Geology of the Graham Bank Volcano

by

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The Graham Bank located 26 mls SW of Sciacca (Sicily) erupted briefly in 1831. The event was observed and widely publicized. At its culmination the eruption created a 260 m high (60 m a.s.l.) steep-flanked cone rising from a vast plateau 200 m deep. The latter also supports the Nerita and Terrible banks. A smaller cone rose from south side of the main cone to a depth of 76 m. The short-lived cinder island, formed by top of main cone, become known as Giulia-Ferdinandea. It was subsequently razed by action of waves and wind so that today the bank is an oval terrace of sand and scoriae 25-30 m deep. From its center an oval hard-rock stock, about 20 m across, rises to a depth of 8.80 m (Lat. 37°10′6″ N, Long. 12° 42′54″ E). Linear magnetic anomalies exist over the Graham Bank. Their highest value of 104 was observed over the secondary cone. A dipole interpretation places the magnetising center at 1000 m below surface. An acceptable depth for a magma chamber, further supported by the petrography of the lava. The base plateau is separated from Sicily by deep basins and troughs shown in bathymetric and seismic sections confirmed by low Free Air gravity values. The Bouguer anomaly contours show a mild positive re-entrant (45 mgals) in the area of the plateau. This is superimposed on strong regional gradient from a 90 mgals " high " in the centre of the Strait of Sicily to — 100 mgals " low " in the Basin of Caltanisetta caused by the NE-dipping mantle. The re-entrant may be associated with a local topographic high on the mantle. Samples of volcanites were collected from the cone top by dives and from the flanks by grabs.

The steep flanks of the bank are covered with sands while silty clays and clays mantle the gently sloping base. The sorting of sand samples shows only modest actual effects of the wave action and currents at shallow depths dwindling to zero at greater depths. The weak sorting results from the nature of the volcanic deposits which comprise materials of wide granulometric spectrum. The skewness suggests strong variations of the environmental energy which can be attributed to intense phases of rapid growth and similarly rapid destruction of the volcanic edifice. The sands found at greater depths contain always certain quantity of fine materials of the present sedimentation; this become preponderant in the samples collected at greatest depths.

The structure of the lavas is porphyric with phenocrystals of bytownitic *plagioclase* (An 80 - Ab 20), fosteritic *olivine* (Fo 80 - Fa 20) and more rarely *titano-augite;* the matrix is made up of microlites of plagioclase, rare monoclinic pyroxenes, dark brown glass. They belong chemically to the volcanic alkali-olivin-basalt association. The analysed samples show a hawaiitic trend with a very strong sodium character (Table 1). The enrichment in total Fe is somewhat limited and can be explained by fractionating of a solid phase constituted mainly from olivine plagioclases and magnetite at rather high $P_{H_2}O$ and f_{O_2}. This type of conditions is found normally in shallow crystalisation. We suggest that these subcrustal magmas rose rapidly through the communication channels (opened up by deep-seated regional tectonic activity) almost without crustal contamination. Only in the superficial zones the magmas underwent weak fractionation. The close structural and magmatological similarities between the lavas of Graham, Linosa and Pantelleria show that the conditions of crustal tension persist in the Strait of Sicily.

Rapp. Comm. int. Mer Médit., **23**, 4a, pp. 107-108 (1975).

Samples	43	45	50	51
SiO_2	48.91	48.01	47.34	50.56
Al_2O_3	16.07	15.83	15.83	15.81
Fe_2O_3	2.11	1.49	2.38	1.71
FeO	8.18	8.78	8.01	9.02
MnO	0.16	0.15	0.14	0.17
MgO	7.18	7.05	8.18	6.81
CaO	8.23	9.09	9.21	7.91
Na_2O	3.78	4.06	3.66	3.90
K_2O	1.41	1.66	1.38	1.05
TiO_2	3.03	2.79	2.83	1.98
P_2O_5	0.63	0.45	0.61	0.30
H_2O	0.09	0.13	0.08	0.06
H_2O^+	0.73	0.92	0.80	0.99
	100.51	100.41	100.45	100.27

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Discussion

M. Soffel :

Question : Did you measure the curie-temperatures of the rocks. The titanium and iron content which you have measured for the rocks indicates that the curie temperatures should be very low. This would imply that the rocks have not been contaminated by crustal material.

Answer : The curie temperatures have not been measured, only the magnetic anomaly which is of some hundred gammas.