

# Salinization problems in the NEGB: Results from thermohaline simulations

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**Abstract:** The occurrence of salty waters close to the surface is a well-known problem in the North East German Basin. Previous numerical simulations showed that near-surface brine occurrences are due to the interaction of hydrostatic and thermally induced forces (mixed convection). The influence of hydraulic permeabilities and thermal conductivities on the observed patterns remained an open question. Based on a hydro-geochemical dataset, thermohaline simulations are carried out in order to quantify the impact of these physical parameters on brine migration. The results indicate that the salinity and temperature profiles are strongly controlled by hydraulic permeabilities and can locally be influenced by thermal conductivities. © Springer-Verlag 2007.

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#### References:

- Boving, T.B., Grathwohl, P., Tracer diffusion coefficients in sedimentary rocks: Correlation to porosity and hydraulic conductivity (2001) *J Contam Hydrol*, 53, pp. 85-100
- Diersch, H.J.G., Kolditz, O., Coupled groundwater flow and transport: 2. Thermohaline and 3D convection systems (1998) *Adv Water Resour*, 21, pp. 401-425
- Diersch, H.J.G., Kolditz, O., Variable-density flow and transport in porous media: Approaches and challenges (2002) *Adv Water Resour*, 25, pp. 899-944
- Evans, G.E., Nunn, J.A., Free thermohaline convection in sediments surrounding a salt column (1989) *J Geophys Res*, 94, pp. 12413-12422
- Flocks, J.G., Kindinger, J.L., Davis, J.B., Swarzenski, P., Geophysical investigations of upward migrating saline water from the Lower to Upper Floridan aquifer, Central Indian River Region, Florida (2001) *Water-resources Investigations Report 01-4011*, pp. 135-140
- Grobe, M., Machel, H., Saline groundwater in the Munsterland Cretaceous Basin, Germany: Clues to its origin and evolution (2002) *Mar Petrol Geol*, 19, pp. 307-322
- Grube, A., Hermsdorf, A., Lang, M., Rechlin, B., Schneider, W., Wichmann, K., Prognose des Salzwasseraufstiegs im pleistozänen Grundwasserleiterkomplex eines geplanten Wasserwerkes im Land Brandenburg-Grundwassermodelle und hydrogeochemische Untersuchungen (2000) *Brandenburg Geowiss Beitr*, 7, pp. 41-52
- Grube, A., Wichmann, K., Hahn, J., Nachtigall, K.H., Geogene Grundwasserversalzung in den Porengrundwasserleitern Norddeutschlands und ihre Bedeutung für die Wasserwirtschaft (2000) *Technologiezentrum Wasser Karlsruhe (TZW)*, p. 203. , Karlsruhe
- Hannemann, M., Schirrmeister, W., Paläohydrogeologische Grundlagen der Entwicklung der Süß/Salzwassergrenze und der Salzwasseraustritte in Brandenburg (1998) *Brandenburg Geowiss Beitr*, 5, pp. 61-72
- Hanor, J.S., Kilometre-scale thermohaline overturn of pore waters in the Louisiana Gulf Coast (1987) *Nature*, 327, pp. 501-503
- Heck, H.L., Das Grundwasser in Zusammenhang mit dem geologischen Bau Schleswig-Holsteins (1932) *Preubische Geol*, pp. 106-133. , Landesanstalt
- Ingebritsen, S.E., Sanford, W.E., (1998) *Groundwater in Geologic Processes*, p. 341. , Cambridge University Press, New York
- Johannsen, A., Hydrogeologie von Schleswig Holstein (1980) *Geol Jahrb*, C28, p. 451
- Kohout, F.A., A hypothesis concerning cyclic flow of salt water related to geothermal heating in the Floridian aquifer (1965) *N Y Acad Sci Trans Ser 2*, 28 (2), pp. 249-271
- Lampe, C., Person, M., Advective cooling within sedimentary rift basins - Application to the Upper Rhinegraben (Germany) (2002) *Mar Petrol Geol*, 19, pp. 361-375
- Liu, H.H., Bodvarsson, G.S., Zhang, G., Scale dependency of the effective matrix diffusion coefficient (2004) *Vadose Zone J*, 3, pp. 312-314
- Lowe, C.P., Frenkel, D., Do hydrodynamic dispersion coefficients exist? (1996) *Phys Rev Lett*, 77, pp. 4552-4555

- Magri, F., Derivation of the coefficients of thermal expansion and compressibility for use in FEFLOW (2004), 3, pp. 13-23. , WASY White Papers
- Magri, F., (2005) Mechanisms and Fluid-dynamics Driving Saline Waters Within the North East German Basin: Results from Thermohaline Numerical Simulations, p. 129. , Freie Universität Berlin, Berlin
- Magri, F., Bayer, U., Clausnitzer, V., Jahnke, C., Fuhrmann, J., Moller, P., Pekdeger, A., Voigt, H., Deep reaching fluid flow close to convective instability in the NE german basin - Results from water chemistry and numerical modelling (2005) Tectonophysics, 397, pp. 5-20
- Magri, F., Bayer, U., Jahnke, C., Clausnitzer, V., Diersch, H.J., Fuhrman, J., Möller, P., Voigt, H.J., Fluid-dynamics driving saline water in the North East German Basin (2005) Int J Earth Sci, 94, pp. 1056-1069
- Nield, D.A., Onset of thermohaline convection in a porous medium (1968) Water Resour Res, 4, pp. 553-560
- Nield, D.A., Estimation of an effective Rayleigh number for convection in a vertically inhomogeneous porous medium or clear fluid (1994) Int J Heat Fluid Flow, 15, pp. 337-340
- Ranganathan, V., Hanor, J.S., Density-driven groundwater flow near salt domes (1988) Chem Geol, 74, pp. 173-188
- Reese, R.S., Hydrogeology and the distribution and the origin of salinity in the Floridian aquifer system, Southeastern Florida (2003) Water Resource Investigations Report 94-4010, p. 62
- Sarkar, A., Nunn, J.A., Hanor, J.S., Free thermohaline convection beneath allochthonous salt sheets: An agent for salt dissolution and fluid flow in Gulf Coast sediments (1995) J Geophys Res, 100, pp. 18085-18092
- Scheck, M., (1997) Dreidimensional Strukturmodellierung Des Nordostdeutschen Beckens Unter Einbeziehung Von Krustenmodellen, p. 120. , Freie Universität Berlin, Berlin
- Scheck, M., Bayer, U., Evolution of the Northeast German Basin-inferences from a 3D structural model and subsidence analysis (1999) Tectonophysics, 313, pp. 145-169
- Schirrmeister, W., Aus der Literatur überlieferte Angaben über natürliche Salzwasseraustritte an der Grundwasseroberfläche/ Geländeoberfläche in Brandenburg (1996) Brandenburg Geowiss Beitr, 3, pp. 94-96
- Simmons, C.T., Fenstermaker, T.R., Sharp, J.M., Variable-density groundwater flow and solute transport in heterogeneous porous media: Approaches, resolutions and future challenges (2001) J Contam Hydrol, 52, pp. 245-275
- Simms, M.A., Garven, G., Thermal convection in faulted extensional sedimentary basins: Theoretical results from finite-element modeling (2004) Geofluids, 4, pp. 109-130
- Stackebrandt, W., Manhenke, V., (2002) Atlas Zur Geologie Von Brandenburg in Maßstab 1: 1 000 000, 12. , Landesamt für Geowissenschaften und Rohstoffe Brandenburg (LGRB), Kleinmachnow, Karte
- Straus, J.M., Large amplitude convection in porous media (1979) J Fluid Mech, 64, pp. 51-63
- Straus, J.M., Schubert, G., Thermal convection of water in a porous medium: Effects of temperature and pressure dependent thermodynamic and transport properties (1977) J Geophys Res, 82, pp. 325-333
- Van der Lee, J., De Windt, L., Present state and future directions of modelling of geochemistry in hydrogeological systems (2001) J Contam Hydrol, 47, pp. 265-282
- Yu, Z., Lerche, I., Lowrie, A., Thermal impact of salt: Simulation of thermal anomalies in the Gulf of Mexico (1992) Pure Appl Geophys, 138, pp. 181-192