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References

ALLUM, J.A.E., 1967: Regional photogeological interpretation of the British Solomon Islands, *Aerial Geophys. Surv. Proj.* (U.N.S.F. – B.S.I.P.) 1965-1968:78.

CAREY, S.W. 1968: Tectonic framework of the Sydney Basin, *Fourth Newcastle Symposium on the Sydney Basin.*

COLEMAN, P.J. 1965: Stratigraphical and structural notes on the British Solomon Islands with reference to the First Geological Map. *Br. Sol. Isl. Geol. Rec. 2 (1959-62).*

COLEMAN, P.J., and HACKMAN, B.D., 1974: Solomon Islands. *In* Spencer, A.M. (Ed.), *Mesozoic-Cenozoic Orogenic Belts: Data for Orogenic Studies.* Geol. Soc. Lond. Spec. Pub: 453-461.

COLEMAN, R.G., 1971: Plate tectonic emplacement of upper mantle peridotites along continental edges. *Jnl. Geophys. Res.,* 76(5): 1212-1222.

EWART,A., and BRYAN, W.B., 1973: The petrology and geochemistry of the Tongan Islands. *In* Coleman, P.J. (Ed.) *The Western Pacific: Island Arcs, Marginal Seas, Geochemistry:* 503-522.

HACKMAN, B.D., 1973: The Solomon Islands Fractured Arc. *In* Coleman, P.J. (Ed.) *The Western Pacific: Island Arcs, Marginal Seas, Geochemistry,* Univ. W. Australia Press, Perth: 179-191.

KRAUSE, D.C., 1967: Bathymetry and geologic structure of the north-western Tasman Sea – Coral Sea – South Solomon Sea area of the south-western Pacific Ocean. *N.Z. Oceanographic Insit. Mem.* 41:49p.

LE PICHON, X., 1968: Sea-floor spreading and continental drift. *Jnl. Geophys. Res.,* 73(12): 3661-3697.

MALLICK, D.I.J., and NEEF, G., 1974: Geology of Pentecost, New Hebridies. *Condominium Geol. Surv. Reg. Rept.,* 103 p.

ROSE, J.C., WOOLLARD, P., and MALAHOFF, A., 1968: Marine gravity and magnetic studies of the Solomon Islands. *Amer. Geophys. Union Geophysical Monograph* 12: 379-410.

SHOR, G.G., and RAITT, R.W., 1969: Explosion seismic refraction studies of the crust and upper mantle in the Pacific and Indian Oceans. *Amer. Geophys. Union Geophysical Monograph* 13: 225-230.

STANTON, R.L., 1961: Explanatory notes to accompany a first geological map of Santa Isabel, British Solomon Islands Protectorate. *Overseas Geol. Min. Res.,* 8: 127-149.

THOMPSON, R.B., 1960: The geology of the ultrabasic rocks of the Solomon Islands. Unpub. Ph.D. thesis, University of Sydney.

UNIVERSITY OF SYDNEY, DEPARTMENT OF GEOLOGY AND GEOPHYSICS, 1957: Geological reconnaissance of parts of the central islands of the British Solomon Islands Protectorate. *Col. Geol. Min. Res.,* 6: 267-306.

VARNE, R., and RUBENACH, M.J., 1972: Geology of Macquarie Island and its relationship to oceanic crust. *In* Hayes, D.E. (Ed.) *Antarctic Oceanology II: Australian New Zealand Sector, Antarctic Research Series,* A.G.U., Washington, D.C. 19: 251-266.

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).

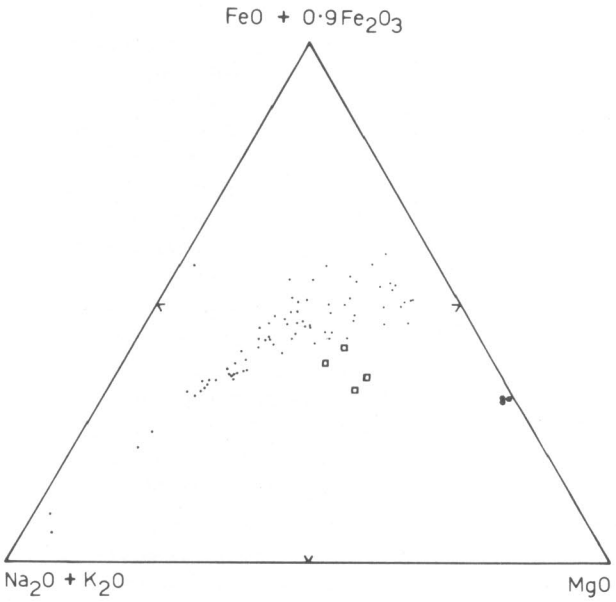
Subsequent regional alteration of these volcanics by low-grade metamorphism renders major element geochemistry as represented by K_2O:SiO_2 and MFA diagrams of little use in deciphering their parentage.

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

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Chemical data for co-existing hornblende and biotite within the different phases show the ratio Mg/Mg+Fe increases with progressive magmatic differentiation for biotite but decreases slightly for hornblende. This feature, coupled with the apparent increase in magnetite content with increasing differentiation, indicates high or increasing oxygen fugacity during crystallisation. This trend has only rarely been reported before in the literature, e.g. at Finnmarka, Norway (Czamanske & Wones, 1973) and, where present, is invariably associated with high-level ring complexes. The implication of increasing fO_2 during crystallisation is the separation of H_2O from the melt and the hydrothermal alteration events at Koloula can be readily explained in this manner.

The Late Miocene to Recent Gellego Lavas of north-west Guadalcanal and Savo Island are contemporaneous with the emplacement of the Koloula Igneous Complex and can be considered as its extrusive equivalents. These lavas show an increase in acidity and a decrease in age from south to north corresponding to increasing distance from the San Cristobal Trench to the south of Guadalcanal Island.

Earthquake epicentral positions (e.g. Denham, 1969; Curtis, 1973) indicate the San Cristobal Trench is the bathymetric expression of a steeply dipping Benioff zone under Guadalcanal and San Cristobal. This zone marks the position of interaction between the Indian and Pacific Plates. Subduction of ocean floor related to the under-thrusting Indian plate can be readily invoked as the mechanism for the generation of the calc-alkaline parent magma of the Koloula Igneous Complex.

The extreme steepness of the Benioff zone thus explains the close proximity of the Late Miocene-Recent volcanoes to the trench axis (between 90 km and 50 km). Similarly, the Koloula Igneous Complex, which is only 50km from the trench, might be expected to exhibit low K_2O and SiO_2 contents. This is reflected by the initial emplacement of gabbro which is volumetrically the largest pluton of the complex. This trend continues with younger, more differentiated felsic magma pulses of the complex, maintaining low to moderate K_2O for any given silica value.

References

CURTIS, J.W., 1973: The spatial seismicity of Papua New Guinea and the Solomon Islands. *Jnl. Geol. Soc. Aust.* 20: 1-19.

CZAMANSKE, G.K., and WONES, D.R., 1973: Oxidation during magmatic differentiation, Finnmarka Complex, Oslo area, Norway: part 2, The mafic silicates. *Jnl. Petrology* 14: 349-380.

DENHAM, D., 1969: Distribution of earthquakes in the New Guinea-Solomon Islands region. *Jnl. Geophys. Res.* 74: 4290-4299.

HACKMAN, B.D., 1971: The regional geology of Guadalcanal: a contribution to the geology of fractured island arcs. Unpubl. Ph.D. thesis. Univ. Western Australia, Perth.