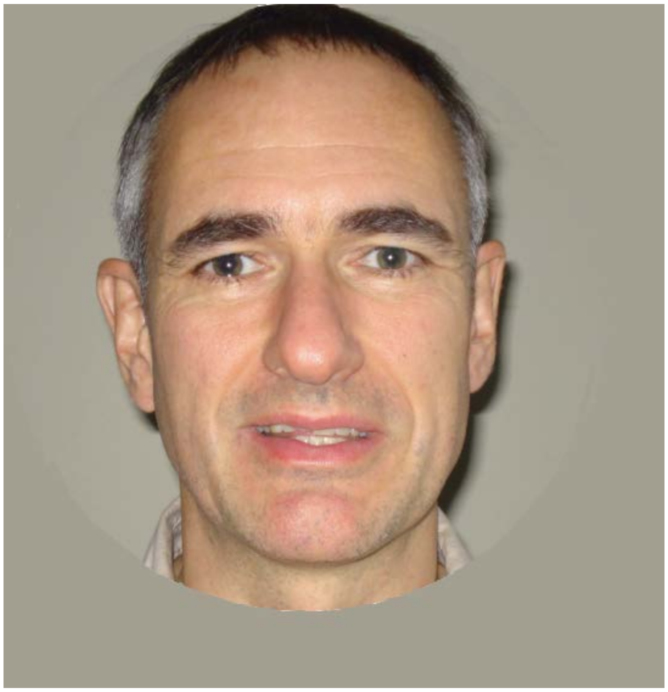

Dr. Ulrich Mayer

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Dr. Mayer's research concentrates on the geochemical evolution of low-temperature groundwater systems with a focus on groundwater contamination and remediation. Dissolved inorganic and organic chemicals are commonly affected by a variety of physical and chemical processes, which influence their mobility, but also alter the geochemical composition of the aquifer material. This is particularly true in the vadose zone, where the exchange of gases with the atmosphere can enhance the progress of geochemical reaction processes. Due to the complexity of these systems and the strong non-linear coupling between the processes, existing conceptual models are often incomplete and data interpretation from field and laboratory studies is not always intuitive. The main objectives of this research program are:

- Development of a process-oriented multicomponent reactive transport model, which can be used to investigate these complex systems and which is generally applicable to a large number of reactive transport problems in the fields of environmental sciences and engineering.
- Numerical analysis of groundwater contamination problems and remediation solutions with the goal to quantify, and potentially improve, existing conceptual models.
- Investigation of transport and reaction processes in groundwater systems using dissolved and vapor phase gases as natural tracers (Ar and N_2) or indicators for biological processes (CH_4, CO_2, H_2, H_2S, O_2, N_2).

The model development is based on the reactive transport model MIN3P. MIN3P was designed to investigate reactive transport in saturated and unsaturated porous media in partial equilibrium systems. The model is capable of simulating groundwater flow, advective-dispersive transport of dissolved species and advective-diffusive gas transport directly coupled with a variety of bio-geochemical and inorganic reactions. To date, processes considered are aqueous complexation, oxidation-reduction, gas dissolution-exsolution, ion exchange, surface complexation, mineral dissolution-precipitation, and microbially-mediated degradation reactions.

Field work and lab work revolve around dissolved gas analysis. Microbiological activity in groundwater systems often leads to the generation of dissolved gases. In shallow groundwater systems, gas solubility is limited and if gas production is significant (e.g. due to denitrification or methanogenesis), gas bubbles will form. This will lead to the partitioning of insoluble gases such ad Ar and N_2 into the gas bubbles. Due to its non-reactive nature, Ar in particular can be used to quantify this process, and calna then also be used to investigate transport away from a reactive zone. In unsaturated media, zones of Ar depletion or enrichment can be used as an indicator for advective gas transport.

Selected Papers

Selected Publications

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