SEDIMENTS AND AUTHIGENIC CARBONATES RELATED TO GAS SEEPAGE STRUCTURES IN THE SEA OF OKHOTSK (NE OFFSHORE SAKHALIN)

Alexey Krylov[1]; Leonid Mazurenko[2]; Elizaveta Logvina[2]; Yutaka Nunokawa[1]; Akihiro Hachikubo[1]; Shin'ya Nishio[3]; Hirotsugu Minami[1]; Hirotoshi Sakagami[1]; Masato Kida[1]; Natalya Nikolaeva[4]; Anatoly Obzhirov[4]; Young Jin[5]; Hitoshi Shoji[1]

[1] KIT; [2] VNIIOkeangeologia; [3] Shimizu Corporation; [4] POI; [5] KOPRI

The main target of multidisciplinary international Korean-Russian-Japan CHAOS 2005 expedition (36th cruise of the R/V Akademik M.A. Lavrentyev, 24 May to 7 June 2005) was investigation of the hydrate-bearing seepage structures within the western flank of Derugin Basin in the Sea of Okhotsk. This study is continuation of CHAOS 2003 cruise (Shoji et al., 2005; Matveeva et al., 2005). The twenty-eight sediment cores with lengths 36 to 385 cm were taken; nine of them contained gas hydrates. Northeast continental slope off Sakhalin Island is located near oil- and gas-bearing areas on the island and the adjacent continental shelf. The first gas-hydrates have been sampled here during the expedition onboard RV Piotr Antropov in 1991 (Ginsburg et al., 1993). Some of hydrate-bearing cores, sampled during CHAOS 2005 expedition, contain big amount of gas hydrates: massive gas hydrate layers (up to 35 cm thick) were recovered. The shallowest submarine gas hydrate accumulation (up to 390 and 385 m water depth) was discovered in association with the Gisella fluid venting structure. Carbonates are the most common authigenic mineral precipitates at cold seeps, typically by dint of anaerobic oxidation of methane. Authigenic carbonates from the Derugin Basin were reported in number of previous publications (Lein et al., 1989; Ginsburg et al., 1993; Obzhirov et al., 2000; Derkachev et al., 2000, 2002; Greinert et al., 2002; Aloisi et al., 2004). We studied carbonates and sediments, which were cored from the new structures, discovered during the CHAOS 2003 and 2005 expeditions. The mineralogical composition of sediments and carbonates was characterized by powder X-ray diffraction analyses and scanning electron microscopy. The texture and morphology of the carbonates were studied macroscopically, microscopically and by SEM. Using the shift in d-spacing of the (104) reflection (3,035 angstrom for stoichiometric calcite; 3,000 angstrom for Mg-calcite), we estimated $MgCO_3$ content of the trigonal carbonate phases. The sediments in general are represented by silty-clay, and composed mostly of siliceous organic debris (diatoms). The carbonate concretions usually overlay the hydrate-bearing and gas-saturated sediments or can be incorporated in the latter. Based on morphology and density, carbonates can be subdivided into four main types. First, poorly consolidated or soft isolations, homogeneous in color (light green); they represent the initial stage of the formation of carbonate concretions. Second, dense concretions with dendritic or elongated shape; sometimes contains the numerous protuberances. They have zonality: gray or light-gray soft (or hard) crust, and dark-gray, very hard inner part. Based on SEM observation, the outer crust contain considerable amount of diatoms, whereas the inner part includes the minor content of silica algae. Third, rounded or subangular dense concretions that has a same zone sequence. Fourth, tubicolous carbonates formed by substitution of Polychaeta worms or burrows. All types of carbonates are composed mainly by Mg-calcite. Based on XRD measurements, the changes of $MgCO_3$ content in carbonate phases were found within the investigated area. The inner part of concretions is enriched by magnesium compare surface. Moreover, surface parts have heaviest delta 13C composition. The good correlation between isotopic values and magnitude of (104) reflection was established. Changes of delta 13C contents testify different sources of methane carbon taking part in carbonate formation.