transition from early to late self-similarity, J. Fluid. Mech. 577 (2007) 363–383. [5] J. M. Nordbotten, M. A. Celia, D. Kavetski, S. Bachu, A semi-analytical model estimating leakage associated with CO₂ storage in large-scale multi-layered geological systems with multiple leaky wells, Environ-

[6] B. Metz, O. Davidson, H. de Coninck, M. Loos, L. Meyer, Special Report on Carbon Capture and Storage,

[7] J. C. Martin, Some mathematical aspects of two phase flow with application to flooding and gravity

H. Møll Nilsen et al./Energy Procedia 4 (2011) 3801–3808 [4] M. A. Hesse, H. A. Tchelepi, B. J. Cantwell, F. M. Orr, Gravity currents in horizontal porous layers:

3808

segregation, Prod. Monthly 22 (6) (1958) 22–35. [8] K. H. Coats, R. L. Nielsen, M. H. Terune, A. G. Weber, Simulation of three-dimensional, two-phase flow in oil and gas reservoirs, Soc. Pet. Eng. J. Dec (1967) 377–388.

mental Science and Technology 43 (3) (2009) 743–749.

Cambridge University Press, UK, 2005.

Recovery, EAGE, Oxford, UK, 2010.

- [9] J. C. Martin, Partial integration of equation of multiphase flow, Soc. Pet. Eng. J. Dec (1968) 370–380. [10] R. Godderij, J. Bruining, J. Molenaar, A fast 3d interface simulator for steamdrives, SPE Journal 4 (4)
- (1999) 400-408.[11] C. H. Neuman, A gravity override model of steamdrive, J. Petrol. Tech. 37 (1) (1985) 163–189.
- [12] M. A. Celia, S. Bachu, J. M. Nordbotten, D. Kavetski, S. Gasda, A risk assessment tool to quantify CO₂ leakage potential through wells in mature sedimentary basins, in: Proceedings of the 8th Conference on Greenhouse Gas Technologies, 2006.
- [13] C. W. MacMinn, R. Juanes, Post-injection spreading and trapping of CO₂ in saline aquifers: Impact of the plume shape at the end of injection, Comput. Geosci. 13 (2009) 483–491. [14] H. E. Huppert, A. E. Woods, Gravity-driven flows in porous layers, J. Fluid Mech. 292 (1995) 55–69.
- [15] S. Lyle, H. E. Huppert, M. Hallworth, M. Bickle, A. Chadwick, Axisymmetric gravity currents in a porous media, J. Fluid. Mech. 543 (2005) 293-302. doi:10.1017/S0022112005006713. [16] D. Vella, H. E. Huppert, Gravity currents in a pourous medium at an inclined plane, J. Fluid Mech. 292
- (1995) 59-65.[17] S. E. Gasda, J. M. Nordbotten, M. A. Celia, Vertical equilibrium with sub-scale analytical methods for geological CO₂ sequestration, S. of Comput. Geosci. 13 (4) (2009) 469–481.
- [18] H. Class, A. Ebigbo, R. Helmig, H. K. Dahle, J. M. Nordbotten, M. A. Celia, P. Audigane, M. Darcis,
 - J. Ennis-King, Y. Fan, B. Flemisch, S. E. Gasda, M. Jin, S. Krug, D. Labregere, A. N. Beni, R. J. Pawar, A. Sbai, S. G. Thomas, L. Trenty, L. Wei, A benchmark study on problems related to CO₂ storage in geologic formations, Comput. Geosci. 13 (4) (2009) 409-434. doi:10.1007/s10596-009-9146-x.
- [19] J. M. Nordbotten, M. A. Celia, Geological Storage of CO₂: Modeling Approaches for Large-Scale Simulation, for publication with John Wiley, 2010.
- [20] M. Bickle, A. Chadwick, H. E. Huppert, M. Hallworth, S. Lyle, Modelling carbon dioxide accumulation at Sleipner: Implications for underground carbon storage, Earth Planet. Sci. Lett. 255 (1-2) (2007) 164-176.
- [21] R. A. Chadwick, P. Zweigel, U. Gregersen, G. A. Kirby, S. Holloway, P. N. Johannessen, Geological reservoir characterization of a CO₂ storage site: The Utsira Sand, Sleipner, Northern North Sea, Energy 29 (9-10) (2004) 1371-1381.
- [22] R. Arts, O. Eiken, A. Chadwick, P. Zweigel, L. van der Meer, B. Zinszner, Monitoring of CO₂ injected at Sleipner using time-lapse seismic data, Energy 29 (9-10) (2004) 1383–1392.
- [23] V. Singh, A. Cavanagh, H. Hansen, B. Nazarian, M. Iding, P. Ringrose, Reservoir modeling of CO₂ plume behavior calibrated against monitoring data from Sleipner, Norway (2010).
- [24] Schlumberger Information Systems, Eclipse technical descrition, Report Houston, TX (2007).
- [25] J. Nordbotten, H. Dahle, Impact of the capillary fringe in vertically integrated models for CO₂ storage, Under review.
- [26] I. Ligaarden, H. M. Nilsen, Numerical aspects of using vertical equilibrium models for simulating CO₂ sequestration, in: Proceedings of ECMOR XII-12th European Conference on the Mathematics of Oil