

deposits, the other mixed siliciclastic/carbonate sediments (PF4 to PF6) and the calcareous groups (PF7, PF8) are related to Cretaceous deposit.

The polymictic clasts are realised during mud volcano activity, PF9 is made by early lithification during hydrate precipitation and PF10 is formed while the re-sedimentation of liquefied sediment.

The sediments of the matrix consist of gravelly sand, marls and clay. The gravelly sand are composed of: quartz, feldspar, calcite, micas, glauconite, framboidal pyrite, authigenic and detrital zircon, rock fragments (siltstones, marlstones, limestones, volcanic rocks), polymictic clasts, relict bioclasts and well preserved planktonic and benthic foraminifera, coccoliths and corals. The detrital components of the matrix are also inherited from older geological formations of Cretaceous to Oligo - Miocene age.

GAS-RELATED ACOUSTIC ANOMALIES IN THE UPPER PART OF SEDIMENTARY SEQUENCE IN THE CENTRAL PART OF THE BLACK SEA

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The mud volcanic areas in the Black Sea were investigated during TTR-1, TTR-3, TTR-6 and TTR-11 cruises within the UNESCO "Training-through-Research" programme in 1991, 1993, 1996 and 2001. On the base of these surveys, the interdisciplinary investigations were carried out in the Black Sea within M52/1 cruise on board R/V *Meteor* Leg 1, project MARGASCH, January, 2002. This survey was devoted to study mud volcanoes, gas-hydrates, their occurrence and distribution. The investigations were concentrated in the Sorokin Trough and Central part of the Black Sea and included multichannel seismic survey, parasound, hydrosweep, side-scan sonar survey, bottom sampling and CTD. This job was based on seismic data from the M52/1 cruise with comparison of TTR-1 data (Ivanov et al., 1992; Bohrmann and Schenck, 2002). It was done in the framework of co-operation between the Bremen University, Germany and the UNESCO/MSU Centre for Marine Geoscience, Russia.

The multichannel seismic system of the Bremen University was used to collect seismic data. The streamer was 600-hundred meters long, offset length was 90 meters. It consisted of 96 channels. Two types of sources were used: GI gun (generator-injector gun, 2x1.7 l) and Water Gun (0.16 l). For data processing the following flowchart was used: data input, bandpass filtering, true amplitude recovery, static correction, deconvolution, velocity analysis, stacking and migration. These data were compared with the single channel seismic data collected during the TTR-1 cruise. For collecting data during the TTR-1 cruise the single channel seismic streamer was used. Offset length was 96 meters. The type of source was sparker.

During Meteor cruise 11 profiles were shot in the Central part of the Black Sea. Seismic lines were passing the well-known mud volcanoes (MSU, Kornev, Vassoevich and others) in submeridional direction. Mud volcanoes occur in the Central part of the Black Sea in great variety of sizes - up to 2.5 km in diameter, and may rise more than 120 m above seafloor.

Average penetration of the seismic signal was about 1.2 s (M52-1 cruise, 2002). In comparison with GI gun data (Meteor cruise) the TTR-1 seismic data had smaller penetration of the seismic signal (0.9 s). Besides, GI gun data from the Meteor cruise had higher vertical resolution - 7 m (15 m for TTR data). Water gun data theoretically had vertical resolution 3 m. But Water gun produces a mixed phase wavelet. Precursor precedes the main pulses by about 20 ms. It is possible to mute precursor above sea bottom reflection, but many of the primary reflections within the sedimentary sequence are inferred by precursor. And real vertical resolution was about 5 m.

Such acoustic anomalies as bright spots are well distinguished within the sedimentary sequence. Interpretation of a certain amplitude anomaly as being gas-related shall be confirmed by estimating of some parameters of the reflected signal.

Intrinsic attenuation of acoustic energy propagating through the sediments is proved to be much more sensitive to the type of pore fluid than to lithology. Thus, a significant increase in intrinsic attenuation, when identified, may be considered as a reliable evidence for shallow gas accumulation. On several bright spots attenuation was calculated. To obtain a value of intrinsic attenuation within the sedimentary sequence an attenuation was calculated in the area free of bright spots.

Different frequency spectrum of the seismic data collected, using Water gun source and GI gun source, allowed us to calculate attenuation more precisely and in a wide frequency range. For calculating the absorption we used the method of time-frequency analysis (Agibalov and Almendinguer, 2002).

Comparison of these values demonstrated significant increase in intrinsic attenuation from bright spots. This result allowed us to conclude that these anomalies are gas-related.

References:

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THE AL ARAICHE DIAPIRIC FIELD AND ITS "EXOTIC" MUD VOLCANIC DEPOSITS RECOVERED DURING THE TTR-12 CRUISE IN THE GULF OF CADIZ

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Since 1999 the UNESCO/IOC "Floating University" carries out a scientific exploration in the Gulf of Cadiz, following a broad mapping of the area with SeaMap long-range side-scan sonar performed by USA Naval Research Laboratory and concentrating mainly on detailed studies of fluid-venting related structures. During four research cruises about 20 mud volcanoes were discovered in the deep Gulf of Cadiz, most of them were sampled, and mud volcanic breccia were recovered. By 2002 a large database on composition of mud volcanic deposits of the region has been compiled and studied.

Mud volcanic deposits of the Gulf of Cadiz consist of very poorly sorted matrix-supported mixture of lithified and semi-lithified rock clasts in sandy-silty clay. The clasts are represented by large variety of siliclastic and clayey rocks and abundant micritic and detrital limestones. The rock clasts are believed to be samples of different series of olistostrome complex emplaced in the Gulf of Cadiz during Miocene, which at the present day are brought to the surface through mud volcanic conduits. The rock age ranges mainly from Upper Cretaceous to Miocene. Apart from small differences in mud breccia composition, which allowed tentative subdivision into three main mud volcanic zones of the Gulf of Cadiz (Portuguese, Spanish and Moroccan), the deep-sea mud volcanic deposits show much similarity.