

## Ecological aspects of mud volcano activities in the Azov-Black Sea region

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### Introduction

Since 1990, the Ukrainian-Russian team of scientists headed by the second author of this presentation has performed multidisciplinary research on mud volcano activity in the Azov-Black Sea region over the course of dozens of onshore and offshore expeditions carried out aboard various Ukrainian R/Vs. These expeditions enabled the mapping of mud volcanoes on the sea bottom and on land, and they have provided some insight into their physical and gasbiogeochemical properties, origin, as well as ecological aspects of their activity (Shnyukov et al., 2005a).

### Spatial distribution and origin of mud volcanoes

Areas with the most abundant mud volcanoes include the northern part of the Western Black Sea, the Sorokin trough, the Tuapsinskaya trough, the Shatskiy arch, and the Kerch downfold (the area south of the Kerch peninsula). The exact number of mud volcanoes is unknown. As of today, the number of known offshore mud volcanoes is close to seventy, however, every year new mud volcanoes are discovered.

Their eruptions are usually calm, creating positive relief forms on the seabed. Sometimes, they can reveal a character that is catastrophic in the scale of gas emissions. In this respect, the mud volcano Dvurechenskiy in the Sorokin Trough and the recently opened mud volcano Mitin on the continental slope south of the Kerch Peninsula are especially exemplary (Shnyukov et al., 2005b,c).

Currently, mud volcanoes are regarded as a manifestation of diapiric tectonics accompanied by outbursts of clay breccia; gases, most often methane; and fragmentary, broken rock material. These outbursts can be very strong, especially in shallow water (Fig. 1).

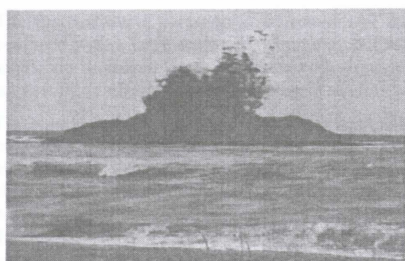


Figure 1. Strong eruption of mud volcano Golubitsky in the Sea of Azov in 2000.

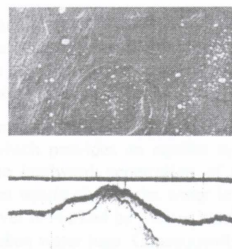


Figure 2. Mud volcano Peresyp'skiy (Temryuk bank, Kazbek). Above: the liberated gas bubbles; below: the bottom of the sonar profile.

### Ecological aspects of mud volcanoes emissions

Gas outbursts from offshore mud volcanoes affect the hydrochemical regime of the sea, producing currents and acoustics (Fig. 2).

Their activities affect ecosystems and, most of all, routes of fish during seasonal migrations (Shnyukov et al., 2004). To a certain degree, the entire biota in the Black Sea are affected by fluctuations in the level of hydrogen-sulfide exposure.

Mud volcano activities often cause great damage to the environment. Powerful eruptions can cause ground subsidence in nearby areas (Fig. 3). If located within the limits of urban agglomerations, the mud volcanoes present a threat to human settlement, as happened in Kerch (Crimea) and Temryuk in Krasnodar County (Fig. 4).



Figure 3. Subsidence of ground and fired breccia at mud volcano Karabetova Mount.



Figure 4. Consequences of the eruption of mud volcano Dzhardzhava on the outskirts of Kerch peninsula in 1930.

Contamination of the air with mercury and other elements escaping from mud volcanoes is hazardous to people as well.

Mud volcanoes have a significant effect on maritime traffic, especially in narrow waters, e.g., the Kerch Strait, where seven mud volcanoes are known and where nearly ten thousand ships cleave their way annually. Overlooking the water surface, a giant bubble of gas can cause a sharp bank and rolling over of a vessel. Unloading pieces of mud volcano, e.g., with pockets of gas in the sediments, can stimulate even small earthquakes (Shnyukov and Maslakov, 2009). Recommended traffic routes for shipping often pass through areas of mud volcanism (Fig. 5, 6).

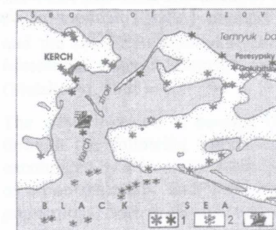


Figure 5. On-shore and off-shore mud volcanoes in the Kerch Strait area: 1 = known, 2 = estimated from seismic data, 3 = location where a ship ran aground due to the eruption of a mud volcano.

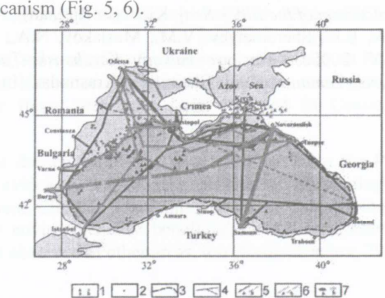


Figure 6. Distribution of gas seeps, mud volcanoes and location of gas pipes on the Black Sea floor: 1 = mud volcanoes: a – on-shore, b – off-shore; 2 = gas seeps; 3 = shelf edge; 4 = main recommended navigation routes; 5 = underwater cable fiber-optic lines: a – acting, b – projected; 6 = underwater gas pipelines: a – acting, b – gas; 7 = underwater hydrocarbon resources: a – oil, b – gas.

## Ecological aspects of mud volcano activities in the Azov-Black Sea

Mud volcanoes represent a danger to underwater communication systems, such as the new communication cables that will connect Sevastopol with Odessa, Sevastopol with Kerch, and Sevastopol with Georgia. They also can be hazardous to already existing “Blue Current” and planned “Southern Current” gas pipes that will cross the Black Sea from east to west. Both pipelines cross the Black Sea bottom, which is polluted by  $H_2S$  and abundant mud volcanoes. This can be also have ecological consequences for the entire basin.

In general, mud volcanism in the Black Sea region is an extremely interesting phenomenon of multi-dimensional importance that deserves an especially in-depth ecological study. This presentation will outline the main gaps in our knowledge and the main directions of future research into the ecological aspects of mud volcano activities in the Azov-Black Sea region.

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