# Ionic and isotopic analyses of pore waters from gas hydrate-bearing sediment cores retrieved at Tatarsky trough off Sakhalin Island, Russia

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The Sakhalin Slope Gas Hydrate Project (SSGH) is an international collaborative effort by scientists from Japan, Korea, and Russia to study natural gas hydrates (GHs) that have accumulated on the continental slope off Sakhalin Island, Russia. In 2012, 2013 and 2014, the R/V Akademic M.A. Lavrentyev conducted two research cruises for the SSGH-12, SSGH II-13 and -14 projects – the LV59, LV62 and LV67 cruises, respectively, to investigate possible GH occurrence at Tatarsky Trough. Four GH-bearing sediment cores were retrieved at the study area using steel hydro- and gravity corers. In order to study the characteristics of pore water of the GH-bearing sites, the isotopic and ionic composition of sediment pore water was examined. The concentrations of anions were determined by an ion chromatograph. Stable oxygen isotopic composition was analyzed by an isotope ratio mass spectrometer.

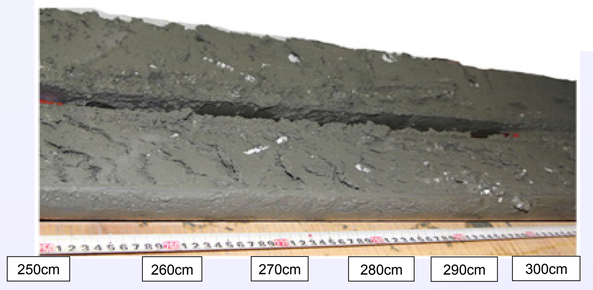
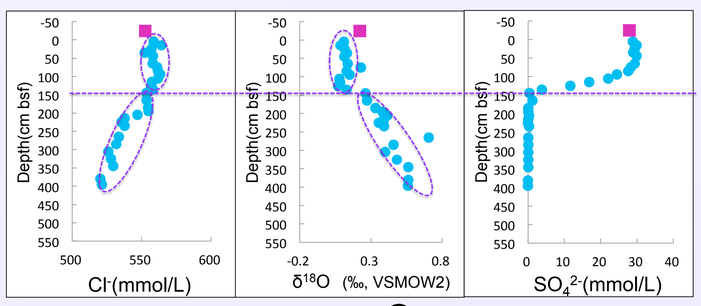
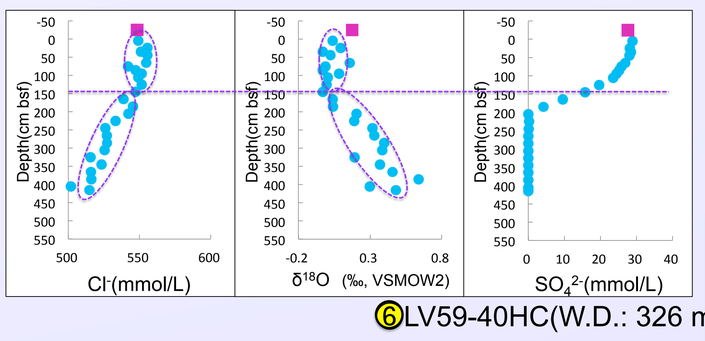


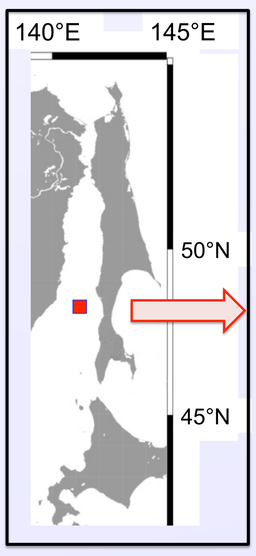

Fig. 1 GH-bearing interval of core LV62-17HC(W.D. 323 m)(Fig. 2:⑤)※




⑦LV59-42HC(W.D.: 326m)




⑥LV59-40HC(W.D.: 326 m




Coring sites
Gas flares
Gas flares (Fig.4)

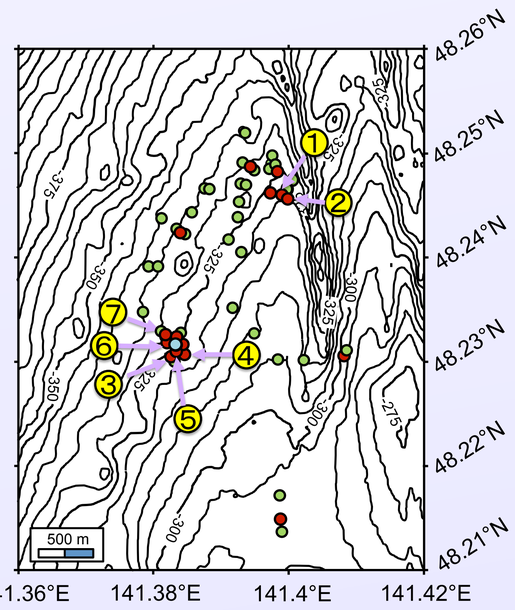
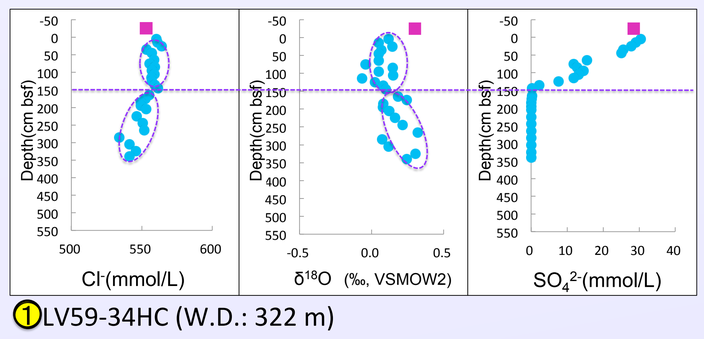
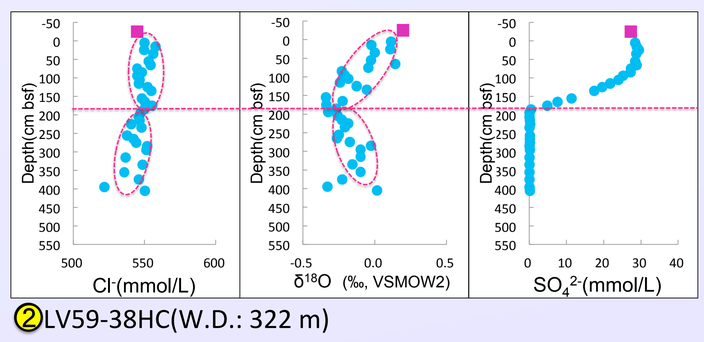


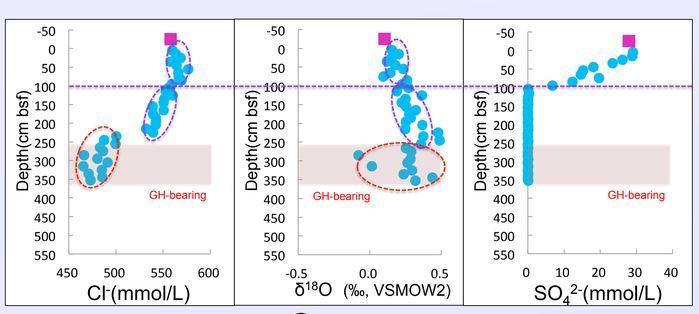

Fig.2 Study area (Tatarsky Trough)※



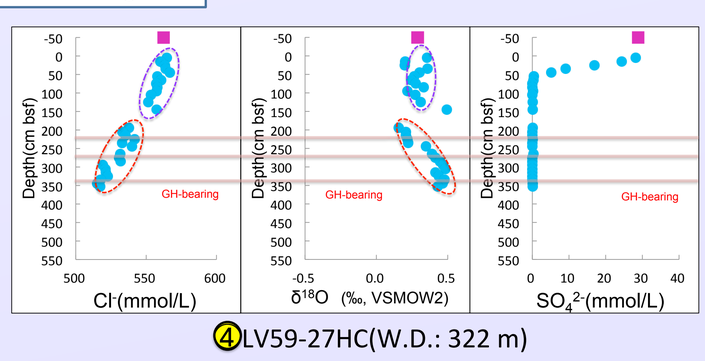

①LV59-34HC (W.D.: 322 m)



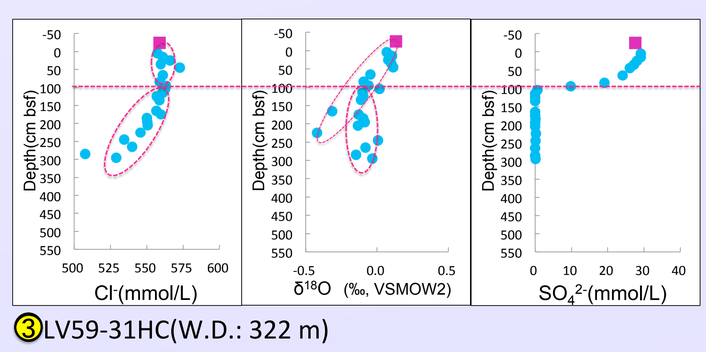

②LV59-38HC(W.D.: 322 m)




⑤LV62-17HC(Fig. 1)(W.D.: 323 m)




④LV59-27HC(W.D.: 322 m)




③LV59-31HC(W.D.: 322 m)

Fig. 3 Depth profiles of $Cl^-$, $\delta^{18}O$, and $SO_4^{2-}$ in pore water and bottom seawater samples

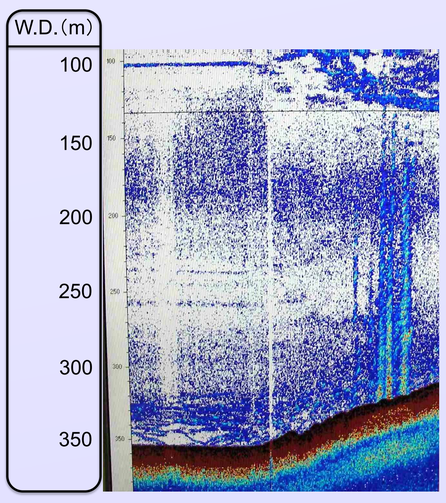



Fig. 4 Gas flares (at ○ in Fig. 2)

## Chloride and Oxygen isotopic composition-depth profiles

Three cores showed linear depth profiles of chloride concentrations and oxygen isotopic composition. By contrast, the chloride concentrations in the other nine cores are initially similar to those of the bottom seawater, and then decrease with depth. The isotopic composition in the seven cores are initially similar to those of the bottom seawater, and then increase with depth. The other two cores initially decrease the isotopic composition with depth, and then increase with depth as shown in Fig. 3.

## Possible mechanism of $Cl^-$ and $\delta^{18}O$ anomalies

Chloride is recognized as a conservative ion, and variations in $Cl^-$ concentration can be used to estimate water mixing. The finding that $Cl^-$ and $\delta^{18}O$ of the pore waters varied their behavior with depth suggests that the pore water originated from seawater are mixed with $Cl^-$-depleted/$\delta^{18}O$-rich fluid. One of the possible mechanism to produce this fluid is GH dissociation since $\delta^{18}O$-rich and pristine pure water is used when GH forms. The fact that a large number of gas flares are observed at the sites where ionic and isotopic anomalies are recognized supports this mechanism.

## 【Conclusion】

The findings we obtained in this study suggest that excessive free gas could induce flow through cracks such as those produced by fracturing. If this is the case in this study area, the diffusive process as well as the chloride-depleted and $\delta^{18}O$-rich/free gas-rich fluid flow as an advective process may contribute to these low chloride anomalies in the pore waters. One of the possible mechanism of those phenomena are supposed to be due to GH dissociation below the cores. The fact that the area we observed $Cl^-$ and $\delta^{18}O$ anomalies are in accord with that of the gas chimney structure (B. Baranov, in this conference) supports our interpretation. However, future studies are needed.

**References**
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