

Short CURRICULUM VITAE

Prof. Dr. habil. MARIO SCHIRMER



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Education:

Habilitation	Applied Geology, University of Tübingen, Germany, 2002
Ph.D.	Earth Sciences, University of Waterloo, Canada, 1999
German Diplom (M.Sc.)	Geophysics, Technische Universität Bergakademie Freiberg, (Technical University Mining Academy Freiberg), Germany, 1991

Research and Work Experience:

Head Research Group Hydrogeology since March 2008
Eawag - Swiss Federal Institute of Aquatic Science and Technology, Department Water
Resources and Drinking Water (W+T), Switzerland

Associate Professor since August 2008
University of Neuchâtel, Faculty of Sciences, Centre for Hydrogeology, Switzerland

Univ.-Prof. for Hydrogeology and Modelling, December 2004 – February 2008
Martin-Luther-University Halle-Wittenberg, Institute for Geological Sciences, Germany

Head of Department of Hydrogeology, July 2002 – February 2008
Helmholtz Centre for Environmental Research - UFZ, Leipzig and Halle / Saale,
Department of Hydrogeology, Germany

Interim Head of Department of Hydrogeology, January 2002 – June 2002
UFZ Centre for Environmental Research Leipzig-Halle, Halle / Saale, Department of
Hydrogeology, Germany

Postdoctoral Research Associate, July 1999 – December 2001
UFZ Centre for Environmental Research Leipzig-Halle, Leipzig, Dept. Industrial and
Mining Landscapes, Germany

Scientist, December 1998 – June 1999
University of Waterloo, Department of Earth Sciences, Canada

Ph.D. candidate, September 1993 – November 1998

University of Waterloo, Department of Earth Sciences, Canada

Thesis: Investigation of multiscale biodegradation processes: A modelling approach

Scientist, March 1991 - June 1993

Institute for Hydraulic Engineering, University of Stuttgart, Germany

Teaching Experience:

Lecture at the University of Neuchâtel "Urban Hydrogeology" (since Fall Semester 2016)

Course at the ETH Zurich "Transdisciplinary Case Study - River Management of the Thur Catchment", Lectures on societal and ecological issues of river restoration as well as groundwater – surface water interactions (Spring Semester 2012)

Lecture at the ETH Zurich "Water Resources and Drinking Water", Lectures on groundwater and contaminants (since Fall Semester 2009)

Lecture at the University of Neuchâtel "Characterization of Contaminated Sites" (since Spring Semester 2009)

Lecture and Practical Training at the University of Neuchâtel "Field school - Hydrogeological Investigation Techniques" (since 2009)

Lecture at the Martin-Luther-University Halle-Wittenberg "Representative Groundwater Sampling Technologies" (2005 - 2008)

Lecture at the Martin-Luther-University Halle-Wittenberg "Hydrogeological Modelling: Part Transport Modelling" (2005 - 2008)

Lecturer at the University of Tübingen within the M.Sc. Program "Applied Environmental Geoscience", Course "Hydrogeological Investigation Techniques" (2002 - 2010).

Co-ordinator and instructor, University of Waterloo, Dept. of Earth Sciences

Graduate Level: Field Methods in Hydrogeology

Lectures on: Hydraulic aquifer parameter evaluation (pumping tests / slug tests)
Groundwater monitoring and sampling equipment

Major conferences organized as conference chair:

River Corridor Restoration Conference 2011 (RCRC11): Towards a mechanistic understanding of coupled hydrological and ecological processes in near-river corridors, March 13–18, 2011, Centro Stefano Franscini, Monte Verità, Ascona, Switzerland (about 75 participants).

Groundwater Quality Conference 2010 (GQ10): Groundwater quality management in a rapidly changing world, June 13 - 18, 2010, Zurich, Switzerland (about 220 participants).

Board Memberships:

- 2018-today Member of the Swiss Hydrological Commission (CHy), Geosciences Platform of the Swiss Academy of Sciences
- 2010-15 Scientific Advisory Board German Centre for Groundwater Research, Dresden, Germany
- 2010-14 Advisory Board Section Hydrogeology within the German Association of Geosciences

Editorship:

- 2018 - today Editorial Board of the Journal "Water"
- 2006 - 2009 Editor of the Journal "Grundwasser"
- 2003 - 2005 Associate Editor of the Journal "Grundwasser"

List of Publications

Google Scholar (updated May 07, 2018):

https://scholar.google.com/citations?view_op=list_works&hl=en&user=rn2otYYAAAAAJ

Published documents: 303

h-index: 37 (22 since 2013)

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Refereed Journal Publications

Belletti, B., Nardi, L., Rinaldi, M., Poppe, M., Brabec, K., Bussetini, M., Comiti, F., Gielczewski, M., Golfieri, B., Hellsten, S., Kail, J., Marchese, E., Marcinkowski, P., Okruszko, T., Paillex, A., Schirmer, M., Stelmaszczyk, M., Surian, N. 2018. Assessing restoration effects on river hydromorphology using the process-based morphological quality index in eight European river reaches. *Environmental Management*, 61, 69–84, DOI 10.1007/s00267-017-0961-x.

Moeck, C., Affolter, A., Radny, D., Dressmann, H., Auckenthaler, A., Huggenberger, P., Schirmer, M. 2018. Improved water resource management for a highly complex environment using three-dimensional groundwater modelling. *Hydrogeology Journal*, 26, 133–146, DOI 10.1007/s10040-017-1640-y.

Minnig, M., Moeck, C., Radny, D., Schirmer, M. 2017. Impact of urbanization on groundwater recharge rates in Dübendorf, Switzerland. *Journal of Hydrology*, **in press**.

Betterle, A., Radny, D., Schirmer, M., Botter, G. 2017. What do they have in common? Drivers of streamflow spatial correlation and prediction of flow regimes in ungauged locations. *Water Resources Research*, 53, 10,354–10,373, <https://doi.org/10.1002/2017WR021144>.

Betterle, A., Schirmer, M., Botter, G. 2017. Characterizing the spatial correlation of daily streamflows, *Water Resources Research*, 53(2), 1646-1663, doi: 10.1002/2016WR019195.

Moeck, C., Radny, D., Popp, A., Brennwald, M., Stoll, S., Auckenthaler, A., Berg, M., Schirmer, M. 2017. Characterization of a managed aquifer recharge system using multiple tracers, *Science of the Total Environment*, 609, 701–714.

Bretzler, A., Lalanne, F., Nikiema, J., Podgorski, J., Pfenninger, N., Berg, M., Schirmer, M. 2017. Corrigendum to “Groundwater arsenic contamination in Burkina Faso, West Africa: Predicting and verifying regions at risk” [*Sci. Total Environ.* 584–585 (2017) 958–970]. *Science of the Total Environment*, 598, 562.

Moeck, C., Radny, D., Auckenthaler, A., Berg, M., Hollender, J., Schirmer, M. 2017. Estimating the spatial distribution of artificial groundwater recharge using multiple tracers, *Isotopes in Environmental and Health Studies*, 53(5), 484-499, <https://doi.org/10.1080/10256016.2017.1334651>.

- Bretzler, A., Lalanne, F., Nikiema, J., Podgorski, J., Pfenninger, N., Berg, M., Schirmer, M. 2017. Groundwater arsenic contamination in Burkina Faso, West Africa: Predicting and verifying regions at risk. *Science of the Total Environment*, 584–585, 958–970.
- Doulatyari, B., Betterle, A., Radny, D., Celegon, E. A., Fanton, P., Schirmer, M., Botter, G. 2017. Patterns of streamflow regimes along the river network: The case of the Thur river. *Environmental Modelling & Software*, 93, 42–58.
- Ghasemizade, M., Baroni, G., Abbaspour, K., Schirmer, M. 2017. Combined analysis of time-varying sensitivity and identifiability indices to diagnose the response of a complex environmental model. *Environmental Modelling & Software*, 88, 22–34.
- Möck, C., Radny, D., Stoll, S., Borer, P., Rothardt, J., Affolter, A., Huggenberger, P., Auckenthaler, A., Hollender, J., Berg, M., Schirmer, M. 2017. Multivariate Statistik zur Optimierung des Wasserressourcenmanagements im Hardwald. *Aqua & Gas*, 2, 14–20.
- Moeck, C., Radny, D., Borer, P., Rothardt, J., Auckenthaler, A., Berg, M., Schirmer, M. 2016. Multicomponent statistical analysis to identify flow and transport processes in a highly-complex environment. *Journal of Hydrology*, 542, 437–449.
- Chittoor Viswanathan, V., Jiang, Y., Berg, M., Hunkeler, D., Schirmer, M. 2016. An integrated spatial snap-shot monitoring method for identifying seasonal changes and spatial changes in surface water quality. *Journal of Hydrology*, 539, 567–576.
- Odeh, T., Gloaguen, R., Mohammad, A. H., Schirmer, M. 2016. Structural control on drainage network and catchment area geomorphology in the Dead Sea area: an evaluation using remote sensing and geographic information systems in the Wadi Zerka Ma'in catchment area (Jordan). *Environmental Earth Sciences*, 75(6), 482. DOI 10.1007/s12665-016-5447-2.
- Doulatyari, B., Betterle, A., Basso, S., Biswal, B., Schirmer, M., Botter, G. 2015. Predicting streamflow distributions and flow duration curves from landscape and climate. *Advances in Water Resources*, 83, 285–298.
- Basso, S., Frascati, A., Marani, M., Schirmer, M., Botter, G. 2015. Climatic and landscape controls on effective discharge. *Geophysical Research Letters* 42(20), 8441–8447.
- Ghasemizade, M., Moeck, C., Schirmer, M. 2015. The effect of model complexity in simulating unsaturated zone flow processes on recharge estimation at varying time scales. *Journal of Hydrology*, 529, 1173–1184. Online available: DOI.org/10.1016/j.jhydrol.2015.09.027.
- Badin, A., Schirmer, M., Wermeille, D., Hunkeler, D. 2015. Perchlorethen-Quellendifferenzierung mittels Kohlenstoff-Chlor-Isotopenanalyse: Felduntersuchungen zur Beurteilung der Variabilität der Isotopensignatur. *Grundwasser*, 20(4), 263–270.
- von Freyberg, J., Rao, P.S.C., Radny, D., Schirmer, M. 2015. The impact of hillslope groundwater dynamics and landscape functioning in event-flow generation: a field study in the Rietholz bach catchment, Switzerland. *Hydrogeology Journal*, 23(5), 935–948.

- Chittoor Viswanathan, V., Schirmer, M. 2015. Water quality deterioration as a driver for river restoration: a review of case studies from Asia, Europe and North America. *Environmental Earth Sciences*, 74, 3145–3158.
- von Freyberg, J., Möck, C., Schirmer, M. 2015. Estimation of groundwater recharge and drought severity with varying model complexity. *Journal of Hydrology*, 527, 844–857.
- Basso, S., Schirmer, M., Botter, G. 2015. On the emergence of heavy-tailed streamflow distributions. *Advances in Water Resources*, 82, 98–105.
- Kurth, A.-M., Weber, C., Schirmer, M. 2015. How effective is river restoration in re-establishing groundwater – surface water interactions? – A case study. *Hydrol. Earth Syst. Sci.*, 19, 2663–2672.
- Chittoor Viswanathan, V., Molson, J., Schirmer, M. 2015. Does river restoration affect diurnal and seasonal changes to surface water quality? A study along the Thur River, Switzerland. *Science of the Total Environment*, 532, 91-102.
- Odeh, T., Rödiger, T., Geyer, S., Schirmer, M. 2015. Hydrological modelling of a heterogeneous catchment using an integrated approach of remote sensing, a geographic information system and hydrologic response units: the case study of Wadi Zerka Ma'in catchment area, north east of the Dead Sea. *Environmental Earth Sciences*, 73, 3309-3326. DOI 10.1007/s12665-014-3627-5.
- von Freyberg, J., Radny, D., Gall, H. E., Schirmer, M. 2014. Implications of hydrologic connectivity between hillslopes and riparian zones on streamflow composition. *Journal of Contaminant Hydrology*, 169, 62-74.
- Doulatyari, B., Basso, S., Schirmer, M., Botter, G. 2014. River flow regimes and vegetation dynamics along a river transect. *Advances in Water Resources*, 73, 30–43.
- Schirmer, M., Luster, J., Linde, N., Perona, P., Mitchell, E.A.D., Barry, D.A., Hollender, J., Cirpka, O.A., Schneider, P., Vogt, T., Radny, D., Durisch-Kaiser, E. 2014. Morphological, hydrological, biogeochemical and ecological changes and challenges in river restoration – The Thur River case study. *Hydrology and Earth System Sciences*, 18, 1-14.
- Kurth, A.-M., Schirmer, M. 2014. Thirty years of river restoration in Switzerland: implemented measures and lessons learned. *Environmental Earth Sciences*, 72(6), 2065-2079.
- Diem, S., Renard, P., Schirmer, M. 2014. Assessing the effect of different river water level interpolation schemes on modeled groundwater residence times. *Journal of Hydrology*, 510, 393-402.
- Lazzaro, G., Basso, S., Schirmer, M., Botter, G. 2013. Water management strategies for run-of-river power plants: Profitability and hydrologic impact between the intake and the outflow. *Water Resources Research*, 49, 8285–8298, doi:10.1002/2013WR014210.
- Diem, S., Renard, P., Schirmer, M. 2013. New methods to estimate 2D water level distributions of dynamic rivers, *Ground Water*, 51(6), 847-854.

- Diem, S., Cirpka, O.A., Schirmer, M. 2013. Modeling the dynamics of oxygen consumption upon riverbank filtration by a stochastic-convective approach. *Journal of Hydrology* 505, 352–363.
- Diem, S., Rudolf von Rohr, M., Hering, J.G., Kohler, H.P.E., Schirmer, M., von Gunten, U., 2013. NOM degradation during river infiltration: Effects of the climate variables temperature and discharge. *Water Research* 47(17), 6585–6595.
- Diem, S., Schirmer, M., Rudolf von Rohr, M., Kohler, H.P.E., Hering, J.G., von Gunten, U., 2013. Qualität des Uferfiltrats: Einfluss der klimabestimmten Variablen Temperatur und Abfluss. *Aqua & Gas*, 11, 14–21.
- Schirmer, M. 2013. Das RECORD-Projekt - Flussrevitalisierung, eine ökologische Massnahme in einem komplexen Umfeld, *Aqua & Gas*, 3, 22-28.
- Ghasemizade, M., Schirmer, M. 2013. Subsurface flow contribution in the hydrological cycle: Lessons learned and challenges ahead - A review. *Environmental Earth Sciences* 69, 707-718. Online available: DOI 10.1007/s12665-013-2329-8.
- Nikiema, J. Gläßer, W., Krieg, R., Schirmer, M. 2013. Trace elements and their correlations in hand-dug wells in a laterite environment in a semi-arid region: case study of Tikare', Northern Burkina Faso. *Environmental Earth Sciences* 69(7), 2393-2414.
- Odeh, T., Geyer, S., Rödiger, T., Siebert, C., Schirmer, M. 2013. Groundwater chemistry of strike slip faulted aquifers: the case study of Wadi Zerka Ma'in aquifers, north east of the Dead Sea. *Environmental Earth Sciences* 70(1), 393-406.
- Schirmer, M., Leschik, S., Musloff, A. 2013. Current research in urban hydrogeology – A review. *Advances in Water Resources* 51, 280–291.
- Kurth, A.-M., Dawes, N., Selker, J., Schirmer, M. 2013. Autonomous distributed temperature sensing for long-term heated applications in remote areas. *Geoscientific Instrumentation, Methods and Data Systems* 2, 71-77, doi:10.5194/gi-2-71-2013.
- Jiang, Y., Hu, Y., Schirmer, M. 2013. Biogeochemical controls on daily cycling of hydrochemistry and $\delta^{13}\text{C}$ of dissolved inorganic carbon in a karst spring-fed pool. *Journal of Hydrology* 478, 157-168.
- Schirmer, M., Davis, G. B., Hoehn, E., Vogt, T. 2012. Editorial: GQ10 "Groundwater quality management in a rapidly changing world". *Journal of Contaminant Hydrology* 127, 1–2.
- Schirmer, M., Lyon, K., Armstrong, J., Farrell, K.N. 2012. A socio-ecological adaptive approach to contaminated mega-site management: From 'control and correct' to 'coping with change'. *Journal of Contaminant Hydrology* 127, 101–109.
- Kueffer, C., Underwood, E., Hirsch Hadorn, G., Holderegger, R., Lehning, M., Pohl, C., Schirmer, M., Schwarzenbach, R., Stauffacher, M., Wuelser, G., Edwards, P. 2012. Enabling effective problem-oriented research for sustainable development. *Ecology and Society* 17(4): 8.

- Hayashi, M., Vogt, T., Mächler, L. Schirmer, M. 2012. Diurnal fluctuations of electrical conductivity in a pre-alpine river: Effects of photosynthesis and groundwater exchange. *Journal of Hydrology* 450–451, 93–104.
- Hering, J.G., Hoehn, E., Klinke, A., Maurer, M., Peter, A., Reichert, P., Robinson, C., Schirmer, K., Schirmer M., Stamm C., Wehrli B. 2012. Moving targets, long-lived infrastructure, and increasing needs for integration and adaptation in water management: An illustration from Switzerland. *Environmental Science and Technology* 46, 112-118.
- Vogt, T., Schirmer, M., and Cirpka, O. A. 2012. Heat transport of diurnal temperature oscillations upon river-water infiltration investigated by fiber-optic high-resolution temperature profiling. *Hydrology and Earth System Sciences* 16, 473-487.
- Alfreider, A., Schirmer, M., Vogt, C. 2012. Diversity and expression of different forms of RubisCO genes in polluted groundwater under different redox conditions. *FEMS Microbiology Ecology* 79, 649-660.
- Schirmer, M., Reinstorf, F., Leschik, S., Musolff, A., Krieg, R., Strauch, G., Molson, J.W., Martienssen, M., Schirmer, K. 2011. Mass fluxes of xenobiotics below cities: challenges in urban hydrogeology. *Environmental Earth Sciences*, 64(3), 607-617.
- Leschik, S., Bayer-Raich, M., Musolff, A., Schirmer, M. 2011. Towards optimal sampling schedules for integral pumping tests. *Journal of Contaminant Hydrology*, 124(1-4), 25-34.
- Hug, S.J., Gaertner, D., Roberts, L.C., Schirmer, M., Ruettimann, T., Rosenberg, T.M., Badruzzaman, A.B.M., Ali, M. A. 2011. Avoiding high concentrations of arsenic, manganese and salinity in deep tubewells in Munshiganj District, Bangladesh. *Applied Geochemistry*, 26(7), 1077-1085.
- Schneider, P., Vogt, T., Schirmer, M., Doetsch, J. A., Linde, N., Pasquale, N., Perona, P., Cirpka, O. A. 2011. Towards improved instrumentation for assessing river-groundwater interactions in a restored river corridor. *Hydrology and Earth System Sciences*, 15(8), 2531-2549.
- Schubert, M., Brueggemann, L., Knoeller, K., Schirmer, M. 2011. Using Radon as an environmental tracer for estimating groundwater flow velocities in single-well tests. *Water Resources Research*, 47, W03512, doi:10.1029/2010WR009572.
- Schirmer, M., Martienssen, M., Schirmer, K. 2011. Comment on Schriks, M. Heringa, M.B., van der Kooi, M.M.E., de Voogt, P., van Wezel, A.P., 2010. Toxicological relevance of emerging contaminants for drinking water quality. *Water Research* 44, 461-476. *Water Research*, 45, 1512-1514.
- Schirmer, M., Vogt, T. 2011. River restoration with complex hydrological and ecological interactions: the RECORD-Project. In: UGG2011: Conceptual and Modelling Studies of Integrated Groundwater, Surface Water, and Ecological Systems, p. 190-193. Eds.: Abesser, C., Nützmann, G., Hill, M.C., Blöschl, G., Lakshmanan, E. Red Book, IAHS Publication No. 345. ISBN 978-1-907161-20-9.

- Schirmer, M., Hoehn, E., Vogt, T. 2011. Preface. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. v-vi. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Reinstorf, F., Leschik, S., Musolff, A., Gläser, H.-R., Osenbrück, K., Möder, M., Strauch, G., Schirmer, M. 2011. Methodologies and tools for the estimation of mass fluxes of xenobiotics at different scales in urban areas. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 37-41. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Leschik, S., Bayer-Raich, M., Musolff, A., Schirmer, M. 2011. Optimal sampling schedules of integral pumping tests for the investigation of groundwater contamination from urban line sources. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 46-49. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Musolff, A., Leschik, S., Strauch, G., Schirmer, M. 2011. Micropollutant mass flow in urban receiving waters. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 59-62. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Schirmer, M., Niemes, H. 2011. Societal costs for remediation of an MTBE groundwater contamination by air stripping. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 84-87. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Schirmer, M., Farrell, K. N., Lyon, K., Armstrong, J. 2011. Contaminated mega-site management: the complex problem challenge. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 194-198. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Vogt, T., Schneider, P., Peter, S., Durisch-Kaiser, E., Schirmer, M., Cirpka, O. A. 2011. Assessing groundwater travel times and biogeochemical processes during riverbank filtration under the aspect of river restoration. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 401-404. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
- Odeh, T., Geyer, S., Schirmer, M., Rödiger, T., Siebert, C., Gloaguen, R.. 2011. Development of groundwater salinity in the Wadi Zerka Ma'in catchment area, Dead Sea, Jordan. In: GQ10: Groundwater Quality Management in a Rapidly Changing World, p. 487-490. Eds.: Schirmer, M., Hoehn, E., Vogt, T. Red Book, IAHS Publication No. 342. ISBN 978-1-907161-16-2.
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- Musolff, A., Leschik, S., Reinstorf, F., Strauch, G., Schirmer, M. 2010. Micropollutant loads in the urban water cycle. *Environmental Science & Technology* 44(13), 4877–4883.

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- Schirmer, M., Niemes, H. 2010. Sustainable technologies and social costs for eliminating contamination of an aquifer. *Sustainability*, 2, 2219-2231.
- Nikiema, J., Schirmer, M., Gläßer, W., Krieg, R. 2010. Correlative and comparative characterization of main ion concentrations in laterite groundwater in semi-arid northern Burkina Faso. *Environmental Earth Sciences*, 61, 11-26.
- Musolff, A., Leschik, S., Möder, M., Strauch, G., Reinstorf, F., Schirmer, M. 2009. Temporal and spatial patterns of micropollutants in urban receiving waters. *Environmental Pollution*, 157 (11), 3069-3077.
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- Leschik, S., Musolff, A., Martiensen, M., Krieg, R., Bayer-Raich, M., Reinstorf, F., Strauch, G., Schirmer, M. 2009. Investigation of sewer exfiltration using integral pumping tests and wastewater indicators. *Journal of Contaminant Hydrology*, 110(3-4), 118-129.
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Reinstorf, F., Leschik, S., Musloff, A., Osenbrück, K., Strauch, G., Möder, M., Schirmer, M. 2008. Mass fluxes and integrated modelling of urban micropollutants in the city of Halle, Germany. In: GQ07: Securing Groundwater Quality in Urban and Industrial Environments, p. 110 - 117. Red Book, IAHS Publication 324, ISBN 978-1-901502-79-4.

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Oswald, S., Griepentrog, M., Schirmer, M., Balcke, G. U. 2008. Interplay between oxygen demand reactions and kinetic gas-water transfer in porous media. *Water Research*, 42(14), 3579-3590.

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