THE CRUST OF THE IONIAN ABYSSAL PLAIN - OLD OCEANIC ?

Werner Hieke [1]*, Hans B. Hirschleber [2], G. Ali Dehghani [2]

[1] Technische Universität München, Lehrstuhl für Geologie, Lichtenbergstr. 4, 85747 Garching, Germany
[2] Universität Hamburg, Institut für Geophysik, Bundesstr. 55, 20146 Hamburg, Germany

Abstract

New observations from the Ionian Abyssal Plain give arguments for a thinned continental crust underneath. They support the idea that the abyssal plain is not a relic of the Jurassic Tethys ocean but part of the Adria promontory of the African plate.

Key-words : crust structure, Ionian Sea

The nature of the crust beneath the Ionian Abyssal Plain (IAP) is contested at all times. Base of the controverse interpretations are seismic observations and models as well as plate tectonic reconstructions made to explain the mountain building processes of the Alps-Apennines-Hellenides system. The spectrum of interpretations includes: oceanic and thinned continental crust, thicknesses of the igneous crust between 5 and 50 km, ages of the crust between Lower Jurassic and Miocene.

A synopsis of the published interpretations of the crust beneath the IAP is given by Hieke and Dehghani [1].

The controversy can be simplified to the extreme questions:

- Is the IAP underlain by an old oceanic crust as a relic of the Tethys or by a young, thinned continental crust ?
- Is Adria a microplate separated completely from the African plate since Jurassic time or is Adria only a promontory of the African plate even with a fragile connection to the main part ?

The published data and observations allow to find support for various scenarios. Thus, the data are obviously not as definite as necessary for a clear interpretation. New observations made during the campaigns MEDRAC (cruise *Valdivia* 120, 1992) and MEDRAC II (cruise *Meteor* 25/4, 1993) may help to clarify the contested situation.

The southeastern corner of the IAP is traversed by a narrow, SW-NE trending subbottom structure (Victor Hensen Structure = VHStr). There, pre-Messinian non-volcanic rocks rise to higher stratigraphic levels and culminate in the Victor Hensen Seahill (VHS). In the southwestern prolongation of the VHS, this structure also rises above the seafloor, building the Victor Hensen Seahill 2 (VHS-2) within the Medina Ridge Glacis. Northeast of the VHS, the VHStr obviously influences the relief of the deepest part of the Mediterranean Ridge flank where the isobath trend changes from the usual S-N to a SW-NE orientation (Fig. 1).

The reported elements of the VHStr are separated from each other and shifted in a left-lateral sense. Following this sense, VHStr can be connected with the eastern finger of the Medina Ridge. A reflection seismic profile crossing the latter shows a structural situation which is almost identical with those of the VHS and the VHS-2. Therefore, the complete chain from the eastern finger to the SW-NE trending isobaths on the Mediterranean Ridge flank is considered as a particular structure with a minimum length of 270 km (Medina-Victor Hensen Structure = MVHStr). Recent or subrecent vertical movements are documented along this structure.

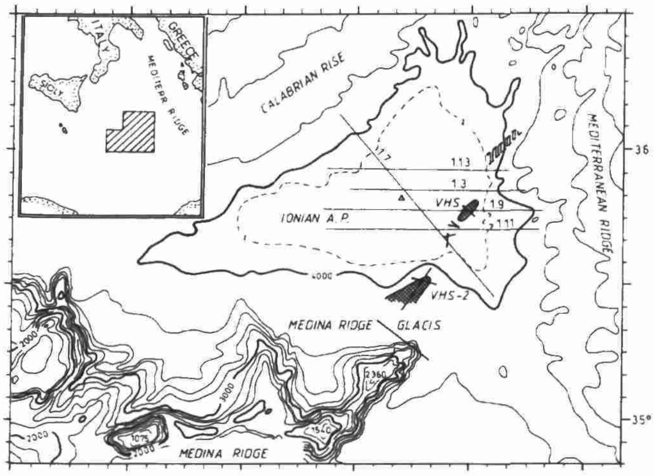

Fig. 1: Bathymetric map of the central Ionian Sea (IBCM). Isobaths in meter. Dashed line: Contour of the Ionian Abyssal Plain. Crosshatched: VHS and VHS-2. Hatched: Area of SW-NE trending isobaths. Unnumbered short lines: bottom and subbottom records of VHStr. Numbered lines: reflection seismic records (MEDRAC). Triangle: DSDP Site 374.

The area of the VHStr is characterized by a strong positive Bouguer gravity anomaly. In contrast, the pattern of the residual magnetic anomalies is not easy to correlate with the VHStr. The eastern finger of the Medina Ridge is not conspicuous in the Bouguer gravity but characterized by positive magnetic anomalies. Details are published by Hieke and Dehghani [1].

The MVHStr is the most spectacular one in the plain but not the only one. It is accompanied in the northwest by a similar structure of less extent (Nathalie Structure = NStr). The existence of more structures is not yet evidenced.

VHStr and NStr are prominent elements in a tectonic pattern which dominates the main part of the subbottom of the IAP (recorded along tracks 1.13, 1.3, 1.9, 1.11 and 1.7 in Fig. 1): Tilted sequences of parallel reflectors beneath the Messinian evaporites as shown in Fig. 2 (as an example). Tilted blocks are characteristic features originating during rifting of continental crust. The tilted units have a SW-NE orientation similar to those of the VHStr and the NStr which may represent extreme horsts (more details will be published by Hieke *et al.*) [2].

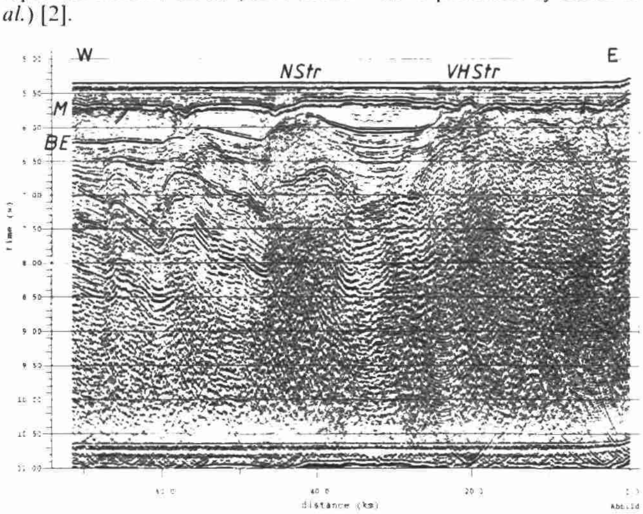

Fig. 2: Multichannel seismic line 1.11. M = Reflector M (top of evaporites). BE = Base of evaporites.

The Medina Ridge is accepted generally as an area underlain by continental crust. From our observations we conclude the following concerning the nature of the crust underneath the IAP:

- The 270 km long and only a few kilometers wide MVHStr comprises the eastern finger of the Medina Ridge (continental crust) as well as those parts passing the abyssal plain (oceanic or thinned continental crust). This is a powerful argument for the same kind of crust beneath the Medina Ridge and the Ionian Abyssal Plain - namely a continental one though in different stages of thinning.
- The tilted units underneath the abyssal plain support strongly the idea of a thinned continental crust.
- The age of the wedge-like syn-rift sediments (just pre-Messinian) suggests a maximum activity of the rifting processes during Miocene times. Dislocations of the M Reflector (top of the evaporites) as well