

Distribution of the structure II gas hydrate in Lake Baikal

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Gas hydrates are crystalline clathrate compounds composed of water and gas molecules that are stable at low temperatures and high partial pressures of each gas component. Natural gas hydrates exist in sublacustrine sediments of Lake Baikal, Russia. In the framework of MHP (Multi-phase Gas Hydrate Project, 2009-2012), more than 15 new places where gas hydrates exist in the sub-bottom sediments were discovered. Gas hydrate crystals were retrieved onboard and stored in liquid nitrogen. We also measured molecular and isotopic compositions of hydrate-bound gas and dissolved gas in pore water. Kida et al. (2006) first reported coexistence of the structure I and II gas hydrates at the Kukuy K-2 mud volcano (MV) in the central Baikal basin. Granular sII hydrates appeared above the massive sI hydrates, and sometimes connected with each other by vein-like sI hydrates. sII hydrate layers contained about 14% of ethane; on the contrary, sI hydrate layers contained several % of ethane. In the MHP cruises, existence of sII hydrate was suggested by the high ethane concentration at the Kukuy K-10 MV in 2010. Granular sII hydrates were also discovered at the Kukuy K-4 MV in 2011 and the Kukuy K-3 MV in 2012. They exist not only in the Kukuy Canyon area (central Baikal basin), but also in the PosolBank area (southern Baikal basin). Concentration of ethane in sII hydrates ranged 13-15% in the total hydrocarbon gases, whereas that of propane was relatively small (several hundred ppms). Neopentane (2,2-dimethylpropane) was concentrated in the guest gas of sII hydrates. The concentration of neopentane was about 1% of the total hydrocarbon gases at the Kukuy-Pockmark, located between K-2 and K-3 MVs. These heavier hydrocarbons are the signal of thermogenic origin; however, some questions regarding selective enclathration (scarce propane, and enrichment of ethane and neopentane) remain unresolved. Concentration of hydrate-bound ethane widely ranged from several hundred ppms to 15%, and mixed-gas of microbial and thermogenic gases is dominant in Lake Baikal.

Kida M, Khlystov O, Zemskeya T, Takahashi N, Minami H, Sakagami H, Krylov A, Hachikubo A, Yamashita S, Shoji H, Poort J, Naudts L (2006) Coexistence of structure I and II gas hydrates in Lake Baikal suggesting gas sources from microbial and thermogenic origin. *Geophys Res Lett* **33**: L24603. doi:10.1029/2006GL028296

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