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# Crystallization of mixed gas hydrates under equilibrium and non-equilibrium conditions: PVTx measurements and thermodynamic modeling

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# Crystallization of mixed gas hydrates under equilibrium and non-equilibrium conditions: PVTx measurements and thermodynamic modeling

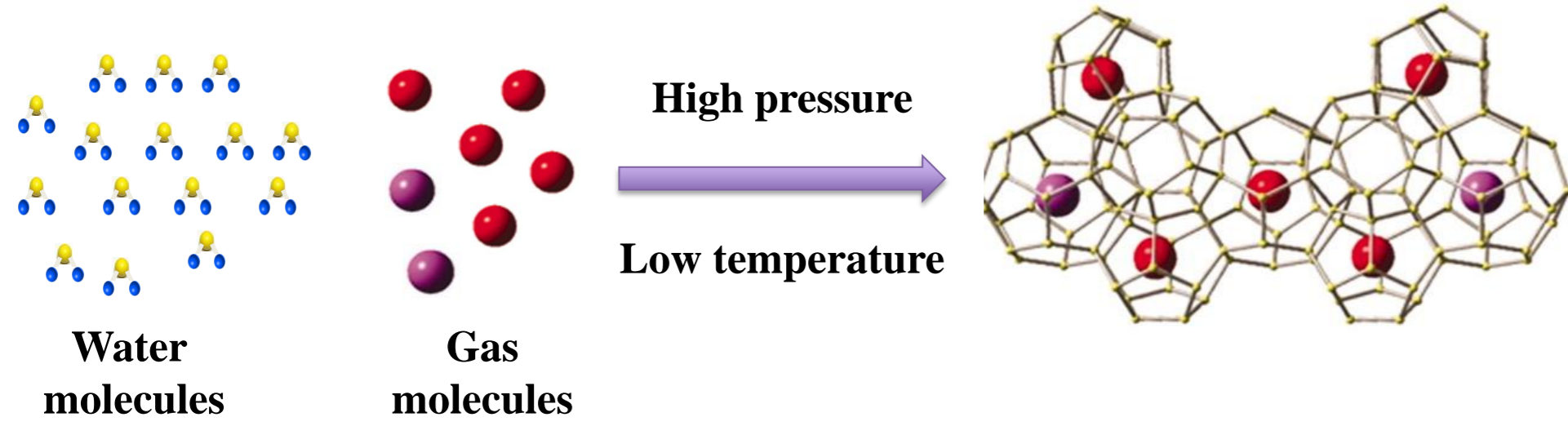
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## Introduction

### What are the gas hydrates?



- Gas hydrates, an issue in oil and gas industry
- Natural gas hydrates in permafrost and seafloor sediments; an unconventional energy resource
- Potential applications of gas hydrates
  - CO<sub>2</sub> capture and sequestration
  - Gas separation
  - Water desalination

### Research and problematics

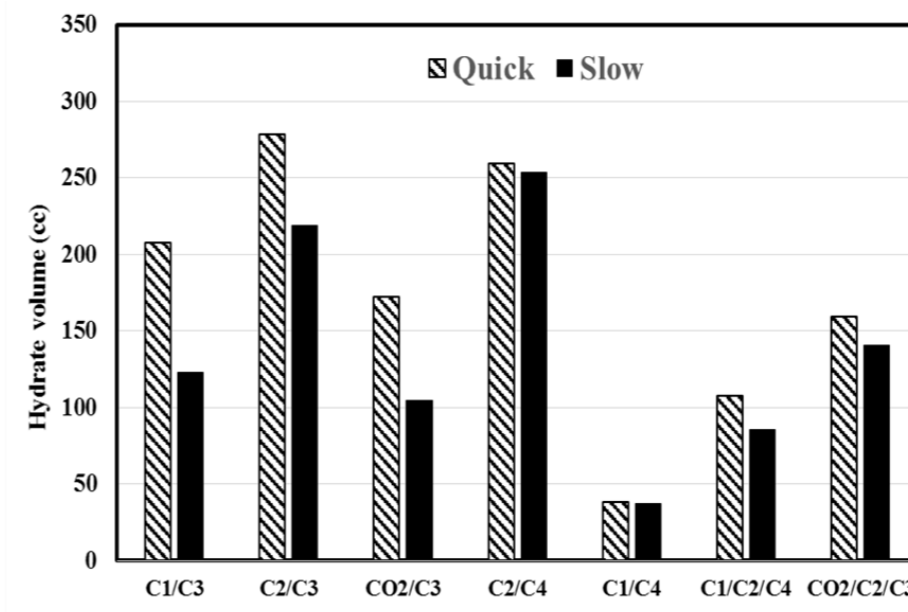
How much (volume) do gas hydrates form?

How is the guest distribution in hydrate phase?

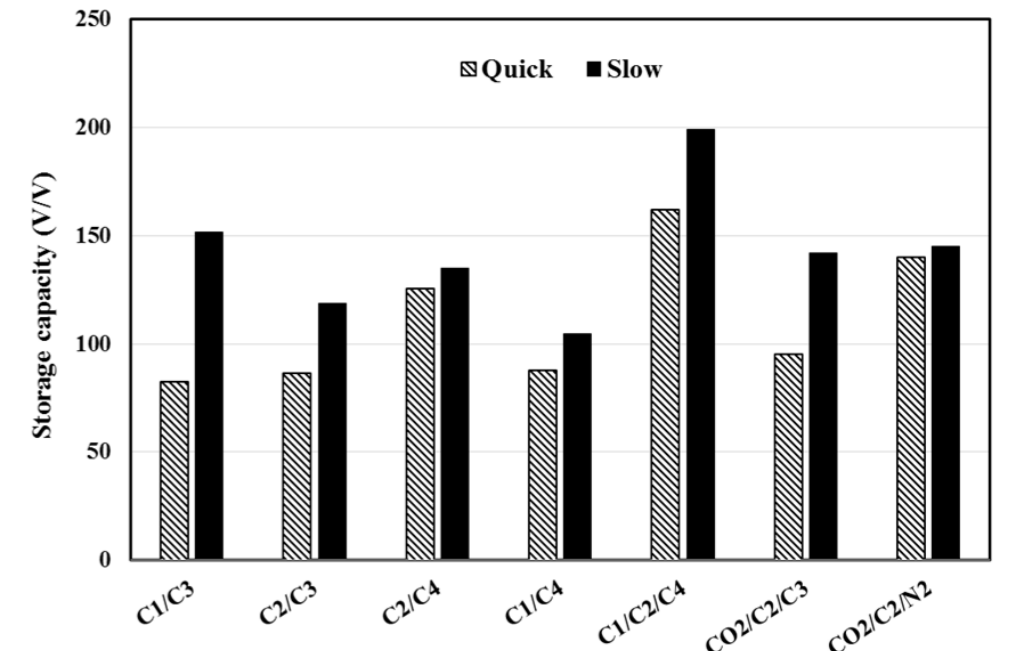
How does the rate of crystallization affect the final state?

## Experimental and modeling results

### Hydrate volume

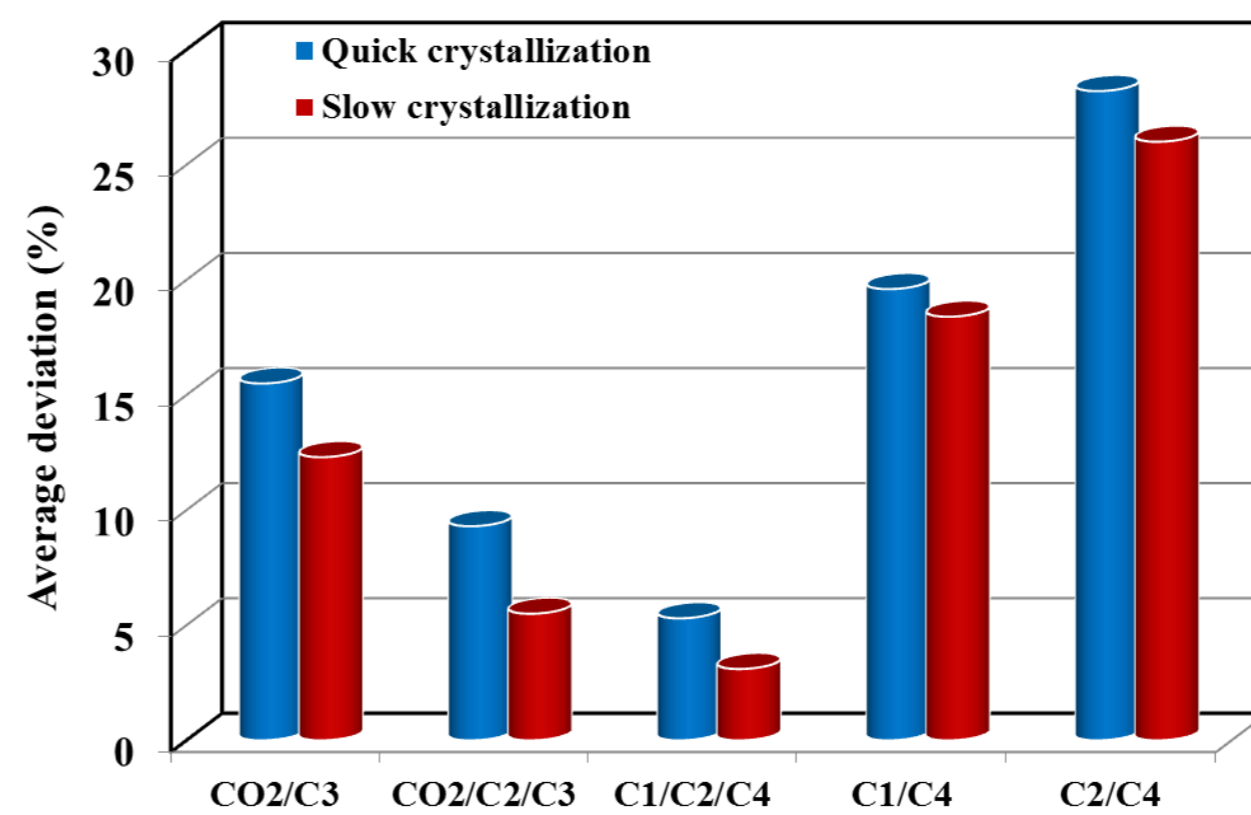


### Storage capacity



Different hydrate composition and pressure at final state

### Thermodynamic model simulation, equilibrium pressure

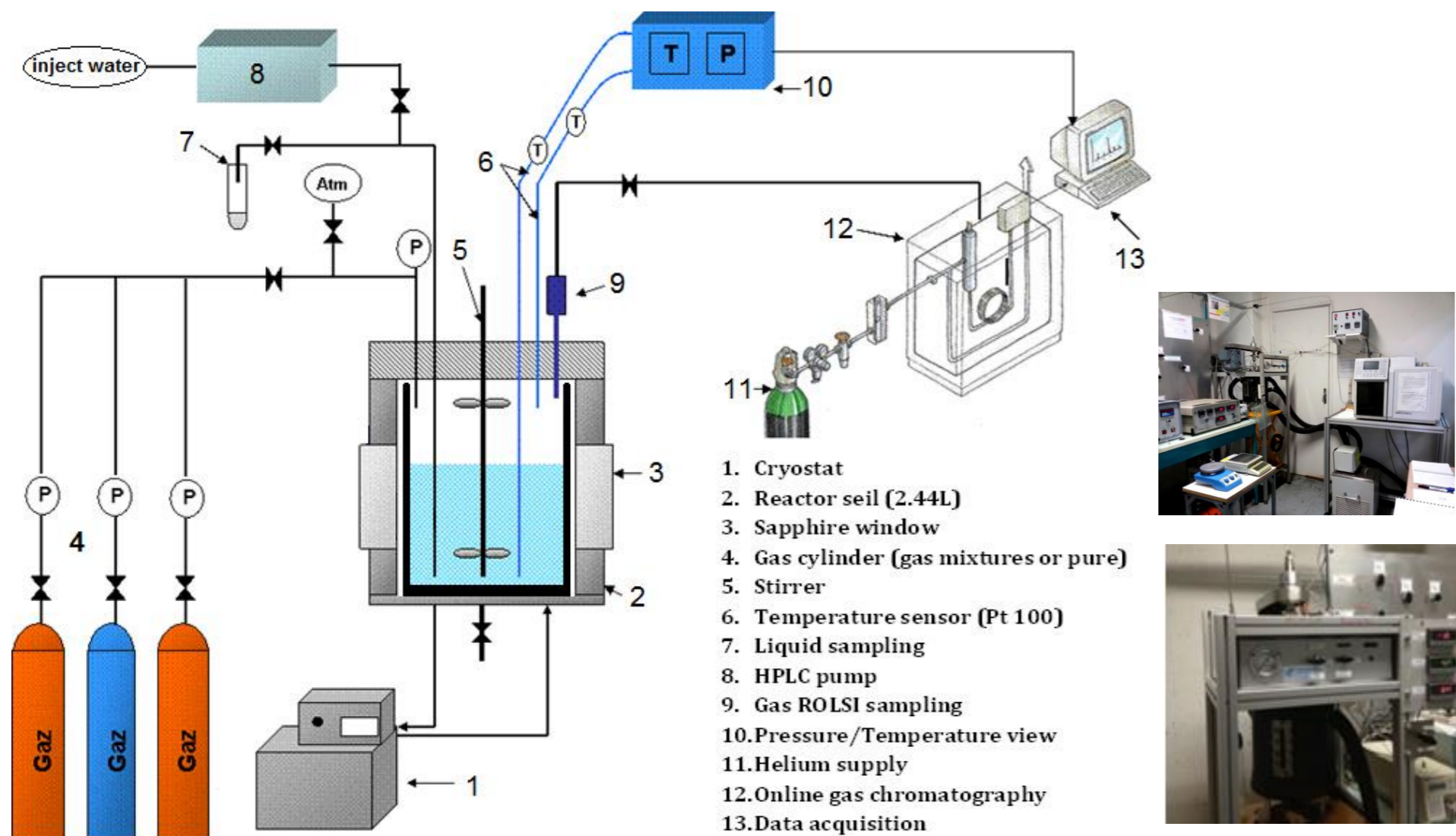


Hydrate composition simulation

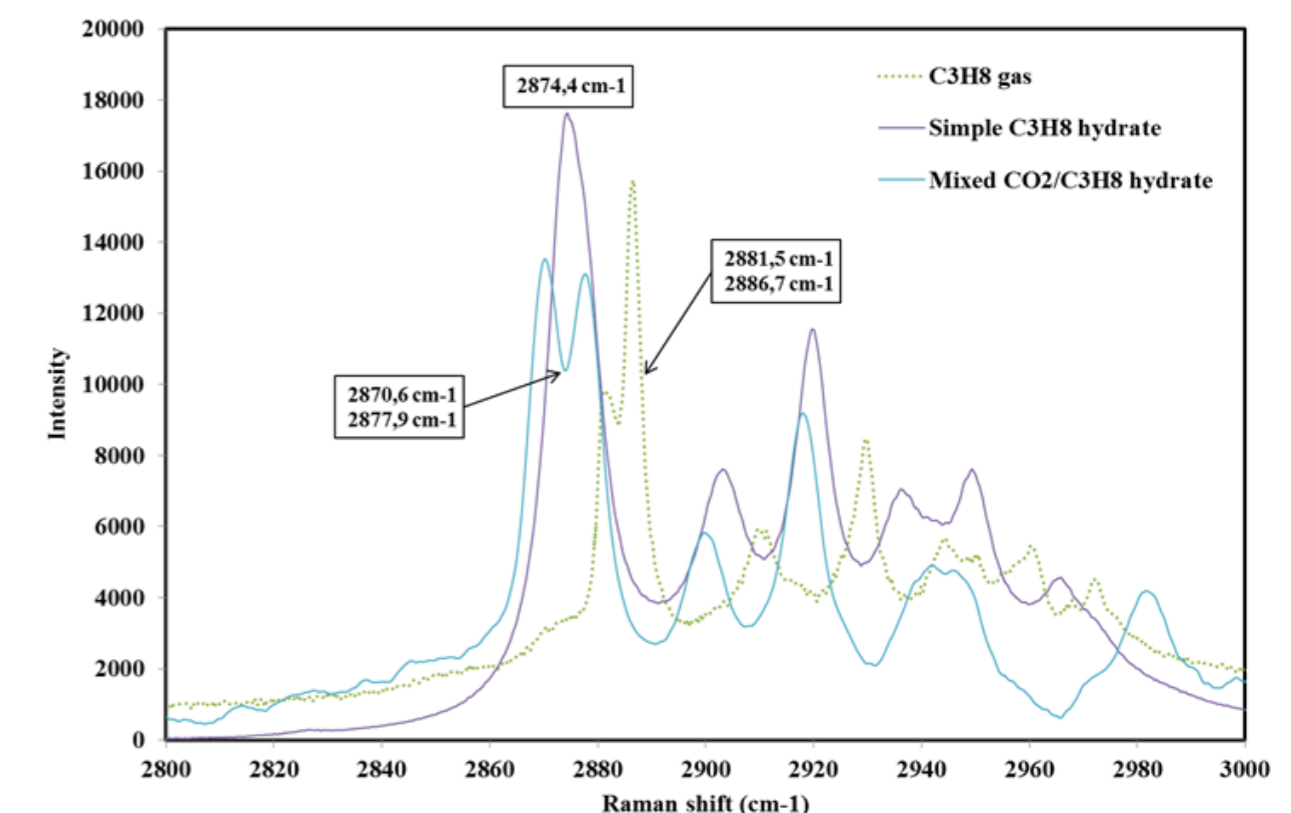
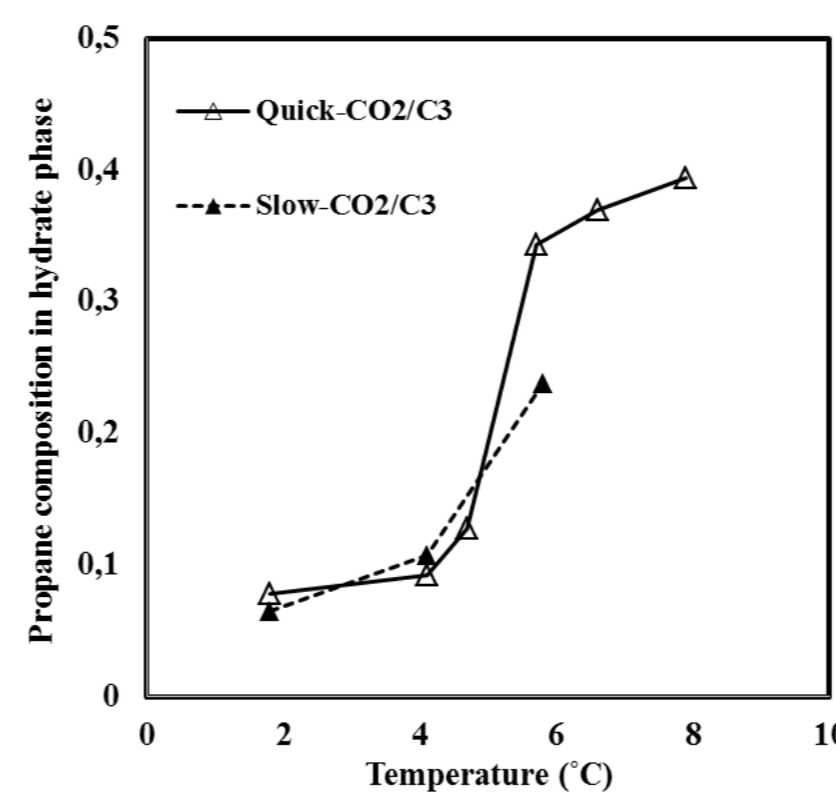
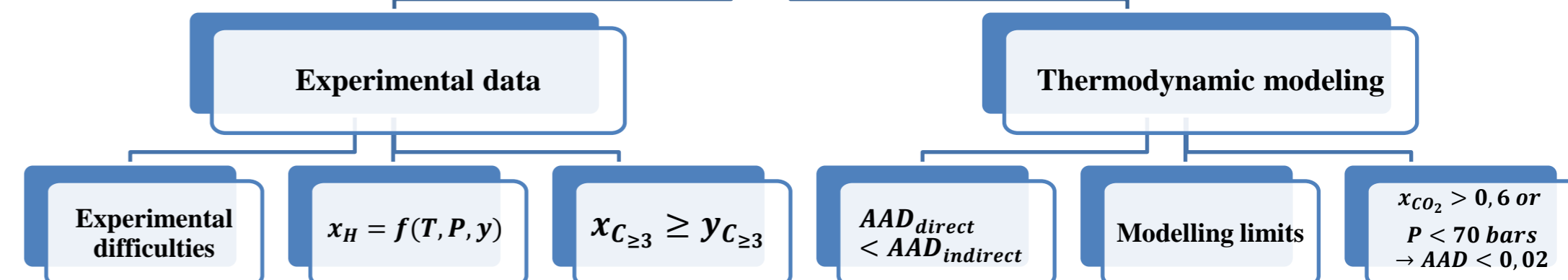
Average absolute deviation Slow < Quick

More homogeneous phase

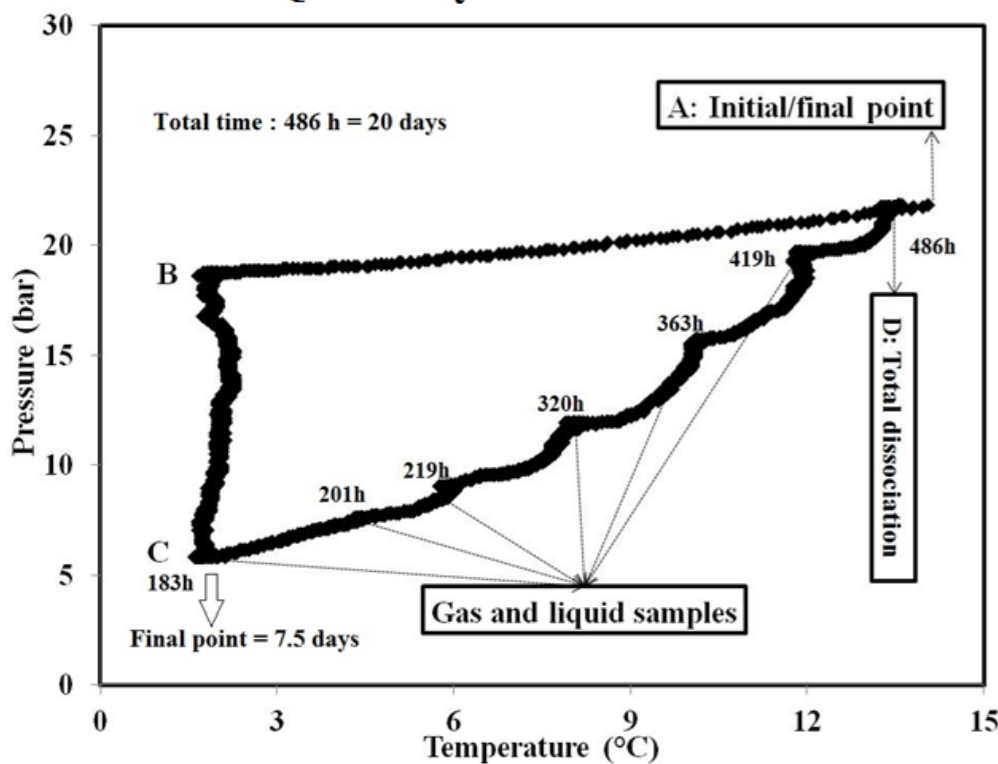
## Experimental set-up and procedures



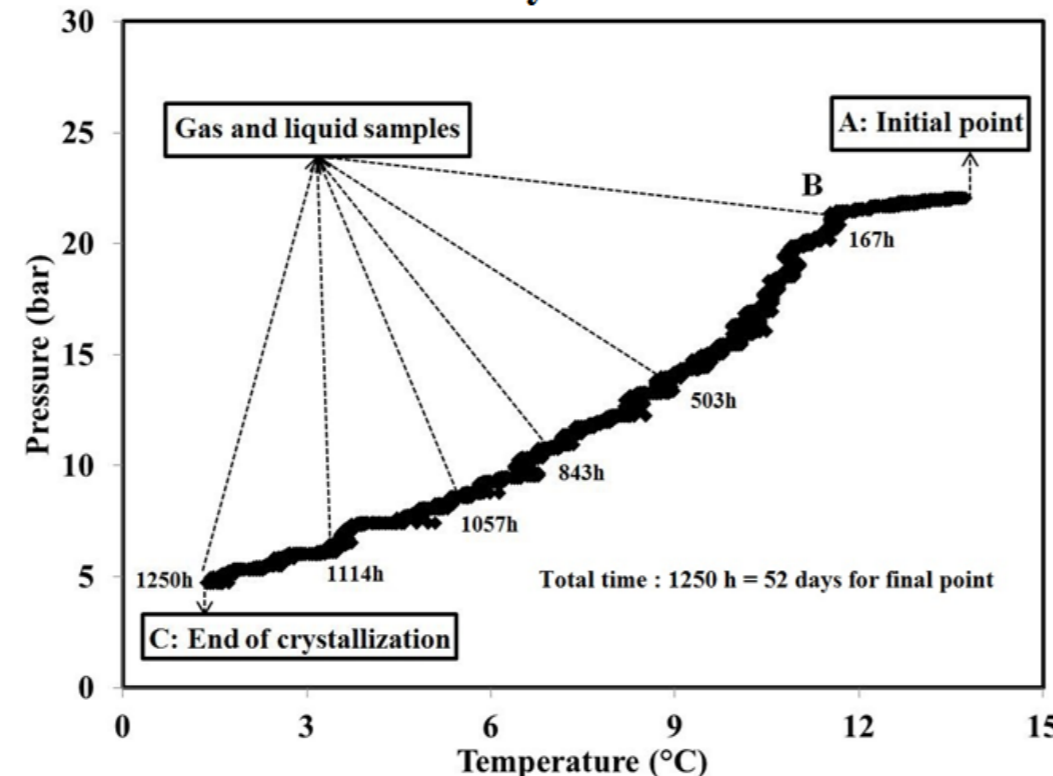
### Hydrate composition



### Quick Crystallization



### Slow Crystallization



Schematic diagram of the experimental procedures: a) Quick crystallization process. b) Slow crystallization process

## Conclusion

