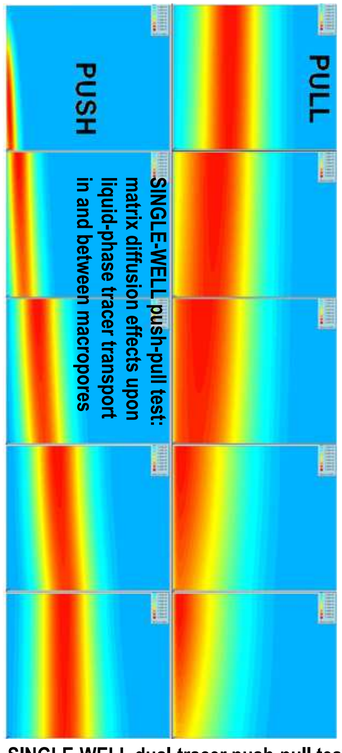
Dual-tracer push-pull tests for quantifying residual CO_2 interface area and saturation

MUSTANG EC FP7, Collaborative Large Scale Integrating Project

I. Ghergut[1], H. Behrens[1], A. Niemi[3], M. Nottebohm[1], T. Licha[1], M. Sauter[1]
[1]University of Göttingen, [2]Uppsala University

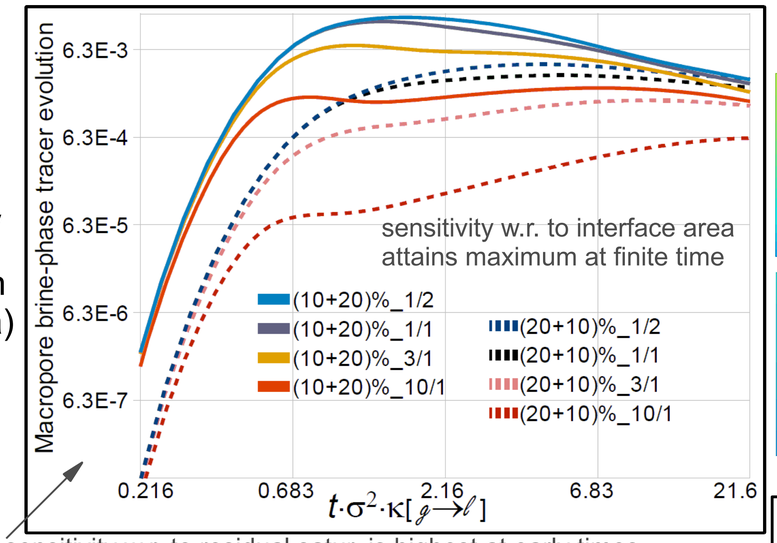
MOTIVATION : residual trapping plays important part in mid- to long-term storage safety

GOAL : quantify residual CO_2 distribution (vol. fraction, CO_2 – brine interface area) alongside with parameters controlling solute transport in georeservoirs (preferential-flow-path aperture, mobile-fluid – rock interface area). None of these parameters can be measured by hydraulic or geophysical tests.
→ *Need for tracer tests!*

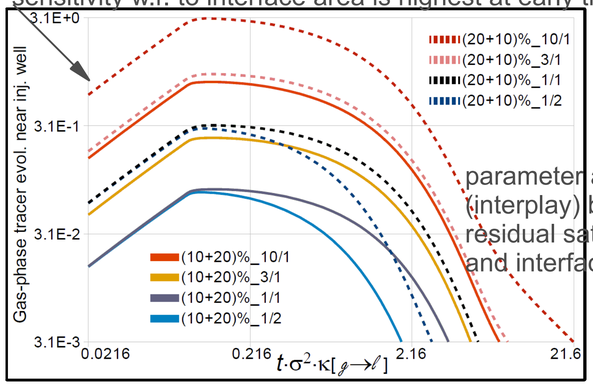


PROPOSED METHODS :

- use brine-phase tracers with high diffusivity to quantify macropore density (consider using heat as a tracer!)
- use partitioning tracers with rapid exchange to quantify residual saturation
- use partitioning tracers with slow exchange, or (slow) chemical reactions at interfaces to quantify interface areas

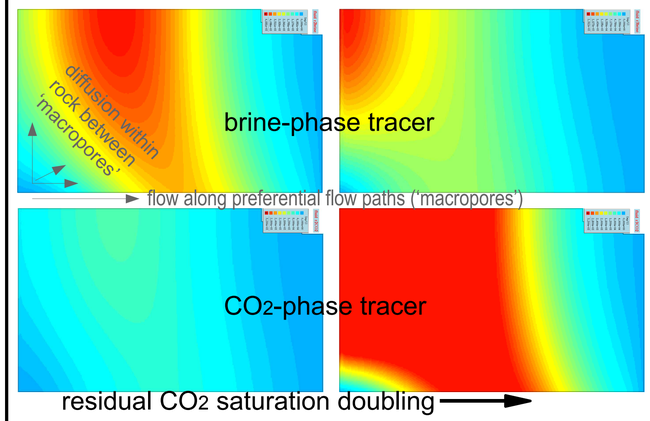


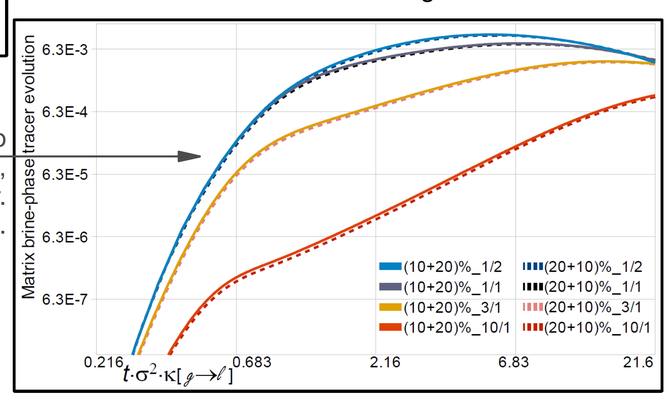
sensitivity w.r. to residual satur. is highest at early times
sensitivity w.r. to interface area is highest at early times



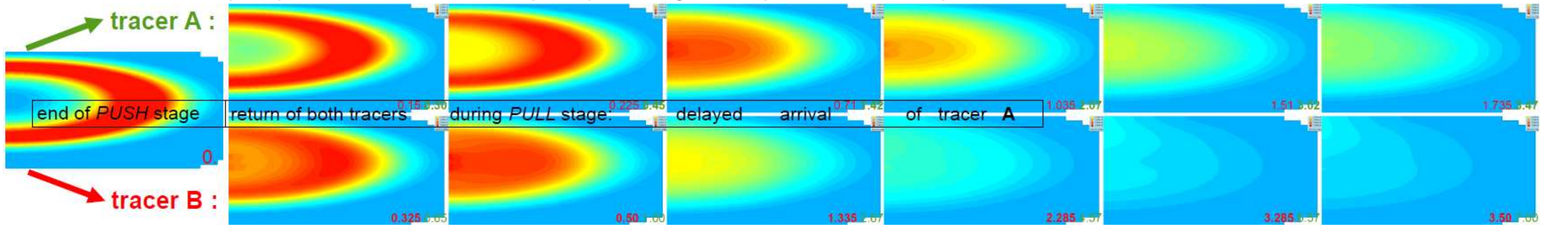
sensitive w.r. to interface area, insensitive w.r. to residual sat.

parameter ambiguity (interplay) between residual saturation and interface area





SINGLE-WELL dual-tracer push-pull test: matrix diffusion and phase partitioning effects upon dual-tracer transport



We gratefully acknowledge 3 intellectual sources for this study:

- *Carrera et al. 1998* : major ideas for an efficient treatment of matrix diffusion (with interface area as a distributed parameter);
- *Tomich et al. 1973* : oilfield use of in-situ hydrolysis of oil- and brine-soluble ester (A), to form brine-only-soluble alcohol (B);
- *Licha, Nottebohm, Schaffer, Sauter 2009* : identification of suitable esters undergoing hydrolysis at CO_2-brine interfaces.

The research leading to these results has received funding from Baker Hughes (Celle) and from the Lower-Saxonian Science and Culture Ministry (MWK Niedersachsen) within the GEBO G6 project, and from the European Community's 7th Framework Programme FP7/2007-2013 under grant agreement n° 227286.

Contact

www.co2mustang.eu
www.gebo-nds.de