SHORT CRUISE REPORT

METEOR cruise M52/1

Dates: January 2 – February 1, 2002

Port calls: Istanbul – Sevastopol – Istanbul

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R/V METEOR left Istanbul on January 2 around noon, and reached the Black Sea after a three-hour transit through the Bosporus. In the early morning of January 4, a first CTD was deployed to 2000 m depth in the central part of the Sorokin Trough in order to sample the water column and obtain a sound velocity profile for calibration of the Hydrosweep system. In the evening of January 4, the OFOS TV-sled (Ocean Floor Observation System) was used to map three lines along the seafloor. The results were excellent in spite of rough seas, and quite suitable sampling sites were found. A subrecent mud flow was sampled using the TV-controlled multicorer, followed by very precise TV-grab sampling of a fluid vent in the top area of the mud volcano. In the afternoon of January 5, a first set of seismic reflection profiles across Sorokin Trough was shot. The second week was started by deploying the TV grab at night-time to sample a fluid vent site in the center of an active mud volcano. A sample of seep carbonates and mud breccia was retrieved. Refraction seismic mapping followed. Ten ocean bottom seismometers (OBS) and five ocean bottom hydrophones (OBH) were deployed in a cross pattern with the centre focusing on the Kazakov mud volcano and the Odessa mud volcano being covered at the cross margin. Corresponding to the deployment pattern, two orthogonal lines were covered by R/V METEOR with two large-volume airguns of 32 l generating signals of around 8 Hz. For about 2/3 of the profiles, additional signals could be generated using a 1.7 l GI gun. However, the GI gun had to be recovered when the seas became too rough. Bad weather also kept us from deploying a streamer parallel to the large airguns. The seismic recordings should allow imaging of the deeper structure of the mud volcanoes in order to learn more about the sources and depths of mud expulsion. The subsequent recovery of the OBS/OBH was hampered by a strong wind of Beaufort 7. With an air temperature of -8°C, splash water quickly froze on the working deck. When the wind increased even more, to Beaufort 8 and sometimes even 9, working had to stop for a few hours.

In the following morning, the bad weather had gone and gravity cores could be taken from three mud volcanoes. The first two cores, each about 1 m long, were taken directly from active venting fields. They contained massive, up to 5 cm thick gas hydrate layers just a few cm to mm below the seafloor. The third location was at a relatively fresh mud flow. For the first time, several thermometers were mounted to the outer tube of the 6-m-long gravity corer. A 4.10 m long sediment core was retrieved. Apart from its upper section of about 50 cm, it was completely interspersed with thin, white gas hydrate layers. The rest of that very successful day in gas

hydrate sampling was dedicated to further reflection seismic surveying, which took until noon of the next day and was followed by the first deployment of the sidescan sonar. R/V METEOR entered the bay of Sevastopol on January 11. The programme on R/V METEOR during that day was a tightly packed schedule, the highlights being a press conference for a large number of interested journalists and a reception for invited guests. Sevastopol was left in the morning of January 12.

In the afternoon, R/V METEOR reached the second working area in the central Black Sea. A 24-hour seismic reflection survey was started along several east-west profiles in order to image larger tectonic structures around mud volcanoes. Afterwards, MSU mud volcano was examined more closely by sampling OFOS profiles. After a reflection seismic survey in the central Black Sea and a deployment of the new digitally recording high-resolution side-scan sonar, R/V METEOR sailed back to the Sorokin Trough, which belongs to the Eastern Basin of the Black Sea. Parasound and Hydrosweep mapping followed. Furthermore, side-scan sonar mapping was carried out in several areas dominated by mud volcanoes, including Dvurechenskii mud volcano. An extensive sampling programme including gravity corer, mini corer and detailed sampling of the water column was run on January 17 and 18. The gravity corer was equipped with thermistor thermometers. For the first time, information could be obtained on the in situ temperature of the sediment within Dvurechenskii mud volcano. While water temperatures are about 9°C at the seafloor, the upper sediment in the central part of the mud volcano showed temperatures of up to 16°C in depths of up to 6 m. These high temperatures suggest a currently active rise of mud in Dvurenchenskii mud volcano. In spite of the high temperature, the pressure is high enough at a water depth of 2000 m to allow the formation of gas hydrate. All four sedimentary cores from the mud volcano contain plenty of finely dispersed gas hydrate which dissociates fast when exposed on board. Almost all of the pore water samples from Dvurechenskii mud volcano showed a high salt content, indicating a content of chloride up to 2.5 times higher than that of seawater. An increased concentration of hydrocarbons in the water column was found above the mud volcano, indicating that the mud releases an increased amount of these substances into the water column. OFOS and TV grab work followed.

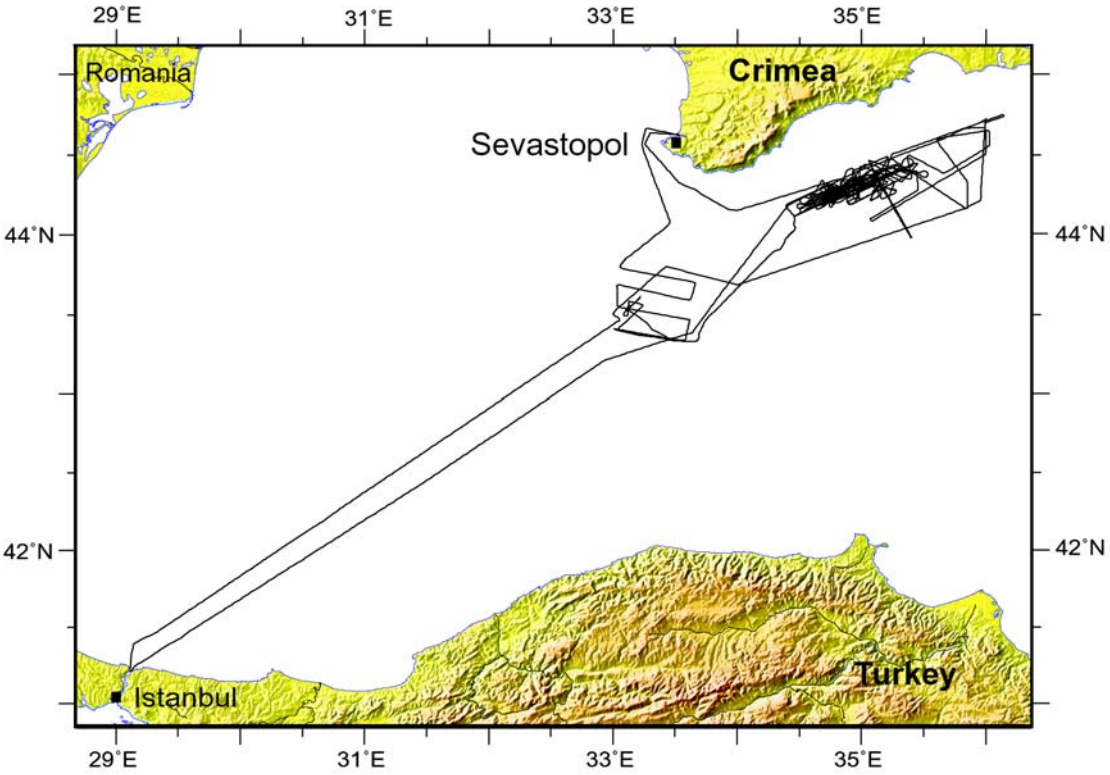
At the beginning of the fourth week the side-scan sonar survey that had been started on the weekend was completed. An area of about 200 km^2 was mapped that contains several mud volcanoes. On January 21 a long sampling programme was run including gravity corer and mini corer. Another set of gravity cores was taken from Dvurechenskii mud volcano, again with thermistor thermometers that indicated an increased temperature flow in the western and southern areas of the mud volcano. A second set of water sampling and CTD above the active mud volcano showed a markedly increased concentration of methane near the seafloor, which is evidence for a current gas venting activity. Further gravity cores were taken from two adjacent mud volcanoes, each of them about 1 km in diameter. None of them had a name and the names "Sevastopol" and "Yalta" mud volcanoes were introduced.

Almost 5 days were subsequently spent on seismic work focussing on Sevastopol mud volcano. An area of 7 x 2.5 km was covered by seismic 3-D mapping in order to obtain detailed images of the pathways that gases and fluids take when moving upwards from deeper sediment layers. Seismic signals from an airgun and a watergun were recorded parallely by a high-resolution streamer system at the surface and by 14 ocean bottom hydrophones and seismometers at the seafloor. Apart from

providing information about sedimentary layering and tectonic processes, the combined data will help quantifying volume characteristics in order to find out the locations and the quantities of gas hydrate enclosed in the sediment. The seismic work ended after a successful recovery of all ocean bottom units on Saturday night (January 26).

The weekend preceding the fifth week in the Black Sea was dedicated to TV grab sampling at the Sevastopol and Yalta mud volcanoes. One of the deployments was hampered by battery failure, so that the grab had to be recovered before a sample had been taken. On the second deployment, however, a highly interesting 7 cm - thick bacterial mat on a carbonate crust was retrieved. In the night of January 27, the OFOS TV sled was run along two profiles across Dvurechenskii mud volcano. At the edge of the mud volcano, a relatively large area covered by a white bacterial mat was identified. In the centre of the volcano numerous active vent sites were found in the form of small holes with elevated rims that stick out from an otherwise very homogeneous seafloor. A CTD towed on the TV-sled showed a clear increase of temperature in the water column above the mud volcano. The maximum temperature correlates well with the centre of the mud volcano.

On January 28, further sampling of the water column was followed by a deployment of the side-scan sonar, using the 410 kHz high-resolution signal directly above the flat top of the mud volcano. In the evening of January 29, R/V METEOR sailed to the eastern edge of our working area in order to sample known gas vents at shallow depths. The occurrence of three gas vents at water depths of 300 - 700 m was proved. The vents were marked by acoustic plumes in the water column above the seafloor and can be detected by the 18 kHz Parasound signal. A set of CTD and water sampling was run on one of these plumes, complemented by plankton netting. Some additional Hydrosweep and Parasound mapping was run until the evening of January 30, when the station work of R/V METEOR cruise M52/1 - MARGASCH officially closed.



Track lines of R/V METEOR during cruise M52/1 (January 2 - February 1, 2002; Istanbul – Sevastopol – Istanbul).

Statistics of scientific work:

CTD and hydrocasts	15 stations
Water sampling	9 stations
Gravity corer	9 stations
Gravity corer with thermistor sensors	8 stations
Multi mini-corer	6 stations
TV-grab deployments	7 stations
Ocean floor observation system	9 profiles
Ocean bottom seismometer/hydrophone	29 deployments
Multichannel seismic work	163 profiles
Deep towed Sidescan	20 profiles

In addition Hydrosweep and Parasound profiles