

73c Hydrate Formation and Dissociation Processes Investigated by NMR

Shuqiang Gao, Waylon House, and Walter G. Chapman

Gas hydrates are ice-like structures in which water molecules, under pressure, form structures composed of nano-scale polyhedral cages surrounding gas molecule "guests" such as methane and ethane. The natural gas trapped in the naturally occurred gas hydrate deposits represents a potential source of energy many times all known natural gas reserves. Hydrates can form as well in undersea piping and above ground gas pipelines where they pose a major problem for gas/oil producers. Detailed understanding of hydrate melting and formation mechanisms on a molecular level is important for successfully tackling all hydrate challenges with accuracy and confidence.

Nuclear Magnetic Resonance (NMR) has been shown to be a powerful tool to non-invasively measure molecular level dynamic information. In this work, for the first time, we employ spin-spin relaxation times (T₂) measurement of tetrahydrofuran (THF) in deuterium oxide (D₂O) during the transient hydrate formation and dissociation processes, which dynamically reflect the changes of water molecular arrangements around the spin bearing THF molecules. Microscopic insights of the hydrate processes gained from this NMR investigation will contribute significantly to the fundamental understanding of hydrate mechanisms.