

**Veröffentlichungen aus dem Technologiezentrum Wasser
Band 63 – Verbleib von DOC und Spurenstoffen bei der
Grundwasseranreicherung in den Langen Erlen (Basel)**

Contents

Zusammenfassung	i
Summary	v
Contents	ix
List of Tables	xiii
List of Figures	xv
List of Abbreviations	xix
1. Introduction	1
1.1. Drinking water production using natural cleaning systems	1
1.2. AGR site Lange Erlen	3
1.2.1. Aquifer and groundwater	4
1.2.2. Soils and vegetation	4
1.2.3. Drinking water production	5
1.3. Pollution of surface waters - a hazard for drinking water production	6
1.4. Efficiency of natural cleaning systems	10
1.4.1. Biodegradation and impact of redox milieu	10
1.4.2. Temperature	12
1.4.3. Sorption	12
1.4.4. Contribution of subsoil horizons	13
1.4.5. The role of dissolved organic carbon	13
1.5. Objective of this study	15
2. Gas sampling in a partly saturated soil in an artificial groundwater recharge site	17
2.1. Abstract	17
2.2. Introduction	17
2.3. Material and Methods	19
2.3.1. Sampled sites	19
2.3.2. Installation of gas sampling systems and sampling	19
2.3.3. Gas analysis	21
2.3.4. Data analysis	22
2.4. Results and Discussion	22
2.4.1. CO ₂ , N ₂ O and δ ¹³ C - extraction of gas only	24
2.4.2. CO ₂ , N ₂ O and δ ¹³ C - simultaneous extraction of gas and water	24
2.4.3. Indifferent results for CH ₄	26
2.4.4. Literature on subsurface gas sampling and the impact of water	27
2.5. Conclusion	28

3. Self-cleaning vadose zone - the fate of dissolved organic carbon in an artificial groundwater recharge site	29
3.1. Abstract	29
3.2. Introduction	30
3.2.1. The fate of DOC - a matter of concern?	30
3.2.2. Dilution	30
3.2.3. Sorption	31
3.2.4. Degradation	31
3.3. Material and Methods	33
3.3.1. Sites investigated	33
3.3.2. Sampling of water, solid and gas phase	33
3.3.3. Preparation and analyses of water, solid and gas samples	35
3.3.4. Definitions and calculations	42
3.4. Results and Discussion	46
3.4.1. Overall removal of DOC	46
3.4.2. Dilution	47
3.4.3. Removal of DOC by degradation and sorption	54
3.4.4. Sorption onto the solid phase	55
3.4.5. Degradation of DOC	61
3.4.6. Spatial and temporal variation of subsurface gas phase composition	69
3.5. Conclusion	79
4. Removal of dissolved organic carbon (DOC) and organic trace pollutants in a column percolation experiment	83
4.1. Abstract	83
4.2. Introduction	84
4.3. Material and Methods	86
4.3.1. Bulk material for filling the columns	86
4.3.2. Stainless steel columns – setup	86
4.3.3. Column Percolation	88
4.3.4. Time table of the percolation experiment and treatments	88
4.3.5. Water sampling	91
4.3.6. Water analytics	92
4.3.7. Gas sampling	93
4.3.8. Gas Analytics	95
4.3.9. Automated sampling circuit and software	96
4.3.10. Soil column hydraulic properties - break through curves	96
4.3.11. Calculations and statistics	97
4.4. Results and Discussion	98
4.4.1. Hydraulic properties of soil columns: Breakthrough curves (BTC) of NaCl and estimation of retention time	98
4.4.2. Test for sorption or release of anions and cations	99
4.4.3. Experimental conditions and redox setting	100
4.4.4. Removal of DOC	108
4.4.5. Removal of organic trace pollutants	115
4.5. Conclusion	125
4.5.1. Removal efficiency and role of subsoil horizons	125
4.5.2. Priming effects of saccharose	126

4.5.3. Scenarios with pollution of the Rhine	127
4.5.4. Column experiments - a useful tool	128
5. Co-Regulation of redox processes in freshwater wetlands as a function of organic matter availability?	129
5.1. Abstract	129
5.2. Introduction	130
5.3. Methods and Sites	131
5.3.1. Site descriptions	131
5.3.2. Methods	131
5.4. Results and Discussion	134
5.4.1. Redox processes under high DOC regime: Results from the Lehstenbach catchment	134
5.4.2. Redox processes under low DOC regime: Results from Lange Erlen	137
5.5. Conclusion	140
5.6. Acknowledgements	140
6. Concluding Discussion and Outlook	141
6.1. Cleaning efficiency of AGR site Lange Erlen	141
6.1.1. Processes contributing to the removal of DOC and trace pollutants .	141
6.1.2. Parameters impairing or enhancing the cleaning efficiency of the AGR system	142
6.2. Comparison of conventional and natural treatment	147
6.3. Future developments	147
6.4. Outlook	148
Bibliography	151
A. Appendix	175
Acknowledgements	179