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THE ISLAND OF STROMBOLI

ABSTRACT. — Stromboli is the only island of the Aeolian arc in a persistent volcanic activity since historical time. The island has been mapped in detail and a 1/10.000 scale geological map is presented here. Two main cycles of volcanic activity have been recognized in the subaerial part of this central strato-volcano:

- an old cycle, which built up all the eastern half of Stromboli with a rithmical sequence of pyroclastic products and lava flows;
- a young cycle which erupted all the volcanics (mostly lavas) of the western half of the island; it includes the present activity of Sciara del Fuoco.

Some parasitic centres were active both during the old cycle (Strombolicchio) and during the young cycle (Vigna Vecchia, Timpone del Fuoco).

Most of the volcanic activity at Stromboli has to be related to a main tectonic line which crosses the central part of the island along a NE-SW trend.

The magmatic products of Stromboli are typical of island arc volcanism, showing a temporal evolution from calc-alkaline to shoshonitic. During the old cycle of activity, the magmatism of Stromboli evolved from calc-alkaline to high-K andesitic products. A further evolution is observed in the young cycle and present activity, which erupted shoshonitic products. All the available data suggest that the different terms present in each of the three magmatic series are produced by dominant crystal-liquid equilibria, while the transition from one series to another seems most probably to be related to a deepening, over a very short time interval (< 0.5 m.y.), of the Benioff zone beneath the Aeolian island arc. The volcanic and petrogenetic evolution of Stromboli fit therefore very well the general geodynamic framework of the southern Tyrrhenian Sea.

RIASSUNTO. — Stromboli, celebre fin dall'Età Classica, è l'unica isola dell'arco vulcanico delle Eolie a trovarsi in uno stato di attività persistente da circa due millenni.

Un rilevamento geologico di dettaglio è stato effettuato nel 1975 e la nuova carta geologica che ne risulta (scala 1 : 10.000) è allegata alla presente nota.

La parte subaerea di questo strato-vulcano centrale si è formata essenzialmente durante due ben distinti cicli di attività: — un ciclo antico, costituito da ritmiche eruzioni di materiale piroclastico e di colate di lava, ha dato luogo alla formazione di tutta la parte orientale dell'isola; — un ciclo più recente, durante il quale venivano eruttate essenzialmente colate laviche, responsabile invece della formazione di tutta la metà occidentale di Stromboli. L'attività attuale delle bocche sovrastanti la Sciara del Fuoco, viene considerata come facente parte del ciclo recente. Apparati eccentrici si sono manifestati sia durante il ciclo antico (Strombolicchio), sia durante quello recente (Vigna Vecchia e Timpone del Fuoco).

La maggior parte dell'attività vulcanica di Stromboli è da mettere in relazione con un'importante linea tettonica regionale che taglia praticamente in due l'isola, secondo una direzione NE-SW.

I prodotti magmatici di Stromboli appartengono ad associazioni caratteristiche delle strutture di arco insulare (da calco-alkaline a shoshonitiche). La successione stratigrafica delle prin-

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cipali formazioni vulcaniche è caratterizzata da importanti cambiamenti nella natura petrologica dei magmi eruttati. Si è infatti potuto riconoscere durante il ciclo più antico di attività, un'evoluzione da vulcanismo calco-alcalino tipico verso prodotti calco-alcalini ricchi in potassio. Un'ulteriore evoluzione magmatica ha poi condotto all'emissione dei prodotti del ciclo recente ed attuale, a composizione shoshonitica.

Introduction

Stromboli is the northernmost island of the Aeolian Archipelago and the only one which is presently in a persistent state of activity.

This island was known since the Classical Age for the rithmical explosive eruptions of scoria, cinder and ashes. This type of volcanic activity has been described by many authors and the term of «strombolian» has been adopted by volcanologists all over the world, to describe such a kind of eruptions.

However the geological, volcanological and petrological knowledge of this famous volcano was surprisingly scanty. In fact in the abundant literature on Stromboli, the available data (volcanology, petrochemistry, etc.) only concern the historical and present activity of the volcano.

Up to date, a detailed geovolcanological map of Stromboli was lacking. In fact, an old photogeological interpretation (MAGNANI, 1939) and a 1/100,000 scale map (Foglio 244, carta geologica d'Italia) were the only available geological maps of this island.

The aim of the present paper is to bring a contribution to the geological knowledge of this volcano. A detailed mapping (1/10,000 scale) of the island has been done, as well as an accurate sampling of the different volcanic products. Petrochemical studies of these products gave useful informations about the magmatological significance of Stromboli in the wider context of the Aeolian islands volcanism and, in turn, in the general geodynamic framework of the Southern Tyrrhenian Sea.

Physiographic outline

The island of Stromboli is located in the Southern Tyrrhenian Sea, about 60 km West of the Calabrian coast (fig. 1). The surface of the island is 12,2 km², with a coastal countour of 14,4 km. Stromboli has an almost perfect conical shape above sea level, with a maximum elevation of 924 m a.s.l. at I Vancori.

The most evident morphological feature of this volcano is represented by the Sciarra del Fuoco (NW slope), a deep (more than 300 m) and wide (1,000 m) depression bounded by parallel steep walls (fig. 2).

A bathymetric survey of the neighborhood sea floor has been recently made (TESTONI & SEGRE, 1971). It is clear from the profile of fig. 3 that: 1) Strombolicchio rock structurally belongs to Stromboli, from which it is separated by a shallow (about 20 m) water depth; 2) the submerged part of Stromboli is the regular prolongation of the subaerial cone; 3) the volcanic edifice seems to be on the whole a

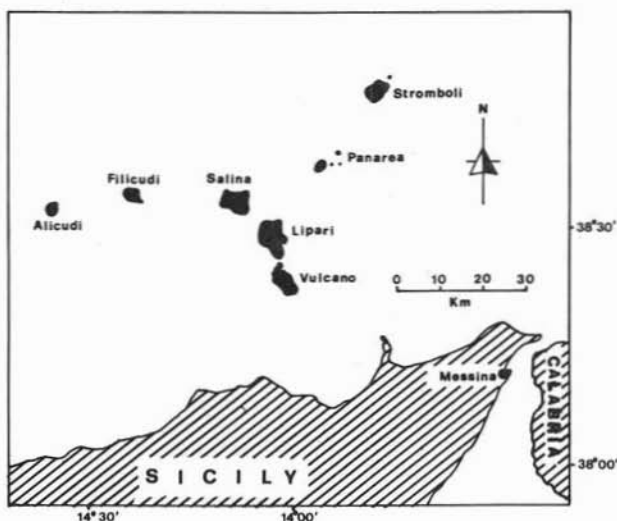


Fig. 1. — Location map.

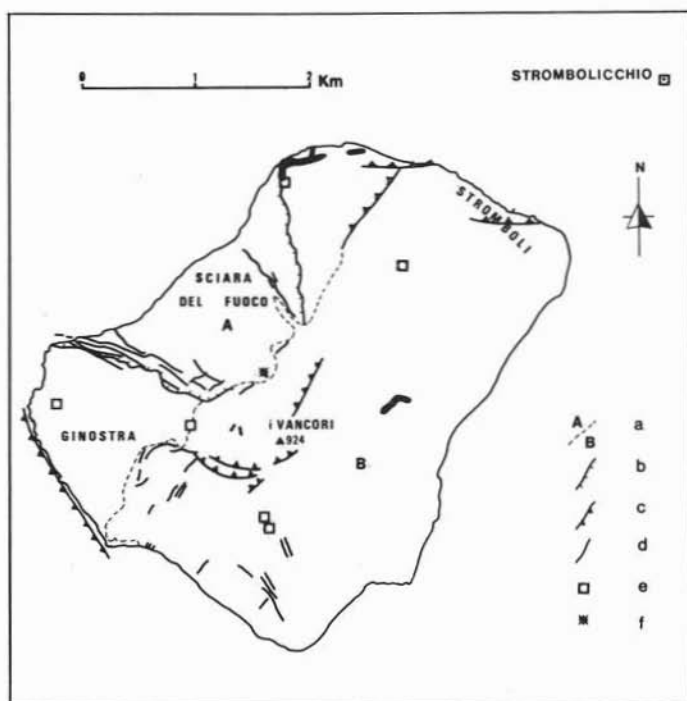


Fig. 2. — Main physiographic and tectonic features of Stromboli: *a*) limit between young and old cycles products; *b*) Sciara del Fuoco borders; *c*) main faults and caldera rims; *d*) dikes and sills; *e*) fossil parasitic centres; *f*) active vents.

rather regular cone, about 3,000 meters high. However, while some authors (BULLARD, 1963) consider Stromboli as big as Etna, some others (SEGRE, 1968) believe that

the volcanic nature of the submerged relief slopes at about 1,000-1,200 meters depth, where the crystalline basement is suggested to exist. Another interesting physiographic character, put in evidence by the bathymetric survey of Stromboli, is the continuation, below the sea level, of the Sciara del Fuoco which extends for about 2 km off the coast, down to a depth of nearly 500 meters. Finally, two small sea mounts located at about 4 km SW of the island are clearly visible from the bathymetric survey of TESTONI & SEGRE (1971). One of them, at about 1,200 m depth, has a symmetrical position if compared with Strombolicchio.

Volcanology

Stromboli is totally made of volcanic products: lava flows, dikes, sills and pyroclastics. The only sedimentary materials are represented by recent beach deposits: gravels, sands and layered reworked pyroclastics exist only around S. Vincenzo-Ficogrande (see geological map).

Although neither stratigraphic nor radiometric age determinations exist, Strom-

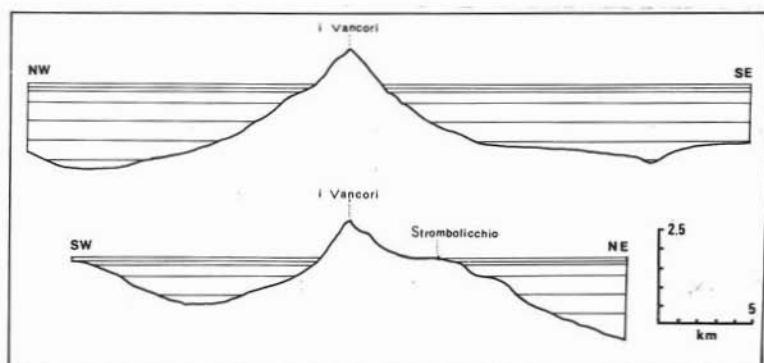


Fig. 3. — Morphological cross sections of Stromboli after TESTONI & SEGRE (1971).

boli must be considered very recent (Upper Pleistocene) in all its subaerial part. This can be inferred according to chronostratigraphic criteria, adopted for the other islands of the Aeolian Archipelago. KELLER (1972) distinguished the Aeolian volcanism into two main periods according to the distribution and elevation a.s.l. of marine terraces, radiocarbon dating and tephra layers. The first of these periods has a Lower to Middle Pleistocene age and corresponds to the formation of Panarea, Alicudi, Filicudi and part of both Salina and Lipari. During the second period (Upper Pleistocene) Vulcano and Stromboli were formed while Lipari and Salina were completed up to their present morphology.

No marine terraces exist on Stromboli; all the subaerial activity of this volcano must be therefore considered to belong to the second main period of the Aeolian volcanism.

Chronological correlation, based on marine terraces, have a rather limited



Fig. 4. — Lava flows issued from Vigna Vecchia parasitic vent (3/4 to the top of the picture) seen from Ginostra harbour.

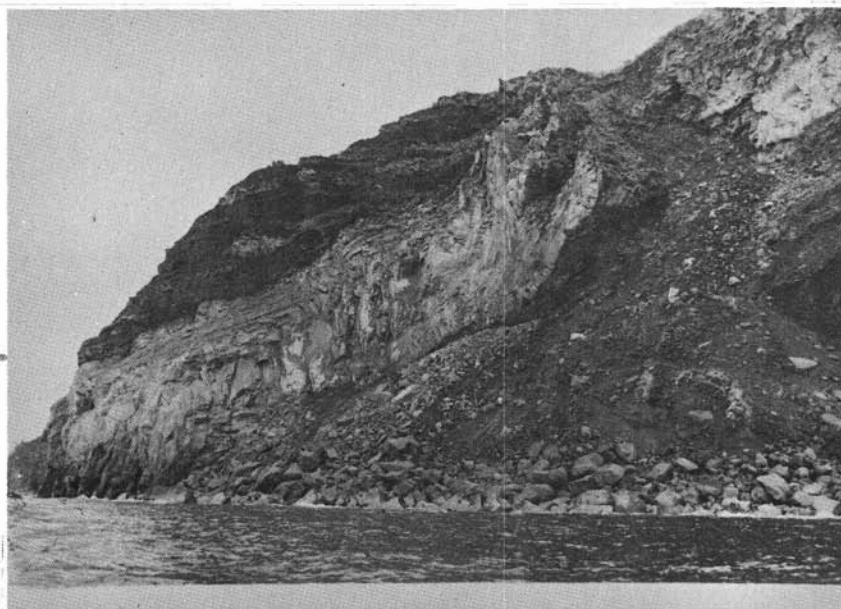


Fig. 5. — Huge dike cutting the lavas which limit Sciara del Fuoco to the North (Punta Labronzo).

reliability when concerning volcanic islands. However the correlation made by KELLER (1972) is in a good agreement with the oldest radiometric age limits available for Salina (< 0.5 m.y.) and Filicudi (< 1.0 m.y.) (BARBERI et al., 1974).

Although the volcanic products of Stromboli must be considered very recent, on the whole it is possible to divide its activity into two well defined main cycles (old and young). The transition from the old to the young cycle is marked by a series of volcano-tectonic events, by a western shifting of the eruptive axes and by a significant change of magma affinity.

It is worthy of note that, if the island of Stromboli is cut by an hypothetical NE-SW line, passing through the presently active vents, two well distinct areas, of old and young volcanic products respectively are defined. In fact, all the ancient products are confined to the eastern part of the island, while the younger ones constitute all the western half of Stromboli (except for the thin layers of present ashes covering part of the eastern summit of the volcano, near the vents). This NE-SW line is actually an important tectonic lineament marked by trending of dikes and active or extinct craters. This line is moreover coincident with the elongation of the island; finally on its NE off shore continuation an old eruptive vent (Strombolicchio neck) outcrops.

PARASITIC CENTRES AND LATERAL ERUPTIONS

An important volcanological feature of Stromboli is represented by lateral eruptions. Among them it is possible to distinguish those related to fractures parallel to the main tectonic trend (NE-SW) from those related to a system of radial fissures. The formers erupted a more important volume of products than the latters and they built up some well defined individual centres, e.g. Strombolicchio and Vigna Vecchia.

Strombolicchio - The rock of Strombolicchio is located 1.7 km NE of Fico-grande. It is a monolithic structure which rises from the sea level up to an elevation of 49 m. It has to be considered a volcanic neck of a rather important ancient cone, almost completely destroyed by marine erosion. The stratigraphic position of Strombolicchio lavas cannot be exactly determined; it is however reasonable, also on the basis of its chemical composition, to presume that it belongs to the old cycle of activity.

Vigna Vecchia . On the western part of the island, about 800 m SW from the present boccas, an important lateral centre (Vigna Vecchia) has been recognized at 600 m a.s.l. (fig. 4). A significant volume of products has been erupted from this centre, covering a large part of the western slope of the volcano, above the village of Ginostra. These products (a monotonous sequence of lava flows and scoria) have a very recent age (young cycle), since they represent the last eruptions just before the formation of Sciara del Fuoco.

Timpone del Fuoco - Timpone del Fuoco (western coast of the island) is an important lateral centre, not related to the main tectonic direction of Stromboli. The shape of Timpone del Fuoco is similar to that of a very small shield volcano and it is made up of an horizontal pile of lava flows, up to an elevation of 147 m a.s.l.. The best exposure of these lavas is found along the faulted coast line where

they outcrop as a 100 m high vertical wall. Timpone del Fuoco lavas are also very recent: they are just a little older than the lavas of Vigna Vecchia.

DIKES

Radial dikes and mantle sills are numerous on Stromboli (fig. 5). Radial dikes are found almost everywhere but they are particularly concentrated at Valloni di Rina, Vallone del Monaco, at the margins of Sciara del Fuoco and near the presently active vents. Mantle sills seem to be less numerous than radial dikes; however, according to RITTMANN (1967) mantle sills should represent 20 % of the volcanic products. The best example of a mantle sill is visible at Le Schicciolo.

Stratigraphy

OLD CYCLE

The older part of Stromboli consists of a typical strato-volcano, on which three main stratigraphic units have been distinguished. They are, from the base to the top:

- pyroclastic basal formation
- lavas of the basal formation
- Vancori complex (lower, middle and upper)

and they will be described in some detail in the following sections.

Pyroclastic basal formation - A series of explosive volcanic products (Petrizza tuffs, Cavoni tuffs and Valloni di Rina tuffs) have been grouped under this name.

These pyroclastics represent the oldest stratigraphic products outcropping on Stromboli. They are exposed in the deepest erosional cuts of the island and they are covered by lavas of the basal formation.

Petrizza tuffs have a maximum apparent thickness of about 50 meters at Valonazzo (Eastern coast of the island). They consist from the base to the top, of: a coarse breccia (about 10 m thick), a pumiceous layer containing numerous lithic xenoliths (mostly affected by hydrothermal alteration), an ash layer covered by some lava flows ⁽¹⁾ (about 15 m thick) and a top layer of lapilli.

Cavoni tuffs mostly outcrop in the highest part of the Cavoni gully (eastern slope of the island). These products mainly consist of scoria, with minor xenoliths and lapilli.

On the NE wall of the gully, a 50 m thick sequence of red and grey layers of these tuffs are found, while on the SW wall the tuff layers interbedded, near the top, with more and more numerous lava flows. This makes a gradual upward transition to a lava flows formation (Serro Monaco lavas).

Valloni di Rina tuffs (East of Ginostra) cover an area of about 0.3 km² with a variable exposed thickness, reaching a maximum of 50 m. They consist of several red and grey layers of weathered, scoriaceous material. These tuffs are

⁽¹⁾ These lava flows contain several big quartz xenocrysts. They were firstly recognized by H. JOHNSTON LAVIS (1894). It has to be mentioned that quartz xenocrysts are also present in lavas of Strombolicchio neck.

partly covered to the west by the recent lavas of Vigna Vecchia parasitic centre. Valloni di Rina tuffs are cut by numerous dikes most of which show a trend which is coherent with the main tectonic direction of Stromboli (NE-SW).

The important landslides, visible on the southern and on part of the eastern slopes of Stromboli, are related to the high unstability of deposits belonging to the pyroclastic basal formation.

Lavas of the basal formation - Under this name, all the lavas covering the pyroclastic basal formation have been grouped. They are represented by Serro Monaco lavas (southern part of the island) and by the lavas of the NE sector of the volcano. They can be distinguished only on petrochemical basis.

Lavas of Serro Monaco appear frequently dislocated by sliding of the entire flow sequence.

The lavas of the NE sector of the island (just above the village of Stromboli), show a stratigraphic position comprised between the pyroclastic basal formation and the Vancori complex. It has to be noted that, on this part of the island, some non erosional morphological anomalies, which break the regular conical shape of the volcano, appear. They could be the result of an old lateral activity which is now hidden by the most recent products. According to PLATANIA (1906) as historical lava flow should have covered ancient human settlements near S. Bartolo. A detailed exploration of that area did not confirm the existence of such historical lava. Moreover the composition of all the lavas of this area is much more similar to that of the ancient products than to that of the historical ones.

Vancori complex - An important almost circular, old depression of about 1 km wide has been recognized just at the top of Stromboli. This depression, which formed after the eruption of Serro Monaco lavas, should correspond either to a small caldera collapse or to a large explosion crater. The lack of any accumulation of ejected material around the visible rim, makes the first interpretation more likely. Anyway this structure marks an important event in the activity of the old eruptive cycle.

The depression was later filled by a huge pile of lava flows and pyroclastics the Vancori complex. A weak fumarolic alteration is sometimes visible on Vancori products. This complex has been divided into three subunits: lower, middle and upper Vancori.

Lower Vancori - The activity which renewed after the formation of the summit depression, produced the lava pile which is now visible along the lowest outer part of Vancori rim. These flows are perfectly horizontal and generally thin (about 2 m) but some of them can reach a thickness of more than 10 m. Some of these thick lava layers can be interpreted as mantle sills.

The top of this formation is visible only on the western side of Frontone and corresponds to a paleo-erosional surface which unconformably cuts the lower lava flows. This surface is marked by a yellow-brown layer of fine pyroclastic material.

Middle Vancori - Between middle and lower Vancori no important differences exist, since the latter still consists of several horizontal lava flows. However, a distinction has been made because they represent two distinct periods of activity,

separated by a break, during which lower Vancori products were partially eroded.

Upper Vancori - They represent the last products of the old volcanic cycle at Stromboli. They consist of lavas and pyroclastics, outcropping on the summit part of the volcano (Vancori and Pizzo Sopra la Fossa). On the inner wall of Vancori rim, the base of the formation is represented by a sequence (about 20 m thick) of yellow and red tuffs. Tuffs are covered by two coarse breccia layers (about 20-30 m thick each) with a 15 m thick lava flow in between; the top of the formation consists of few and very thin (about 1 m) lava flows.

The same sequence of products (tuffs, lavas and breccia) are also found on the summit eastern part of the volcano (Pizzo Sopra la Fossa).

YOUNG CYCLE

The end of the ancient cycle is marked by a sinking of the craters which fed the upper Vancori lavas.

This collapse was probably a consequence of a violent explosive event. In the north-eastern part of this depression the vents of the young cycle get opened. The tuffs of Pizzo Sopra la Fossa and the lavas which occur at the edge of Sciara del Fuoco, were erupted from these boccas. Later, the activity moved westward and the lateral structures of Timpone del Fuoco and Vigna Vecchia were built up. The very recent collapse which formed Sciara del Fuoco, marked a further shifting of the activity towards the centre of the cone giving to Stromboli its present appearance. Some small displacements of the boccas are frequently still observed.

Pizzo Sopra la Fossa tuffs - These tuffs are the typical products of Stromboli explosive activity: welded and unwelded scoriae, bombs and blocks cemented by an ash-sandy matrix. They always appear as cross-bedded layers, probably as a result of a contemporaneous activity at different vents. The total thickness of this formation (NW wall of Pizzo) exceeds 150 m. The formation is strongly affected by current and fossil fumarolization processes. Contemporaneously and immediately after the eruption of Pizzo Sopra la Fossa tuffs, the products which form the Sciara del Fuoco margins were also erupted. They are represented by an alternance of lava flows and pyroclastic layers, cut by numerous radial dikes. These products cover both the upper Vancori formation and the lavas of the basal formation. In the western sector they are covered by the products from the eccentric vents of Timpone del Fuoco and Vigna Vecchia.

Elsewhere they are covered by historical pyroclastics. The thickness of this formation is very relevant (at least 300 m).

The lavas of Sciara del Fuoco - Sciara del Fuoco is the most striking structure which marks the recent volcanological evolution of Stromboli. Following its formation, in fact, the centre of activity emplaced on the summit part of it, at an elevation of 750 m a.s.l.. Since that moment all the erupted products have flowed down this very steep ($\sim 40^\circ$) surface, made up of several thin flows and pyroclastic layers.

Lavas very frequently flow in tunnels on Sciara del Fuoco. This fact makes

sometimes difficult the localization of the eruptive vent and can drive to the wrong conclusion that some historical eruption of Stromboli were fed by boccas opened at sea level (ABRUZZESE & CAVALLARO, 1955).

VOLCANO-SEDIMENTARY PRODUCTS

The recent age and the small dimensions of the island prevented the formation of an important hydrographic network. Erosion therefore did not play an important role and sediments are extremely rare and mostly localized along the narrow coastal plain, where the village of Stromboli stands. The maximum thickness of these products is of a few tens of metres. The products consist either of volcanic ashes, mostly wind-transported or of volcanic material, partially reworked by the sea. Finally, the finest material presently erupted at the near summit vents, is mostly deposited on the eastern part of the island, due to the action of westerly winds which, at Stromboli, dominate. These products cover a large area of the island but their thickness is generally in the order of few meters.

Volcano-tectonic evolution of Stromboli

The most important structural features of Stromboli are shown in fig. 2.

The most evident tectonic line shows a NE-SW trend and along it, Strombolichio, the present active vents and the parasitic centre of Vigna Vecchia are perfectly aligned. Furthermore, on this line, which matches the elongation of the island, the highest number of dikes trends, as well as many zones of fumarolic activity, gas emission (mostly CO_2) and hot springs (about 40°C). This tectonic trend is therefore interpreted as a structural element of regional importance.

An important fault (with a visible throw of more than 100 m) perpendicular to the main trend, marks the western coast-line of Stromboli (Scoglio del Vento - Secche di Lazzaro).

Another minor tectonic direction (EW) is that marked by two faults and by a huge dike on the northern coast of Stromboli.

Sciara del Fuoco is the most spectacular volcano-tectonic feature, being the result of a very important sliding which affected all the NW sector of the volcano and part of the submerged cone, down to a depth of 500 m below sea level.

The steep walls which limit Sciara del Fuoco (Fili di Baraona to the SW and Filo del Fuoco to the NE) are cut by a large number of dikes, converging to the top of the volcano near the active vents.

According to RITTMANN (1967), Sciara del Fuoco was formed by a sliding along an arched surface, due to a gravitational instability, and favoured by the lubricant action of a mantle sill injection. The dikes at Sciara del Fuoco margins should have been injected, from the same sill, into fractures opened during the first stages of sliding.

An alternative mechanism which could account for the genesis of Sciara del Fuoco structure is suggested. The present margins of the Sciara, represent two

important fractures produced by tectonic movements which acted perpendicular to the main tectonic trend of Stromboli. The opening of these fractures, also marked by the emplacement of numerous dikes, produced the sliding of the lava pile which, in this part of the volcano, must have reached its maximum thickness. The sliding was favoured by the lubricant action of the underlying, old pyroclastic formation.

Some structures of minor importance are those found on the eastern and SW slopes of the island. They are simple landslides probably originated by episodic shaking of the volcano. The best example is represented by Rina Grande. Some authors gave the name of «*Sciara Vecchia*» to Rina Grande, because they believed that it was the ancient equivalent of *Sciara del Fuoco*. Actually, *Sciara Vecchia* has a completely different and much less important significance than *Sciara del Fuoco*, as stated above.

Some informations about the deep structure of Stromboli can be obtained from the gravimetric survey of BONASIA and YOKOYAMA (1972). The distribution of Bouguer anomalies is characterized by the presence of a minimum, localized in the centre of the active zone, and by the two maxima, respectively in the West of the island (Ginostra) and at the NE limit of Stromboli, including Strombolicchio. While the maximum at Ginostra can be explained by the existence of Timpone del Fuoco basic lavas, the other has not a clear volcanological meaning. The minimum in the centre of the island has been interpreted by BONASIA and YOKOYAMA (1972) as due to the existence of a submerged caldera. Accordingly, all the emerged part of Stromboli should be considered as formed during a post-caldera stage of activity. An alternative hypothesis proposed by the same authors, is that the minimum could be the result of a local structural low of the crystalline basement, on which the volcano stands. In this last case, the structure should have a very important regional significance. However no evidences of such a structure can be deduced from the available bathymetric and gravimetric data on this part of the Tyrrhenian Sea. The hypothesis of a submerged caldera, cannot of course be verified on geological basis. However, it is not excluded that the gravimetric minimum could be the result of the filling, by light pyroclastic material, of the summit part of the volcano which has been affected by some volcano-tectonic collapse.

Petrochemistry

CLASSIFICATION

Major elements chemical analyses and C.I.P.W. norms of 36 samples (selected after a detailed petrographic study of 90 rock samples) which are believed to be representative of the whole volcanic products outcropping on Stromboli (fig. 6), are reported in Table 1.

The different products of Stromboli have been plotted on the K_2O/Na_2O vs. SiO_2 diagram (fig. 7a). Boundary lines have been taken from BARBERI et al. (1974).

There is a marked tendency for Stromboli rocks to show a more rapid increase of K_2O/Na_2O ratio with increasing SiO_2 content with respect to the boundary

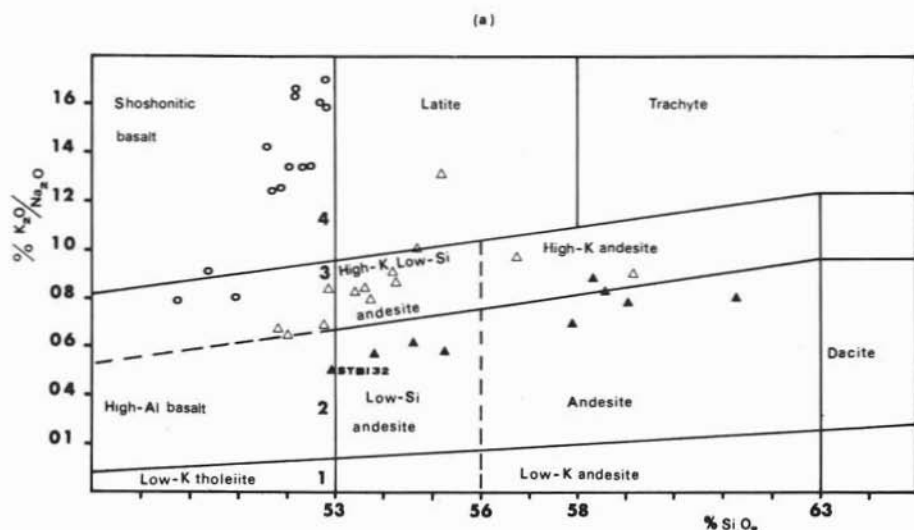
Tab. 1: continued

HIGH-K ANDESITIC SERIES													
	15	16	17	18	19	20	21	22	23	24	25	26	27
	Std8	Std10	Std5	Std35	Std10	Std14	Std6	Std24	Std38	Std12	Std46	Std12	Std13
SiO ₂	51.78	52.00	52.74	52.83	53.41	53.61	53.74	54.19	54.25	54.68	55.19	56.78	59.18
TiO ₂	0.83	0.83	0.81	0.92	0.99	1.02	1.03	0.97	0.92	0.86	0.99	0.82	0.73
Al ₂ O ₃	17.66	18.15	17.66	18.12	17.76	18.90	17.85	19.16	18.55	18.02	18.96	17.50	17.43
Fe ₂ O ₃	2.75	2.40	2.99	3.55	2.30	2.79	3.12	1.94	2.73	3.91	3.00	2.62	2.05
FeO	5.46	5.51	4.80	4.22	5.19	4.78	4.68	5.08	4.54	3.53	4.33	3.94	3.58
MnO	0.15	0.15	0.15	0.16	0.17	0.15	0.16	0.15	0.15	0.14	0.16	0.16	0.15
MgO	5.56	4.78	5.00	4.63	4.96	2.16	3.39	2.86	3.92	3.45	3.00	2.87	1.89
CaO	10.67	10.55	10.33	8.70	8.63	8.40	8.71	8.14	8.10	8.77	8.51	6.73	5.47
Na ₂ O	2.49	2.71	2.76	2.92	3.07	3.44	3.10	3.01	3.07	2.16	3.63	4.00	
K ₂ O	1.73	1.80	1.90	2.46	2.55	2.91	2.74	2.81	2.63	3.12	2.84	3.56	3.66
F ₂ O ₅	0.27	0.30	0.30	0.41	0.28	0.75	0.41	0.58	0.51	0.05	0.28	0.47	0.43
L.O.I.	0.66	0.82	0.57	1.08	0.69	1.06	0.73	1.02	0.69	0.39	0.58	0.92	1.44
	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00
C.I.P.W. NORMS													
Q	1.42	1.23	2.43	2.89	0.81	2.94	1.91	3.85	4.36	3.83	9.43	4.86	8.02
Or	12.21	10.65	12.20	14.53	15.07	17.20	16.20	16.60	15.54	18.44	16.78	21.03	21.65
Ab	21.08	22.93	23.33	24.70	25.96	29.31	29.11	26.22	25.46	25.98	18.27	30.74	33.79
An	31.90	32.02	30.21	29.07	27.15	27.44	25.16	30.07	29.34	26.17	33.65	20.92	18.81
Di	Wo	8.05	7.66	7.96	4.76	5.77	3.90	6.43	2.72	3.13	7.08	2.81	3.93
	En	5.08	4.56	5.20	3.32	3.59	1.97	3.93	1.40	1.97	5.16	1.71	2.38
	Fs	2.45	2.70	2.21	1.04	1.84	1.85	2.14	1.26	0.97	1.26	0.95	1.34
Hy	Wo	8.75	7.33	7.25	8.20	8.76	3.41	4.51	5.72	7.79	3.42	5.76	4.76
	En	4.22	4.34	3.08	2.56	4.48	3.21	2.46	5.15	3.86	0.83	3.19	2.68
	Fs												2.95
Ol	Wo	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	En	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	Fs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Mt	3.99	3.47	4.34	5.15	3.34	4.04	4.52	2.81	3.96	5.67	4.35	3.80	2.97
	Il	1.57	1.58	1.53	1.75	1.88	1.95	1.96	1.84	1.70	1.63	1.88	1.55
	Ap	0.63	0.72	0.71	0.97	0.66	1.77	0.97	1.37	1.21	0.13	0.66	1.11
													1.03

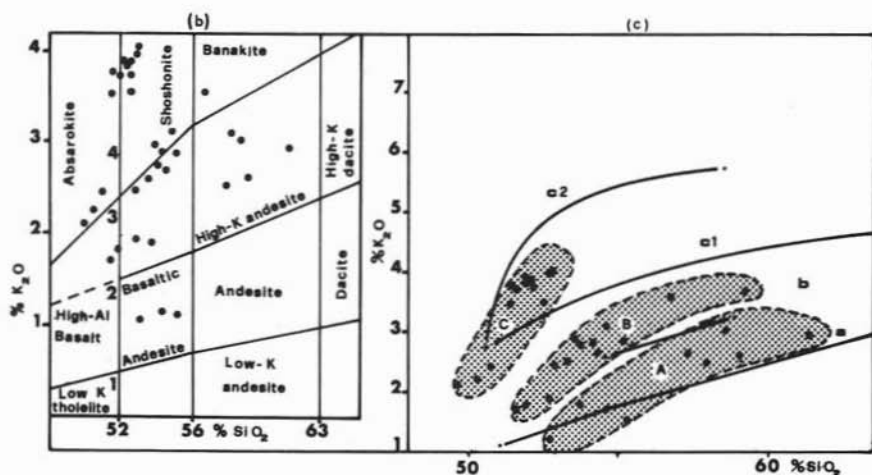
Tab. 1: continued

CALC-ALKALINE SERIES										
	28	29	30	31	32	33	34	35	36	
	Std12	Std42	Std5	Std34	Std45	Std7	Std12	Std14	Std5	
SiO ₂	52.88	54.58	55.23	57.89	58.28	58.60	59.01	61.29	53.76	
TiO ₂	0.88	0.76	0.73	0.76	0.76	0.76	0.79	0.66	0.94	
Al ₂ O ₃	16.42	17.44	15.86	17.19	17.37	16.26	17.32	16.81	17.17	
Fe ₂ O ₃	4.79	3.32	2.79	2.83	2.99	3.57	2.09	1.72	4.31	
FeO	2.97	4.14	5.15	2.87	3.10	2.50	3.72	3.27	3.47	
MnO	0.18	0.15	0.16	0.15	0.14	0.15	0.15	0.14	0.15	
MgO	6.13	5.19	5.05	4.16	3.04	2.93	3.41	2.83	4.55	
CaO	10.41	8.95	9.61	6.52	6.68	6.19	6.67	5.75	8.78	
Na ₂ O	2.35	2.75	2.65	3.66	3.57	3.62	3.32	3.62	3.20	
K ₂ O	1.17	1.71	1.54	2.51	3.14	3.02	2.60	2.92	1.81	
F ₂ O ₅	0.23	0.23	0.19	0.26	0.27	0.32	0.27	0.24	0.26	
L.O.I.	1.33	0.78	1.03	1.20	0.66	1.98	0.65	0.75	1.60	
	99.74	100.00	100.00	100.00	100.00	100.00	100.00	100.00	100.00	
C.I.P.W. NORMS										
Q	7.90	6.95	7.77	8.33	8.42	10.91	10.73	12.79	5.86	
Or	6.90	10.10	9.11	14.83	18.55	17.82	15.36	17.25	10.69	
Ab	19.90	23.26	22.37	30.95	30.19	30.61	28.08	30.62	27.06	
An	30.80	29.38	26.85	23.07	22.10	19.22	24.78	21.00	27.15	
Di	Wo	8.10	5.64	8.18	3.16	3.87	3.93	2.77	6.14	
	En	7.00	3.97	5.13	2.39	2.73	3.11	1.75	4.81	
	Fs	0.00	1.19	2.55	0.45	0.80	0.37	0.84	0.65	
Hy	Wo	8.20	8.95	7.44	7.97	4.84	4.19	6.74	5.52	
	En	0.40	2.69	3.69	1.50	1.42	0.50	3.24	0.89	
	Fs									
Ol	Wo	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	En	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	
	Fs									
Mt	6.90	4.81	4.05	4.10	4.34	5.17	3.03	2.49	6.25	
Il	1.70	1.44	1.39	1.44	1.44	1.44	1.50	1.25	1.78	
Ap	0.50	0.54	0.45	0.62	0.64	0.76	0.64	0.57	0.62	

lines of fig. 7a, which are based on the average chemical composition of the Aeolian arc volcanics. In the K₂O-SiO₂ diagrams of fig. 7b and 7c, the Stromboli rocks are plotted into the classification scheme (7b) proposed by PECCERILLO and TAYLOR (1976) and compared (7c) with the average trends of the rock series of the Aeolian



(a) (b) 1: Island arc tholeiitic series 2: Calc-alkaline series 3: High-K andesitic series 4: Shoshonitic series



(c) A-B-C: Stromboli series a-b-c1-c2 Average trends of aeolian islands

Fig. 7. — a) K_2O/Na_2O vs. SiO_2 plot for Stromboli volcanic rocks; boundary lines after BARBERI et al. (1974). ○ Young cycle; △ Vancori complex and lavas of the NE sector; ▲ Serro-Monaco lavas; ▲ STBI 32, Strombo'icchio. b) Stromboli volcanics plot into the classification K_2O vs. SiO_2 diagram by PECCERILLO and TAYLOR (1976). c) K_2O vs. SiO_2 diagram for the Stromboli volcanic series, compared with the average trends for the Aeolian Islands (BARBERI et al., 1974). A-a, calc-alkaline series; B-b, high-K calc-alkaline series; C-c1-c2, shoshonitic series.

islands. It can be seen that also the rate of K_2O increase is more marked in Stromboli lavas, particularly in the shoshonitic basalts, than in the other volcanic series of the Aeolian Arc.

This character is even more marked if one considers that the K_2O - SiO_2 va-

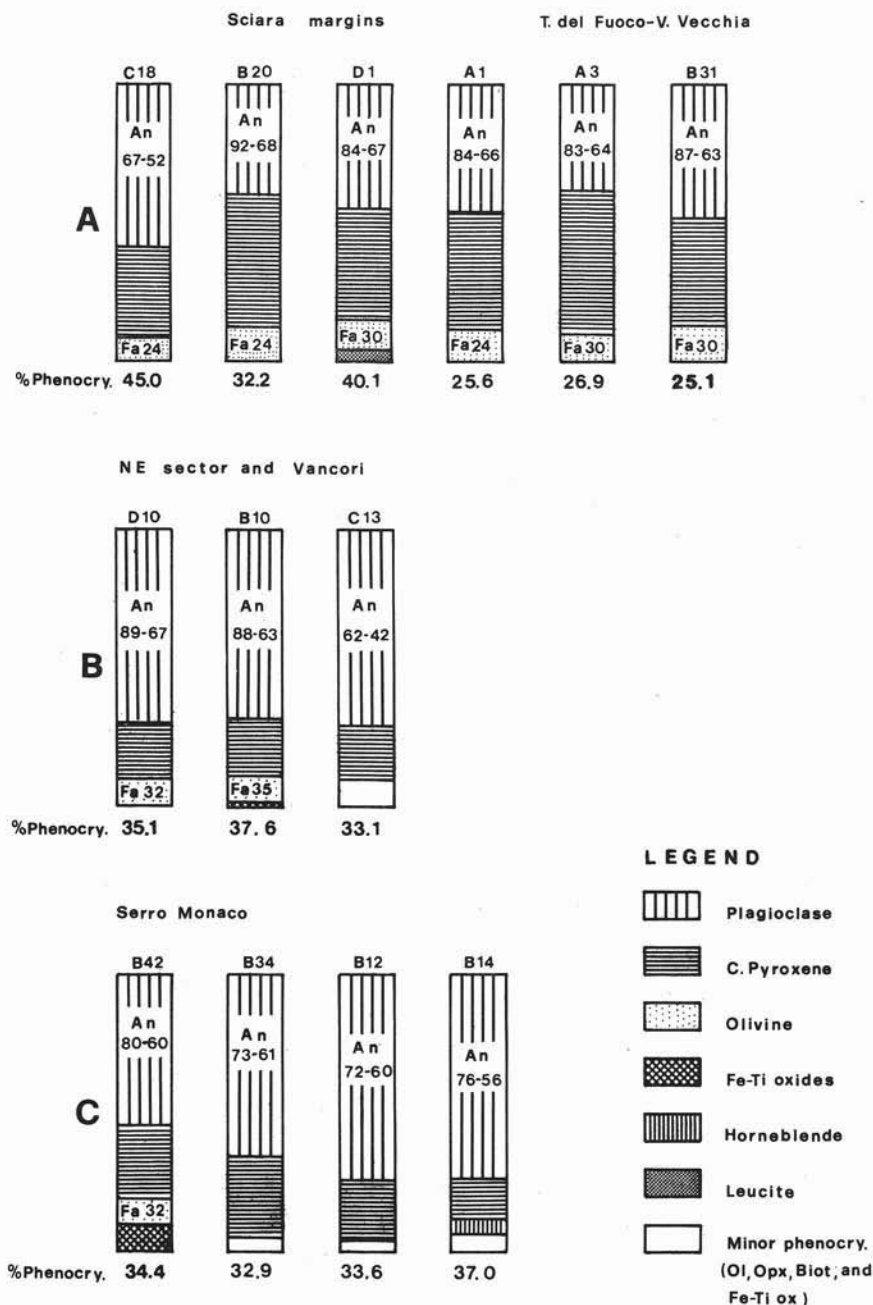


Fig. 8. — Modal estimations of minerals (phenocrysts) in some representative samples of Stromboli volcanic rocks (Symbol St has been eliminated). A) shoshonitic series; B) high-K calc-alkaline series; C) calc-alkaline series.

TABLE 2
Main petrographic characteristics of the most representative lavas
of Stromboli analysed in this paper (¹)

OLD CYCLE

Calc-alkaline series

Sample	Texture	Phenocrysts and microphenocrysts	Groundmass	Rock type and geological setting
StBI32	Porphyritic micro-crystalline	Oscillatory zoned plagioclase (core ⁸⁰ An - rim ⁵⁶ An), augitic clinopyroxene, orthopyroxene and unstable olivine (Pa 31).	Labradoritic plagioclase, clino and orthopyroxene microlites. Fe-Ti oxides grains.	High-al basalt. Lava of Strombolichio neck.
*StB 42	Porphyritic hypocrystalline	Zoned plagioclase (core ⁸⁰ An - rim ⁶⁰ An), augitic clinopyroxene, unstable olivine (Pa 32) and Fe-Ti oxides.	Plagioclase, clinopyroxene and Fe-Ti oxides. Interstitial glass.	Low-SiO ₂ andesite. Lava flow of Serro Monaco along the coast.
StB 34	Porphyritic hypocrystalline	Zoned plagioclase (core ⁷³ An - rim ⁶⁸ An), augitic clinopyroxene, orthopyroxene rimmed by clinopyroxene, biotite, Fe-Ti oxides and rare olivine.	Plagioclase and clinopyroxene microlites, Fe-Ti oxides grains in a rather abundant glassy matrix.	Andesite. Lava flow of Serro Monaco in Valloni di Rina.
StBI2	Porphyritic micro-crystalline	Zoned plagioclase (core ⁷² An - rim ⁶⁰ An), augitic clinopyroxene, orthopyroxene rimmed by clinopyroxene, biotite and Fe-Ti oxides.	Plagioclase microlites (⁵⁶ An), clinopyroxene and Fe-Ti oxides.	Andesite. Lava flow interbedded with Petrasza tuffs along the coast.
StB 14	Porphyritic micro-crystalline	Zoned plagioclase (core ⁷⁶ An - rim ⁵⁶ An), augitic clinopyroxene (2V = 56°; c/g = 43°), orthopyroxene rimmed by clinopyroxene, rare olivine, brown hornblende and Fe-Ti oxides.	Plagioclase microlites, clinopyroxene and Fe-Ti oxides grains.	Andesite. Lava flow of Serro Monaco at Malpasso, along the coast.
StD 7	Porphyritic vitrophyritic	Zoned plagioclase, augitic clinopyroxene, rare olivine, brown hornblende, Fe-Ti oxides. Contact metamorphic xenoliths (hornfels).	Rare plagioclase microlites and clinopyroxene in abundant bubbled glass.	Andesite. Pumice of Petrasza tuffs along the coast.
StB 45	Porphyritic micro-crystalline	Zoned plagioclase (core ⁷⁰ An - rim ⁵⁸ An), augitic clinopyroxene, scarce olivine, orthopyroxene rimmed by clinopyroxene, rare biotite and Fe-Ti oxides.	Plagioclase microlites, clinopyroxene and Fe-Ti oxides.	Andesite. Lava flow of Serro Monaco, SW coast.

* StB 42 is representative of the mineralogical assemblage of all the low-SiO₂ andesites of this series.
(¹) Olivine and plagioclase composition b optical data (determinative curves by POLDERVAART (1950) and FRANZINI (1965)).

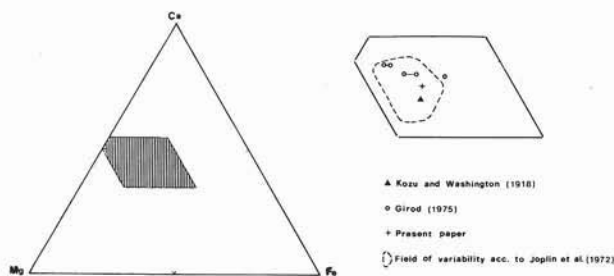


Fig. 9. — Plots of Stromboli clinopyroxenes within the Ca-Mg-Fe diagram (atomic %).

riation lines of Aeolian rocks have in turn a more steep slope than circumpacific calc-alkaline series. Their trends would in fact cross the boundaries of K₂O-SiO₂ classification diagram commonly adopted (see f.i. fig. 2 in PECCERILLO and TAYLOR, 1976).

Tab. 2: continued

OLD CYCLE

High-K andesitic series

Sample	Texture	Phenocrysts and microphenocrysts	Groundmass	Rock type and geological setting
*StB 10	Porphyritic hypocrystalline	Zoned plagioclase (core ⁸⁹ An - rim ⁶⁷ An, augitic clinopyroxene and olivine (Fa 32).	Plagioclase microlites, clinopyroxene, olivine and interstitial glass dusted by Fe-Ti oxides.	High-Al basalt Lava flow of the NE sector along the coast.
**StB 10	Porphyritic hypocrystalline	Zoned plagioclase (core ⁸⁸ An - rim ⁶³ An), olivine (Fa 35), augitic clinopyroxene and Fe-Ti oxides.	Plagioclase (⁶⁶ An), clinopyroxene, olivine, Fe-Ti oxides and interstitial glass.	High-K low-SiO ₂ andesite. Lava flow of the NE sector along the coast.
***StC 13	Porphyritic hypocrystalline	Zoned plagioclase (core ⁶² An - rim ⁴⁶ An), olivine with orthopyroxene reaction rim, orthopyroxene, augitic clinopyroxene and Fe-Ti oxides.	Plagioclase and clinopyroxene microlites in abundant glassy matrix.	High-K andesite. Lava flow of Upper Vancori formation. Summit part of Vancori.

*StB 10 is representative of the mineralogical assemblage of all the High-Al basalts of this series. In sample StB 35 olivine is pure forsterite (Fa 1).

**StB 10 is representative of the mineralogical assemblage of most the low-SiO₂ andesites of this series; only in few samples, with completely crystalline groundmass, a narrow rim of alkali-feldspar around plagioclase has been observed.

***StC 13 is representative of the mineralogical assemblage of all the andesites of this series.

(1) Olivine and plagioclase composition by optical data (determinative curves by Földerváart, 1950 and Franzini, 1961; 1964; 1965).

YOUNG CYCLE

Shoshonitic series

Sample	Texture	Phenocrysts and microphenocrysts	Groundmass	Rock type and geological setting
*StB 20	Porphyritic hypocrystalline	Zoned plagioclase (core ⁹² An - rim ⁶⁸ An), olivine (Fa 24) and augitic clinopyroxene.	Plagioclase, clinopyroxene, olivine, sanidine, brown mica, Fe-Ti oxides and interstitial glass.	Shoshonitic basalt. Lava flow of Sciara del Fuoco margin (Pilo del Fuoco).

*StB 20 is representative of the mineralogical paragenesis of most the shoshonitic basalts of this series except for samples StA 3, StC 9, StD 1, in which leucite microphenocrysts are also present.

(1) Olivine and plagioclase composition by optical data (determinative curves by Földerváart, 1950 and Franzini, 1961; 1964; 1965).

It is however evident from the diagrams of fig. 7 that at Stromboli three distinct magmatic series can be recognized. They mark an important petrogenetic evolution in time which probably reflects some significant tectonic changes in the geodynamic regime of the Aeolian Island Arc. In fact, the products of the old volcanic cycle have a calc-alkaline affinity, showing a transition from calc-alkaline

to high-K calc-alkaline. The high-K calc-alkaline series is in turn replaced by basic rocks of shoshonitic affinity, i.e. all the products erupted during the young cycle of activity up to present.

PETROGRAPHIC AND MINERALOGICAL OUTLINES

A short petrographic description, including optical determinations of the silicate minerals of the main rock types, are given in Table 2. In fig. 8, some modal estimates are reported. Optical data concerning minerals of Petrazza tuffs, have been published by SARTORI (1969). They are in good agreement with those found in the andesitic lavas.

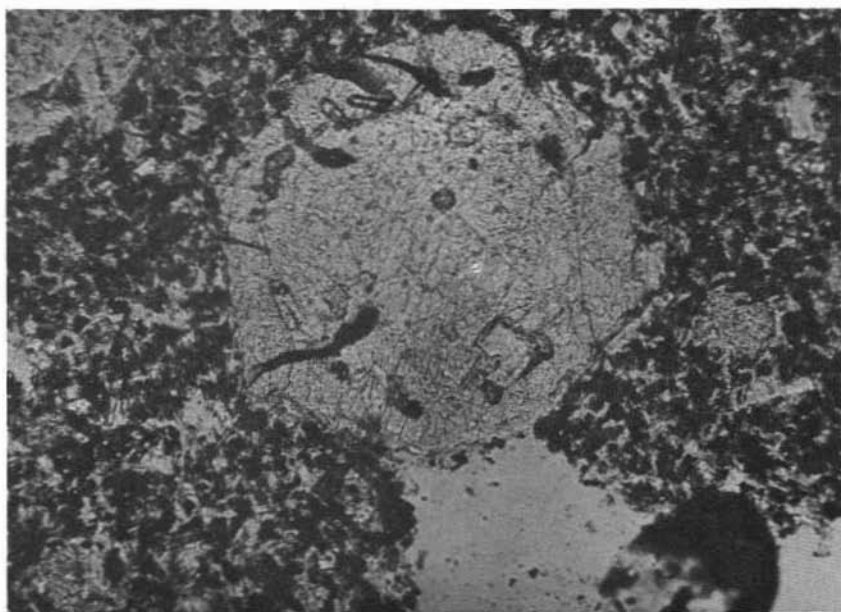


Fig. 10. — Microphotograph of sample StC 9 showing inclusions with the typical arrangement parallel to the leucite faces. The original leucite has been completely transformed into analcite. // Nicols.

Isolated clinopyroxene crystals, found within pyroclastics of the current activity at Pizzo Sopra la Fossa, have been analysed. The results are reported in Table 3 together with another analysis of pyroxene from the same locality (KOZU and WASHINGTON, 1918).

Fig. 9 shows the variability field of clinopyroxenes from shoshonitic associations, according to JOPLIN et al. (1972). Stromboli pyroxenes of Table 3 plot within this field as well as those, reported by GIROD (1975), belonging to an analcite bearing Ne-normative lava flow from Filo del Fuoco.

As pointed out by JOPLIN et al. (1972), the main feature of clinopyroxenes belonging to the shoshonitic association is their narrow compositional range, even in rocks with a quite variable chemical composition (from absarokites to latites).

In fact, the Fe/Mg ratio, which usually is a very sensitive parametre of fractional crystallization, remains almost constant in shoshonitic pyroxenes. The only chemical variation which can be noticed from JOPLIN *et al.* (1972) data, is a decreasing of Ca content in the pyroxene from absarokites to latites. It has to be noted, however, that the data of JOPLIN *et al.* (1972) do not allow any definite estimation about the variation range of clinopyroxene during the evolution of a given shoshonitic series.

The rock analyzed by GIROD has a higher SiO₂ and alkalis content than the lavas presently erupted by Stromboli (to which the pyroxene analyzed in this paper belongs), whereas the pyroxenes show rather higher Mg and Ca contents. This is therefore in contrast with the characters stressed by JOPLIN *et al.* (1972), i.e. a decreasing of Ca in the shoshonitic pyroxene, with increasing SiO₂ content of the rock.

The existence of leucite in Stromboli lavas was firstly recognized by JAKOB (1958), on the other side microphenocrysts of analcite have been found by GIROD (1975) in a shoshonitic lava from Filo del Fuoco. Both minerals actually exist in some of the most recent products of Stromboli. Leucite is present as microphenocrysts or in the groundmass (see fig. 10), while analcite (determined in sample StC9 by X-ray diffractometry) has been interpreted as an alteration product of leucite (see fig. 10).

Interesting data by GIROD (1975) on the groundmass of Stromboli shoshonitic lava are the abundance of sanidine (up to 21 % by volume), the phlogopitic composition of brown mica and the composition of titanomagnetite (Usp. 54.3 mol.%).

PETROGENESIS

In order to decide whether or not the numerous chemical data published on Stromboli rocks could be utilized in the present discussion, a comparison between old chemical analyses and present ones, has been done (see Table 4), referring to samples collected at the same localities.

The most striking differences between new and old analyses is the K₂O content which is always higher in the latter. If the two analyses of Narici (quoted by JAKOB, 1958) were plotted in the K₂O-SiO₂ diagram, they would indicate a shoshonitic affinity for both Strombolicchio and Vancori lavas. However, all the present volcanological, mineralogical and chemical data clearly indicate that these lavas respectively belong to the calc-alkaline and to the High-K andesitic series.

The old chemical data on Stromboli rocks are therefore not taken into consideration in the present paper. It is furthermore interesting to compare the present chemical data with those concerning the other islands of the Aeolian archipelago which evolved in a relatively short time interval, towards more and more potassic members. Until now, high-K rocks were known only at Lipari; the present data on Stromboli seems to supply a good example of a complete three-steps magmatic evolution.

The main petrogenetic problem of Stromboli volcanism concerns the rela-

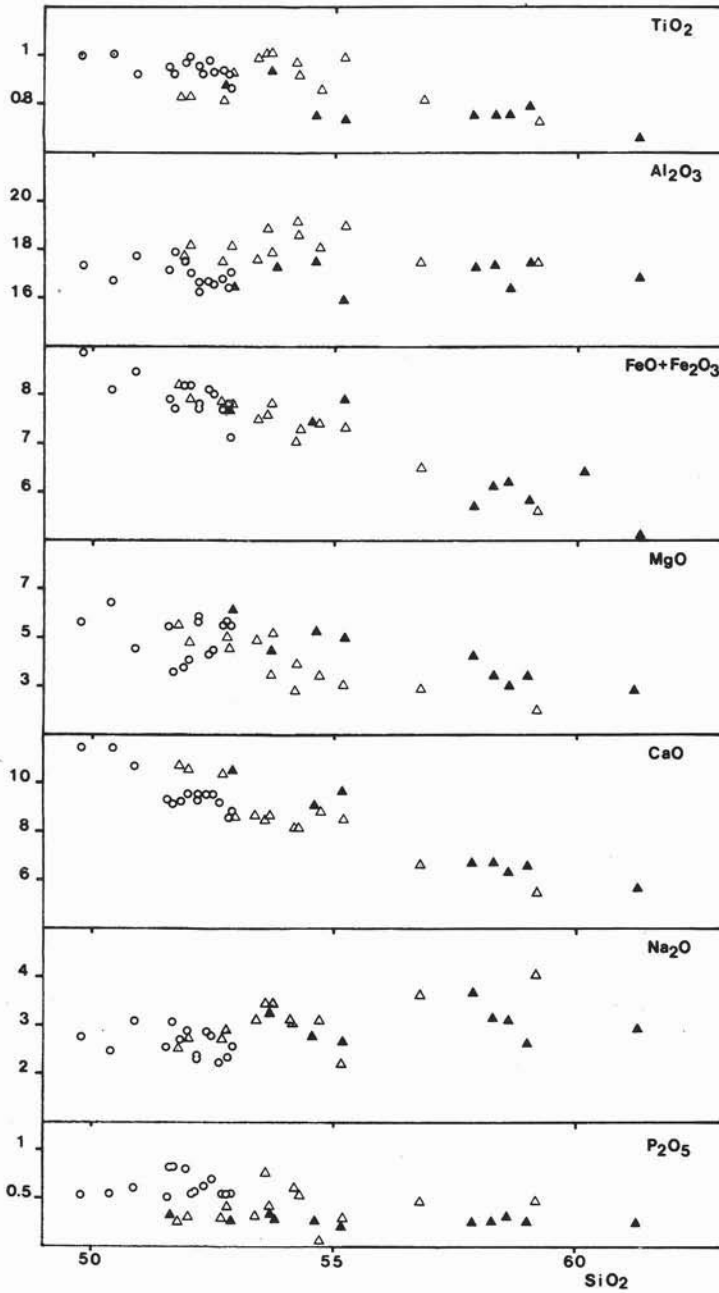


Fig. 11. — Variation diagrams for major elements of Stromboli volcanic rocks (Wt%). Same symbols as in fig. 6.

tionships among the different members of each single rock series as far as those among the three different series.

TABLE 3

Clinopyroxene megacrysts from the pyroclastics presently erupted

	Present paper ⁺	Kosu and Washington (1918)
SiO ₂	49.48	50.04
TiO ₂	1.07	0.96
Al ₂ O ₃	4.33	3.37
Fe ₂ O ₃	3.31	2.05
FeO	5.68	7.41
MnO	-	0.10
K ₂ O	13.73	14.59
CaO	21.16	20.34
Na ₂ O	0.35	0.61
K ₂ O	0.02	0.18
F ₂ O ₅	0.09	-
L.O.I.	0.64	-
H ₂ O	-	-
	100.06	100.55

⁺Wet analysis by R. Cioni and M. Rosi (University of Pisa)

Cation ratio on the basis of 6 oxygens				Atomic percent	
	Present paper		Kosu and Washington (1918)	Present paper	Kosu and Washington (1918)
Si	1.85	2.00	1.88	2.00	
Al	0.15		0.12		Ca 45.0
Al	0.04		0.03		Mg 40.7
Fe ⁺³	0.09	0.15	0.06	0.12	Fe 14.3
Ti	0.03		0.03		15.3
Mg	0.77		0.91		
Fe ⁺²	0.18	0.953	0.23	1.14	
Mn	0.003		-		
Ca	0.85		0.90		
Na	0.02	0.87	0.01	0.91	
K	-		-		
F	0.003		-		

TABLE 4

Literature analyses compared with new ones (samples from the same locality)

	Narici ⁺	Present paper ⁺	Narici ⁺⁺	Present paper ⁺⁺
SiO ₂	50.61	52.88	50.35	54.19
TiO ₂	0.88	0.88	0.96	0.97
Al ₂ O ₃	18.42	16.42	17.64	19.16
Fe ₂ O ₃	4.02	4.79	9.08	1.94
FeO	2.59	2.97	1.84	5.08
MnO	0.11	0.18	0.15	0.15
MgO	6.11	6.13	2.23	2.86
CaO	10.76	10.41	10.88	8.14
Na ₂ O	4.04	2.35	2.51	3.10
K ₂ O	2.16	1.17	2.56	2.81
F ₂ O ₅	0.27	0.23	1.54	0.58
L.O.I.	0.29	1.33	0.37	1.02
H ₂ O	0.10	0.26	0.09	-
	100.36	100.00	100.20	100.00

⁺Stromboliochio⁺⁺Vancori

Both calc-alkaline series of Stromboli range from high-Al basalts to andesites. Chemical variations of major elements of the three series are shown in fig. 11. The chemical variations within the two calc-alkaline series are in agreement with a possible evolution by fractional crystallization. The regular increase of alkalis with increasing SiO₂ as well as the parallel decrease in MgO, total iron and CaO, is in fact coherent with a fractionation controlled by the solid phases (olivine, clinopyroxene, plagioclase and Fe-Ti oxides) which occur as phenocrysts in the porphyritic rocks. Fractionation of olivine is suggested to act only at the beginning of both calc-alkaline series and it probably drives the transition from the slightly silica undersaturated High-Al basalts, to the typical calc-alkaline oversaturated rocks of Stromboli.

The shoshonitic series has a much more limited compositional range with SiO₂ varying from 49.8 to 52.8 %. It is formed by two groups of samples, respectively represented by currently erupted lavas (lower SiO₂ content) and by the lavas of the Sciara borders, Vigna Vecchia and Timpone del Fuoco. The most significant chemical change between the two groups is the K₂O increase from about 2 to 4 % with increasing SiO₂ (from 53% to 55 %). CaO, total iron and MgO all decrease, although less linearly the last, whereas Na₂O does not vary significantly. These variations are qualitatively consistent with fractionation of a Ca-rich plagioclase,

olivine and pyroxene in such proportions to maintain close to one the bulk solid-liquid partition coefficient of Na_2O . The high porphyricity of all the analysed rocks does not allow them to be considered as a suite of liquids formed by fractional crystallization.

The only mineralogical change which can be noticed between the two groups of shoshonitic rocks, is the presence of leucite in the samples A3, C9, D1, of the K_2O -rich shoshonitic lavas. The other minerals (olivine, clinopyroxene and plagioclase) have almost identical compositions in both groups.

On the AFM diagram of fig. 12 are plotted all the analysed samples from Stromboli. Their trends suggest a negligible iron enrichment, typical of orogenic associations. The High-K series shows a more marked decrease of magnesium content, than the other series.

The available chemical data therefore indicate quite clearly that the different magmatic series observed at Stromboli are the result of three individual processes of differentiation, probably controlled by a shallow crystal/liquid fractionation.

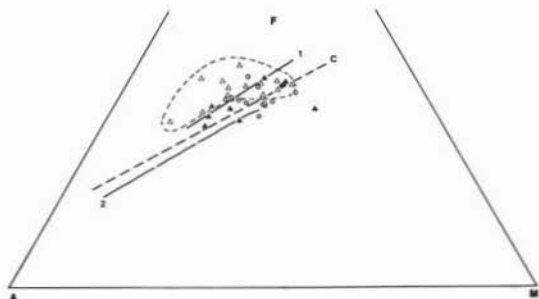


Fig. 12. — AFM diagram of Stromboli volcanic rocks (Wt%). Same symbols as in fig. 6. (C = cascades; 1 and 2 = calc-alkaline and shoshonitic trends of the Aeolian arc after BARBERI et al. 1974).

The parent magma at upper crustal levels, can be respectively identified in the most basic member of each suite; i.e. low- SiO_2 andesites, High-K High-Al basalt and shoshonitic basalts.

Although more geochemical work is needed in order to better clarify the peculiar character of these rock series, the available data seems to exclude the existence of a direct genetic relationship between the three associations. Particularly the chemical differences between High-Al and shoshonitic basalts are such as to rule out the possibility of a genetic link through a process of fractional crystallization. Shoshonitic basalts have in fact higher potassium and lower SiO_2 content than High-Al basalts and are, moreover, characterized by higher values of $^{87}\text{Sr}/^{86}\text{Sr}$ and incompatible elements such as Rh, U, Th.

It seems therefore more likely to suggest that the three volcanic suites of Stromboli were produced by the fractionation of three different parent magmas, originally generated under different tectonic conditions, as discussed in the following section.

Stromboli in the general geodynamic framework of the Aeolian arc

The structural meaning of Aeolian volcanism and its evolution in time has been discussed by many Authors (RITSEMA, 1969; BARBERI et al., 1973; BARBERI et al., 1974; KELLER, 1974). The most relevant features which have been pointed out by these authors are:

- the Aeolian islands have volcanic nature and geophysical structure similar to the circumpacific island arcs;
- the trench which represents the boundary between African and Eurasian plates is located in the Ionian Sea off the coast of Calabria;
- the metamorphic belt is represented by the Calabria-Peloritani chain, while the Tyrrhenian Sea abyssal plain is considered to be a back-arc marginal basin;
- under the Aeolian islands an inclined seismic zone dipping about 50° towards the Tyrrhenian Sea (i.e. to the NW) has been recognized;
- the deepest earthquake are located within the Tyrrhenian Sea abyssal plain;
- the lateral extension of the inclined seismic zone is very limited (200 km);
- the Aeolian volcanism as a whole shows a significant evolution in a short time interval (less than 0.5 m.y.) with an important increase of potassium content which marks the transition from calc-alkaline to shoshonitic series;
- there is a good correlation between potassium content in historical lavas of Stromboli and Vulcano with the depth of the seismic zone beneath them (300 km) and the K/h values of circumpacific island arc volcanoes (HATHERTON and DICKINSON, 1969).

As shoshonitic rocks usually occur in a late stage of the subduction process, their presence in the Aeolian Arc would indicate that this arc has reached a senile stage of evolution (BARBERI et al., 1974) or, in other words, that the subduction process of an oceanic slab beneath the Aeolian islands has presently come almost to an end. This is also indicated by the continental nature of the crust on both sides of the Ionian trench (FINETTI and MORELLI, 1972).

$^{87}\text{Sr}/^{86}\text{Sr}$ isotopic ratios of Aeolian volcanics (KLERX et al., 1974) suggest that magmas have a subcrustal origin and did not suffer significant contamination by upper crustal material. Recent experimental geochemical work (NICHOLLS and RINGWOOD, 1973; KUSHIRO et al., 1972; MYSEN et al., 1974) indicate the upper-mantle as the most probable zone of island arcs magma generation.

The present data on Stromboli perfectly fit in such a general geodynamic context. In fact, at Stromboli, the different magmatic series correspond to well defined cycles of volcanic activity, and the evolution of its products as well as in other islands of the Aeolian Arc (especially Lipari and Vulcano) is much more important in time than in space. If the increase of K content in a magma is an indicator of the source depth, the volcanic evolution of Stromboli indicates a rapid deepening of the Benioff zone beneath the arc.

Chemical data indicate that shoshonites are richer in radiogenic and in residual

elements such as U, Th, Rb, K than andesites. Shoshonitic magma should therefore represent either a liquid produced by partial melting of mantle peridotite overlying the subduction zone, with a minor degree of melting compared to that necessary to generate andesitic magma (as hypothesized by BARBERI et al., 1974), or the result of some process of zone refining within the mantle (MACKENZIE and CHAPPEL, 1972).

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GEOLOGICAL MAP ERRATA

Printing errors

<i>Errata</i>		<i>Corrige</i>
Pizzo o Sopra la Fossa	:	Pizzo Sopra La Fossa
Pisciata	:	Piscità

Drawing errors

- 1 - The fault line from Secche di Lazzaro to Sciara del Vento has been drawn too far off the coast.
- 2 - Some dikes cut by the cross section between Serro delle Capre and Fili di Barona have been omitted.

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CARTA GEOLOGICA DELL' ISOLA DI STRÓMBOLI

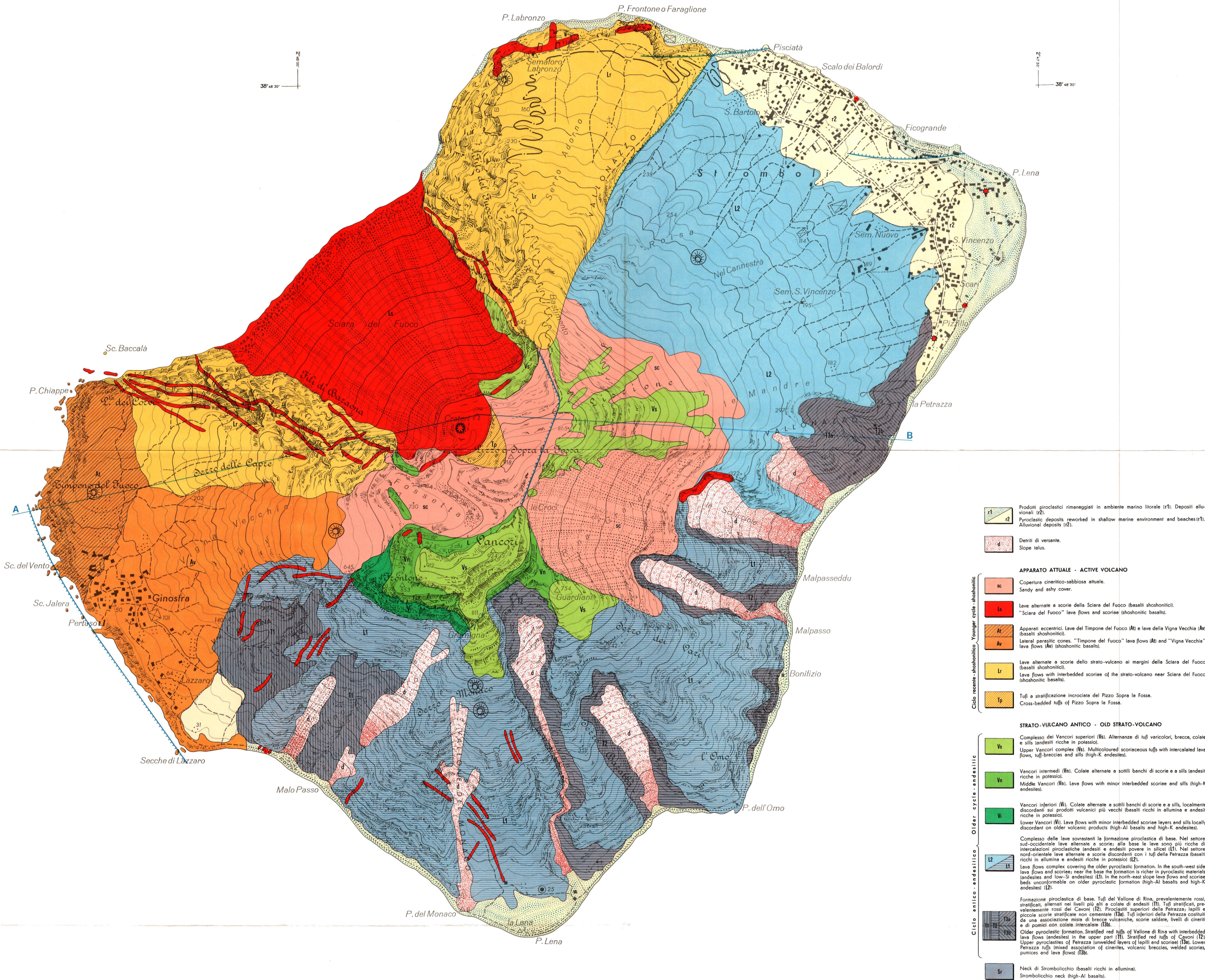
GEOLOGICAL MAP OF THE ISLAND OF STRÓMBOLI (AEOLIAN ISLANDS)

MAURO ROSI

SCALA 1:10.000



Lanterna
Strombolicchio



RILEVAMENTO ESEGUITO NELL'ANNO 1975 - MAPPED IN 1975

Controllato ai sensi della Legge 2-2-1950 n. 66. Nulla osta alla diffusione n. 61 in data 21-2-1976

