Geological observations in the submarine Caldera of Santorin (Aegean Sea)

by

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Abstract

The volcanic island group of Santorin (Thira) stands about 120 kms. north of Crete and is part of an arc of volcanoes in the Aegean Sea. The Santorin Volcano has been intermittently active in historical times; a major eruption took plate about 1400 BC and produced a large submarine caldera about 83 km^2 in area. Subsequent submarine eruptions have caused the Kameni Islands to rise from the submerged caldera. The unique features of the Santorin Island Group are of great geological, geochemical and archeological interest; and were the reason for preliminary exploration of the area which was carried out by the R. V. *Pillsbury* in 1965.

A bathymetric survey of the caldera was carried out with a Precision Depth Recorder, and a bathymetric chart was made (Fig. 1). An area of sharp bottom reliefs lies east of Nea Kameni Island, which suggests that submarine lava flows were emplaced there during recent eruptions. Bottom photographs and dredge hauls were obtained from this area; The rocks dredged consist of large (up to ½ meter in diameter) boulders of fresh-looking lava. Thin section study of them indicates phenocrystals of andesine, augite and a rhombic pyroxene in a ground mass of feldspar laths and glass; the whole arranged in hyalopilitic texture. A chemical analysis of this rock is reported in table 1a.

This rock appears to be an augite-hypersthene-andesite similar to that produced in recent eruptions at Nea Kameni. No evidence of high-temperature reactions between the lava and sea water is apparent in these rocks.

Sediment samples were collected at three locations within the Santorin caldera and were studied by optical and X-ray diffraction techniques. The sediment larger than 100 microns consists essentially of pumiceous glassy fragments. The $<$ 100 micron fraction contains, in addition to biogenous carbonates, volcanic glass fragments, feldspars and pyroxenes. The $<$ 2 micron fraction consists mainly of kaolinite and montmorillonite. Most of the sediment in the bottom of the caldera must have derived locally from within the caldera and from material eroded from the emerged portions of the volcano. Thus it is assumed that kaolinite was mainly formed by subaereal weathering of the volcanic material on the islands and was subsequently washed into the lagoon, while montmorillonite originated by reactions of the volcanic material with sea water directly on the bottom of the caldera.

Near the southeastern shore of Nea Kameni Island a warm-water spring flows into sea water. Rocks adjacent to the spring are covered by a red precipitate. X-ray diffraction studies show this precipitate to be made of a poorly crystalline FeO(OH) : (goethite). Chemical composition of this material is reported in table 2. Suca an iron deposit was probably formed by oxidation and precipitation of iron which was introduced into the sea water by the thermal spring.

A small submarine volcanic cone (Ifalos Koloumbos) lies about 5 kms northeast of Thira (see Fig. 1). Rocks dredged from this location consist of light colored, porous glassy volcanic fragments; clearly produced by explosive eruptions. A chemical analysis of this rock is in table 1b.

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Additional work on the material collected in the Santorin area is in progress at the Institute of Marine Science.

TABLE 1

per cent by weight	*a*	*b*
SiO_2	60.70	63.60
Al_2O_3	20.07	15.16
Fe_2O_3	2.09	2.32
Fe O	2.83	1.12
Ca O	3.64	2.80
Mg O	1.86	2.22
Mn O	0.11	0.09
K_2O	1.80	4.85
Na_2O	4.90	3.55
TiO_2	0.92	0.35
P_2O_5	0.24	0.10
H_2O	0.74	3.50
Total	99.90	99.66

TABLE 1 : Chemical analyses of two submarine volcanic rocks recovered in the Santorin area : a = East of Nea Kaureni b = Northeast of Thira; Analyses by R. Mazzuoli.

TABLE 2

	per cent by weight
SiO_2	23.50
Al_2O_3	0.23
Ca O	2.50
Mg O	0.50
K_2O	0.27
Fe	40.5
Mn	0.45
H_2O	13.50

TABLE 2 : Spectrochemical analysis of a precipitate near the mouth of a thermal spring, Santorin caldera.