Swapping Global Warming Gases for Methane in Gas Hydrate Layer

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On the continental margins and in permafrost regions, natural gas, which has been expected to replace petroleum energy, exists in solid hydrate form. World hydrate reserves including natural gas are estimated at about twice as much as the energy contained in total fossil fuel reserves. Because of its vast quantities, the efficient recovery of natural gas from natural gas hydrate becomes the most important factor on evaluating the economic feasibility in the sense of commercialization. It has been noted that carbon dioxide, one of the well-known green house gases, possibly can be stored in the ocean floor as a carbon dioxide hydrate. If the natural gas hydrate could be converted into carbon dioxide hydrate, natural gas hydrate deposits would serve as energy sources as well as carbon dioxide storage sites in the deep ocean sediments. The primary purpose of this work is to address the cage-specific distribution of various guests within the host-lattice networks and then examine its potential application to CO_2 sequestration at the preliminary phase. In this study, we first attempted to examine the real swapping phenomenon occurring between guest molecules and gas hydrate through spectroscopic identification such as NMR and Raman spectroscopy. Using the NMR, cage occupancy and molecular distribution were identified. The cage dynamics and kinetics were also examined by Raman spectroscopies. Particularly, the simultaneously-occurring dual mechanism of CO_2 sequestration and CH_4 recovery is expected to provide scientific background for leading to the development of a promising large-scale approach with economic feasibility.