

Geochemical Control of Subsurface Gas Hydrate Formation at the Seeps in the Sea of Okhotsk

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The Sakhalin shelf and slope towards the Derugin Basin (the Sea of Okhotsk) form a remarkable active hydrocarbon seep region provided by deep hydrocarbon source layers through active fault systems. An area of focused fluid venting off NE Sakhalin, was investigated in 2003-2006 during expeditions within the framework of the CHAOS International Project (Hydro-Carbon Hydrate Accumulations in the Okhotsk Sea). Numerous structures related to seafloor gas venting were discovered and gas hydrates were sampled from nine of them. In this study we consider geochemical factors controlling formation of hydrates associated to the studied gas seeps.

Geochemical analysis of the interstitial fluids was used to define the mechanisms of gas hydrate accumulation and spatial distribution pattern of gas hydrates in the seep sediments. A model of the ascending fluid discharge along one of the seeps named CHAOS was made based on the measured chlorinity (salinity function) of the pore waters and calculated chlorinity gradients. The chloride ion distribution profiles with depth at the CHAOS site represent alike increasing and decreasing trends both in hydrate-bearing and hydrate-free cores. The model testifies an upward water infiltration of more saline water in vicinity of coring stations recovered gas hydrates and relatively desalinated water mostly around those hydrate-free. It was established that gas hydrate formation at the CHAOS site is focused at the locations of intensive ascending flow of water enriched by salts that is probably function of gas solubility in water in the equilibrium with hydrate. Fugacity coefficient of methane dissolved in saline gas-saturated water which is in equilibrium with hydrates, is higher than that in more fresh water though the solubility is lower (Handa, 1990). Therefore, if a gradient of water salinity exist under conditions of hydrate stability, diffusion of methane induces hydrate formation by segregation on the outside a boundary fresher/saline water. We suppose that the feature is responsible for the hydrate formation just at the locations of the saline water up flows (other conditions being equal).

References

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