

Anomalous Pleistocene oceanographic conditions on the Eastern Tyrrhenian Margin reflected by faunistic and isotopic records

A.M. BORSETTI*, L. CAPOTONDI*, P. COLANTONI**, S. D'ONOFRIO***, R. TAMPIERI* and C. VERGNAUD-GRAZZINI**

* Istituto per la Geologia Marina, CNR, Via Zamboni 65, 40127 Bologna (Italia)
 ** Istituto di Mineralogia e Petrografia, Università, Urbino (Italia)
 *** Dipartimento di Scienze Geologiche, Università, 40127 Bologna (Italia)
 * Dipartimento di Scienze della Terra, Università, Torino (Italia)
 ** CNRS, Département de Géologie Dynamique, Paris (France)

Quantitative and qualitative studies of the benthic and planctic Foraminifera, of the Pteropoda, of the fluctuations in the Oxygen and Carbon isotope composition in two taxa (*Globigerina bulloides* and *Uvigerina* spp.) and ¹⁴C dating, carried out in a 390 cm long core from the eastern Tyrrhenian continental slope, at 660 m of depth, allow to define the sedimentary sequence of the last 26000 years and to postulate a past complex hydrographic regime in the area.

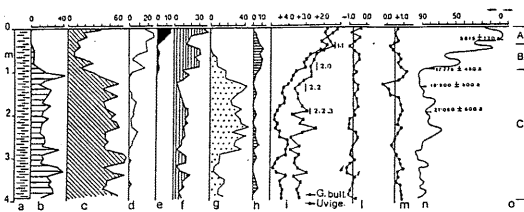
A drastic change in the assemblages of planctic Foraminifera is shown in the core at 100 cm from the top. In the lower part boreal faunas, such as *N. pachyderma*, *G. bulloides*, *G. quinqueloba* and *G. scitula*, are nearly the only species present and only between 140 and 260 cm *G. ex gr. ruber*, together with *G. dutertrei*, occurs.

In the upper part the above mentioned species decline and are replaced by varying percentages of tropical and sub-tropical forms such as *G. ruber*, *G. trilobus*, *G. sacculifer*, *G. omissus*, *G. inflata*, *G. truncatulinoides*, *O. universa*, *Globigerinella* and *Hastigerina*, *G. calida* and *G. digitata*.

Benthic Foraminifera show a clear variation at 290 cm from the top. Below this depth the assemblage is well diversified and *Sphaeroidina bulloides* and *Uvigerina mediterranea* are very frequent, whereas between 290 and 130 cm the assemblage is dominated by *Bolivina* and *Brizalina*; from 130 cm up to 40 cm the most peculiar character is the high frequency of *Gyroidinoides altiformis*, and finally the upper part of the core is characterized by the highest percentages of *Uvigerina mediterranea*.

A, B, C, zones of BUCCHERI & TORELLI 1981 are present in the Pteropoda associations: in particular the C zone has been recognized below 100 cm, the B zone between 100 and 40 cm, and the A zone from 40 cm up to the top. The results of radiocarbon dating are as follows:

31 - 33 cm	5815 ± 120 y.B.P.
98 - 100 cm	17775 ± 450 y.B.P.
138 - 140 cm	19900 ± 500 y.B.P.
198 - 200 cm	21060 ± 600 y.B.P.



a, lithology; Planctic Foraminifera: b, *G. scitula*; c, *G. quinqueloba*; d, *G. ex gr. ruber*; e, *G. truncatulinoides* - Benthic Foraminifera: f, *U. mediterranea*; g, *Bolivina* and *Brizalina*; h, *Gyroidinoides altiformis* - i, $\delta^{18}\text{O}$ *G. bulloides* and *Uvigerina* spp.; j, $\delta^{13}\text{C}$ *G. bulloides*; k, $\delta^{13}\text{C}$ *Uvigerina* spp.; l, $\delta^{13}\text{C}$ Pteropods; m, $\delta^{13}\text{C}$ Pteropods; n, Paleoclimatic curve - o, Pteropods.

Isotopic stages of Emiliani 1955, based on analysis of the oxygen composition in *G. bulloides* and *Uvigerina* spp., were also defined in the core. Isotopic stage 1, showing the well known Mediterranean characteristic has been detected from the top down to 100 cm, while below this depth it is problematic to recognize the peaks of isotopic stage 2.

Some negative peaks can in fact be interpreted as representative of stage 4; this should imply the lack of stage 3.

The $\delta^{13}\text{C}$ profile of *Uvigerina* spp. (bottom waters) parallels that of *G. bulloides* (surface waters) only in the deglaciation; while during last glacial the surface and bottom waters show different oxygenation. Moreover the $\delta^{13}\text{C}$ of the deep water has characteristics that resemble those of an open ocean rather than of the Mediterranean.

Because neither lithology nor microfaunistic analysis point out a hiatus and the study of carbonates excludes that the isotopic signal may be modified by terrigenous supplies, the explanation must be found in a particular oceanographic state of the area during the last glacial stage. We can therefore suppose that the weak positive pulse recorded by planctic Foraminifera, by Pteropods and by $\delta^{18}\text{O}$ curve coincide with a melting phase of Appenninic glaciers that brought to the sea fresh water enriched in light isotopes.

Because of the low sea level and consequent reduced seaway between Tyrrhenian and Ligurian seas, this water remained entrapped in the area for a period long enough to cause the anomalous variation in the isotopic signal and to reduce vertical exchanges between bottom and surface waters.

Isotopic $\delta^{13}\text{C}$ curve of *Uvigerina* spp. and the high frequencies of *Bolivina* and *Brizalina* record the low oxygen content, while primary productivity variations can be responsible for the anomalous trend of the $\delta^{13}\text{C}$ in the lower part of the core.

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Underwater survey of Panarea volcanic complex (Aeolian Islands)

A. CAPRA*, D. POSTPISCHL* and P.L. ROSSI**

* Istituto di Topografia, Geodesia e Geofisica Mineraria, Università di Bologna, Facoltà di Ingegneria, Viale del Risorgimento 2, 40100 Bologna (Italia)
 ** Dipartimento di Scienze Mineralogiche, Università di Bologna, Piazza di Porta San Donato 1, 40100 Bologna (Italia)

Panarea has been considered in literature as belonging to a volcanic complex more ancient than the Aeolian islands (South Tyrrhenian Sea) because the end of its activity death about 500,000 years.

New geophysical, volcanological, structural and radiometric data provide a morphological-structural reconstruction of the underwater part of Panarea volcanic complex and a model for the evolution of the whole complex.

The island of Panarea represents a small portion of a much larger submarine edifice with the overall shape of truncated cone with an eastern protusion. The base of the cone is about 1,500 m below sealevel, and has a diameter of about 23 km and an area of 460 sq km. Several lobes affect the steep eastern slopes of the cone.

Three stages characterize the evolution of the Panarea volcanic complex: 1) Development of a regular central volcano in the western sector of the complex. The island of Panarea represents the top of this volcano.

2) Eastward shifting of volcanic activity, producing development of the lobed eastern sector of the complex

3) Extensive caldera collapse of the central part of the complex and replacement, within the collapsed area, of domes and lava bodies of different affinities, some of which are basaltic.

NE-SW-oriented structures seem to have had a fundamental role during the development of the Panarea volcanic complex. These structures have been active until recent times, the datation of Basiluzzo reef with K-Ar method shows that it is younger than 10,000 years.

Some structures have regional significance because the evolution of Stromboli has been controlled by NE-SW-trending structures. Panarea and Stromboli also have similar magnetic anomaly trend, geochemical affinities, and temporal relationships of volcanism.

Others factors show that volcanic activity is still present.

Underwater researches between Basiluzzo, Dattilo and Lisca Nera reefs, at N-E of Panarea, led to the discovery of submersed structures at 15 metres depth, that probably manufactured, perhaps identifiable with Roman hand-made contemporaneous to known presence on land (about 2000 years old).

The subsiding of 15 m. in 2000 years is very considerable and, not being bradisism phenomenon in this area, is to ascribe to tectonic events related to a volcanic activity and probably to caldera evolution, when even Roman wharf gives evidence because it is submersed at 3 m. depth in the island of Basiluzzo.

We found many of submarine emissions in large zones near Panarea. The gas analysis of these fumarole samples verified the presence of magma in the substrate. This result is further evidence of activity in the volcanic complex.