The Sadowa Igneous Complex, Eastern Papua New Guinea: Ophiolite or not?

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Milsom and Smith (1975) suggested the Sadowa Igneous Complex (SIC) could represent a fragment of oceanic crust that has been thrust into its present position. Pigram and Symond (1991) suggested another contemporaneous spreading center north of the Coral sea. The SIC floored that basin between the continental fragments of the Eastern, Papuan and proto-Owen Stanley terranes (Fig. 1). The late Cretaceous to Eocene SIC is mainly composed of gabbro, dolerite, basaltic conglomerate, breccia, lower (with pelagic clasts) and upper volcanic rocks (interbedded and overlained by volcaniclastic graywackes) and a few serpentinites, serpentinized dunites, clinopyroxenites and plagiogranites. The SIC is conformably overlain by pelagic sediments and is cut by reverse or normal faults. It was obducted onto the Owen Stanley metamorphics during the Late Eocene to Middle Oligocene to form the Eastern Papuan Composite Terran (EPCT) after the emplacement of the Papuan Ultramafic Belt (Pigram and Davies, 1987). Subsequently tectonism could be expected to have reversed the southward subduction to northward subduction from the Port Moresby trench (Hamilton, 1979). During the Miocene the EPCT collided with Eastern and Papuan Plateaus (Pigram and Davies, 1987). The Astrolabe agglomerate contains subduction related Late Miocene to Early Pliocene high K calc-alkaline to shoshonitic ensialic arc volcanics, and is mainly composed of basalt, andesite, agglomerate and minor plagiogranite and phreatomagmatic tuff (pers. comm. J. V. Wright, 1993).

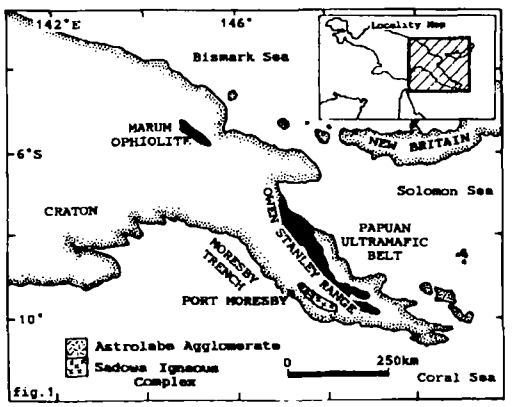

FIG. 1.

Geochemistry

Whole rock chemical analyses data are shown in (Table 1).The gabbros, dolerites and basalts from the SIC belong the low potassium tholeiite series and are covered by deep water sediments, so the origin of the SIC in an oceanic environment is not in doubt. The serpentinites are poor in *REE* as a consequence of their residual nature. Other ophiolites show total *REE* content increases with SiO_2, Zr and FeO^*/ MgO as to be expected by fractional crystallisation and the SIC rocks show similar behaviour, but there is a slight change in Ce/Yb ratio.The rare earth element data from gabbro, dolerite and basalts in the SIC range from mildly depleted in LILE (Ce_N/Yb_N = 0.6 to 0.9) to mildly enriched in LILE (Ce_N/Yb_N = 1.1 to 2. 7). The samples depleted in LILE are similar to N-type MORB and those enriched in LILE are similar to E type MORB. But in some samples contents of Ce_N/Yb_N ratios are much higher than in typical MORB (< 0.703, Weaver *et al.*, 1979).

Metamorphism

Field relations and contact metamorphism suggest that the gabbros were tectonically emplaced while they were still hot. Zeolite, prehnite-pumpellyite minerals, as well as those of greenschist facies suggest pervasive hydrothermal metamorphism; hydrothermal activity was probably episodic and related to distinct periods of magmatic intrusion.

Discussion and conclusion

Plagiogranites from the SIC are very similar to those from a back arc basin rather than a oceanic ridge. The Sadowa Igneous Complex, eastern Papua New Guinea, although not complete with respect to an ideal ophiolite sequence, is none-

TABLE 1. Whole rock chemical analyses data

Analysis	1	2	3	4	5	6	7	8	9	10
Sample	W26	L1	L2	W36	W37	D1	D17	W18	K50	K6
SiO_2	38.60	38.6	52.8	45.30	48.50	46.80	47.40	75.80	74.5	58.20
TiO_2	0.01	<0.01	0.31	0.66	0.93	1.10	3.02	0.20	0.37	0.77
Al_2O_3	1.33	0.25	1.21	24.50	16.40	15.30	12.90	11.80	12.80	16.10
Fe_2O_3	6.50	2.60	3.40	1.95	3.10	4.60	5.80	*3.16	1.29	2.94
FeO	1.55	4.40	6.15	3.20	5.50	5.60	10.40	n.d.	1.07	3.56
MnO	0.11	0.09	0.58	0.07	0.15	0.20	0.26	0.08	0.02	0.13
MgO	34.60	48.30	13.90	2.10	6.90	6.15	5.65	0.04	0.67	3.42
CaO	0.08	0.05	20.30	12.50	12.60	11.60	8.55	1.55	0.15	4.42
Na_2O	<0.01	0.03	0.55	3.66	2.88	3.38	2.72	6.35	4.28	3.64
K_2O	<0.01	<0.01	<0.01	0.21	0.11	0.63	0.83	0.34	1.11	3.42
P_2O_5	0.01	0.01	<0.01	0.07	0.03	0.12	0.36	0.03	0.06	0.33
H_2O^+	12.20	6.35	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
H_2O^-	3.90	0.25	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
CO_2	0.30	0.25	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.	n.d.
LOI	n.d.	n.d.	1.49	5.95	3.40	4.34	2.20	1.06	1.89	3.42
Rest	0.69	0.48	0.09	0.10	0.14	0.18	0.22	0.22	0.08	0.26
Total	99.88	101.66	100.78	100.27	100.64	100.00	100.31	100.63	98.29	100.61
Ba	<10.00	<10.00	15.00	35.00	25.00	100.00	220.00	740.00	250.00	780.00
Rb	0.50	0.50	1.00	4.00	3.00	16.00	9.50	3.00	30.00	105.00
Sr	5.00	<5.00	15.00	390.00	140.00	160.00	190.00	250.00	90.00	640.00
Th	<0.50	<0.50	0.08	0.14	0.14	n.d.	1.26	3.00	1.66	n.d.
Zr	<10.00	10.00	30.00	35.00	35.00	70.00	220.00	460.00	90.00	150.00
Nb	<10.00	<10.00	0.50	4.00	7.00	<10.00	16.00	20.00	4.50	<10.00
Y	<1.00	<1.00	25.00	10.00	15.00	25.00	50.00	140.00	10.00	20.00
La	0.22	0.35	2.05	3.95	2.10	4.00	15.00	35.00	6.40	12.00
Ce	0.25	0.6	3.93	8.40	4.20	9.00	40.00	70.00	13.00	28.00
Nd	0.10	0.5	9.40	5.00	6.20	6.95	35.00	62.00	6.40	14.00
Sc	10.00	<10.00	10.00	15.00	45.00	40.00	45.00	n.d.	n.d.	20.00
V	40.00	<20.00	300.00	140.00	280.00	280.00	400.00	n.d.	n.d.	170.00
Cr	2550.00	600.00	30.00	40.00	130.00	300.00	60.00	n.d.	n.d.	50.00
Ni	2400.00	3050.00	105.00	20.00	85.00	50.00	40.00	n.d.	n.d.	20.00
Hf	n.d.	n.d.	1.00	0.50	1.00	2.00	6.50	20.00	0.50	2.00
Eu	<0.02	0.04	0.66	0.72	0.68	0.96	2.44	4.00	0.42	1.40
Sm	0.02	0.16	3.10	1.08	1.72	2.34	8.40	16.00	0.92	3.85
Gd	<0.05	0.15	5.00	1.50	2.35	2.75	11.00	20.00	0.95	2.75
Dy	0.06	0.20	5.40	1.56	2.72	1.50	11.00	26.00	0.78	1.21
Er	0.05	0.10	3.05	0.83	1.44	1.55	5.40	17.00	0.50	1.13
Yb	0.10	0.10	2.74	0.80	1.21	2.20	4.70	15.00	0.55	1.70

* = total FeO. n.d. = not analysed. Analyses 1-8 = Sadowa Igneous Complex. 9-10 = Astrolabe agglomerate. 1 = serpentinite ; 2 = serpentinised dunite; 3 = clinopyroxenite; 4 = gabbro; 5 = dolerite; 6 = lower pillow lava; 7 = upper pillow lava; 8 = plagiogranite; 9 = plagiogranite ; 10 = andesite. Elements are analysed by ICP-MS and -OES, AMDEL, Adelaide.

theless similar to well documented ophiolites elsewhere. No cumulate texture gabbros or sheeted dykes have been recognised. The serpentinites, serpentinized dunites, clinopyroxenites, gabbros, dolerites, plagiogranites, lower and upper volcanic rocks are petrologically and geochemically similar to other ophiolite suites. The Sadowa Igneous Complex appears to be part of the Milne Ophiolite (Hamilton, 1979).

References

Hamilton, W. (1979) *Prof. Pap. U.S. Geol. Surv.*, **1078**.

Milsom, J.S. and Smith, I.E. (1975) *Geology*, **3**, 117–20.

Pigram, C.J. and Davies, H.L. (1987) *BMR J. Aust. Geo. Geoph.*, **10**, 193–212.

Pigram, C.J. and Symond, P.A. (1991) *J. SE Asian. Earth Sci.*, **6**, 307–18.

Weaver, S.D., Saunders, A.D., Pankhurst, R.J., and Tarney, J. (1979) *Contrib. Mineral. Petrol.*, **68**, 151–69.