid, black Mn-oxide (psilomelane-pyrolusite). This Mn-oxide accumulation corresponds to the unit described by Kingma (1971, p.107) (see unit F on Fig. 1 – this paper), but its thickness is probably far from reaching anywhere near the 2ft. suggested for the central part of the Island. The underlying lava is 10-15m thick, but thickness may increase to the W.

6. The pillow lava at the top of the volcanic sequence has again more abundant pink-red, often baked calcareous interpillow sediment. The pillows, of olive-green-grey colour with pale rusty surfaces, are massive, with phenocrysts of plagioclase. Interpillow spaces as well as fractures across pillows are filled occasionally with calcite and radiating coarse-acicular thomsonite, while open spaces contain fine acicular natrolite (both these zeolites had been described from here by Mason 1955). Thickness of this unit is 6-10m but may increase to the SW.

7. Superposed on this lava unit is a bright orange ferriferous-siliceous (and partly also calcareous) bed with abundant large radiolaria. In striking colour contrast there is a thick band or lens (up to tens of cm thick) of massive to crustified aggregates of black Mn-oxide (manganite with predominant pyrolusite) at the base of the orange-coloured bed. Mn-oxide is rarely seen as fillings of fractures across the underlying pillows. The whole unit may be up to 1m thick.

8. The uppermost formation consists again of dusky-red to grey-red, laminated, ferri-manganiferous, partly phosphatic argillaceous limestone to shale (similar to the sedimentary formation immediately underlying the whole volcanic pile), but only about half a metre of this sedimentary rock is left on top of the Island. A reasonably thick soil has derived from this unit, forming the gently sloping "summit pasture" mentioned by Wright (1976).

## PRELIMINARY CONCLUSIONS

It appears that the major part of the Island, i.e. all the lava (units 3-6 and the related unit 7) sandwiched between similar pink to dusky-red micro-fossiliferous limestones (units 2 and 8) comprises a sequence of four consecutive cycles of basaltic volcanic extrusions into a calcareous sedimentary environment.

All the interactions between lava and sediment (baking; squeezing of the sediment in between the pillows and even into fractures across the pillows; the sagging of pillows into the underlying sediment; the local shearing and slickensiding, varying widely in direction, and in particular the irregular deformation seen between the lava units and indicative of slumping of one mass over another; the breaking-up of the pillows in concentric shells and radiating fracture patterns ("exploding"), as well as the infilling of these crack networks with recrystallized coarse calcite, chlorite and also zeolites) indicate the emplacement of the hot lava into and onto a soft, cooler calcareous sea-bottom sediment. Furthermore the tuffaceous admixtures and the content of manganiferous matter of the underlying sediment indicate already an early pre-lava stage of explosive and exhalative activity. The moderate concentration of Mn at the close of the third cycle and especially the strong concentration of Mn, Fe and $SiO_2$ at the end of the fourth cycle demonstrate the exhalative, submarine, hydrothermal final stage of the magmatic activity. The obvious recrystallization of these substances from a gel-like precipitate is indicated by the colloform fabric and radiating growth of individual crystals as well as by the shrinkage cracks developed in the ferriferous silica complexes. Also these substances infill and/or encrust, but do not replace the tests of the microfossils except in advanced stages of recrystallization.

The orange-coloured ferriferous-siliceous formation (unit 7) cannot therefore be explained as lateritic weathering "cap" of a mafic volcanic pile under subaerial conditions (suggested in Fig. 1 above). The lavas are severely zeolitized (groundmass and particularly the plagioclases), any glass is chloritized and vesicles are filled by limonite, chlorite and calcite (rarely also zeolites), probably due to interaction of lava with the hydrous environment.

Structural and stratigraphic evidence so far seems to suggest a major break between units 1 and 2, the older volcanic-sedimentary complex (units 2-8) being thrust over and onto the younger formation (unit 1). The western portion of the Island is tectonically more disturbed, while steeply dipping, later N-S faults cut the Island into segments with successive easterly downthrows. In the light of such structural features it may be dangerous to project the geology and structures of Karamea onto the mainland coast (Kingma 1971, fig. 8) as there may well be a concealed major fault parallel to the coast, thus isolating this Island not only morphologically but also tectonically from the adjacent land.

## FINAL REMARKS AND ACKNOWLEDGEMENTS

It is obvious that considerably more detailed work (in progress) is needed to substantiate all the conclusions suggested above. It is hoped that the regional synthesis will allow a comparison with the Tangihua volcanic complexes in Northland, similar "homeless" masses but with the difference of containing also subvolcanic mafic igneous formations and having Cu-Fe-(Zn)-sulphide mineralization associated instead of the Fe-Mn-oxides here. This latter feature suggests also a certain similarity with the geosynclinal assemblages of Fe- and Mn-oxides with siliceous precipates, spilitic mafic volcanics – predominantly pillow lavas – and the occasional limestones in a greywacke/argillite environment of Northland and East Cape regions.

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REFERENCES

Kingma, J.T. 1971: "Geology of Te Aute Subdivision". *N.Z. Geol. Surv. Bull. 70*. 173pp.

Mason, B.H. 1955: Notes on some New Zealand minerals. *N.Z. Jl. Science & Technology B36(6)*: 557-560.

Wright, A.E. 1976: Vegetation of Karamea (Red Island) Southern Hawkes Bay. *Tane 22*: (this volume).