A detailed reflection profiling survey in the Eastern Mediterranean

by

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Cambridge seismic reflection profiles from a regional survey showed that in one part of the Herodotus plain there is a large thickness of sediment which is strongly deformed. The result of a small-scale seismic reflection survey is that the deformation in the selected area is probably due to salt tectonics, not compressional tectonics.

The survey is centred on 33°40' N, 28°50' E, in the Herodotus plain, on the margin of the Nile Cone, in a water depth of about 3 km. The grid consisted of eight lines 45 km long in a direction 045°, and eight lines perpendicular to these. The lines were spaced 5 km apart. Navigation was by satellite and moored radar transponder. The profiles were made with a 2.7 litre airgun with a repetition rate of 10s. Sediment velocities were obtained in the flatter sedimentary basins using sonobuoys and a 5 litre airgun.

The profiles show that the area is not an abyssal plain, as sediment is ponded between highs in an underlying sedimentary layer. The highs are up to 0.5 km above the level of the sediment ponds. The ponded sediment bends up at the edges of the ponds; as this would have been deposited initially flat this indicates that the highs are still rising. Below the ponds there is a sequence of reflectors becoming more highly bent at depth.

The deepest continuous reflector that can be seen (up to 3.5s below sea bed) is thought to be the reflector M from the western Mediterranean which is above the Messinian evaporite sequence. The velocity above this reflector is 3.2 km. s^{-1}. No velocity could be obtained below this reflector.

A bathymetric map of the grid shows approximately circular rises and flat sediment ponds.

A contour map of depth to the deepest reflector shows a strong linear high in a north-south direction. Superimposed on this are smaller, approximately circular rises.

The problem in this area is the origin of these structures. Profiles show the following features :

1. The deep reflector is continuous over the grid area.

2. The rises are 10 - 20 km wide at their bases.

3. The gradient of the sides of the rises is 20 - 30°.

4. The sedimentary sequence is less deformed higher in the sequence.

5. The sediments thin over the highs, but are continuous over them — no higher reflectors end against the deepest reflector.

6. There is faulting over some highs.

7. The recent ponded sediment is best up at the highs.

There are no magnetic anomalies associated with the highs so they are not caused by doming above an igneous intrusion. The structures could be caused by syn-depositional folding, or sedimentary doming. I do not think folding is the cause as an east-west axis of compression would be needed to produce a north-south fold, and there is no evidence for such a compressional axis in this part of the Mediterranean. The structures are probably caused by sedimentary movement, probably salt flowage as this is known to be present by drilling under reflector M in the Mediterranean. This is consistent with all the features seen on the profiles.

Rapp. Comm. int. Mer Médit., **23**, 4a, pp. 219-220 (1975).

The origin of the N - S feature is not obvious. Linear salt features in an area generally have the same trend, as in northern Germany or Mexico, so this feature may be part of a regional trend in this area. It is not caused by fractures in reflector M., as in the western Mediterranean, or a sediment loading effect, as in the Gulf of Mexico which produces salt features parallel to a coast or delta, as the Nile Cone adjacent to this area has a north-east trending edge. It may be caused by basement structures.

The extent of these intense tectonics is limited to an area 60 km^2 .

Intervention

G. Flores. — Do you have gravity data on the features discussed? Do you have interval?

Réponse — We have no gravity data for this survey, but gravity profiles across nearby highs have negative Bouguer anomalies.

G. Flores — Do you have interval velocity measurements in the supposed salt?

Réponse — We have no interval velocity measurements in the diapiric material below reflector M.

G. Flores — The features could also represent high pressure shale diapirs, since they occur within great thicknesses of shales in a fairly deep basin.

Réponse — Yes, we have not enough evidence to distinguish between salt and shale diapirs.