rock types of the Solomons have been dredged as samples from fracture zones and the gross topography of the chain, even to its *en echelon* arrangement, can be paralleled, for example, in that of the Romanche Fracture Zone (Tomczak and Annutsch, 1970). That such abyssal fractures could tap magmas simultaneously along their length is perhaps a strange idea, but again we have the Line Islands example.

To pursue this notion, the Solomons, unlike such possible analogues as the Line Islands and the Marshall-Gilbert chain, were directly affected by the change in direction of relative motion of the Pacific plate (recent estimates, 42-48 m.y.b.p.), and by the complications which arose from additions to the India plate in the region, beginning in the Eocene, and the consequent northerly movement of the Australasian continental mass relative to Antarctica. From being possibly in line with the New Hebrides (*see* Falvey, this volume) the Solomons, it is suggested, were partly rotated anticlockwise and disrupted. This calls for some subduction to the south in the Palaeogene, possibly along the Inner Melanesian line. As new seafloor was created in the Southern Ocean and Coral Sea basin a shearing collision arose between westwards-moving Pacific plate and northwards-moving India plate. In the Solomons region, accommodation was partly met by Neogene subduction marked by the New Britain trench (and, just possibly, by the younger San Cristobal trench) and partly by shattering of lithosphere into chunks (sub-plates) with overall strong, sinistral transcurrent movement between them. The Solomons became partly locked into the India plate and underwent a shearing collision with the Ontong Java Plateau roughly 10 m.y.b.p.. Along with New Ireland and the northern part of the Bismarck Sea and the Ontong Java Plateau, the Solomons are now moving as part of the Pacific plate.

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CRUSTAL VARIATIONS IN THE SOLOMON–PAPUA–NEW GUINEA REGION BASED ON SEISMIC INVESTIGATIONS

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Explosion seismic investigations provide the definition required to enable the variations in gross crustal structure over quite small areas to be outlined. Typifying the crustal structure in any particular area may however be misleading. A number of seismic surveys have now been conducted which outline the variations in crustal structure between the Barkley Tablelands of northern Australia and the Ontong Java Plateau of the western Pacific. These surveys involved a number of different shooting/recording configurations; land shooting and recording, marine shooting/land recording and marine shooting and recording.

The upper mantle is usually taken to begin where the P wave velocity approaches 8 km/s but over the region this is shown to vary between 7.7 and 8.6 km/s and occur at depths ranging from less than 5 km to 43 km. Some crustal thicknesses in "continental" Australia (27 km) appear to be much thinner than those on the Ontong Java Plateau (43 km) with considerable variation throughout the region in between. The parameters controlling the stability or otherwise of a region would therefore appear not to be those of the crust but those of the deeper mantle.

OPHIOLITE BASEMENT COMPLEX IN A FRACTURED, ISLAND CHAIN, SANTA ISABEL, BRITISH SOLOMON ISLANDS

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Introduction

As part of a continuing programme involving the structural, petrological, and geochemical evolution of the British Solomon Islands, attention has now centred, among other islands, on Santa Isabel, where a well developed basement ophiolite sequence is exposed. Further work in the area will involve the geochemical relationships between the various members of the ophiolite basement. The Solomons lies within Suess's outer 1st Australian Arc, now regarded as the margin between the India and Pacific lithospheric plates (Le Pichon, 1968) and have been termed a composite, fractured island chain (Coleman and Hackman, 1974). The Group comprises a double en échelon chain of islands, which is believed to reflect a system of basins and anticlinal horsts now progressively offset by sinistral shear (Carey, 1968: Krause, 1967; Hackman, 1973). Five Provinces were originally recognised in the region (Coleman, 1965) and these were subsequently amended to four (Hackman, 1973).

Santa Isabel is some 230km in length and up to 25 km wide, and rises to over 1200 km at Mt Marescott and together with Choiseul and Malaita comprise the outer en échelon chain of the Solomons. Initial geological publications on the island

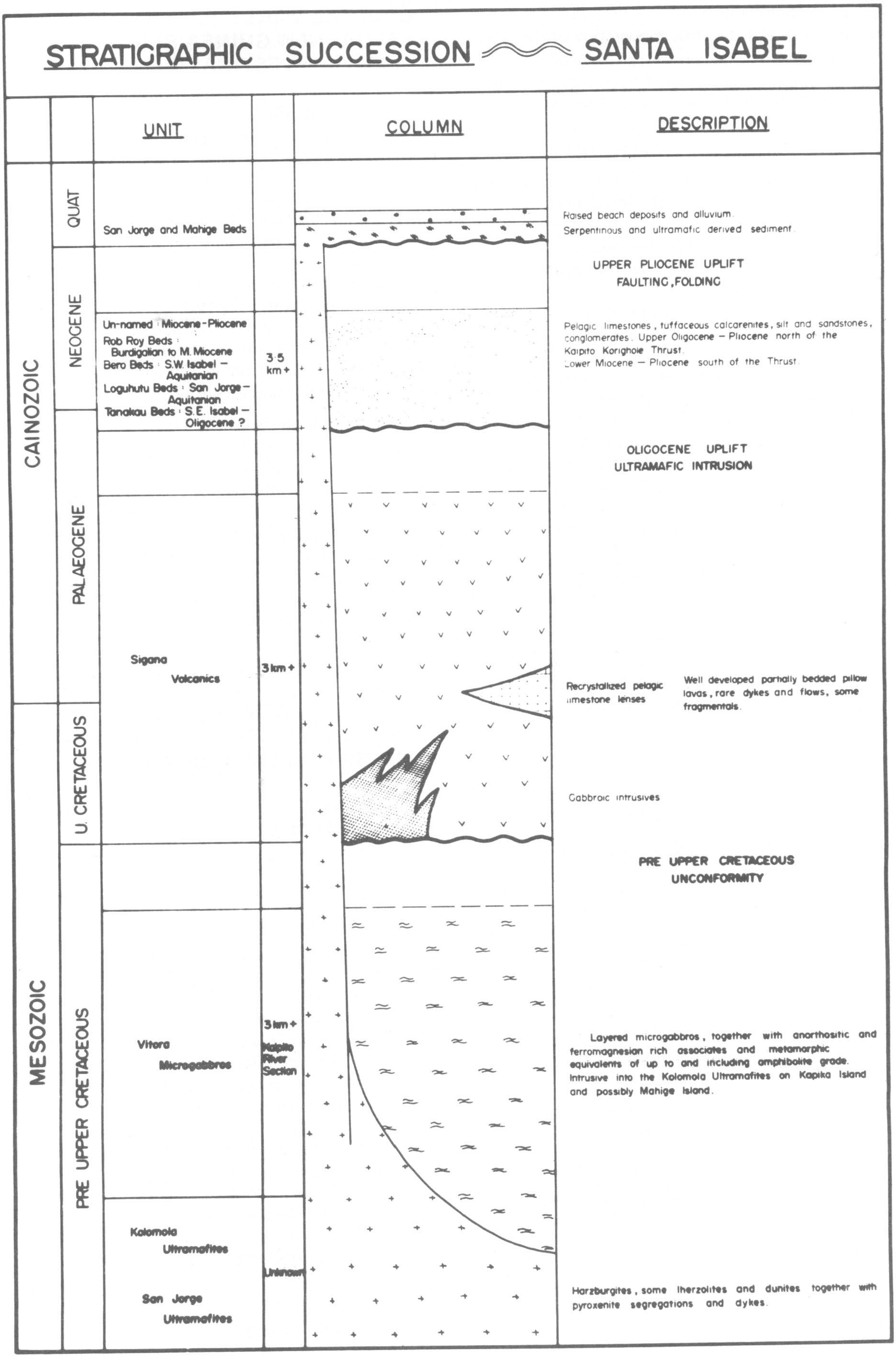

Fig. 1. Tentative Stratigraphic Succession for Santa Isabel, British Solomon Islands — not to scale.

include the University of Sydney Department of Geology and Geophysics (1957), Stanton (1961), Thompson (1960), Allum (1967). Major structural trends on the island show a dominant north-west grain, which is reflected in the regional Bouguer gravity anomalies (Rose, Wollard and Malahoff, 1968).

Geology

The basement rocks of Santa Isabel constitute an ophiolite sequence, comprising ultramafic rocks (San Jorge Ultramafites and Kolomola Ultramafites), layered microgabbros, which in places attain amphibolite grade metamorphism (Vitora Microgabbros) and unconformably overlying basaltic pillow lavas and occasional, thin lava flows (Sigana Volcanics).

The San Jorge Ultramafites, which are somewhat circular in outline crop out on San Jorge Island and have been suggested by several workers to represent a plug-like body. For the purposes of this statement the San Jorge Ultramafites will not be considered further.

The Kolomola Ultramafites, exposed on Isabel itself are characterised by linear fault-controlled ultramafic bodies and the lack of thermal metamorphic effects in the surrounding country rock. Type locality is a 1.75 km wide exposure in the Kaipito River and dominant rock type is harzburgite, which grades in places to dunite with diminishing amounts of orthopyroxene. The olivine is optically positive as is the orthopyroxene. Feldspar is typically absent. Pyroxenite segregations and dykes up to 1.5 m wide transect many of the exposures and range from clinopyroxenite through websterite to orthopyroxenite. Some samples have up to 5% modal olivine. Minor podiform chromite occurs on Kolare Island. The Kolomola Ultramafites show variable evidence of deformation with ptygmatic pyroxenite segregations and isoclinal folding in some exposures and undulose extinction, kinking and intercrystal granulation present in many thin sections.

To date contacts observed between the Kolomola Ultramafites and the Vitora Microgabbros are either faulted as in the Kaipito River section or intrusive, as evinced on Vitora Island, where gabbro dykes invade harzburgite at the contact or on Kapika Island, where a sill-like body of microgabbro intrudes, with chilled margin, the ultramafics. Contacts with the overlying Sigana Volcanics are all sharply faulted and so far no mineral assemblages indicative of unusually high pressures have been observed in the pillow basalts.

Type locality for the Vitora Microgabbros is Vitora Island, where a sequence of massive to schistose to gneissic microgabbros, together with pegmatitic veins and dykes, crop out. Primary mineralogy comprises labradorite, augite, less common magnesian olivine (Fo_{70-80}) and minor opaques. Rare anorthosites, comprising 90% modal plagioclase (An_{65-75}), augite and minor serpentinised olivine occur.

Complete gradation from microgabbros showing evidence of minor retexturing, through partially recrystallized to completely recrystallized rocks of amphibolite grade is found. The more extreme grade metamorphic rocks have a well developed granoblastic texture containing variable amounts of andesine, clinopyroxene, faint pink to pink-brown pleochroic amphibole ±sphene ± relief olivine ± relief hypersthene. The University of Sydney (1957) reported the presence of albite-epidote-amphibolites from Loghoto River Point. Subsequent uralitization is wide spread.

The Sigana Volcanics have their type locality on Sigana Island, south-east Santa Isabel and comprise well-formed pillow lavas characterised by radial joints, thin glassy selvedges and the general absence of vesicles. Thin lava flows intercalated within the pillows may occur, whilst exposures of fragmental rocks are highly restricted. Basaltic dykes invading the underlying microgabbros are uncommon. In thin section textures vary from intergranular to ophitic to less common porphyritic and the mineralogy comprises labradorite to calcic andesine, titaniferous augite and opaque oxide. Olivine is lacking. Alteration may occur in areas of shearing and may comprise chlorite, albite, zeolite, carbonate and secondary quartz. Minimum thickness for the effusive pile is 3.5 km. One radiometric date of 66 m.y. has been obtained by N.J. Snelling of the Institute of Geological Sciences, which suggests a similar time relation to the Upper Cretaceous Fiu lavas of Malaita (University of Sydney, 1957; Coleman and Hackman, 1974). Overlying the Sigana Volcanics, at least by local unconformities is a sequence of largely undifferentiated Tertiary sediments which comprises recrystallized pelagic limestones, tuffaceous calcarenites, silt and sandstones and minor coarse conglomerates and diamictites. The sediments have a minimum thickness of 3.5 km and the oldest rocks so far dated are Upper Oligocene (Coleman, 1965).

Summary

In fig. 1 is presented a tentative stratigraphic succession for Santa Isabel, employing data already published and the results of recent field work. The sequence may be subdivided into a basal ophiolite sequence, having a minimum thickness of 8 km and overlying Cainozoic sediments, with a minimum thickness of 3.5 km. The thickness of the various components of the ophiolite sequence compared with estimates of sequences elsewhere (Coleman, 1971) indicates a remarkable well developed basalt-gabbro sequence. A combined minimum thickness of 6.5 km shows a comparable thickness to that estimated by Shor and Raitt (1969) of 6 km for the oceanic crust (layers 2 and 3). Major field problems as yet unsolved, include the dating of the dynamothermal event or events, which affected the Vitora Microgabbros, the length of time involved during the extrusion of the Sigana Volcanics and the nature of the contact between the lavas and the overlying sediments. In some localities at least, this contact is believed to be unconformable. From the presence of ultramafic-derived detritus it appears that initial ultramafic intrusiton, together with warping and uplift of the ophiolite basement occurred in Oligocene times (Coleman, 1965).

Subsequent Late Pliocene, remobilization of the Kolomola Ultramafites, uplift, faulting and folding has imprinted a dominant north-west trend on the island. This region, together with a few other examples in the south-west Pacific (Mallick and Neef, 1974; Ewart and Bryan, 1973; Varne and Rubenach, 1972) constitutes the development of an ophiolite sequence in an oceanic environment. Subsequent evolution of the area has given rise finally to calc-alkaline plutonism, associated volcanism and genetically related ore mineralization.

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GEOCHEMISTRY OF THE KOLOULA IGNEOUS COMPLEX, GAUDALCANAL

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The Plio-Pleistocene Koloula Igneous Complex is situated close to the south or Weather Coast of central Gaudalcanal and intrudes moderately dipping basaltic andesites, andesites and pyroclastics of the Suta Volcanics. Numerous small lenses of limestone, interbedded with the upper portions of the Suta Volcanics, yield Early Miocene foraminifera and the considerable thickness of underlying volcanics are thus considered to be of Oligocene to Early Miocene age (Hackman, 1971). Subsequent regional alteration of these volcanics by low-grade metamorphism renders major element geochemistry as represented by K_2O:SiO_2 and MFA diagrams of little use in deciphering their parentage.

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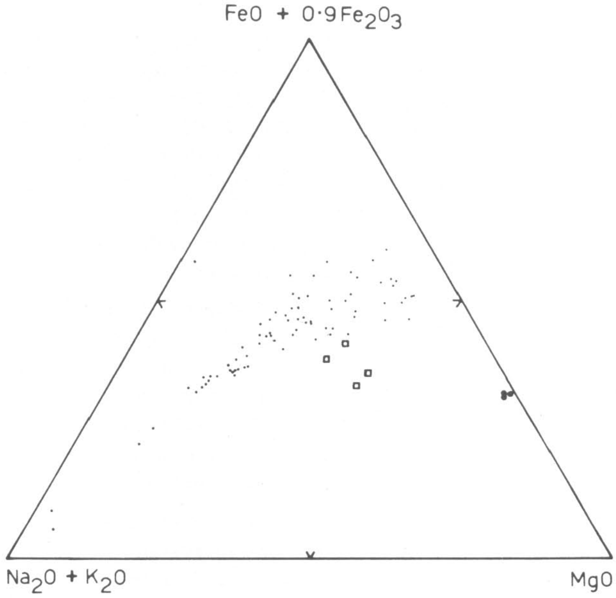
The Complex comprises eleven recognisably different intrusive phases, the oldest of which is a high-Al leucogabbro within which occurs a tabular cumulate body of olivine pyroxenite. Successively younger phases include hornblende diorite, biotite hornblende granodiorite, meladiorite, quartz diorite, tonalite, granodiorite, quartz monzonite dykes, tonalite porphyry and andesite dykes. There are two distinct episodes of hydrothermal activity within this sequence, giving rise to porphyry copper mineralisation.

Within the core of the complex, successive magma pulses have formed a concentrically zoned pluton with an outer rim of meladiorite contaminated by the assimilation of gabbro on the western margin and by basaltic andesites of the Suta Volcanics on the north-eastern margin. Within this rim crop out phases of quartz diorite, tonalite and granodiorite which are progressively coarser grained, more biotite-rich and hornblende-poor.

Major element geochemistry of the intrusive rocks define a calc-alkaline suite with moderate potash content. On a graph of K_2O against SiO_2, a generalised gradient is defined by a line passing through K_2O=O at an SiO_2 content of 47% and K_2O=1.1% at SiO_2 =57.5%.The most highly differentiated rock unit, the quartz monzonite dykes, have an SiO_2 content of 78%.

On an MFA triangular plot, as seen in the accompanying figure, a typical calc-alkaline trend is evident for the Koloula data. The cumulate olivine pyroxenite plots close to the MF edge, whilst the late-stage andesite dykes which show textural evidence of contamination and disequilibrium form a separate field outside the normal calc-alkaline trend.



MFA Diagram for rocks of the Koloula Igneous Complex
84 analyses

- ° Olivine Pyroxenite
- ▫ Andesitic dykes
- · other rock units