Deep ground water migration in Brazilian Federal District based on isotope geochemistry

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The young capital of Brazil is placed geographically in the Brazilian Central Plains, where the average altitude is close to a 1,000 m above sea level. The area includes drainages that flow to three of the most important river basins of the country: the Paraná, the Amazon, and the São Francisco river basins. Because population has already reached more than 2 million people and continues to grow, policy makers increasingly use groundwater reservoirs.

In order to evaluate the geochemical stability of these reservoirs, we performed an 18 month detailed monitoring of is $\delta^{13}C$, $\delta^{18}O$, δD and $^{87}Sr/^{86}Sr$ isotopic composition. The isotopic data revealed two main behaviors of these reservoirs: 1) those that present a narrow range of isotopic variation; and 2) those that present a wide range of isotopic variation. While the former were interpreted as isotopic equilibrated water-host rock reservoirs, the later were interpreted as reservoirs that did not reached isotopic equilibrium due to the young age of their waters. We further show that isotopic fluctuation observed in these reservoirs may be related to changes in hydrostatic pressure induced by seasonal variations of rainfall amount.

Biogeochemical and microbial controls of ^{129}I mobility in groundwater

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Due to its long half-life (17 My), high mobility, and biophilic properties, ^{129}I, a major by-product of nuclear fission, is one of the three major risk drivers at nuclear disposal sites. In aquatic environments, iodine (I), mainly exists as I^-, IO_3^- and organic iodine (OI). Field and laboratory batch and column studies were established to understand the inter-conversion of I species in an ^{129}I-contaminated plume located in F-area of the Savannah River Site (SRS), by determining speciated ^{129}I and stable ^{127}I using GC-MS [1]. These studies demonstrated that the mobility of I species greatly depended on the I concentration used [2, 3]. It was found that bacteria isolates can accumulate I^- at environmentally relevant concentrations (0.1 μM I^-); some isolates were also found to oxidize I^- to IO_3^- [*4*]. When the hypothesis that I^- mobility can be controlled through an engineered barrier system was tested, results showed that while the majority of I (as ^{127}I and ^{129}I) existed as I^- near the source term, iodide transformed into iodate and organo-I downgradient [5], and was removed through the formation of immobile particulate OI and partly released as mobile OI [6], depending on aromaticity and relative hydrophobicity; the greater the aromaticity, the greater the uptake of iodine [7].

[1] Zhang *et al.* (2010) *ES&T* **44**, 9042–9048. [2] Schwehr *et al.* (2009) *ES&T* **43**, 7258–7264. [3] Zhang *et al.* (2011) *ES&T* submitted. [4] Li *et al.* (2011) *Appl. Environ. Microbiol.* 77 2153–2160. [5] Kaplan *et al.* (2011) *ES&T* **45**, 489–496. [6] Otosaka *et al.* (2011) *Sci. Tot. Environ.* submitted. [7] Xu *et al.* (2011a,b) *GCA, ES&T*, submitted.