Trap of deep sourced fluid at gas hydrate in sediments from the Krishna–Godavari Basin, eastern continental margin of India

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National Gas Hydrate Program Expedition 02 (NGHP-02) was conducted in early 2015 by D/V *Chikyu* in the western part of the Bay of Bengal, India. Analyses of interstitial water in sediment from four drilling sites (Area-B: NGHP-02-17, NGHP-02-19, NGHP-02-22, and NGHP-02-23) in the Krishna–Godavari Basin show that dissolved chloride (Cl^-) concentrations decreased with depth from seawater values (>550 mM) near the sediment surface to 300–400 mM at 350–400 m below seafloor (mbsf). These asymptotic profiles suggest upward advection of low-Cl^- fluid from below the depths reached by the holes. On the other hand, excursions of Cl^- concentrations toward low values in gas hydrate zones in and around two reservoir sections (R1 and R2) were attributed to the presence of fresh water released by dissociation of gas hydrate during core recovery. At Sites NGHP-02-17 and NGHP-02-23, Cl^- concentrations below R2 (around 280 mbsf) were ca. 60 mM and ca. 45 mM lower than those from above R2, and $\delta^{18}O$ and δD values were 1–2‰ and 0.7–1.3‰ higher than those from above R2, respectively. These results suggest that a fraction of migrating low-Cl^- fluid is trapped in the gas hydrate zone as cage of water molecule in the gas hydrate, causing decreases of $\delta^{18}O$ and δD in the residual water due to isotopic fractionation during gas hydrate formation. From mass-balance calculations, we estimated that 10–20% of the advected fluid is trapped at the gas hydrate zone. The $\delta^{18}O$ and δD values below R2, representing relatively unaltered low-Cl^- fluid, were 0.5–1‰ higher and ca. 15‰ lower than those of seawater, respectively. This trend is consistent with water derived from the dehydration of clay minerals, which generally occurs at temperatures higher than 60˚C. Given the thermal gradient at these sites (58–70 mK/m), the depth where the low-Cl^- fluid originated is deeper than ca. 1000 mbsf. Our results suggest that fluid advection contributes to the accumulation of gas hydrate in the study area.

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