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Methane distribution regularities in the marine sediments corresponding to the sea floor morphology along the N-S transect across the Sea of Okhotsk

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The main objective of the work: explore a new methane distribution features, gas anomalous zones and gas migration pathways in the middle part of the Sea of Okhotsk.

Previous studies exposed that in the margins of the Okhotsk Sea methane is supplied to the water column from cold vents and leakages limited in the Cenozoic thick sediment complexes bearing the oil and gas deposits, gas saturated subsurface sediments and methane hydrates, gashydrothermal springs, mud volcanoes and others. Nevertheless, middle part, especially deep sea morpho-structures for the gas hydrocarbons migration investigated poorly.

New 6 areas of methane and gas hydrocarbons anomalous zones in sediments were found by us during state research program in the Sea of Okhotsk by expedition R/V "Akademik M.A. Lavrentyev", Cruise 42, 05 September – 04 October 2007.

180 sediment cores (up to 5 meters length, 206.3 meters in total) along 1600 km distance from Magadan coast to Urup Island through the shallow shelf, continental slope and deep sea area in the north-south direction were recovered (see fig.1). 975 sediment samples for GC gas-hydrocarbons content analyses (using head space, express and water-heating extraction) in the Holocene sediments were processed.

In the sediment gases methane, ethane, propane, butane and pentane were measured.

Methane, detected in the all samples, varied from 2.0 to 1550 ppm (10^{-4}%).

Methane maximum from 10 – 150 to 1000 – 1200 ððm (st. 160, 161, 162à, 163) were found in the Kurile Basin – area of modern volcanic activity (3000-3500 meter water depth, fig. 2); lowest content 1,5-10 ððm - in the central deep (1000-1500 m) area of the sea; intermediate values from 5 – 15 to 315 – 475 ððm (st. 2 – 28) distributed on the North-Okhotsk shelf (50-500 m). Toward down of the sediment methane content was increased always, nevertheless, sediment layers characterized by methane exhaustion were found. GC analyses has shown, that methane content in the lowest levels (3-4 meters below sea floor) usually 2 – 150 times higher than in the upper oxidized sediment layer. Ethan was detected in 86% of samples, highest values in the North-Okhotsk Shelf (15 ppm).

Fig. 2. Methane distribution diagram on the bathymetric profile across Sea of Okhotsk from north to the south and methane anomalies in the upper sediments measured in the sediment cores bottom. Profile location plotted on the Fig. 1. Bars on the sea-floor profile indicate methane distribution also.

Background methane content in the sediments was computed statistically 3 cm^3/m^3 (3 ppm).

Methane saturation in sediments was studied also: 1) the highest values revealed in the Kurile Basin (up to 1000 cm^3/m^3); 2) North-Okhotsk shelf - average 30 cm^3/m^3; 3) continental slope 6 cm^3/m^3; 4) central area of the sea 4.2 cm^3/m^3, except Makarov Trough 6-23 cm^3/m^3. Lowest methane saturation was detected above basement rises: 4 $cm3/m^3$ average.

It is important, that near the Urup Island in the bottom of 2 sediment cores were detected strong H_2S odour and sediment texture similar to the hydrate bearing sediments in other Okhotsk Sea areas.

Thus, across middle part of the Sea of Okhotsk methane distribution was studied in detail for the first time. Methane and high hydrocarbon gases distribution characteristically vary within the different geomorphology areas. In these areas there are sediment cover thickness from hundred (basement rises) to several thousands (North-Okhotsk Shelf and Kurile Basin) meters influenced by certain geodynamics, seismic and volcanic activity. Hydrocarbon productivity of this areas resulted in explained regularities of hydrocarbon and other gas distribution.

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