Monitoring dissolved gases and ions in groundwater using an *in situ* sampling technique

M.P. KYRIAS, D.J. STRATTAN, R.A. SANFORD
AND C.M. BETHKE*

Department of Geology, University of Illinois, Urbana, IL, 61801, USA (*correspondence: bethke@illinois.edu)

We tested an *in situ* method for monitoring the concentrations of aqueous chemical species and dissolved gases in groundwater. We deployed *in situ* samplers in 8 wells completed in the glacial Glasford formation and underlying Banner formation of the Mahomet aquifer, a regional water supply in east-central Illinois. We distributed and retrieved samplers 25 times over 35 weeks. At one point in this interval, we pumped each well to retrieve a sample for standard analysis, for comparison to results obtained by the *in situ* technique. The *in situ* method relies on the diffusion of analytes through a permeable membrane integral to our samplers. The samplers can be deployed and retrieved from a well without the necessity of pumping groundwater. Since no pumping is required, the method allowed the samplers to be monitored from all of the wells within a few hours. SO_4^{2-} concentrations ranged among the wells from below detection (0.01 mM) to 0.84 mM, and Cl^- ranged from 0.01 to 3.08 mM. These results correspond closely to concentrations measured from pumped samples. Over the first 21 weeks, H_2, CO_2, and CH_4 averaged 42.5 nM, 0.012 atm, and 0.090 atm, respectively. At 21 weeks, about the time we pumped the wells, we observed that H_2 increased by a factor of 5, and CH_4 by a factor of 3, in two wells screened in the Glasford formation and three wells screened in the Banner formation. Measurements conducted in the remaining three wells changed little. The concentration of CO_2 in each well remained constant throughout the sampling period in each well. The *in situ* method may provide a useful technique for frequently testing groundwater chemistry over extended periods of time.

Investigation of matrix fluids in fractured aquifers through various gas analyses

T. LABASQUE[1]*, L. AQUILINA[1], O. BOUR[1],
V. DE MONTETY[1] AND E. FOURRE[2]

[1]Géosciences Rennes, UMR 6118, 35000 Rennes, France
(*correspondence: thierry.labasque@univ-rennes1.fr)
[2]LSCE, CEA-CNRS-UVSQ, 91191 Gif sur Yvette, France

We investigated the matrix fluids in a fractured aquifer in French Brittany (Ploemeur, national observatory site). We used four wells close to each others, two of them being pumped for several hours. The four wells were monitored during the whole experiment for chemical composition (major and trace elements) and dissolved gases content: CFC, SF_6, Rn, noble gases and He isotopes. After an equilibration phase, the chemical and gas concentrations evolve during the relaxation phase following pumping. The production of matrix fluids is evidenced through the following observations:

- CFC concentrations decrease, indicating waters with longer residence time;
- He, Rn and SF_6 concentrations increase with time, indicating a potential production mechanism. SF_6 and Rn production have indeed been measured in this aquifer. However, it is interesting to notice that these three elements do not have the same reactivity. they do not have similar production mechanisms and diffusion coefficients;
- Some chemical elements such as silica increase indicating silicate alteration processes;
- The redox conditions also vary with time during the relaxation phase, indicating more reduced conditions with U concentration increases;
- Ar increases also indicate either an Ar production or a recharge temperature of 5°C.

This experiment shows that fluids with various compositions in fractured aquifers are related to various degree of micro- and macro-porosity, and may be associated to various pumping conditions.