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Methodological investigation of light volatile organic compounds in water

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Recent our studies revealed that methanol and formaldehyde were mainly formed in methane hydrate by gamma-ray irradiation (Tani et al., 2008; Tani et al., 2010). Although these compounds may also be formed in natural gas hydrate, their concentrations should be very low because a dose rate of natural radiation from deep-sea sediment is not so high. Therefore, we have the methodological curiosity to detect very low concentration of methanol and formaldehyde in water. We tested two methods: (a) a direct injection method by proton-transfer-reaction mass spectrometry (PTR-MS) (Jurschik et al., 2009) and (b) a headspace method by gas chromatography-mass spectrometry (GC-MS). For methanol, the method (b) has a better detection limit than the method (a). For formaldehyde, quantitative detection is difficult in the method (a) due to similar proton affinities of water and formaldehyde (Hansel et al., 1997). In addition, a good derivative is available for an analysis of aldehyde in water (Kobayashi et al., 1980). In this study, we focused on the method (b) and tested it in different experimental conditions (e.g. oven temperature in GC-MS, heating temperature and time in headspace, reproducibility, influence of multiple sampling, etc.) to develop the method of quantitative evaluation of low-concentration methanol and formaldehyde in water.

Keywords: volatile organic compounds, GC-MS, methanol, formaldehyde, gas hydrate