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In situ measurement of the amount og free gas of deep sea sediments by Time Domain Reflectometry(TDR) method

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The amount of free gas in deep sea sediments is a critical factor for the stability of gas hydrate, however, it is not easy to obtain reliable free gas amount by conventional core sampling methods. In this study, we try to measure the in situ free gas amount of gas hydrate bearing Japan Sea sediments by introducing the Time Domain Reflectometry (TDR) method with an intention to estimate the behavior of methane in deep sea sediments. TDR method has been widely used to estimate the water content of soils in the field of agriculture science.

The TDR sensor is set at the bottom of piston corer and data-logger and battery are stored in a pressure vessel within the weight at the top of the system. The volume of gas has been estimated from observed change in the dielectric constant. The dielectric constant is different in each material, about water is 80 and the soil are 3-9, and air is 1. Moreover, ice is 4.2. The sediment core of a constant amount was taken from bottom of the sea by piston core samplings, and the dry density and the particle density of the soil are measured in a laboratory. Then the amount of solid phase ratios is estimated. Thus the liquid phase rate can be estimated according to the value of the dielectric constant by the TDR method measured at the bottom of the sea. The volume of the gas can be requested from these measurements by the calculation.

The dielectric constant (e) of the sediments was different according to the measurement point. The dielectric constant measure by the TDR method was applied to proofreading type Vw=3.71E06∗e3-3.60E-04∗e2+1.86E-02∗e-5.61E-02 provided by the laboratory experiment, and liquid phase ratio (m3 m-3) was obtained. On the other hand the solid phase ratio (m3 m-3) of the sediments was directly obtained from the core samples. These results were brought together by each measurement point, and gas phase ratio (m3 m-3) was obtained from calculating formula. It is remarkable that the gas phase ratio of gas hydrate bearing sediments showed significant changed by approximately 5 % from sea bottom to sea surface during the experiment, suggesting dissociation of gas hydrate and degassing of dissolved methane due to depressurization during core recovery.

Keywords: TDR, measurement of free gas amount, Japan Sea, gas hydrate, method of marine survey