Quantitative Measurements of CH_4 Production from Hydrates with the Injection of CO_2

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The widespread occurrence of natural gas hydrate deposits in marine and permafrost environments has attracted significant interest in applying various methods to produce gas from these deposits. One attractive method is carbon dioxide injection in which gas is produced from the hydrate deposit (e.g. 277 K, 8 MPa in the N. Slope of Alaska), while simultaneously sequestering the carbon dioxide in the hydrate deposit. Previous studies have provided limited information on the CH4 production rates during the CH4-CO2 hydrate exchange process. However, the rate of CH4¬ production in hydrate systems is not well quantified, and could have significant implications towards quantifying CH4 release from various CH4 hydrate saturations observed in natural settings. In this study, we performed quantitative, well-controlled experiments to investigate the rate of CH4 production from hydrates induced by the flooding of CO2 and CO2-N2 gas mixture systems.

The experiments were performed using CH4 hydrate formed from sieved ice particles (106-125 micron particles) at 10 MPa and 263 K. After sufficient hydrate conversion (>90 %) of the ice particles was achieved, the CH4 gas atmosphere was then purged using liquid CO2. The production of CH4 from the hydrate structure was quantified from a continuous flow (0.04-0.08 cc/min) of liquid CO2 through the sample with a downstream in-line gas chromatograph used to determine the exiting stream composition. Final hydrate compositions were quantified by gas chromatography analysis.