Halogen systematic of pore water in the near-seafloor gas hydrate deposits; application of 129I dating for fluid and gas sources

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Because major halogens (Cl, Br, and I) are physicochemically conservative in marine pore water, their behaviors are similar during gas hydrate formation and dissociation. While Cl concentrations have been used commonly for the determination of presence and origin of gas hydrates, Br and I studies have been undertaken less frequently so far. Their biophilic natures are, however, considerably different in the marine-shallow sediment system, halogen systematic is useful to examine the contribution of marine organic materials responsible for the hydrocarbons accumulated in gas hydrates. Because of the most biophilic behavior of I, coupled with the presence of the cosmogenic long-lived radioisotope 129I, this element has been applied recently for the determination of potential source formations for hydrocarbons and fluids in marine gas hydrate system.

We present here the results of halogen concentration and 129I/I measurements of pore waters collected from the massive gas hydrate deposits near seafloor sustained by active gas seepage, Hydrate Ridge (off Oregon), Umitaka Spur (off Joetsu), and Okhotsk Sea (off Sakhalin). In all areas, concentrations of Cl changes variably from seawater level, probably reflecting the input of Cl-enriched/-depleted fluids from the loci of gas hydrate formation/dissociation, which also shifts potentially the concentrations of Br and I. On the other hand, concentrations of I and, to a lesser degree, Br have been enriched considerably compared to seawater; I concentrations are higher commonly by two orders of magnitude, resulting from the input of deep fluids enriched in I and somewhat Br due to the release of these elements into the aqueous phase during the degradation of organic materials at depths. The 129I/I ratios of pore waters allow us to estimate potential age of the source organic materials since the I (organic materials) has been isolated from seawater. Although the shallow I ages indicate mixing with recent seawater, those below ˜5 mbsf are of old source origin, indicating long-scale transport of fluids enriched in hydrocarbons. These ages are constrained well by the local geological settings, the 129I/I technique has been useful to determine the potential source sediments for hydrated gases and to point out key geology causing active delivery of fluid and hydrocarbons.