

The deep-sea record of Quaternary volcanism in the Mediterranean

by

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About 20 different air-born tephra layers have been identified in deep-sea sediment cores taken by R/V *Meteor*, *Vema* and *Robert Conrad* in the Ionian and Eastern Mediterranean Sea. The *Vema* and *Robert Conrad* cores have been described lithologically and in their climatic record by RYAN 1972. Stratigraphically, the cores cover the last 400.000 years and volcanic layers occur in the upper 200.000 years. A concentration of tephra layers is found within RYAN's Y-zone, which represents the last glaciation.

Petrographical examination has shown that submarine alteration did not substantially change the composition of the tephra. Petrographic characteristics based on phenocryst content and on chemical composition of the pure glass fraction allowed to distinguish clearly different types of the parent magma, which are dominantly potash-trachytic, calc-alkaline andesitic to rhyodacitic, peralkaline, alkali-basaltic and undersaturated potassic.

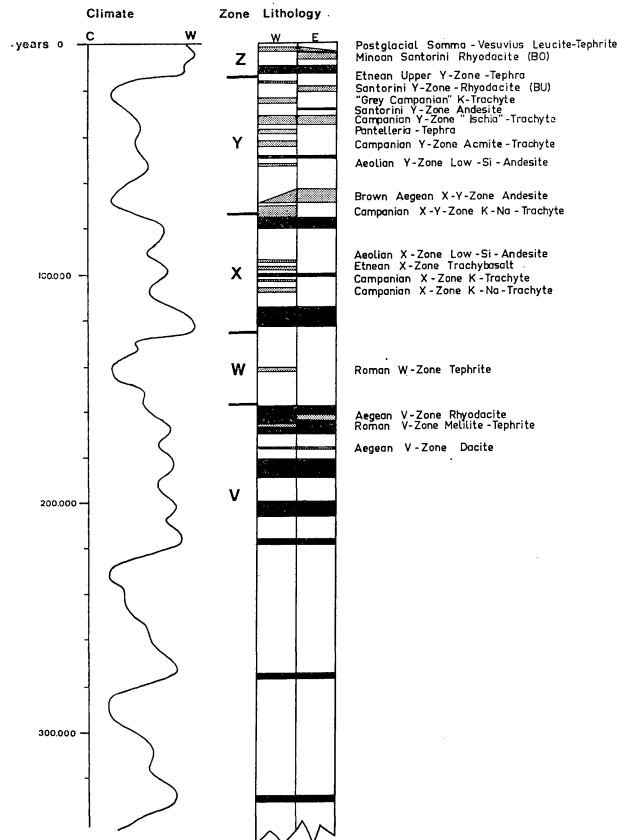


FIG. 1. — Generalized lithologic sequence and climate zones for sediment cores from the Eastern Mediterranean (after RYAN 1972, Fig. 9). Tephra-layers from several cores are projected into this sequence. The column is divided in a western part (Ionian Sea) and an eastern part (south of Crete) reflecting the different distribution of the tephra-layers. Absolute ages approximative. Tephra-thicknesses not to scale with the sedimentary thicknesses.

Rapp. Comm. int. Mer Médit., 23, 4a, pp. 195-197, 1 fig., (1975).

Suggested source areas are : Somma-Vesuvius, Phlegraean Fields with Ischia, the Roman District, Aeolian Islands, Mt. Etna, Pantelleria, the Aegean Arc with Santorini.

Somma-Vesuvius produced a leucite tephritic tephra with widespread distribution in the Post-glacial.

Previous to the Minoan eruption Santorini had a similar tephra-producing explosive activity in the last glaciation, about 20.000 B.P. Older calc-alkaline ashes from the Aegean region are not correlated with a specific event.

During the last glaciation and interglaciation there is a repeated input of very similar Campanian potash trachytes in the Ionian basin. The uppermost layer is likely to correlate with the " Gray Campanian Trachyte " of the First Phlegraean Period.

Maximum extension is determined for the " Ischia-tephra ".

Dark ashes from Mt. Etna occur in two layers only in cores near the volcano itself.

A pantelleritic tephra with a suggested age of ca. 40.000 years is the first stratigraphical determination for the activity of Pantelleria.

Low-silica andesites from the Aeolian Islands confirm such an activity for the last 100.000 years.

Two potassic tephrites in W- and V-zone respectively are correlated with the volcanic province north of Rome.

The distribution for single layers has been traced over more than 2.000 km.

References

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Interventions

M.B. Cita. — I have two questions. Please do not consider the first as a nasty one, but just as a question put forward by a person out of your field, who tries to understand which is the degree of reliability of the correlations based on tephrochronology. As far as the method of the index of refraction is concerned, are the limits of error definitely different from the differences expected from discrete tephra layers? How high is the probability that discrete tephra layers have similar or identical index of refraction? Or in other words, are the correlations based on this method alone always unambiguous?

Réponse — There is a clear answer on your first question that refractive index of the volcanic glass is only one criterion out of a whole set of morphological, physical and chemical parameters used for correlation. Refractive index alone yields only an approximative information on the petrographic character of an erupting magma. However, there exist examples where the problem of a specific correlation or alternative attribution could be reduced just on the determination of refractive index.

M.B. Cita — My second question is more serious : It deals with the age of the Ischia tephra. Tomorrow I have to discuss with CHAMLEY in Marseille the chronology of a long piston-core (Core KS09) taken during the cruise POLYMÈDE II) from the crest of the Mediterranean Ridge in the Ionian Basin, which core we are studying with different techniques. The (provisional) chronology proposed by CHAMLEY and co-workers differs from that which I am proposing for the same core by almost a factor of two. My chronology is based on correlation with other piston cores from the Eastern Mediterranean (see RYAN, 1972) and with the Pleistocene record of DSDP Site 125 (see CITA *et al.*, 1972). The chronology of the

french group is based on the age of the Ischia tephra defined by KELLER & NINKOVICH (1972) at 25 000 y and on the extrapolation of the rate of sedimentation calculated in this way to the bottom of the core. Since I do not know the paper by you and NINKOVICH, I ask you to please precise if this age has to be taken in face value and if you consider as a good practice to extrapolate the rate of sedimentation in this way. I also want to precise that volcanic tuffs from Ischia have been radiometrically dated by EVERNDEN & CURTIS [1965] at about 70000 y and that RYAN (in CITA *et al.*, 1972) correlated the Ischia tephra — which he was able to recognize in Section 1 of Core 1, Site 132- at a position with an interpolated age of some 40.000 y (see fig. 12 of CITA *et al.*, 1972).

Réponse — Regarding your second question I might firstly state that tephrochronology is not a dating but a correlation method. For the so-called Ischia-tephra several independent age determinations and age interpolations range from 24.000 to 40.000 y (KELLER, 1971, KELLER & NINKOVICH, RYAN). Recently TADDEUCCI and FREDERICI dated the source material from Ischia with 28.000 y. The age reported by EVERNDEN & CURTIS from Ischia does not refer to the same formation.

D.C. Krause — Fig. 1 of your distributed paper indicates an accelerating frequency of volcanic eruptions during the last 300.000 years. Are you in agreement with this interpretation?

Réponse — Our cores cover stratigraphically the last 400 000 years and there is indeed a concentration of tephra layers during the last glaciation.

D.C. Krause — How far back into Quaternary or Late Tertiary time do you think you can use your method in the region using such material as DSDP cores?

Réponse — The DSDP results show until now — I am referring to Site 132 — the occurrence of ash layers during the whole Quaternary. Again there is a concentration in the uppermost Quaternary.

E. Zarudzki — Which direction of prevalent high altitude winds is suggested by various ash locations relative to their sources?

Réponse — Prevailing high altitude winds are clearly from West to East, as indicated by the ash distribution. Only one layer points to the opposite direction.

E. Zarudzki — Are the current actions in the Mediterranean responsible for much of diversions from prevailing wind depositions?

Réponse — Currents in the Mediterranean Sea seem not responsible for the broad distribution pattern, but influence variations in thickness and medium grain size of ash layers.

