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GEOCHEMISTRY AND MICROBIOLOGY AT GAS HYDRATE AND MUD VOLCANO SITES IN THE BLACK SEA

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We present geochemical and microbiological results which were obtained from sediments at gas hydrate and mud volcano sites in the Sorokin Trough (northern Black Sea, south east of the Crimean peninsula) at water depths of about 1800 to 2100 m during the METEOR cruise 52-1. The surface near sub-bottom accumulations of gas hydrates (occuring at depths of several meters or less beneath the sea floor) in the Black Sea are associated with numerous mud volcanos. At stations we investigated gas hydrates occurred below 10 cm to 100 cm with a significant influence on the sediment biochemistry. Analyses revealed high methane concentrations, anoxic and sulfidic conditions, a steep sulfate gradient, carbonate precipitation, and high anaerobic methane oxidation rates. In proximity of the so called Odessa mud volcano one investigated sampling station showed maximum methane oxidation rates in the depth horizon of a firm 2 cm thick carbonate crust layer, adhered to by a bacterial mat. This observation is taken to indicate that the bacteria are causing or mediating the crust formation by their anaerobic methane oxidation metabolism. The station was further characterised by two layers of gas hydrate fragments and lenses below 1 m depth. A 2 to 4 cm thick carbonate crust with attached bacterial mat from a Yalta mud vulcano sample (2124 m water depth) was investigated under the scanning electron microscope. The stiff gelatinous mat showed a dense and morphologically uniform population of rod shaped bacteria with only a few nests of coccoid cells. Purified mat material exhibited anaerobic methane oxidation activity. These mats resemble the type previously found in the shallow NW methane seep area of the Black Sea, where it covers carbonate chimneys. Samples from two sites atop the summit of the active but flat-topped Dvurechenskii mud volcano were characterised by very high methane oxidation rates

(up to 563 nmol/cm3/d) at the sediment surface. Strong pore water gradients of chloride, bromide, ammonium, methane, and temperature proved the existence of a rich upward flow of warm fluids from the deeper sediment. At both stations no carbonate crusts or bacterial mats were found. The lack of hemipelagic sediments and at the same time abundance of mud breccia gives ample evidence of the recency of the mud flow.