Geophysical Research Abstracts, Vol. 9, 00438, 2007
SRef-ID: 1607-7962/gra/EGU2007-A-00438

Ecological aspects of gas hydrate accumulations in the Sea of Okhotsk

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Since the time it has been established that gashydrates are a component of the continental slopes within various parts of the World Ocean, scientists show interest in such aspects as environmental risk and climate change. As gashydrates can contain a huge volume of methane (one volumetric unit of hydrate contains gas which occupies from 180 up to 200 volumetric units under normal conditions) it is clear that sediments containing gashydrates play vital part for the sedimentary material mobility of continental slopes, sea biota communities, and also the global processes of climate change.

In the Sea of Okhotsk there are known two areas of gashydrate occurring in the bottom sediments (Ginsburg, Soloviev et al., 1993, 1994; Obzhirov et al., 1999, 2005; Matveeva et al., 2003): the northeastern Sakhalin slope (the northwestern part of Deryugin cavity) and the northwestern slope near Paramushir Island (the southeastern part of Golyginskii flexure). Gashydrate accumulations are part of the Okhotsk sedimentary basin containing thick Mesozoic and Cenozoic sediments disrupted by numerous faults (Belousov and Udintsev, 1981; Gnibidenko and Khvedchuk, 1982), some of them may be conduits for migrating gas. Gashydrates are associated with areas of gas vents located near by active deep faults.

As a result of gasgeochemical research carried out in the Sea of Okhotsk by the Gasgeochemistry Laboratory of the POI FEB RAS for the period from 1984 to 2006, the background and anomalous fields of methane are explored in the seawater on the east shelf and slope near Sakhalin. It is revealed that on the boundary of 1988-1989 there was a sharp increase of methane concentration in the seawater of this area - background values by 2-3 times (70-80 nl/l), and anomalous ones by 1000 times and more

(10 000 – 20 000 nl/l). Received data allow us to conclude that this phenomenon is conditioned by the increase of seismo-tectonic activity. The flux of natural gas became stronger from the sources to the seafloor, from the seafloor to the water and, finally, to the atmosphere due to renew of fault zones. Moreover, the amount of methane vents on the northeastern Sakhalin slope has increased from 2-3 to more than 100 till now. The most representative hydroacoustic anomalies "flares" mapped there, are referred to the methane hydrates studied by direct methods. The received outcomes indicate the urgency of the study of the formation-dissociation mechanism of gashydrates and the influence of the methane flux from hydrocarbon sources on the environment.

The amount of methane preserved in the gashydrate accumulations is estimated approximately $8 \cdot 10^8$ m^3/km^2 for the northwestern part of the Sea of Okhotsk and $2 \cdot 10^{12}$ m^3 for the entire Sea of Okhotsk (Matveeva, Soloviev, 2003). Ò. Ludmann, H.K. Wong (2003) denote still more amount: $15 \pm 12 \cdot 10^{13}$ m^3 for the entire Sea of Okhotsk. Taking into account the relation of methane fluxes with the seismo-tectonic processes in the Okhotsk Sea area (Obzhirov et al., 2003) it is possible to point out the main ecological consequences connected with submarine methane discharge caused by gashydrate decomposition in the regoin.

In 2002-2004 in the places of gas vents, the northeastern shelf and slope near Sakhalin, rapid development bacterial mates and sharply expressed prevalence some of benthos (molluscs, crustacea) have been fixed in comparison with neighbour territories where seawater have background methane concentrations. Received data show that methane fluxes impact on the ecosystem structure.

As a result of the seafloor research it was discovered that there is a bottom deformation with the formation of hills and holes which have diameter more than 10 meters and height more than 2 meters when gashydrates destruct. On the slopes the disturbance and the moving of sediments to down are observed. It is the significant change of bottom morphology. Therefore, it is necessary to take into account the opportunity of gashydrate decomposition with the subsequent bottom destruction, because the consequences of this event may be unpredictable. It is concerned, for instance, engineering-technical works: the lining of oil pipelines, the construction of derricks etc.

As regards the aspect of climate change: a huge amount of methane are released from the seafloor to the water and then from the sea surface to the atmosphere (methane is a strong "greenhouse gas") when gashydrates decompose. And vice versa, when gashydrate accumulations are stable (seismo-tectonic activization is reduced), they can delay methane entrance to the envronment.

Thus, at present it is very important to understand and determine the role of gashydrate

accumulations in the global and regional nature processes.