MUD VOLCANOES, GAS CHIMNEYS, POCK-MARKS AND MOUNDS IN THE NILE DEEP-SEA FAN (EASTERN MEDITERRANEAN)

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Abstract

The Nile continental margin is characterized by numerous fluid seepages which have been well imaged by different geophysical technics and particularly by swath and acoustic data. These features, expressed by mud volcanoes, gas chimneys and pockmarks, occur in diferent settings and reflects different processes of fluid emissions on the sea bed.

Keywords : Nile continental margins, deep sea fan, fluid seepages, deep environnements

The Nile turbidite system, or Nile deep sea fan (NDSF), represents an area of about 100 000 km^2 which results from deposition, chiefly since latest Miocene, of thick salt-bearing and terrigenous sediments covering a segment of the Mesozoic African passive margin of Mesogea (1). Several 360 channel MCS profiles, collected in summer 2002, have allowed us to investigate and image, locally down to the Moho, this African passive margin segment. The terrigenous cone, fed by erosional products transported by one of the world's most important rivers, the Nile river, has moreover been nearly entirely mapped by swath bathymetry and back-scatter imagery during two geophysical surveys run in 1998 and 2000. Simultaneously, continuous high resolution and 3-5 kHz seismic reflection profiling, as well as magnetic and gravity measurements, were recorded; and several Kullenberg piston-cores were collected (2).

In different areas of the NDSF, subdued sub-circular bathymetric features, suggesting active fluid releases and vents directly on the sea bed, have been discovered (3). Some of these, particularly at depths around 3000 meters within the north-western NDSF, are characterized as small cones, ranging from 100 to 900m in diameter and a few tens of meters in elevation; locally small cones are associated with large caldera-like depressions.

Along the NDSF upper continental slope (between 1000 and few hundred meters of water depth), a few large flat subcircular (5 km in diameter) mud "pies" delineate a belt of apparently very active gas chimneys. Most of the fluid-releasing features are clearly fault-controlled. In 2000, two cores, one on a mud cone and a second on a gas chimney, have yielded structure-less and gassy muds with high sulfide content, including rock clasts.

Finally, numerous pock-marks, or mounds, have also been identified on the seabed; depending on the areas, these are associated with strongly destabilized sedimentary masses or with gas chimneys. Most of these fluid-rich features are found in regions where underlying Messinian evaporites are extremely thinned and nearby growth faults act as conduits (3).

More recently (September 2003) the NAUTINIL expedition, the first phase of the European scientific project MEDIFLUX (2003-2006) within the Euromargins programme initiated by the European Science Foundation which involves research groups from France, the Netherlands and Germany, has allowed the observation and demonstrated the occurrence of active fluid seepage through the seafloor at several of these features.

On the Nile margin five main parameters influencing fluid release locations are distinguished: (1) the presence, at depth, of potential source rocks and reservoirs; (2) the regional distribution of Messinian evaporites whose presence may prevent upward fluid migration; (3) the distribution of sedimentary loading which may induce localized overpressures on under-compacted and fluid-rich sediments; (4) the presence of a network of syn-sedimentary faults acting as potential conduits for fluid migration; and finally, and chiefly for pockmarks and mounds, (5) areas submitted to large scale sedimentary instabilities.

References

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