

Analysis of products in ethane hydrate with gamma ray irradiation

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Clathrate hydrate is a crystal compound of water molecules encaging guest molecules. Natural gas hydrate is found under deep ocean sea and in permafrost region, and expected to be a future natural gas resource. Estimation of formation age in natural gas hydrate has been attempted using the ¹²⁹I method (e.g. Fehn et al., 2003), which is an indirect age determination method. In contrast, we have investigated to establish a direct age determination method from hydrate crystal itself. Since natural gas hydrate is formed in sediment and irradiated by natural radiation due to natural radioisotopes like ⁴⁰K, U-series and Th-series, chemical reaction via radicals may occur in natural samples. In methane hydrate, methyl radicals are induced by gamma-rays (Takeya et al., 2004). However, they are unstable at the natural condition of temperature and pressure, and dimerize to ethane (Ishikawa et al., 2007). In another reaction, methanol is also formed after gamma-ray irradiation to methane hydrate (Tani et al., 2008). The amount of methanol in natural gas hydrate would be small because alcohol has a property as an inhibitor to crystallize clathrate hydrate. If the amount of methanol increases after hydrate formation, quantitative measurement on methanol may give a formation age of natural gas hydrate.

Although natural gas hydrate mainly contains methane, some amounts of ethane and propane are also found in natural gas hydrate (e.g. Kida et al., 2006). Those ethane and propane may have influence on formation efficiency of methanol that is essential for our age determination. In this study, we have investigated chemical products formed in gamma-irradiated ethane hydrate.

Ethane hydrate was synthesized and irradiated by gamma-rays of about 6 kGy at 273 K under high pressure. After dissociation, the water was analyzed by GC-MS. Ethanol and the other small peaks were observed.

Keywords: clathrate hydrate, ethane, gamma rays, GC-MS, ethanol