



Experimental mutual solubilities of CO₂ and H₂O in pure water and NaCl solutions

Marie-Camille Caumon, Jérôme Sterpenich, Aurélien Randi, Jacques Pironon

► To cite this version:

Marie-Camille Caumon, Jérôme Sterpenich, Aurélien Randi, Jacques Pironon. Experimental mutual solubilities of CO₂ and H₂O in pure water and NaCl solutions. GHGT-13, Nov 2016, Lausanne, Switzerland. 2016. hal-01409102

HAL Id: hal-01409102

<https://hal.science/hal-01409102>

Submitted on 5 Dec 2016

HAL is a multi-disciplinary open access archive for the deposit and dissemination of scientific research documents, whether they are published or not. The documents may come from teaching and research institutions in France or abroad, or from public or private research centers.

L'archive ouverte pluridisciplinaire **HAL**, est destinée au dépôt et à la diffusion de documents scientifiques de niveau recherche, publiés ou non, émanant des établissements d'enseignement et de recherche français ou étrangers, des laboratoires publics ou privés.

Experimental mutual solubilities of CO₂ and H₂O in pure water and NaCl solutions.

Marie-Camille CAUMON, Jérôme STERPENICH, Aurélien RANDI, Jacques PIRONON
GeoRessources laboratory, Vandœuvre-lès-Nancy, France

OBJECTIVES & METHODS

Context

Prevision of the effects of CO₂ injection in saline aquifers:

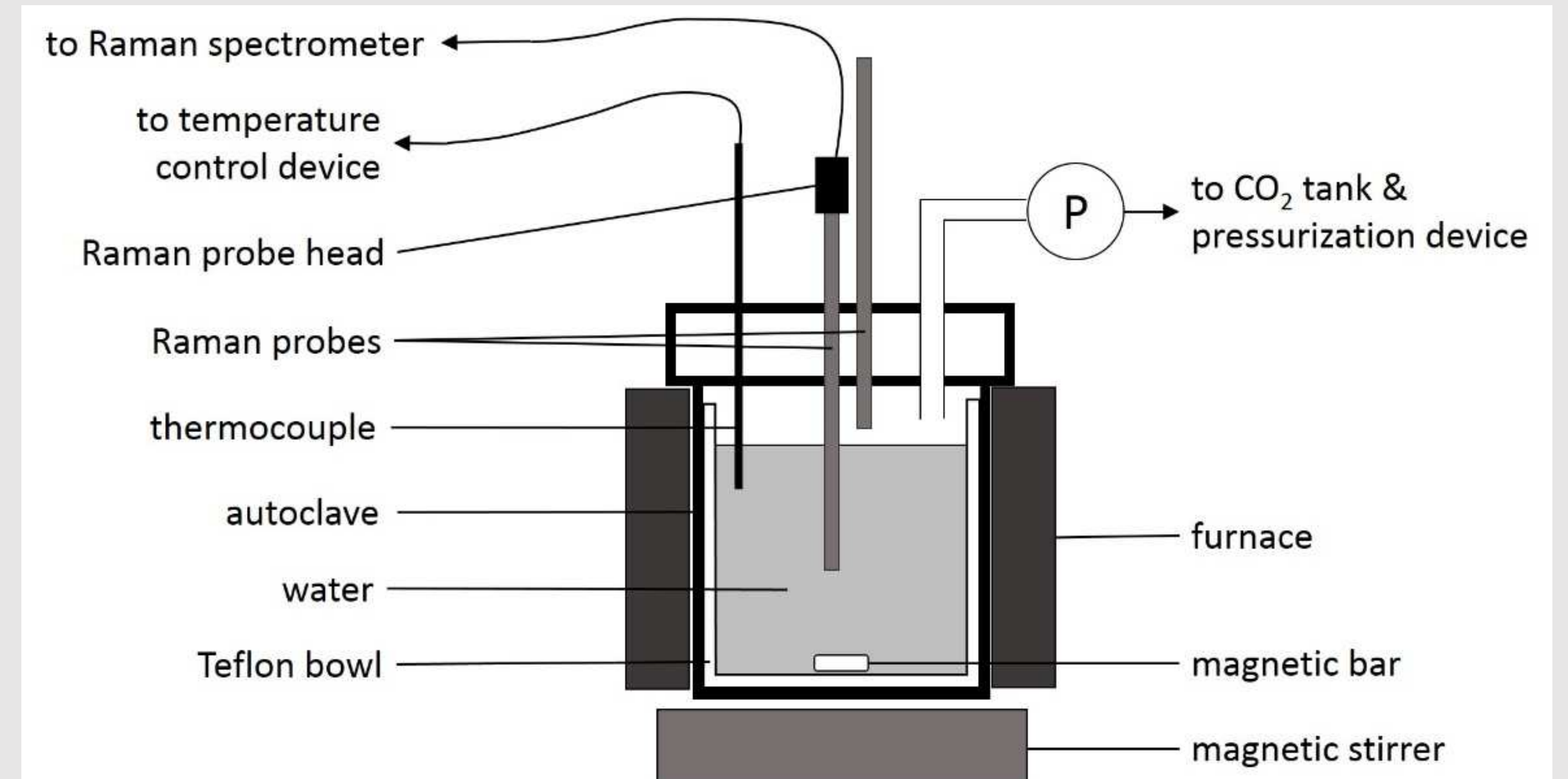
- Lack of solubility data in saline media at high *PT*.
- Lack of H₂O solubility data in the CO₂-rich phase.

Objectives

Acquisition of solubility data in saline media by *in situ* Raman techniques at 100 °C, 0-200 bar, 0-2 M NaCl.

Methods

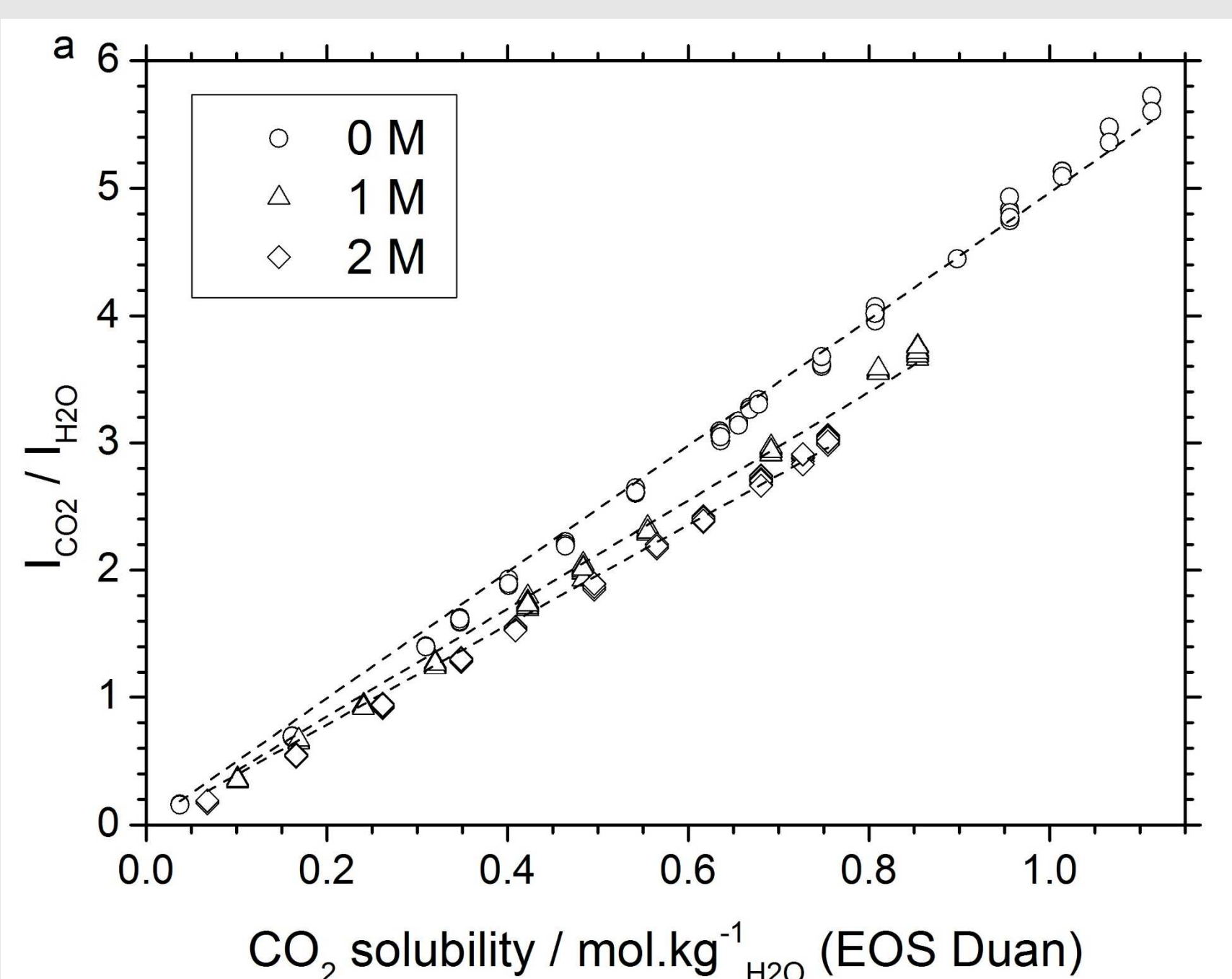
Two Raman probes are connected to a 2L autoclave. Raman spectra are continuously acquired in both vapor and liquid phases while CO₂ is injected.



The IMAGES setup: a *PT*-controlled autoclave connected to two Raman probes and spectrometer (Kaiser Optical Sys.)

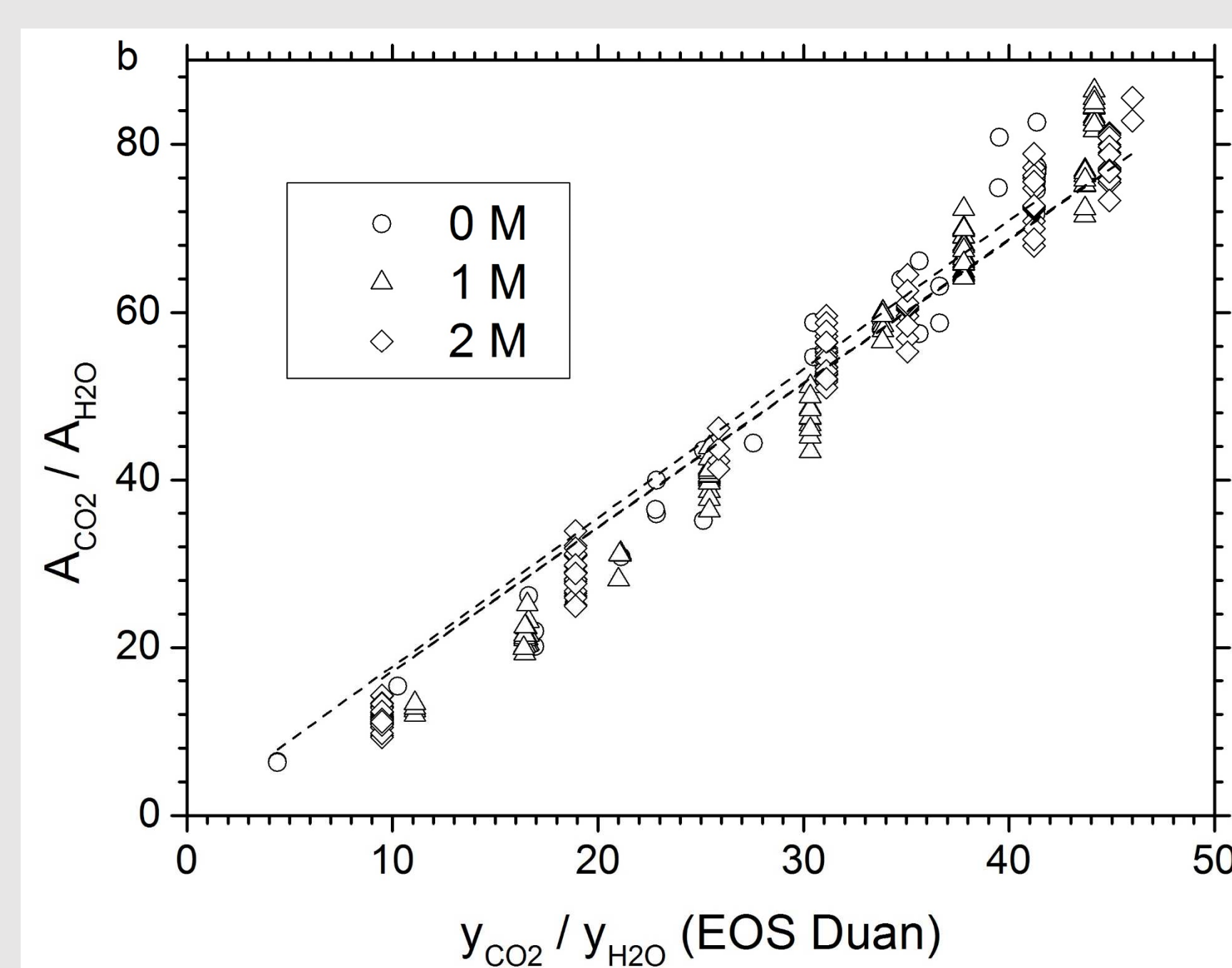
RESULTS

CO₂ solubility vs. salinity



Raman intensity ratios vs. predicted solubility

H₂O solubility in the CO₂-rich phase



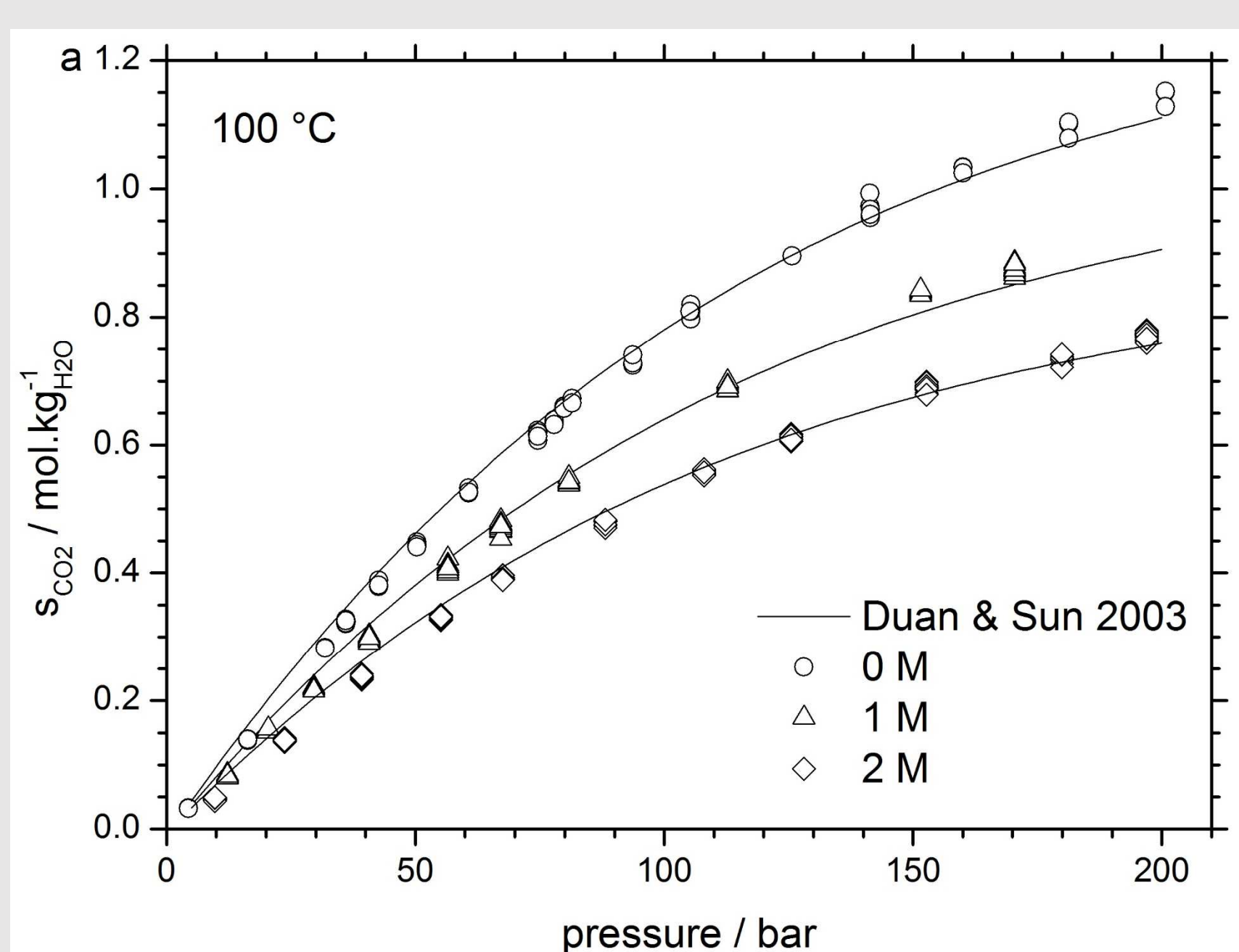
Raman area ratios vs. predicted molar fraction ratios

Method performance

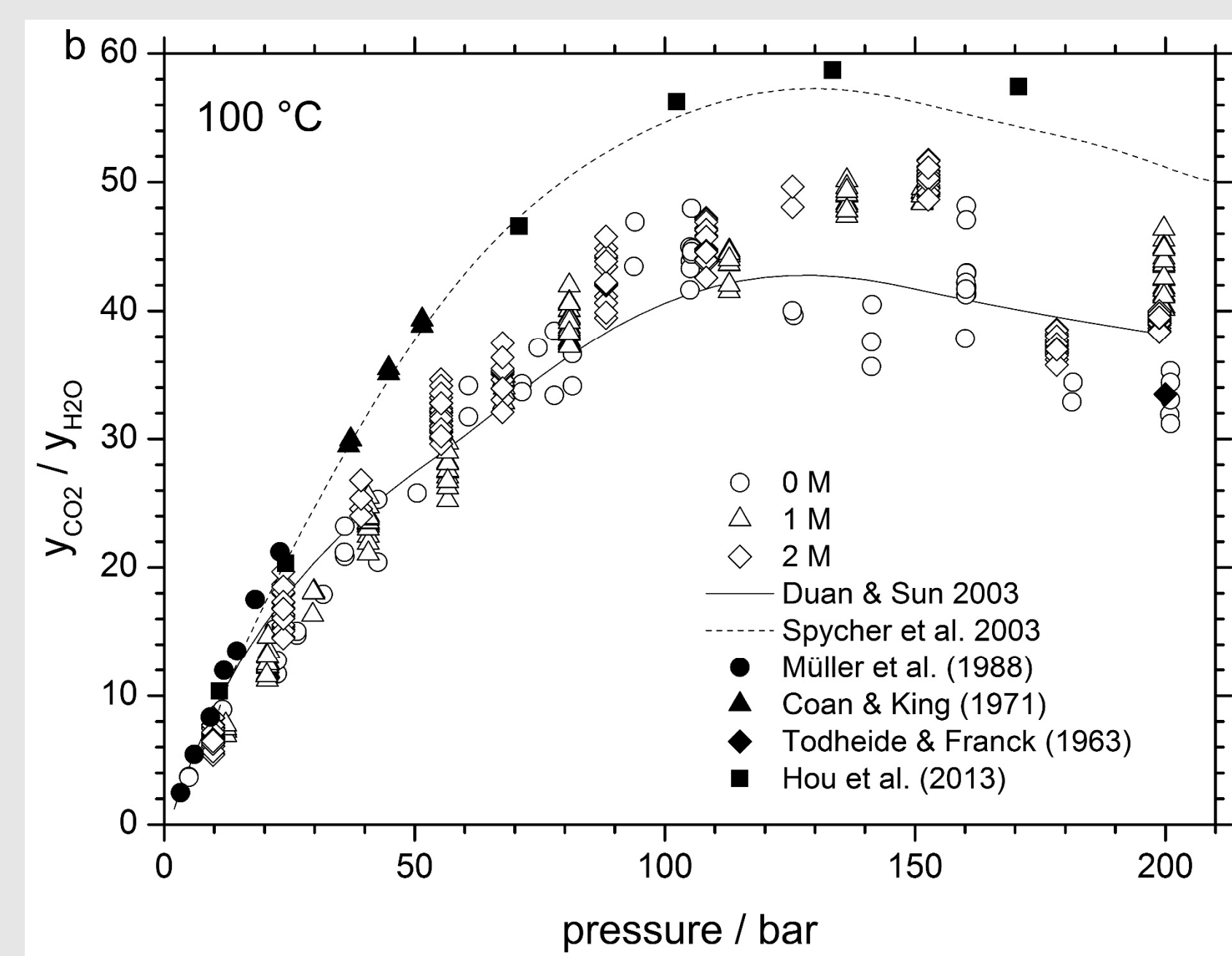
- A correlation is found between Raman data and CO₂ solubility in saline water.
- Salinity affects the calibration curves in the H₂O-rich phase.
- A correlation is found between Raman data and molar fraction ratios in the CO₂-rich phase.
- This correlation does not depend on salinity.

Comparison with thermodynamic models

- Experimental CO₂ solubility in saline water & calculated values (EOS Duan & Sun, 2003) perfectly fit.
- Measured H₂O solubility in CO₂ ranges between the two tested models (Duan & Sun, 2003 & Spycher et al., 2003) and other exp. data.



Experimental & modeled CO₂ solubility vs. pressure



Experimental & modeled molar fraction ratios vs. pressure

CONCLUSION

The determination of **mutual solubilities of H₂O and CO₂** is essential for the modelling and understanding of CO₂ geological storage in deep saline aquifer. Here it is demonstrated that the IMAGES experimental device, coupled to a Raman spectrometer, makes possible to produce **new solubility data at 100 °C up to 200 bar, in the presence of NaCl**. Moreover, it is now possible to measure **H₂O solubility data in the CO₂-rich phase** where data are very sparse. In this last case, previsions may be improved by the optimization of the experimental device.