O4-1 IMAGE CHARACTERISTICS OF THE MEDITERRANEAN SEA AND THE BLACK SEA MUD VOLCANOES AND SEA BED FEATURES

G. CIFCI and M. ERGUN
Dokuz Eylul Universitesi Muhendislik Fakultesi Jeofizik Muh. Bolumu 35100 Bornova-Izmir, Turkey
E-mail: gcifci@izmir.eng.deu.edu.tr

Deep-sea mud volcanism is known from many different parts and tectonic settings from all over the world. These features are important, because they can provide unique information about the deeper geological structures and lithologies and, through e study of the composition and age of associated gas and traces of hydrocarbons, on the source rocks and geochemical conditions at depth. Mud volcanoes are plano-conical features exhibiting relief of up to several hundred meters on the seafloor. Their base dieters range from less than one to over three kilometers. Waves and currents severely restrict these parameters. Mud volcanoes are built of mud cone material accumulated on the sea floor. In some cases, rock fragments up to two or three meters in diameter found in the extruded material. The size of the cones of mud volcanoes themselves depends both upon the frequency of eruption and the character of the solid materials ejected. The lithological composition of the mud breccia (composed of a mixture of clay ground-mass with more or less angular blocks of solid rock material belonging to various stratigraphical horizons) is prime governing factor in the size and shape of the volcanic cone. When the mud breccia is thick, the volcano takes the form of a ce with steep flanks, conversely, when the mud breccia is abundantly thinned with water, the volcano is low in height and tends to be flat and after eruption has ceased, may even develop a concave cone. Presently, the mud volcanoes in the Black Sea and the Mediterranean Sea are among the world's best studied.

Generally the following data were collected during the cruises: Multibeam swath mapping (as well reflectivity), single channel high resolution seismic data, data of the deep tow combined system of side-scan-sonar and sub bottom profile and geological sampling with gravity corer. During the expeditions of Training-through-Research (TTR), a SIMRAD EM 12S low frequency (13 kHz) multibeam echosounder was used to make both high resolution bathymetric and reflectivity maps of the sea floor. The basic model of the echosounder EM 12S, which has an angular coverage sector of 120^0, is composed of several units as transmitter subsystems, transducer array etc. It has full area coverage with a swath width up to 8 times. A single channel seismic system was used during the surveys. The seismic source is composed air gun source (3 litres or two different air gun). The streamer is composed 100 m active section towed behind vessel by 500 m distance. The MAK-1 system is esigned by Yuzmorgeologiya Co. (Russian Federation) to obtain acoustic images of both the sea floor surface (side scan sonar) and sub bottom sediments (sub bottom profiler). This system makes it possible to obtain acoustic images of the sea floor surface th the side scan sonar system for a swath of up to 500 m per side in long range mode (30 kHz) and up to 200 m per side in high resolution mode (100 kHz). The sub bottom profiler works at 6 kHz frequency. This system has to be operated at 1 to 2 knots.

On the Mediterranean Ridge, mud volcanoes and clay diapers are widely distributed along its crustal parts. Before TTR cruises four mud volcano areas have been determined namely: the cobble stone area 3 (Prometheous), the Pan di Zucchera, the Premetheous 2, d the Olympic area. New mud volcanoes and structures were discovered at the Mediterranean Ridge on the eastern end towards the Florence Rise, and situated between the northern and southern deformation fronts of the ridge, named "United Nations (UN) Rise" during the UNESCO-TTR 5 cruise. Some features of the mud volcanoes in the Eastern Mediterranean are similar to the ones in the Black Sea with some differences. They disclose dome like structures. The lower part of the bright spots in the dome like structure in the Eastern Mediterranean indicate gas charged layers covered by the gas hydrate "shield", preventing the escape of gas content. The sizes and the intensities of the bright spots can indicate the amount of gas content.

The Black Sea mud volcanoes are randomly distributed at depths below 2 km in the limited area at the south of Crimea. The mud volcanoes generally look like a mushroom shaped cone on the sea floor in the Black Sea. Some of them has depression at the top, resembling a creater like depression.

Others however, may be flat topped. Brightspots have been observed on seismic profiles which indicate the presence of irregularly and patchy distributions of gas. Mud volcanoes are exist over the deep eastern Western Black Sea Subbasin within rather mited areal distribution. Morphological and structural characteristics of the Black Sea mud volcanoes were investigated during several UNESCO-ESF "(Floating University)" cruises (1991-1996).

There are several types of mud volcanoes in these areas, which have very flat tops, mushroom shaped cones, creaters and collapsed creaters. They are sometimes surrounded by concentric faults, circular or ellipsoidal in shape etc. with different characteristics, that rise out of the surrounding sea floor. The layers arnd mud volcanoes generally look bent down in subbottom and seismic profiles as a result of eruption of gas and mud or the differences of velocity anomalies. There is a transparent unit, no reflectors have been recorded, but they are present on both sidesf it, in addition to bedded layers. Some mud volcanoes have feeder channels which are very visible on the seismic profiles with high frequency content in upper parts and lower frequency in deeper parts. The feeder channels are sometimes columnar or collaed completely.

The Black Sea is framed by structural elements of different age. The Turkish shelf is divided in four areas, namely a sub horizontal plateau, a steep shelf slope, a gentle shelf slope and a shelf basin. Throughout the Turkish shelf, shallow gas has been detected on the subbottom profiler records. Pockmarks occur at the sub horizontal plateau and gentle shelf slope. Slump and creep features are detected on the steep shelf slope. In the contrast with the concave Russian Continental Slope, Turkish Continental Slope has a convex morphology. The slope gradient becomes progressively steeper as it traced downwards from the top, which is the result of either mass movement or structural control.