Geophysical Research Abstracts, Vol. 7, 03841, 2005
SRef-ID: 1607-7962/gra/EGU05-A-03841

Methane venting on the continental margin off NE Sakhalin: nature of gas, authigenic carbonates and gas hydrates

L. Mazurenko (1), V. Soloviev (1), T. Matveeva (1), H. Shoji (2), V. Kaulio (1), E. Logvina (1) H. Minami (2), A. Hachikubo (2), H. Sakagami (2)

(1) VNIIOkeangeologia, Sankt-Petersburg, Russia, (2) Kitami Institute of Technology, Kitami, Japan (leonidius@yandex.ru / Phone: +7 812 1141685)

Introduction. The area of focused fluid venting offshore NE Sakhalin (the Sea of Okhotsk) was investigated before and gas hydrates have been sampled within the Obzhirov gas flare (Ginsburg et al., 1993). The study area is located in the vicinity of oil- and gas-bearing fields of Sakhalin Island and adjacent shelf. This region was investigated in August-October 2003 during the 31 and 32 International expeditions of R/V „Akademik Lavrentyev“ within the framework of the CHAOS project (Shoji et al., 2005). About 40 structures related to fluid discharge were discovered. The gas venting plumes at the water column were observed on echosounder records as "flare"-type anomalies. On the side scan records the fluid discharge areas registered as concentric and some time isometric in plane structures with most acoustic brightness of sediments at their central parts. At the subbottom profiler record the gas seepage structures are correspond to extensive blanking zone in sedimentary cross-section characterized by lost of correlation of the reflection signals due to the presence of free gas. All the fluid vents were considered as potential gas hydrate accumulations. The geological coring was carried out within three of them, named the “Chaos”, the “Hieroglyph” and the “Kitami” and gas hydrates were sampled from all of them.

Core. High values (up to 1.8%) of Organic Carbon (Corg) determined in the gas hydrate-bearing sediment within gas venting area compared to background values (0.5-1.2%), measured in cores taken at considerable distance from the gas vents allow to suggest common origin of fluids involving into gas the hydrate formation and of the hydrate-containing sediments. Increased contents of Corg were also measured in sedi-

ments recovered at a distance from fluid venting areas but within the same sedimentary Basin of the Deriugin depression (core LV31-41GC). The obtained data suggest that not only local fluid venting structures but also studied area at a whole characterized by high rates of the organic matter accumulation in sediment and biogenic methane production. This suggestion is supported by high saturation with gas of sediments recovered during gravity coring at areas in the Deriugin Basin regarded as a background ones as compared to fluid venting areas. It is necessary to note that decreasing trends of the Corg and TOC concentrations with sediment depth may testify upward methane diffusion through pore space of sedimentary thickness of the Deriugin Basin. Total Organic Carbon concentration in the studied sediments is considerably changes with depth. Increase of TOC concentrations downcore at station LV32-09GC (the Kitami fluid venting structure) accompanied by constant values of Corg suggest reduce of authigenic carbonate accumulation and chemosynthetic organisms activity in time. Thus, it is possible to conclude that the Kitami gas venting structure has been more active earlier then we could observe during the CHAOS expeditions. At present time velocity of the methane flux in this gas vent becomes slower. At the other hand, TOC and Corg concentrations distribution along the core LV31-27HC (the Chaos venting structure) evidences step-by-step activity of this vent.

Predominance of methane (more than 99%) characterizing by ratio $\tilde{N}_1/C_2+C_3$higher than 20000 in the studied gas released from hydrates testifies biogenic source of the original gas for gas hydrate formation. It is possible to suggest that methane taking part in the gas hydrate formation within gas venting area offshore Sakhalin was produced during biological reduction of organic matter by microbes in the anaerobic environment below zone of sulfate reduction.

Isotope composition of carbon 13 in the studied authigenic carbonates is varied in the wide range (from -1.7‰ to -49‰ PDB), whereas δ^{18}O measured in the same samples is ranged from -0.2‰ PDB to 5.9‰ PDB. Most high $\delta^{13}\tilde{N}$ values were measured in samples contained *Calyptogena* bivalve and just inside these shells. “Light” isotope composition of carbon 13 suggests that all the abovementioned carbonate formations are resulted from irreversible microbial methane oxidation. At the same time, change of $\delta^{13}\tilde{N}$ values in such wide range evidences different sources of methane carbon taking part in carbonate formation. Most probably there are two sources of the methane: microbial biogenic methane formed *in situ* and deep methane originated from destructing hydrocarbon reservoirs but also biogenic in origin. On the other hand, high values of δ^{18}O in the studied carbonate formations suggest migration origin of oxygen 18 isotope. The source of this oxygen, most probably, is fluid infiltrating from below and characterized by “heavy” isotope composition of oxygen 18.

Obviously, within the each venting structure discovered at the study area, gas hydrate

accumulations have to be formed. Gas hydrate manifestations in some cores were observed from the subbottom depths of 70-110 cm, whereas in others – from 400 cm. Apparently, changes in the depth of upper hydrate-bearing horizon depend from variations of methane concentration in the flow percolating through sediment into the atmosphere. It is evidently, that at those places of the bottom topography where concentrations of the migrating gas are most high, gas hydrate formation will takes place just on the seafloor. Such places should associate to free gas expulsion into the water column. At a distance from these places gas hydrates will form at some subbottom depth due to sublateral diffusion of a free gas at a distance from concentrated gas fluxes into the pore space.

Conclusion. Originating from determinations of the organic matter content, composition of hydrated gas, and carbon-oxygen isotope composition of authigenic carbonates, it is possible to recognize two main sources of gas involving in the formation of gas hydrates:

1) Microbial biogenic methane that was generated *in situ* in the uppermost horizons of sediments of the Deriugin Basin enriching by Organic matter;

2) Methane migrating from deep buried destroying hydrocarbon reservoirs along faulting zones. This methane most probably is also biogenic in origin.

All studied fluid vents off NE Sakhalin are related to the body and tail part of large slide (Baranov et al., 2004). Revealed evidences of fluid vent activity and fading probably connected with redistribution of sediment masses along the NE Sakhalin continental slope.

References:

Baranov B., Solomatin A., Salyuk A., Dozorova K., Karp B. (2004). Gas seeps distribution offshore NE Sakhalin: relationship to tectonics and slope processes. Abstracts of the II International Conference “Minerals of the Ocean”. VNIIOkeangeologia, St.Petersburg, p.52.

Ginsburg, G.D., Soloviev, V.A., Cranston, R.E., Lorenson, T.D., Kvenvolden, K.A. (1993). Gas hydrates from the continental slope, offshore Sakhalin Island, Okhotsk Sea. Geo-Marine Letters, 13, p. 41-48.

Shoji, H., Soloviev, V., Matveeva, T., Mazurenko, L., Minami, H., Hachikubo, A., Sakagami, H., Hyakutake, K., Kaulio, V., Gladysh, V., Logvina, E., Obzhirov, A., Baranov, B., Khlystov, O., Biebow, N., Poort, J., Jin, Y.K., Kim, Y. (2005). Hydrate-Bearing Structures in the Sea of Okhotsk. Eos, Vol. 86, No. 2, 11 January 2005, p. 13-24.