The Problem : need for a biomagnetostratigraphic reference section representing a marine miocene mid-latitude environment. The Answer : re-occupation of DSDP Site 372 (Balearic Basin)

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The correlation of biostratigraphic events to the geomagnetic polarity scale forms a basic element in most attempts to develop a Cenozoic geochronology. It suffices to combine biostratigraphic and magnetostratigraphic data within the framework of a single time scale in order to establish a reliable chronology for deep-sea sediment sequences. The degree of accuracy of such chronology depends largerly on the proper identification of the reversal sequences. Uncertainties arise chiefly from the difficulty of retrieving complete magnetostratigraphic sequences that represent long periods of time. But once adequate magnetostratigraphic sequences are established, we can use biostratigraphy as a key to unravel chronologic relationships.

The need for improved chronological control has increased vastly over the past few decades, and the continous success of modern paleoceanography is closely linked to our ability to understand chronology.

A reasonable number of deep-sea sections is now available from low and mid-latitude environments that possess adequate magnetostratigraphies, encompassing the past few million years. Thus, many Pliocene and Pleistocene biostratigraphic events are tied directly to the magnetic polarity zones. In contrast to this latest Neogene situation, it is surpsising to note that we still do not possess a single continous Miocene section with adequate magnetostratigraphy. The most problematic Miocene interval in this respect covers the interval from the basal Tortonian stage to the Upper Burdigalian stage, or between Anomaly 5 time and Anomaly 6 time in terms of the marine magnetic anomaly time scale. On a geochronometric scale, this interval represents the time span between about 10 Ma and 20 Ma. Even when viewing the entire Cenozoic stratigraphic column, this particular Miocene interval is associated with some of the least precise, or least accurate, bio- and magnetostratigraphic correlations. The Miocene correlation problem presumably results from several interacting phenomena, such as :

(a) short duration of the polarity zones,
(b) existence of large scale hiatuses and unconformities,
(c) low sedimentation rates and loss of biostratigraphic resolution because of dissolution problems (deposition close or below the lysocline).

The solution to the stratigraphic problem lies in the retrieval of continously deposited sedimentary successions representing primarily the Burdigalian-Langhian-Serravallian-Tortonian stages, from a deep-sea depositional setting. These sections should display sedimentation rates in excess of 10 cm/1000 years in order to avoid the pitfalls that resolution problems may cause.

DSDP Site 372, drilled in 1975 in the western Balearic Basin (HSU, MONTADERT *et al.*, 1978) has the potential to solve the problems outlined above.

The succession (Fig. 1) is continuous underneath a major gap related to a Messinian erosional surface.

Nannofossil zones NN1 to NN7 and foraminiferal zones N5 to N1 have been identified (BIZON, CITA & MULLER, 1978). This expanded preMessinian hemipelagic section is 700 m thick, and is potentially well suited for magnetostratigraphic studies.

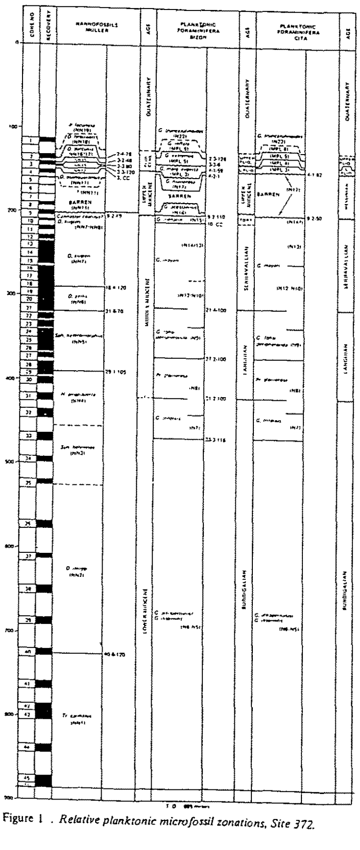

Figure 1 . Relative planktonic microfossil zonations, Site 372.

No continuous coring was accomplished, and no magnetostratigraphic investigations were carried out. With deeper penetration, even the Oligocene/Miocene boundary could be reached, since the initial rifting of the Balearic Basin should have started in the late Oligocene.

This mid latitude Miocene succession is very close to the typesections of the Langhian, Serravallian and Tortonian stages, originally defined in Italy, and of the Aquitanian and Burdigalian stages, defined in France. Thus, it has the advantage of offering easy correlations with the type sections (same bioprovince, similar paleoclimatic situations), but a depositional continuity that no landbased section deposited in an epicontinental marginal basin can provide.

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REFERENCES

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New Data on the structure of the Sardinian Underwater Margin in the Tyrrhenian Sea

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New additional data on the structure and composition of the Sardinian margin in the Tyrrhenian Sea were obtained during the 10th leg of RN "Antares", which was carried out in the Mediterranean Sea in the summer of 1991 by the Institute of Lithosphere of the Russian Academy of Sciences in collaboration with Italian scientists from the Ferrara, Udine and Torino universities. The following conclusions could be drawn:

1. Gneisses, quarzites, schists and metabasalts dredged at the Cornalia mountain and in the southern edge of the Baroni ridge, confirm that the Sardinian margin basement is mostly composed of the Paleozoic metamorphic complex, exposed in Sardinia. Of particular interest are findings of basalts and diabases metamorphosed in the greenschist facies.

The content of minor elements (Tio_2=1.94%, K_2O=0.2%, Ni=238 ppm) and their ratios (Ti/Zr=80, Zr/Y=4.9, Zr/Nb=24, La 104/Ti=6.01) point to affinities to MORB-like tholeiites. They are somewhat similar to ophiolitic and "schistes lustres" basalts developed in Corsica and supposed to be of Late Jurassic age. This implies that the ophiolite sequence obducted upon the metamorphic basement from the west, also extends along the underwater margin of Sardinia.

2. The sedimentary cover of the Sardinian underwater margin has a maximal thickness amounting to 600m. It comprises three stratigraphic unites embracing the time interval from the Late Miocene to the Holocene and lies unconformably on the acoustic Paleozoic-Jurassic (?) basement. If the last epoch of the basement fold-nappe deformation was completed as in the Apennines, the lower pre-Messinian sedimentary complex should belong to the Tortonian. The same age for these formations was obtained by the shipboard party of ODP Leg 107 on the basis of the materials of Hole 654. The seismic profiling data suggest that initially this complex must have been continuous and that its absence in certain parts is due to pre-Messinian and later erosion.

3. The thickness of Messinian evaporites reflects differentiated block shifts, connected with rifting in the Tyrrhenian Sea in Messinian time. The absence of Messinian deposits on certain blocks may be explained either by a position higher than the level of the brines, or by later erosion. The occurrence of underwater-slumping or underwater-avalanche deposits confirms the intensity of tectonic movements during the Messinian.

4. Pliocene-Quaternary deposits unconformably overlie the older deposits up to the basement, locally adjoining them unconformably and revealing facies changes near the uplifts. This is indicative of pre-Pliocene movements along faults. Intensive movements were also recorded in Late Quaternary and in fact determined the recent structure of the margins. Salt diapirism also occurs at that time. These young movements are synchronous with the opening of the easternmost deepwater basin of the Tyrrhenian Sea - the Marsili basin.

5. A previously unknown volcano has been discovered on the southern edge of the Baroni ridge. Slightly altered basalts corresponding petrochemically to MORB tholeiites have been dredged here. It differs from the MORB-like tholeiites have been dredged here. It differs from the MORBlike tholeiites drilled in the deep part of the Tyrrhenian Sea in being enriched in incompatible trace elements (Rb=9 ppm, Ba=109 ppm, Sr=621 ppm, La $10^4/1$=14.2), similar to MORB E-type.

Moreover, according to continuous seismic profiling data, a Tortonian or pre-Tortonian caldera-like structure buried under sedimentary cover is inferred to exist. The new data as well as previous ones suggest an extremely intensive tectonic mobility of the Sardinian margin under active extension from the Late Miocene to the present, i.e; during the opening of deep Tyrrhenian basin.

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