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Outlines of the Neogene and Quaternary volcanism of Asia Minor. Nota II

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Geologia. — *Outlines of the Neogene and Quaternary volcanism of Asia Minor.* Nota II di GIORGIO PASQUARÈ, presentata (*) dal Socio A. DESIO.

RIASSUNTO. — Il vulcanismo recente postorogenico in Turchia costituisce una cintura quasi ininterrotta che decorre da ovest a est lungo il contatto tra i massicci mediani anatolici e gli orogeni del Ponto e del Tauro.

Nel presente lavoro vengono messi in evidenza i principali tipi di strutture vulcaniche, dai grandi edifici centrali compositi, ai vulcani fessurali, ai vulcani semplici monogenetici, alle caldere di esplosione, discutendone la loro posizione e il loro ruolo nell'evoluzione del vulcanismo. Vengono inoltre mostrati i caratteri litologici in relazione all'evoluzione stessa, che dimostrano un'appartenenza decisa alla provincia petrografica pacifica con leggera tendenza a facies transizionali mediterranee nella regione egea.

Vengono infine descritte le serie piroclastiche, particolarmente estese in Anatolia Centrale, dandone anche un inquadramento stratigrafico.

EASTERN TURKEY AND TRANS–CAUCASIAN REGION.

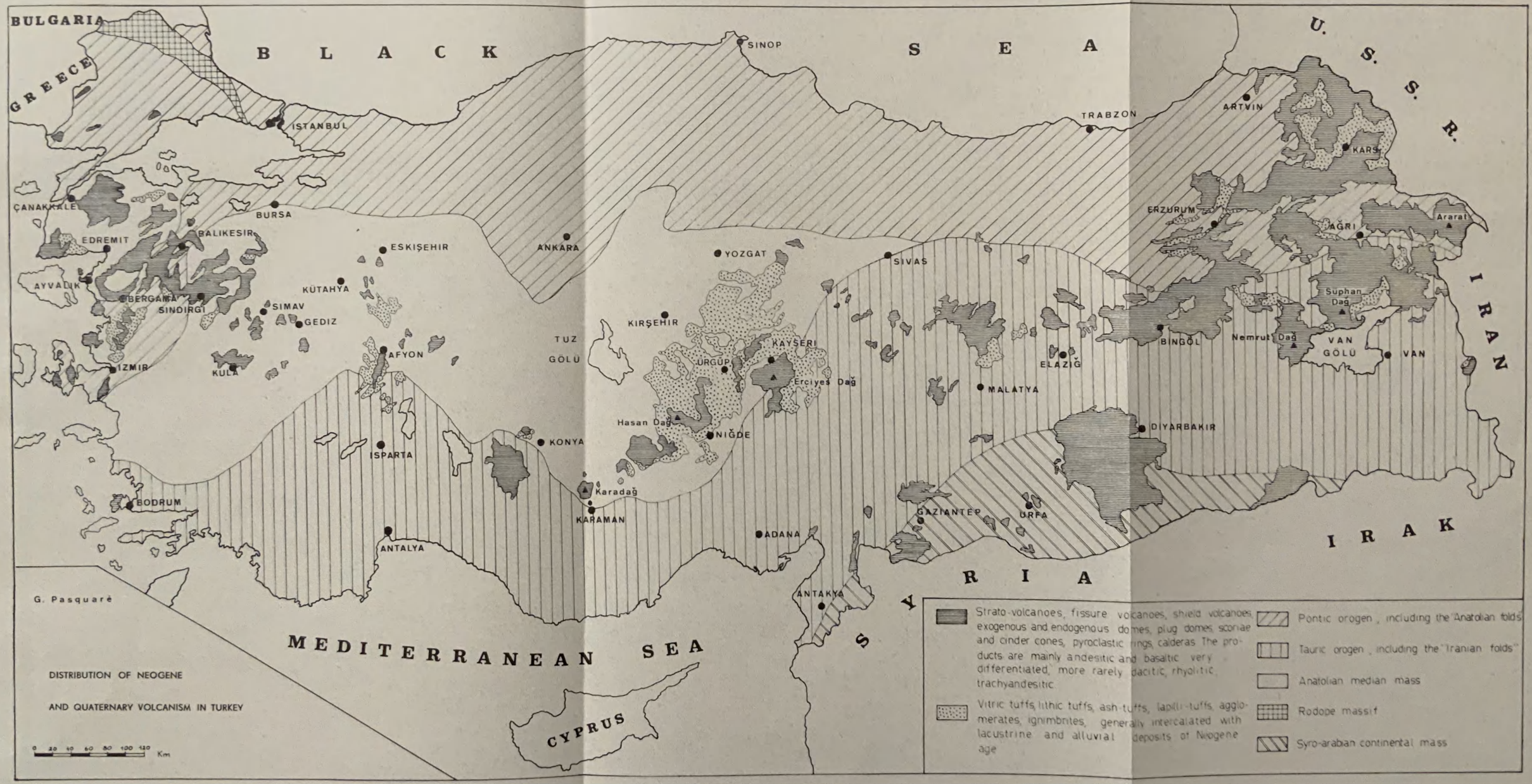
In Eastern Turkey, the Neogene and Quaternary volcanism is greatly developed, being connected north-eastward with the volcanic system of Soviet Armenia.

We can essentially distinguish three groups of activity, ranged from south to north as follows: 1) plateau-basalt eruptions, largely extended and presenting a uniform composition, developed at the marginal part of the continental Syro-Arabic mass; 2) alignment of the great polygenetic mixed volcanoes, essentially andesitic-basaltic, of Nemrut Dağ–Suphan Dağ–Tendürük Dağ–Ağri Dağ (Ararat), having a strong affinity with the south Anatolian volcanic range; 3) andesitic and basaltic outflows in form of small cones, exogenous and endogenous domes followed by great fissural basaltic eruptions, concordant with the tectonic orientation of the Pontic orogen.

Among these systems, the last one represents a volcano-tectonic situation almost unknown in the other regions of Anatolia, but highly developed here, from Bingöl as far as Erzurum and Kars, and in Soviet Armenia.

The volcano-tectonic evolution of this complex can be emphasized as follows especially for the region around Erzurum: after the synorogenic volcanism, probably of Oligocene age, mainly diffused in the chain of Palandöken Dağlari, a magmatic chamber formed under the eastern part of the Anatolian median mass, in the zone where it was assimilated by the Tauric and Pontic orogenetic ranges. The same or a similar magmatic chamber extends eastward, where the Caucasian range is joined to the Tauric and Pontic systems with strong structural discordance. At first initial perforations, ran-

(*) Nella seduta del 22 giugno 1966.


BULGARIA
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B L A C K S E A
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IRAN
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CYPRUS
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TRABZON
ARTVIN
KARS
ERZURUM
AĞRI
Ararat
ÇANAKKALE
BURSA
ISTANBUL
EDREMIT
BALIKESIR
ESKIŞEHIR
ANKARA
AYVALIK
KÜTAHYA
BERGAMA
SINDIRGI
SIMAV
GEDIZ
IZMIR
KULA
AFYON
TUZ GÖLÜ
KIRŞEHIR
YOZGAT
SIVAS
KAYSERI
URGÜP
Erciyes Dağ
ELAZIĞ
MALATYA
BINGÖL
Nemrut Dağ
Süphan Dağ
VAN GÖLÜ
VAN
Hasan Dağ
NIĞDE
KONYA
ISPARTA
Karadağ
KARAMAN
BODRUM
ANTALYA
ADANA
GAZIANTEP
URFA
DIYARBAKIR
ANTAKYA
G. Pasquarè
DISTRIBUTION OF NEOGENE
AND QUATERNARY VOLCANISM IN TURKEY
0 20 40 60 80 100 120 Km
Strato-volcanoes, fissure volcanoes, shield volcanoes, exogenous and endogenous domes, plug domes, scoriae and cinder cones, pyroclastic rings, calderas. The products are mainly andesitic and basaltic, very differentiated, more rarely dacitic, rhyolitic, trachyandesitic
Vitric tuffs, lithic tuffs, ash-tuffs, lapilli-tuffs, agglomerates, ignimbrites, generally intercalated with lacustrine and alluvial deposits of Neogene age
Pontic orogen, including the "Anatolian folds"
Tauric orogen, including the "Iranian folds"
Anatolian median mass
Rodope massif
Syro-arabian continental mass

Fig. 1.

domly scattered in the zones of minor thickness of the crust, took place with outflow of dacitic and andesitic lavas, which remained around the eruptive vents in form of domes and cones. Later, a strongly effusive activity opened the volcanic pipes again, forming cones and domes of vitric ashes and obsidians.

With this phase a great quantity of differentiated basic magma formed. It was accompanied by an ellipsoid-like curvature of the crust and by overflow of basaltic lavas mainly in form of exogenous domes with short flows.

During the next distension phase, the crust split into a system of several parallel fissures concordant with the structural orientation of the Pontic range and, partially, with those of the Tauric range. From these fissures a great quantity and quality of products was erupted: the last differentiated augite-hypersthene-olivine basalts, probably mixed with primary basaltic magma, and the gaseous sialic residuals with ejections of different compositions. Thus great fissural strato-volcanoes were formed, in direction up to 40 km, by massive superposition of basaltic lavas with double direction of flow, intercalated with explosion breccias, cemented scoriae, andesitic, vitric and obsidianeous tuffs, andesitic and basaltic lapilli-tuffs mixed with ashes.

CONCLUSIONS.

The regional distribution of the volcanic activity in Anatolia is worthy of notice and can add new geological evidence to the simple geographic distribution we used in the preceding illustrations.

Three big volcanic complexes can be distinguished: each of them is characterized by a peculiar evolutional sequence, and by similar forms and structures.

(1) The first is the Aegean region complex. This region is characterized by the presence of aggregated volcanoes, which are generally simple, and with independent, though contemporaneous development. These volcanoes are spread throughout a large area without any relationship to tectonic lines of regional importance. They show a clear inverted evolutional sequence with continuous transformation of the magmatism from acid to basic.

The sequence begins with ryolithic and dacitic pyroclastic cones followed by strato-volcanoes and endogenous domes, both of them with andesitic protrusions. Later andesitic and basaltic exogenous domes and flow-domes appear. The initial phases indicate a Pacific suite of late-orogenetic volcanism, characterized by the outflow of anatectic magmas with high explosion index, accompanied by local ignimbritic paroxysms.

The following evolution shows a certain mixture of the anatectic magma with primary basaltic olivine-bearing magma. The olivine-basaltic magma flowed out through the post-orogenic tension fractures. The hybridization phenomenon occurs under conditions of tectonic rest; this may explain the almost total absence of recurrent activities, and the remarkable contemporaneous connection of the volcanism itself. When the andesitic and, locally, trachyandesitic products of hybridization are exhausted, reduced quantities

of basaltic magma flow out to the surface by slow eruptions, often showing assimilation of sialic portions of the substratum, as shown by the typical basaltic volcanoes of Kula.

The genetical mechanism of the latter is to be related to the formation of a sub-crustal magmatic chamber, filled with oceanitic, olivine-bearing basalt. As a consequence of the long-lasting stagnation, the magma underwent a gravitational differentiation with separation of an upper part in which the gaseous transport from the depths caused an abnormal increase of sodium, and the consequent crystallization of nepheline.

The pneumatolithic differentiation appears, however, only slight and incomplete; it is interrupted by the explosion paroxysms which lead to the sudden delivery of scoriaceous, bubble-rich magmas with their pneumatolithic differentiations, and to the outflow of the deep magma enriched in olivine.

(2) The second complex can be defined as a volcanic belt, even if it presents local interruptions. This belt runs from Afyon as far as Mount Ararat, covering more than 1,200 km, wholly running parallel to the inner margin of the Tauric orogen. This belt is characterized by big central, polygenetic, mixed volcanoes, and by many simple areal volcanoes lying round the first mentioned ones. The areal volcanoes have an independent development and are scattered here and there, or ranged in lineal groups over a large area which generally coincides with the Anatolian hinterland.

The whole activity of this complex belongs to the Pacific suite. The big central volcanoes show a recurrent inverse evolutional sequence generally concluded by a phase of high explosiveness, sometimes with formation of calderas. The evolution of each big centre is clearly independent of the others, also from the chronological point of view, as it depends, for each zone, on the different maturity stage of the orogen with which it is connected, as well as on the deep structural formation of the orogen itself. Though these peculiarities are not explained so far, nor their relationships to volcanism, it can be affirmed that the Tauric orogen is distinguished by a great structural unhomogeneousness. Evidence is given by its considerable arches and virgations connected with remarkable junctions to form acute angles, by strong difference in uplift intensity, and by chronological difference in the diastrophism along the axis of the range.

The hypothesis of a Peritauric fissure with contemporaneous and interdependent development of the volcanic activity cannot therefore be accepted; such hypothesis had been put forth after some attempts at tectonic synthesis concerning Anatolia.

However, a few local volcano-tectonic systems, among them some rather large ones, could be reconstructed. The simple areal volcanoes represent one of the evolution stages that, in each one of the connected central volcanoes, overlie one another forming an uninterrupted sequence.

The mixture of anatectic and primary magmas occurred from the first stages of volcanism, giving rise to effusions of strongly plagioclasic andesite, and hypersthene basalt which are not present within the big central volcanoes.

Then a great and long-lasting explosive paroxysm occurred, of prevailingly dacitic and andesitic character, giving rise to ranges of pyroclastic cones, and to huge tabular pyroclastic blankets interrupted at intervals by ignimbritic flows. At the same time the central volcanoes were increased by conspicuous masses of andesitic lavas, and basaltic lavas with olivine and pyroxene. This was the first outflow of basic magmas and occurred also in the surrounding areal volcanoes which, in places, are ranged along deep fractures.

The great ignimbritic eruption of Erciyes Dağ occurred just after this phase of relative rest: it is one of the greatest in the world; and it would be preceded by the formation of a huge substructural reserve of anatectic magma.

It can be concluded that the differentiation of the hybrid magmas in eruptional activity from the beginning was followed by a new enrichment of anatectic products, due to deep metamorphic-metasomatic transformations.

The extension of such a phenomenon can be explained only under synorogenetic conditions: this is confirmed by the Pontian age of the ignimbritic eruption, and also by the fact that the whole marine Miocene has been uplifted to more than 2,000 m. in the central Tauric range. The outflow of indifferentiated primary basaltic magma with olivine occurred in the post-orogenic phase, as well as a few isolated manifestations of highly explosive sialic volcanism, which is probably indebted to the survival of subcrustal pockets of anatectic magma.

The same phase is also inclusive of the explosion calderas ranged along typical post-orogenic block-faulting structures, whilst the calderas opening in the great central volcanoes (Karadağ, Nemrut Dağ) seem to be due to phenomena of magmatic fall and withdrawal.

(3) The third complex, which is diffused throughout the trans-Caucasian and Armenian regions, is essentially composed of a post-orogenic effusive volcanism in which the outflow of anatectic magmas is reduced. This complex too is represented by an inverse sequence, from acid and partially explosive to basic and almost wholly effusive.

The lava and pyroclastic products are both of Pacific nature. As has already been mentioned, the origin of this activity would be indebted to the existence of large intercrustal chambers of primary olivine-basalt which, in part on account of gravitational differentiation, in part of assimilation of substratum portions, gave rise to modest dacitic and andesitic effusions, represented by areal monogenetic volcanoes, followed by strong basaltic fissural eruptions.

In spite of their shape, which is undoubtedly connected with deep longitudinal distension fissures, the fissural eruptions, besides the typical olivine-basalts, consist also of hypersthene or augite-basalts, as well as explosive intercalations of lithoid tuff also containing obsidian fragments.

This abnormal composition demonstrates the existence of magmatic chambers with contaminated, perhaps also hybrid, basalts. The rhythmical recurrence of the activity of the fissural volcanoes is due to deep repeated magmatic contributions mixed up with the differentiated ones of the subcrustal magmatic chambers.

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