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ELEGANCY

Solubility of Hydrogen in Brines Under Geological-Storage Conditions

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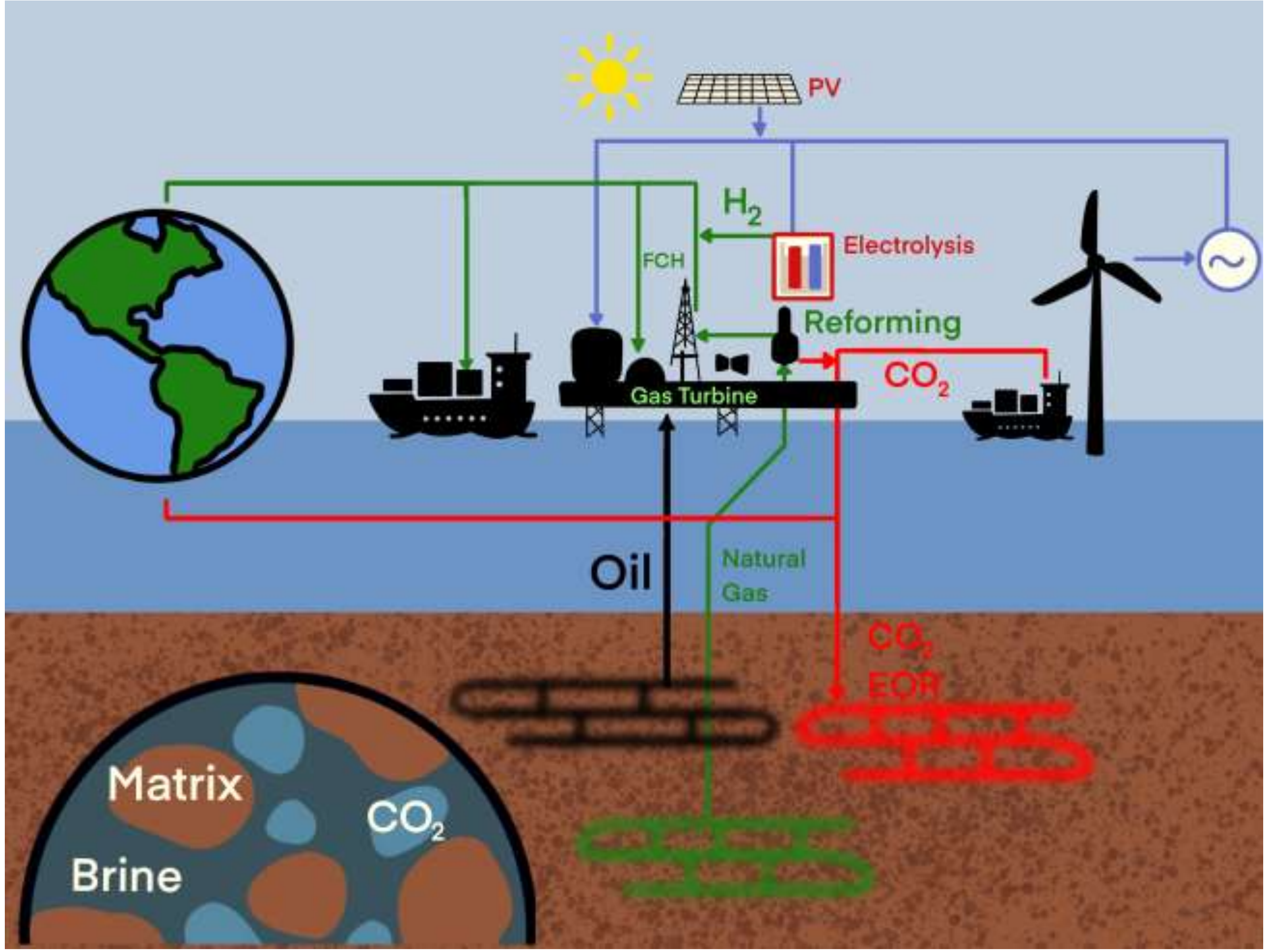
Outline

- Motivation and background
- Experimental work
- Modelling approaches
- Conclusions and Future work

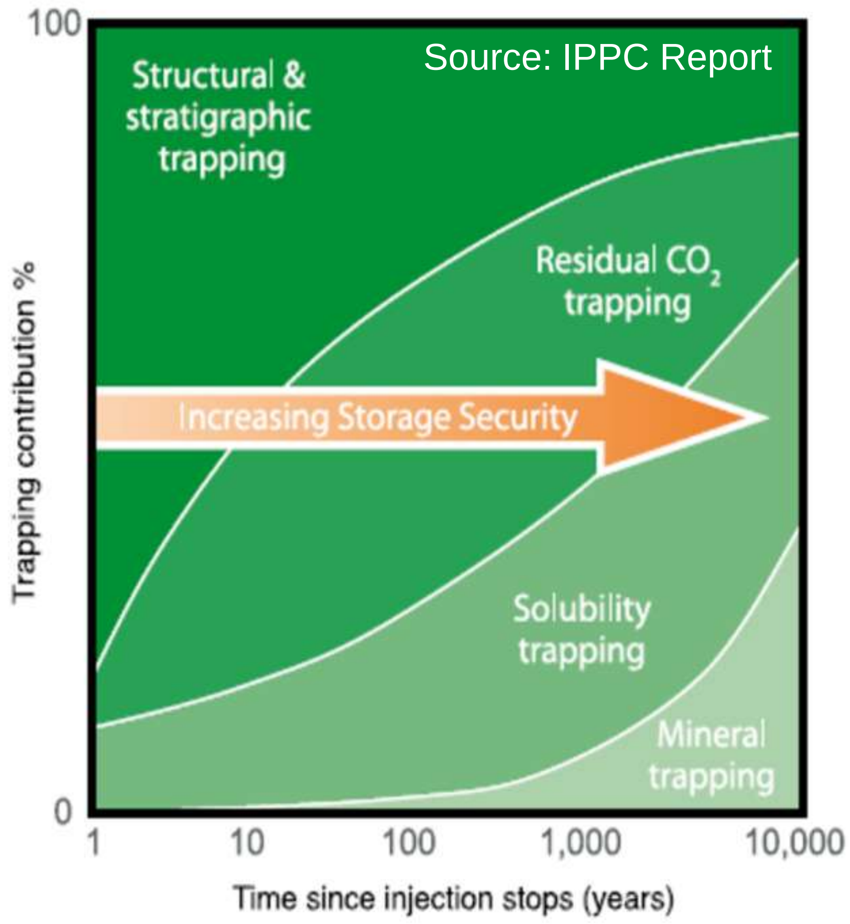
Motivation and Background



- ELEGANCY: coupling H_2 production with CCS
- Imperfect separation processes → impure CO_2 for storage
- H_2 impurity especially important
- Important to understand role of impurities in transportation and **storage**

Trapping mechanisms

- Structural trapping
  - Retention of mobile CO_2 below impermeable cap-rock
- Residual trapping
  - Retention of CO_2 as dispersed micro-bubbles within the pore space
- Solubility trapping
  - Dissolution of CO_2 into the native reservoir fluids
- Mineral trapping
  - Formation of carbonate minerals by chemical reaction



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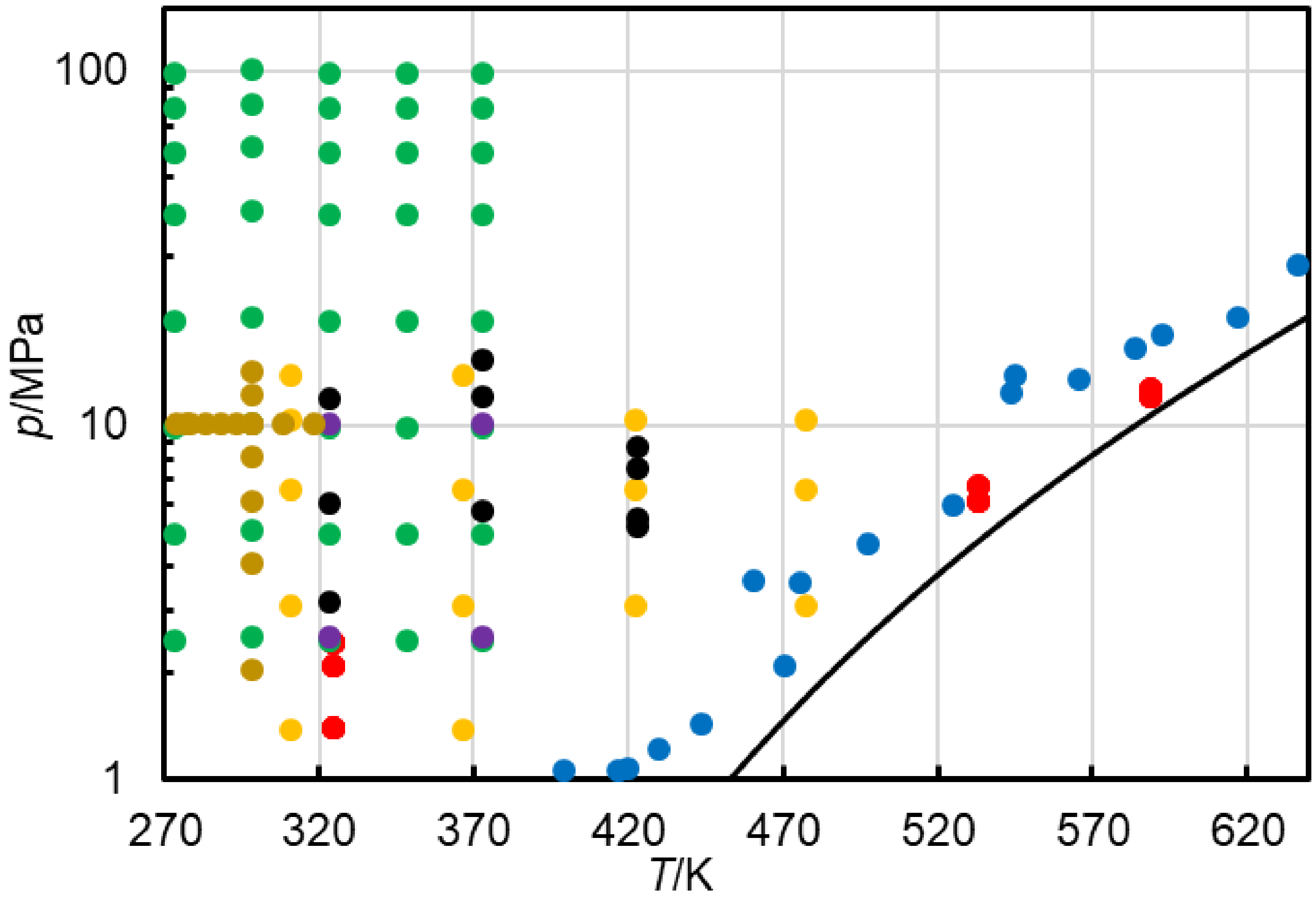
Available Experimental Data



- Solubility of $H_2O + H_2$

  (11 papers up to 550 K) - 1990

- Solubility of $H_2O + CO_2 + H_2$

  (1 paper at 298 K) - 1939

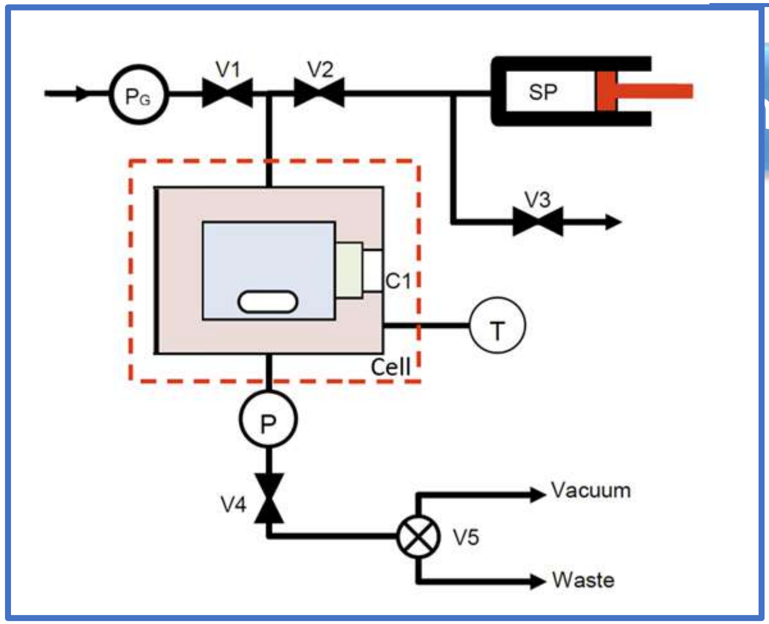
- Solubility of H_2 in Brines

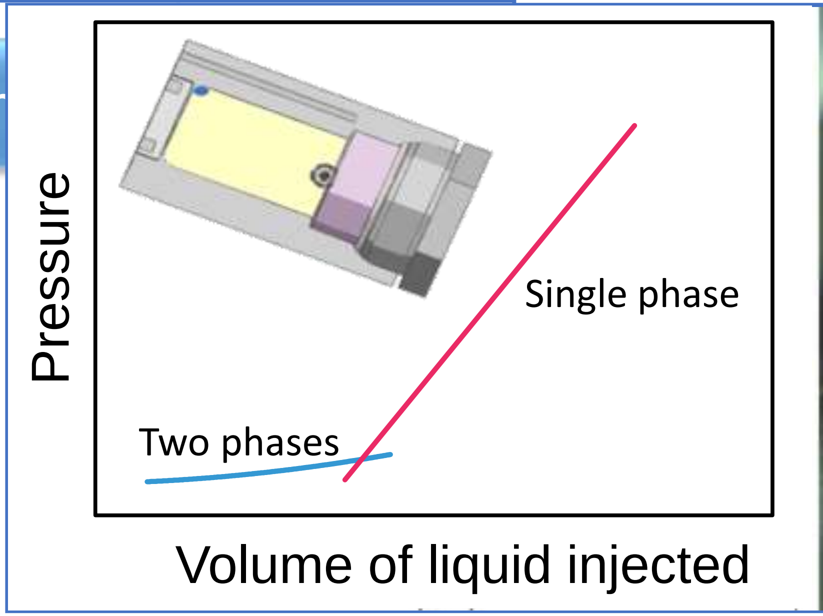
  (No data)

Experimental Approach

Experimental methods for high-pressure VLE

meth





- Operation conditions: pressures ≤ 70 MPa and temperatures ≤ 473.15 K
- Fill gas → inject liquid → Disappearance of bubble → PV analysis

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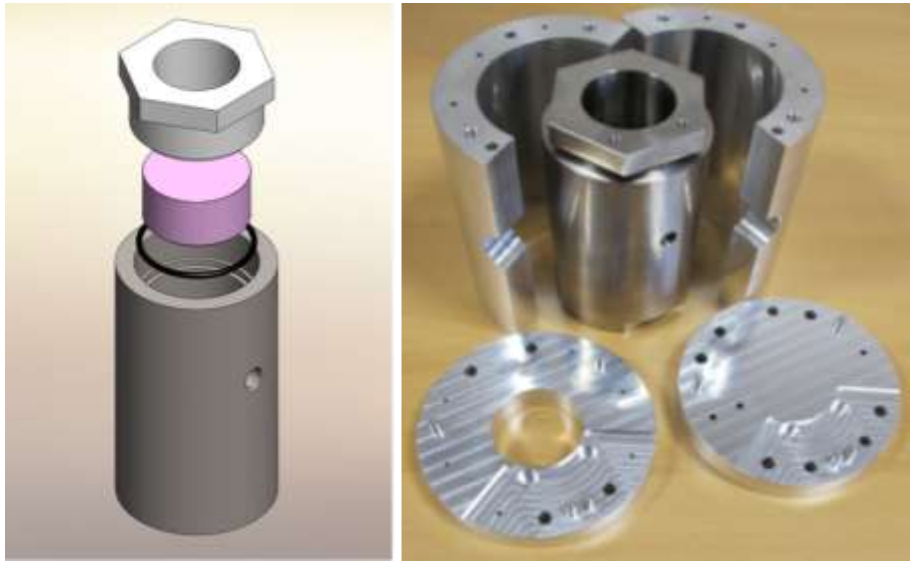
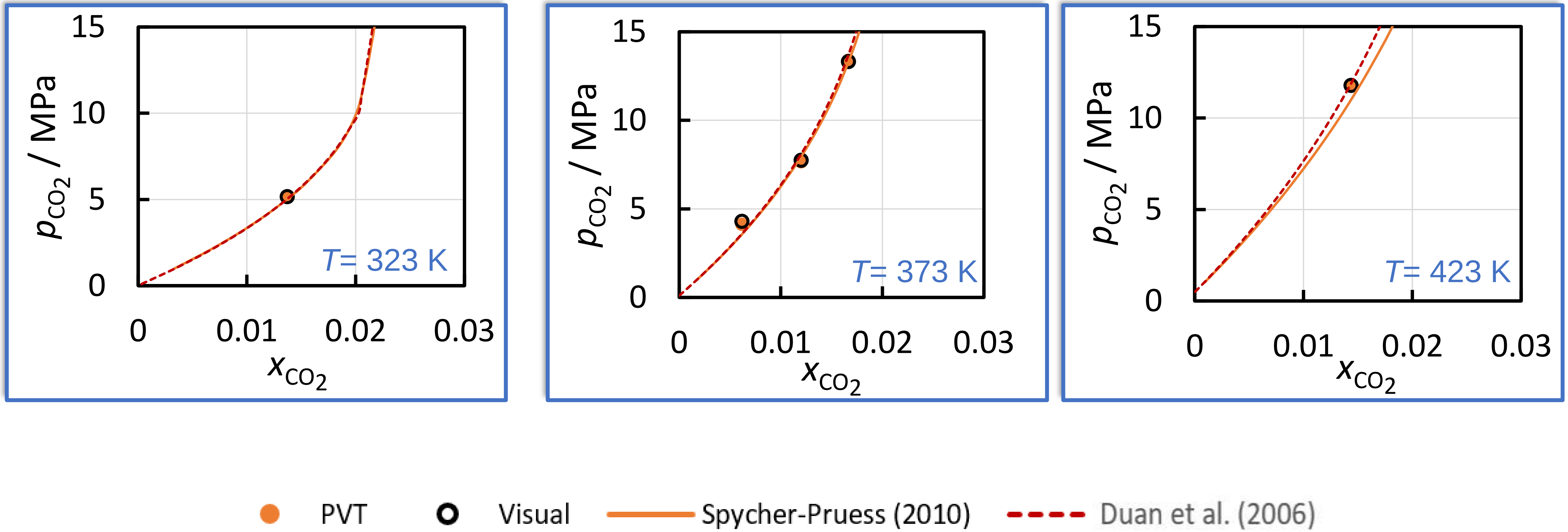
Apparatus Design



High-pressure view cell and heated jacked

Assembled system

Validation: CO_2 solubility in H_2O



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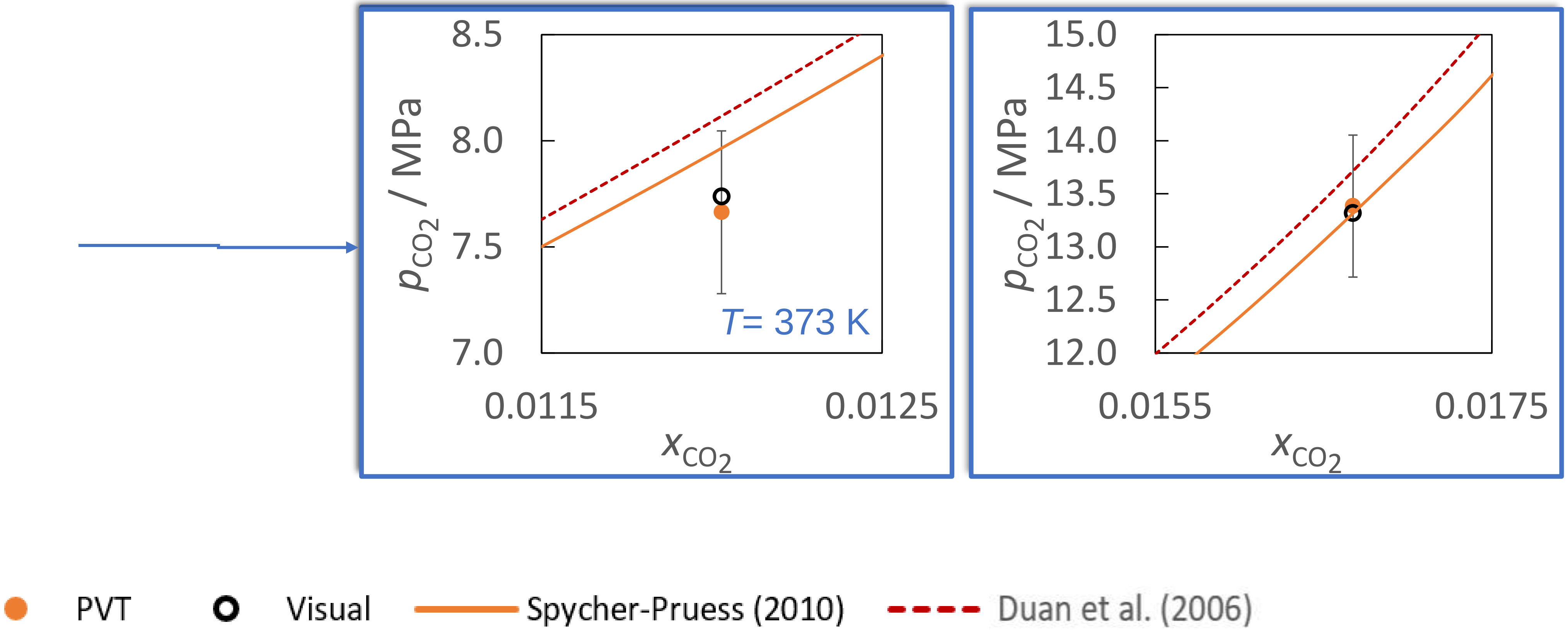

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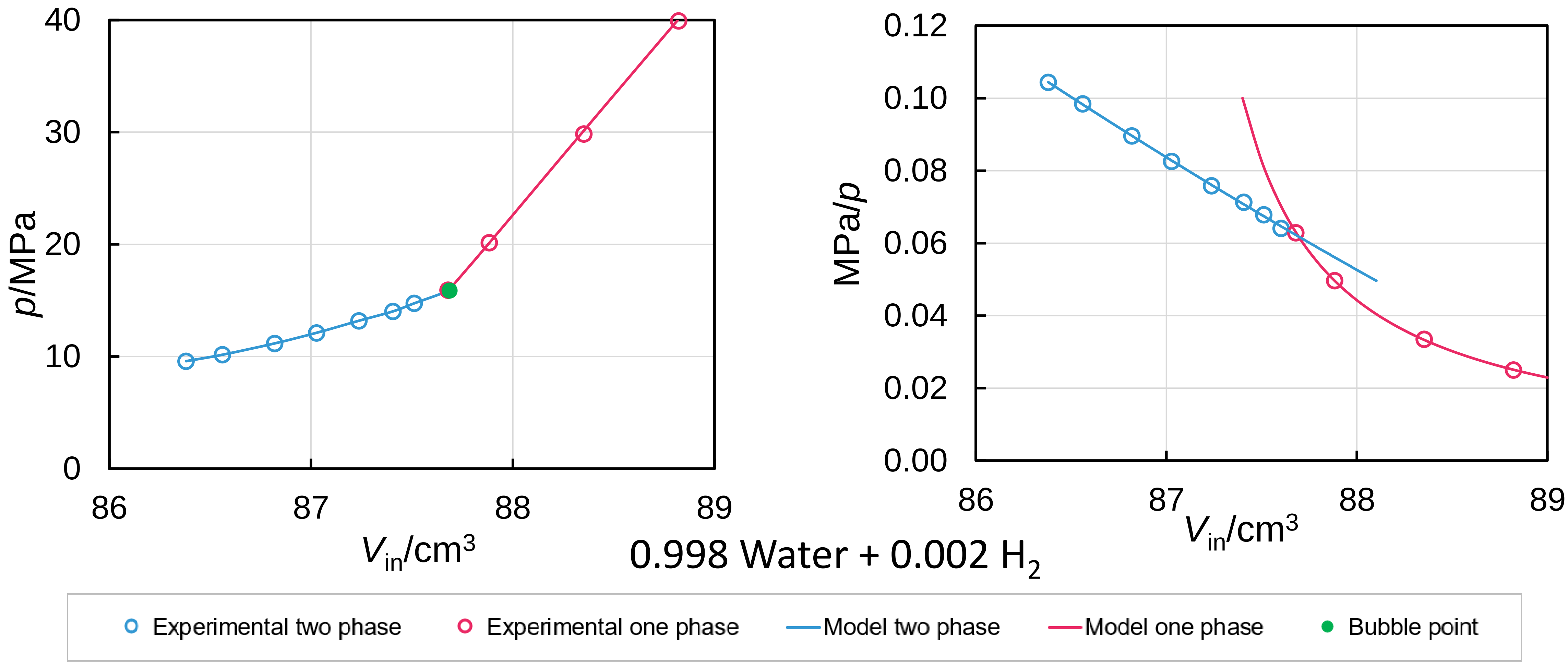
Synthetic Approach

- Visual Observation and PVT

***T*= 323.15 K**



0.998 Water + 0.002 H_2

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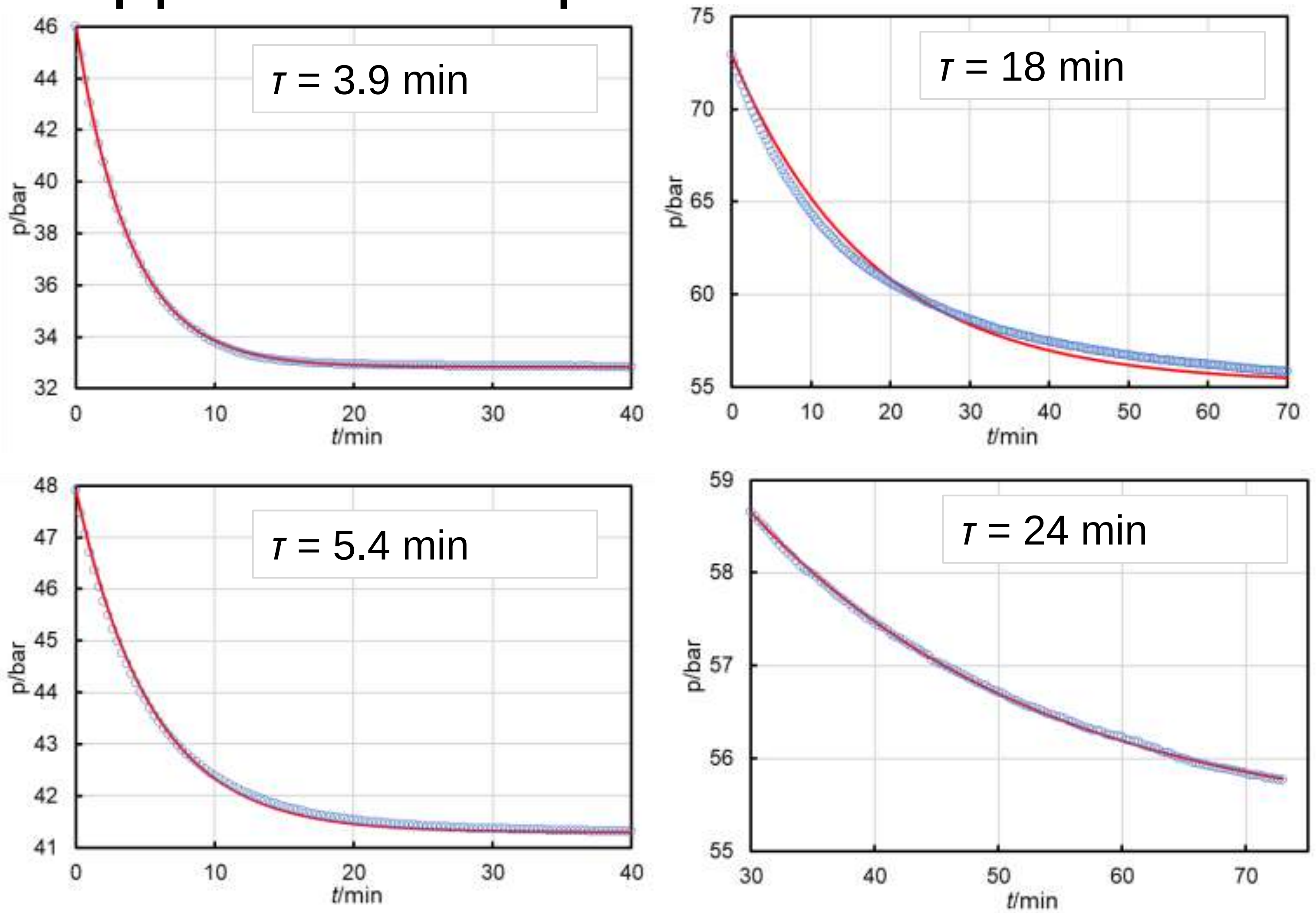
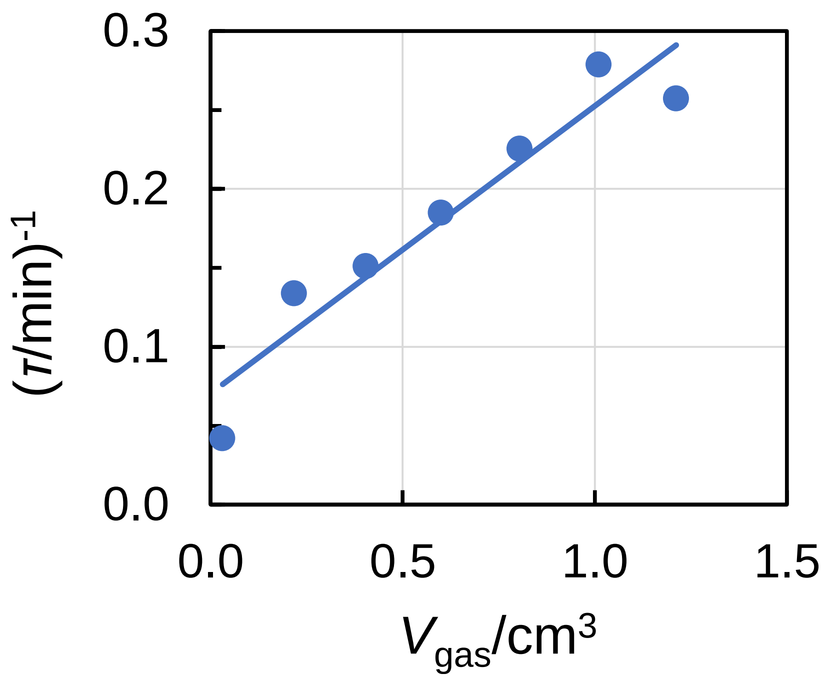
Approach to Equilibrium





τ : Exponential decay constant

ELEGANCY: Thermodynamic Property Models

- Thermodynamic property models for injection and storage
  - To account for H_2 and other impurity gases
  - To account for salts in the aqueous phase
  - Experimental phase equilibria and phase properties required as inputs
- Model development: Ruhr-Universität Bochum
- Experimental measurements: Imperial College London

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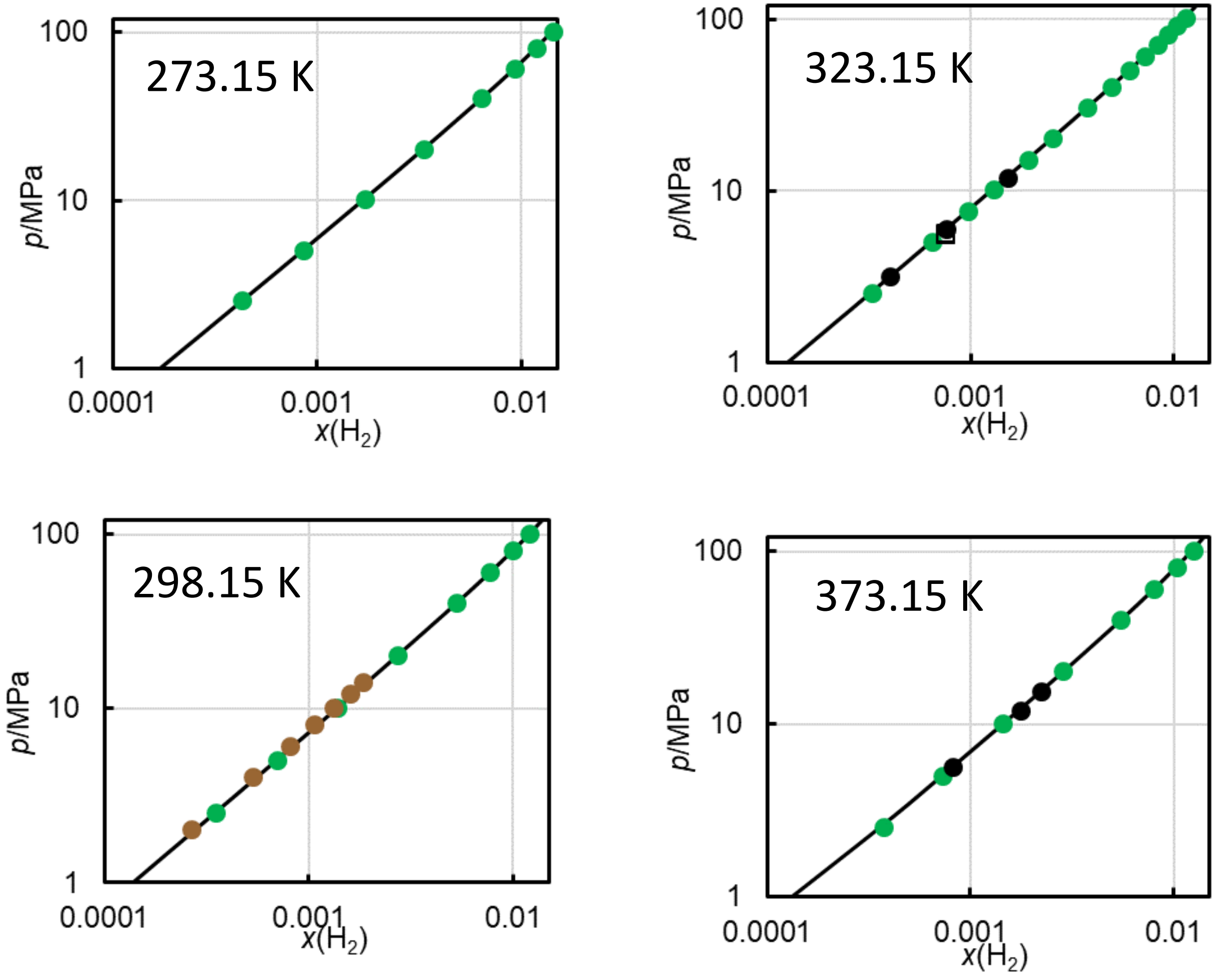
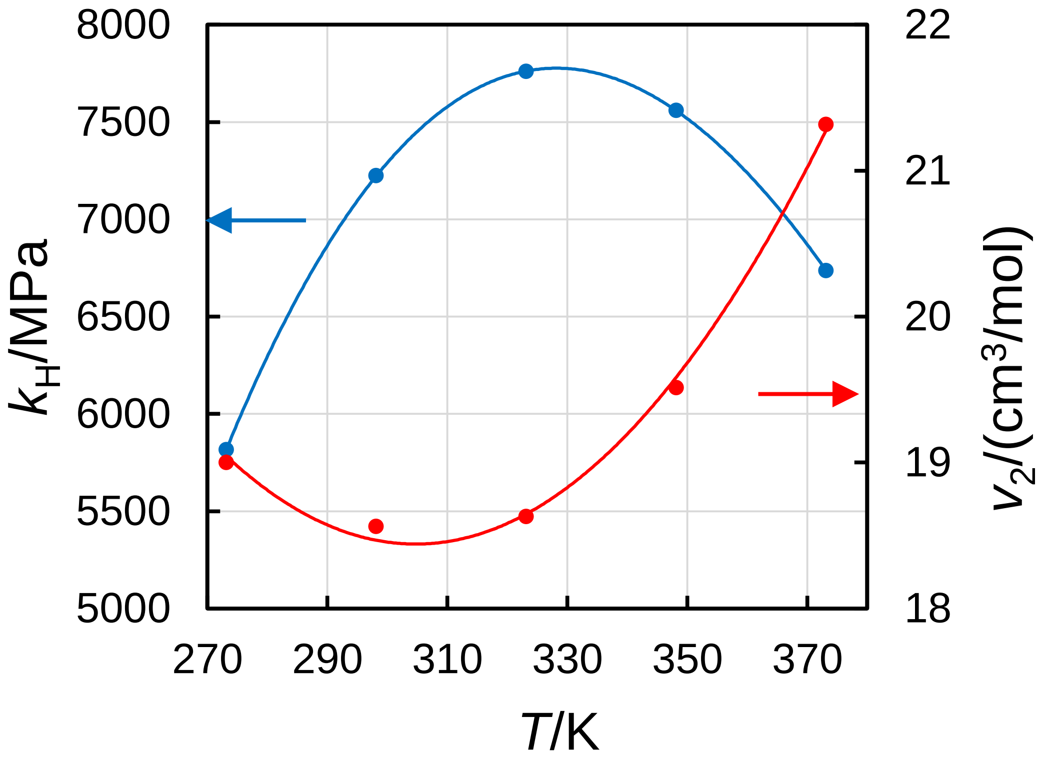
Modelling of H_2 solubility in H_2O: fitting H_{12} and v_1

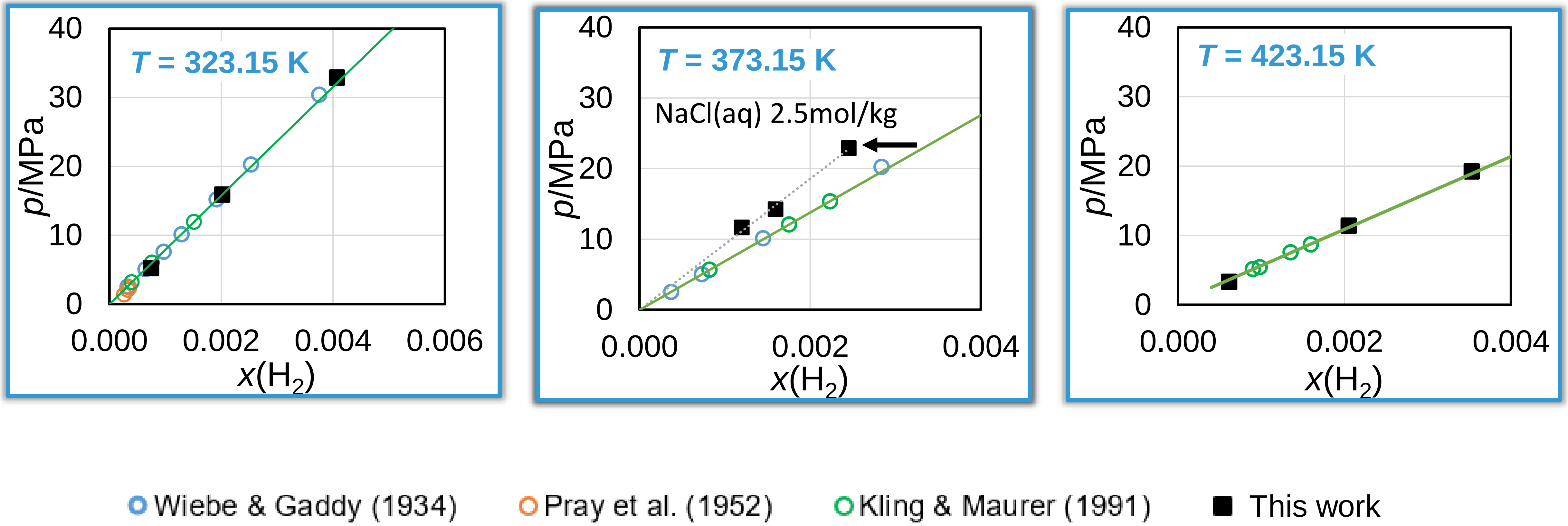


Krichevsky−Kasarnovsky equation

$$\ln(f_1/x_1) = \ln H_{12} + V_1^{\infty}(p - p_{\mathrm{ref}})/(RT)$$



Experimental results: H_2 solubility in H_2O and brines



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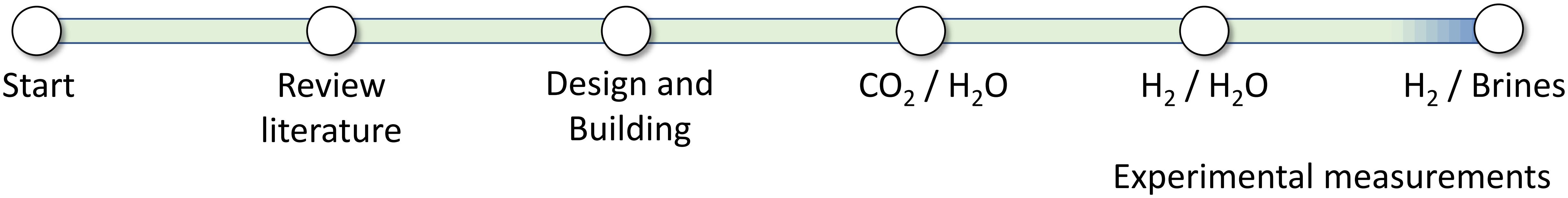
Conclusions and Future work

- Validation of the system with CO_2 solubility in H_2O
- Experimental measurements on H_2 solubility in H_2O
- Measurements on solubility of H_2 in brines (NaCl 2.5 mol/kg) shows a salting out effect of 25%.



Acknowledgement

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