

## Evolution of gas hydrate discovery in the Okhotsk Sea

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The first discovery of gas hydrate was in the surface sediment on the western slope of Paramushir Island in 1986, the Okhotsk Sea where water column flux of methane bubble had been found in 1983.

In 1988 was found the first a few methane flares on the northeastern Sakhalin shelf and slope. In 1991 gas hydrate was found in the surface layers of sediment (2-5 m under Sea floor) in methane flux area. These discoveries opened the second period (from 1988 to 1998). The research goals in the period were to study methane distribution in water column and sediment of the Okhotsk Sea and to investigate methane fluxes and gas hydrate. Every year new methane bubbles fluxes (flares) from sediment to water column were found. In most flare areas, methane concentration in bottom water column and sediment increase up to 100-1000 times as high as background value.

More detailed studies have continued through the third period from 1998 to 2007 in frame Russian-Germany KOMEX-project and Russian-Japan-Korea CHAOS-SSGH projects. In the period, multidisciplinary surveys including geological, geophysics and hydro-acoustics survey has been conducted in the western Okhotsk Sea area. More 200 flares and 15 gas hydrate sites were newly found. Monitoring investigation showed that activities of methane fluxes were strengthened during in the period by seismo-tectonic activity in the western part of the Okhotsk Sea. Subbottom profiles show that methane bubbles come up to the seafloor from deep depths through hydrate-bearing sediment (in gas hydrate stability zone, GHSZ) along pathways (faults). Methane could maintain their form in the GHSZ because of high temperature, high flux and some low pressure in the fault. Methane reaching the seafloor, in turn, forms near seafloor gas hydrates usually with cm-scaled layer or fragments in the water depth deeper 400 m. A remarkable sample was massive hydrate layer with about 40 cm thickness

Thus, integrated investigations with international cooperation allow us to discover gas hydrate and to understand formation/dissociation gas hydrate in the Okhotsk Sea.