Introduction
Increasing demand for clean and abundant energy sources has motivated the field of gas production from natural hydrate deposits. The global potential of methane stored as hydrates is estimated at twice the net carbon stored in conventional fossil fuels—nearly 10,000 gigatons! This work is focused on the concept of hydrate dissociation for gas production, via in-situ combustion, as a point heat source for thermal stimulation of natural gas hydrate deposits. The basis of this research is in investigating the possibility of using CO₂ as an in-situ thermal diluent during the recovery of methane from hydrates while simultaneously sequestering CO₂ in the thermodynamically and geo-mechanically stable hydrate phase.

Recent Findings
Exotherms and pressure reduction used as primary indication of hydrate formation and dissociation CO₂ sequestration potential

Experimental Apparatus
Gas analysis and drying system
Experimental setup
70 liter high pressure reactor

CO₂ and CH₄ Hydrate Formation

CO₂ hydrate formation and exotherm
CH₄ hydrate formation and exotherm
P vs. T during injection, formation and dissociation

Model Results and Verification
Gas evolution during heating simulation
Temperature trace of low heating simulation: experimental and simulation data
Ice formation: experimental and simulation data

Future Direction
Further development of the model will include coupling of simplified kinetic parameters based on temperature or fugacity deviation from equilibrium values. Depending on the temperature regime and porous media characteristics the system may be controlled by either heat and mass transfer or kinetics. The current method of variable switching does not allow for the investigation of relative kinetic and transfer rates that need to be understood for field production. The apparatus has recently been upgraded for multi-gas injection for continued experimental exploration of CO₂-CH₄ exchange methods.

Acknowledgments

References
1. USGS
4. Sloan, E. Dandy, CSMHYD.EXE; FEED.DAT, HYD.EXE, SRK&H&EXE, SRK&H&FOR, DOSMSF.EXE