Environmental isotopes investigation on groundwater residence time and recharge processes in a coastal aquifer, South-East Tanzania

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To determine the residence time and recharge processes in a coastal aquifer south-east Tanzania, we analyzed major elements and environmental isotopes of surface-, rain- and ground-water samples collected from the coastal watershed in April 2009. The $^{87}Sr/^{86}Sr$ ratios of ground- and surface-water of the study area reflect the lithological characteristics of the coastal aquifer as a result of weathering processes and water–rock interactions [1]. The slope for rainwater data ($\delta^2H = 10.5 + 7.2\delta^{18}O$, $R^2 = 0.97$) is slightly lower than global meteoric water lines ($\delta^2H = 10 + 8\delta^{18}O$, $R^2 = 1$), which reflect evaporation and preservation of seasonal fluctuations. The wide range of the $\delta^{18}O$ and δ^2H values in the upper aquifer indicate replenishment with modern meteoric water. In contrast, the narrow range of depleted stable isotope values combined with chemical signal in the lower aquifer indicates that deep groundwater is a part of the regional flow system. The ^{14}C data suggest that the residence time of deep groundwater is in the order of several thousands of years and reflect past recharge during a colder climate than at present. In addition, the hydrochemical data characterized deep groundwater as a high water quality of $Na\text{-}HCO_3$ type and shallow groundwater as a low water quality of Na-Ca-Cl type.

[1] Faure G. (1986) 2nd ed. Springer, Berlin Heidelberg

Time-lapse Electrical Resistivity Tomography (ERT) monitoring of *in situ* hydrogeochemical changes associated with an emulsified vegetable oil injection for bioreduction of Uranium(VI)

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Bioreduction of Uranium (VI) to Uranium (IV) with an electron donor was tested in Area 2 at the DOE Oak Ridge National Laboratory (ORNL) Integrated Field Research Challenge (IFRC) site in 2008-2009. Low U concentration (below US EPA MCL of 0.03 mg/L) were achieved previously by frequent injection of electron donor. To reduce the costs and improve the sustainability for remediation and site maintenance, the research team is exploring the effectiveness of a slowly degrading substrate (commercial emulsified vegetable oil, SRS) as an electron donor.

Time lapse surface electrical (TLERT) data are expected to be useful for understanding the distribution of amendments and long-term reactivity in the presence of subsurface heterogeneity. Our project effort focused on four tasks:

(1) Laboratory Experiments. Flow-through laboratory experiments were conducted using site material and groundwater to understand the electrical response to the SRS biostimulation. This study suggested that time-lapse electrical methods should be useful for monitoring the replacement of groundwater with the SRS and subsequent changes due to biodegradation. (2) Field Monitoring. Time-lapse surface electrical datasets (eight in the first months, and 15 total over the first year) were used to monitor the SRS field biostimulation experiment along two key transects: one parallel to the injection flowcell centerline and one perpendicular to the injection well gallery. (3) Wellbore Data. Co-analysis of the time-lapse fluid electrical logs and wellbore aqueous geochemical data, both collected during the SRS field experiment, has been performed. These data suggest that the fluid electrical conductivity responds significantly to the SRS injection, but that subsequent decreases due to denitrification and increases due to sulfate reduction partially cancel each other out. (4) Synthesis. The three components are analyzed to interpret the time-lapse surface ERT datasets in terms of insights developed through laboratory experiments and through analysis of wellbore data.