Sedimentology, texture and composition of the mud diapirs and mud volcanoes of the Mediterranean ridge

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From 1978 to 1990 twentyt-wo of the sixty piston and gravity cores raised from the four mud diapiric fields identified on the crestal area of the western and central Mediterranean Ridge (Figure 1, CITA *et al.*, 1989; CAMERLENGHI *et al.*, in press) have recovered a sticky dark grey matrix-supported brecciated material containing sedimentay clasts of millimetric to centimetric size. The term mud breccia has been used since 1981 as a descriptive term to identify the lithology of this material (CITA *et al.*, 1981).

The mud breccia has been characterized in its mineralogical composition (carbonate content and clay mineral identification), paleontological content (foraminifera and cooccoliths), texture, sedimentology, geochemistry (gas content, carbon and oxygen isotopic composition), and physical properties.

The main characteristics are:

Lithology: There are no major differences among the different investigated fields. A dark grey (hue 7.5 to 2.5 YR, Munsell Soil Colour Chart) mud breccia with a typical yellowish oxidation layer at the contact with the host hemipelaic oozes is found. The matrix is composed of clay and silt. Most of the clasts have a marly composition, range in color from gray to light brown, and are slightly indurated. The total carbonate content measured on the matrix varies from 12 to 34% in the central Mediterranean Ridge fields, and is only a few percents in the westernmost field. Gas is present (methane and higher hydrocarbons).

Texture: We have distinguished three types of mud breccia. A coarse, firm type where clasts are contimeter-size, and no foliation can be observed; a fine type with millimetric clasts often organized in rough bedding; a muddy-homogeneous type, with very fine grain size composition, homogeneous texture, and millimetric gas vescicles.

Sedimentology: Sedimentary structures can be clearly identified only in the fine type of mud breccia. Planar bedding, rough sorting and finig-up gradation can be recognized. A quantitative analysis of the millimetric indurated clasts retained by the 63μ sieve shows that shape is mostly spherical and elongated.

Composition: the material retained by the 63μ sieve shows quartz, carbonatic fragments, siltstones, shales, glauconite, and pyrite. The clay mineral composition shows higher abundance of smectite in the eastern diapiric fields, where the clay mineral assemblage resembles that of the present Nile derived sediments. An indurated quartz-arenite clast suggests an origin related to the Peleozoic sandstones of the Syrte Basin or to the Oligocene-Miocene Numidic Flysch facies of Northern Africa.

Stratigraphy: The Mud breccia is not found in a precise stratigraphic position. It has been found interfingered in hemipelagic sediments from Late Pleistocene to Holocene. The age distribution of the foraminiferal and nannofossil taxa indicates highest abundance in the Late Oligocene and Lower Miocene for the eastern fields. The Western field shows Aptian (middle Cretaceous) foraminiferal tests.

Physical properties: Consolidation tests performed on oriented specimen indicate that the mud breccia behaves as a remolded material. Very little or no anysotropy has been found in the consolidation curve and the porosity resulted slightly lower than in the surrounding hemipelagic sediments (about 50%). SEM observation of undisturbed specimen did not reveal orientation of the sediment microfabric.

These compositional, textural, and sedimentological observations allow to conclude that :

1) The mud-breccia has been intruded in recent sediments in low shear strength condition as an underconsolidated material. Part of it has been extruded on the sediment surface as a mud volcano that has originated mud flows.

2) In the three eastern fields, the mud breccia has been originated from Late Oligocene-Early Miocene clay rich formations belonging to the African geological domain. We tentatively identify the fine grained facies of transitional environment deposits like the Marada Formation of the Sirte Basin (SELLEY, 1969), widely distributed on the northern african margin, as a possible source material. In the westernmost field the extruded material is older (Aptian) and no source formation has been so far identified.

Finally, we point out the striking textural similarity between the Mediterranean Ridge mud breccia and some of the sedimentary melanges of the Apenninic chain.

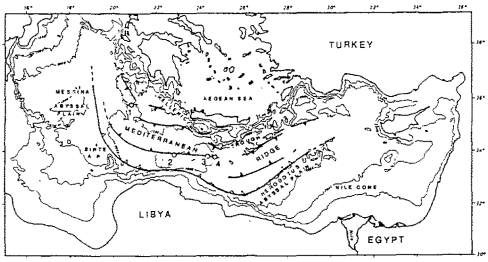

Figure 1. Location of the four diapiric fields: 1- Cobblestone Area-3; 2 - Pan di Zucchero Area; 3 - Prometheus-2 Area; 4 - Olimpi Area.

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