

Can diffusion of dissolved gases provide information on the pore structure of low permeability materials?

Elke Jacops

ejacops@sckcen.be



KU LEUVEN



SCK·CEN

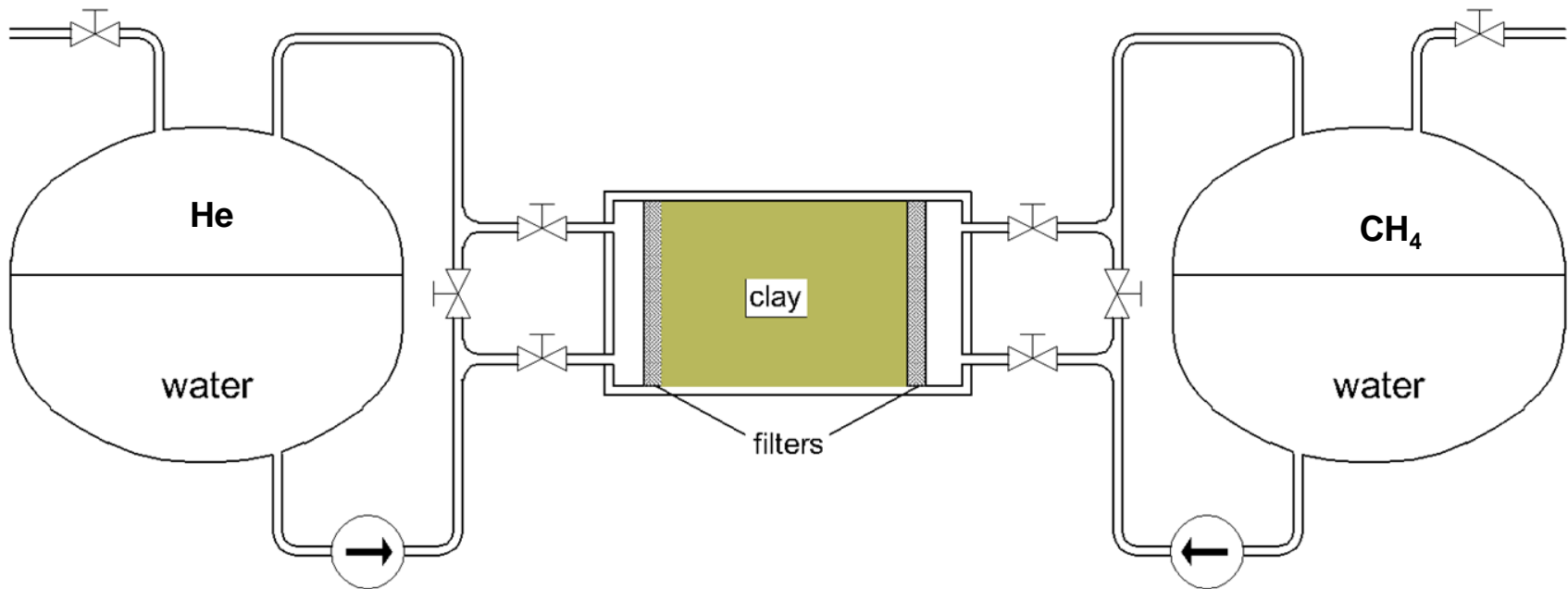
STUDIECENTRUM VOOR KERNENERGIE
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- In Belgium: Boom Clay is considered as a **potential host rock** for the disposal of **high-level and long-lived radioactive waste**
 - Knowledge of its transport characteristics is important
 - Is Boom Clay a suitable long-term barrier?
- How to measure transport characteristics?
 - New and very sensitive technique: diffusion of dissolved gases

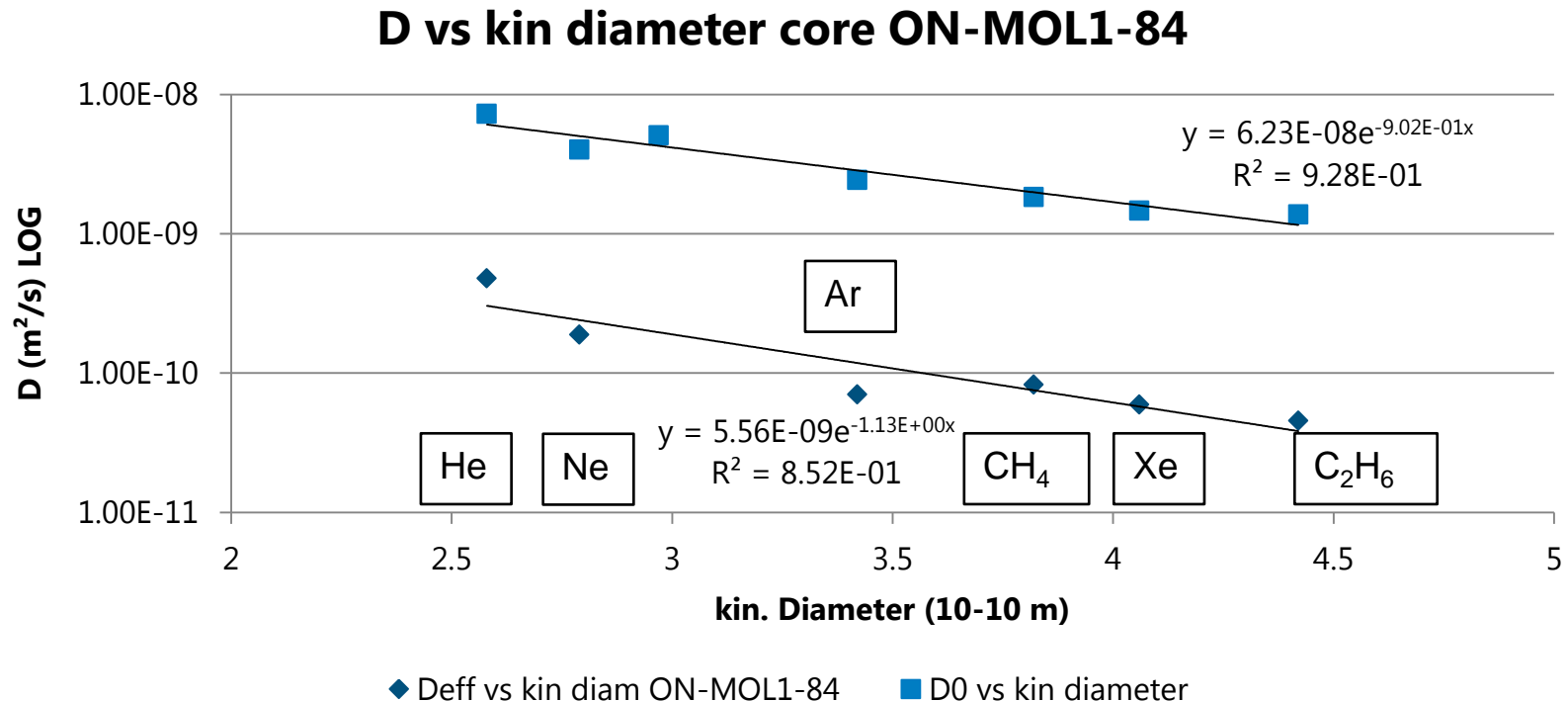
Experimental set-up



- Diffusion coefficients are influenced by pore structural properties

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Nice relations observed



- Diffusion coefficients depend on the size of the diffusing molecule
- Ratio D_{eff}/D_0 : related to a.o. tortuosity and constrictivity
 - Ratio could provide information on the pore structure

Other observations (which need some more research)

- For Boom Clay – samples with different orientation
 - Samples parallel/perpendicular to the bedding plane
 - Clear effect on diffusion: D_{eff}/D_0 higher when diffusion is parallel to the bedding plane

- For Boom Clay - samples with different clay/silt content
 - No clear effect on diffusion, ratio D_{eff}/D_0 : values are very similar
 - However, very pronounced effect on permeability (factor 10)
 - → Molecules use similar tortuous path and porosity in case of diffusion; only some pores dominate in case of advection

Other observations (which need some more research)

- For Opalinus Clay:
 - Results for gasses with higher kinetic diameter not straightforward
 - Trapping of larger gases in pores?
- For compacted bentonite at dry density 1.4 and 1.6 g/cm³
 - No effect of dry density on He diffusion
 - Significant (expected) effect for CH₄ diffusion
 - Does He diffuse through interlayer (smectite)?

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- **No clear answer, maybe more answers than expected...**
- **Need for more data**