Geophysical Research Abstracts
Vol. 13, EGU2011-3386-2, 2011
EGU General Assembly 2011

Long term evolution of water supply sources and groundwater flow in a large scale artificial recharge system assessed through multi-isotope tracing

Wolfram Kloppmann (1), Ido Negev (2), Joseph Guttman (2), Tomer Kraitzer (2), Catherine Guerrot (1), Marie Pettenati (1), Haim Chikurel (2), Avi Aharoni (2), Orly Goren (3), Avihu Burg (3), and the Israeli-French SAT Team

(1) BRGM, Water Department, Orléans, France (w.kloppmann@brgm.fr), (2) Mekorot National Water Company, Tel Aviv, Israel, (3) Geological Survey of Israel, Jerusalem, Israel

The Shafdan site (Israel) offers the unique opportunity to investigate the long-term behaviour of a large scale Soil Aquifer Treatment (SAT) and Artificial Recharge (AR) system over a timescale of several decades. In the Shafdan plant, effluents of Tel-Aviv region are treated and then recharged, by a series of spreading ponds, through a thick unsaturated zone into the coastal Quaternary sandstone aquifer, one of the major freshwater resources of the country. This complementary SAT improves reclaimed water quality to a degree that makes it suitable for unrestricted irrigation and incidental drinking. The present multi-isotope study was motivated by the need to assess the confinement of AR between infiltration basins and the surrounding gallery of pumping wells. Previous studies in 1992-93 (Vengosh *et al*., 1994) and 2006 (Kloppmann *et al*., 2009) provided snapshots of the geochemical and boron isotope fingerprints of the Shafdan system and allow direct comparison with the results obtained in 2010.

A first striking feature is the decrease of boron concentrations in the reclaimed wastewater from a maximum of around 1 mg/L down to 0.2 mg/L. This decrease was already observed in 2006 and can be attributed to a change of Israeli legislation stipulating a stepwise reduction of boron in detergents from 1999 to 2008. The boron isotope effluent signatures in 1992-93 were typical for industrial perborates (δ^{11}B of +5 to +13 ‰ *vs.* NBS951). In 2006, the δ^{11}B only slightly increased to +16 ‰ whereas in 2010 we observe values as high as +40 to +41 ‰ in the secondary treated wastewater before infiltration. Low boron waters with δ^{11}B higher than seawater are compatible with reverse osmosis desalinated seawater using low pH (around +39 ‰ expected) or high pH treatment steps (+48 to +57 ‰ Kloppmann *et al*., 2008). Desalinated water has been introduced for the first time in significant quantities to Tel Aviv water supply in 2007. Recovered sewage-containing groundwater samples still plot close to the theoretical mixing lines between 1992-93 sewage and uncontaminated groundwater and the 2010 signature has not yet been evidenced in the system indicating a delay of B breakthrough with respect to water. δ^{18}O and δ^{2}H values of the recovery wells indicate conservative mixing between an endmember close to 2010 sewage (summer sampling) and local groundwater. Sewage stable isotope signatures can be explained by evaporation but also by mixing of coastal aquifer groundwater with desalinated seawater from Ashkelon. Another potential water supply source is Lake Kinneret water. The present data set will be completed by a winter sampling campaign and by sulphur and oxygen (δ^{34}S and δ^{18}O) data on sewage and groundwater.

Vengosh, A., Heumann, K. G., Juraske, S., and Kasher, R., 1994. Boron isotope application for tracing sources of contamination in groundwater. *Environ. Sci. Technol.* **28**, 1968-1974.

Kloppmann, W., Vengosh, A., Guerrot, C., Millot, R., and Pankratov, I., 2008. Isotope and ion selectivity in reverse osmosis desalination: Geochemical tracers for man-made freshwater. *Environ. Sci. Technol.* **42**, 4723-4731.

Kloppmann, W., Chikurel, H., Picot, G., Guttman, J., Pettenati, M., Aharoni, A., Guerrot, C., Millot, R., Gaus, I., and Wintgens, T., 2009. B and Li isotopes as intrinsic tracers for injection tests in aquifer storage and recovery systems. *Appl. Geochem.* **24**, 1214-1223.