TECTONIC CONTROL OF MUD VOLCANOES FROM THE CENTRAL MEDITERRANEAN RIDGE (SOUTH OF CRETE): A MULTISCALE ANALYSIS.

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Abstract

Recent marine investigations over mud volcanoes of the Central Mediterranean Ridge, based on multibeam echo-sounding (PRISMED II cruise, 1998), deep-tow side scan sonar (MEDINETH survey, 1999) and deep-dives (MEDINAUT cruise, 1998), illustrates obvious relationships between mud expulsions on the sea-floor and tectonic features. At a regional scale, swath-mapping data show evidences of close genetic relationships with structural trends cutting across the Crestal domain of the ridge. Complementary near-bottom observations, and sampling, over a few characteristic mud domes, provide new constraints of this tectonic control, and allow to precise some mechanisms of mud emplacement.

KeyWords: Mud volcanoes, tectonic control, swath-mapping, deep-tow side scan sonar, Central Mediterranean Ridge, Eastern Mediterranean.

The top of the Mediterranean Ridge (MR), in Eastern Mediterranean, is covered by abondant sub-circular bathymetric features (Fig. 1), made of heterogeneous and heterometric clasts in a clayey matrix (2) and commonly known as "mud volcanoes" according to their morphology. Over the Central MR, the distribution of these features is now relatively well know (3, 4) and their genetic relationships with backthrusting (1) as well as with thrusts and transcurent features (5) are well imaged, at a regional scale, by swath-mapping data.

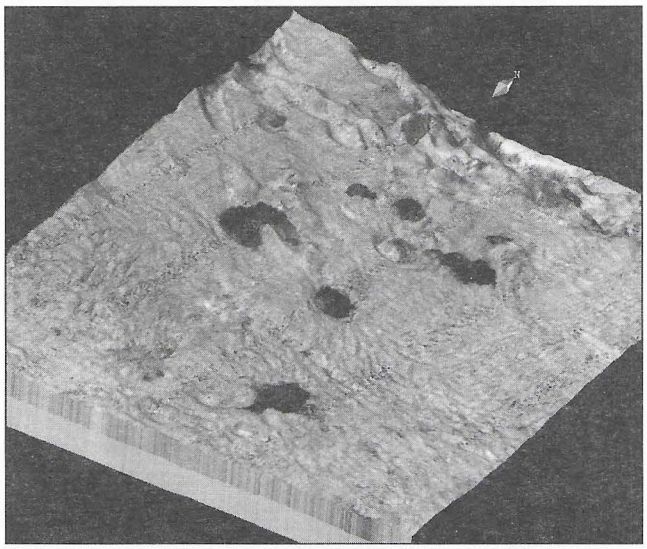

Fig. 1 : 3D-view ofthe Olimpi mud volcanoes field South of Crete. High back-scatter patches indicates recent mud breccia flows.

Integration of these data with ORE-Tech near-bottom side scan sonar records over some of these mud features (MEDINETH survey, 1999) allow to image in details these mud-generated constructions and their successive mud flows, as well as associated brines and carbonate crusts (Fig. 2). They also stress the contrast between small weakly reflective subcircular mud domes (1-2 Km in diameter) and large highly reflective "mud volcanoes" (5). Deep-tow complementary profiles provide new observations of the relationships between mud constructions and tectonics, particularly potential influence of strike-slip faulting. Several examples of mud domes connected with potential riedel-type secondary faults are evidenced.

The MEDINAUT survey (1998), has yielded new near-bottom in-situ observations and rock samples on a few characteristic mud domes, through 20 dives performed with the submersible Nautile. Analysis of videos provides additionnal images of successive mud flows, associated fluid seeps and close associations with active tectonic features; fault escarpments are clearly seen during these dives in connection with mud flows and mud volcanoes (Fig. 3a). Moreover, detail studies of clasts sampled during these dives, help to precise some characters of mud expulsion mechanisms, and subsequent evolution of mud volcanoes. For example, the composition and age gives data concerning paleoenvironmental conditions of deposition, detailled microstructural study shows close control of the clast shapes by early microfractures (Fig. 3b). Subsurface alterations seen on most of the samples are indicative of complex cold-seep context related to mud expulsion.

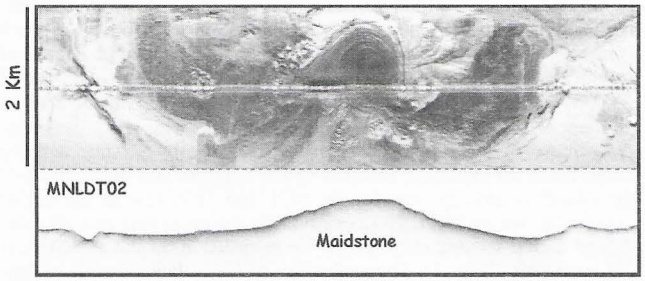

Fig. 2 : Ore-Tech deep-tow side can sonar profile recorded accross the Maidstone Mud Vulcano during the MEDINETH cruise (1999). Variable back-scatter strength indicate successive mud flows, and subcircular chaotic patches are typical of carbonated crusts.

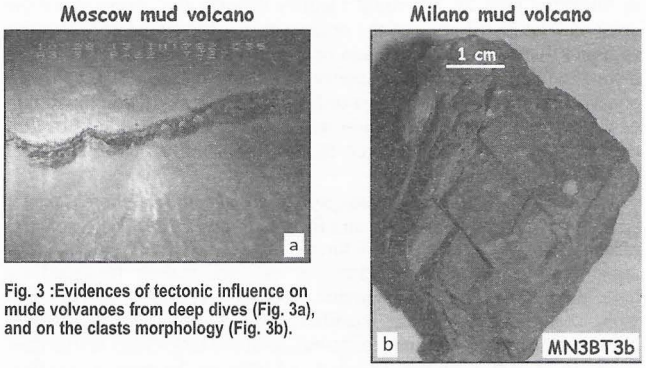

Fig. 3 :Evidences of tectonic influence on mude volvanoes from deep dives (Fig. 3a), and on the clasts morphology (Fig. 3b).

In summary, a clear tectonic control of mud volcanoes is well supported at a regional scale (the entire sedimentary prism), as well as at a local scale according to near-bottom side scan sonar records and deep dives observations.

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