Use of ^{3}H and ^{14}C to characterize the flow system in a fractured aquifer and their implication on water quality

M. R., Franklin[1],V. P., Araújo[2], M., Manzano[3], L., Melo[1], L., Toro[4], L., Araguás-Araguás[4]
e-mail: mariza@ird.gov.br, valeska@ien.gov.br, marisol.manzano@upct.es, leticiamelo@gmail.com, l.toro-espitia@iaea.org L.Araguas@iaea.org

[1]*Institute of Radiation Protection and Dosimetry*
[2]*Institute of Nuclear Engineering*
[3]*Universidad Politecnica de Cartagena*
[4]*International Atomic Energy Agency*

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Knowledge of residence time is an important parameter for understanding aquifer recharge and dynamics, as well as provides important insights on water quality issues.
Although the hydraulic parameters of a fractured aquifer under semi-arid conditions can be obtained by field tests, the characterization of the groundwater flow, including residence time and recharge rates is still limited due to the heterogeneity of the fractured rock and water scarcity. The Caetité Experimental Basin (CEB), located in semi-arid conditions of Northeastern Brazil, faces not only the challenges associated with water scarcity, but also potential contamination processes due to uranium mining and milling activities.
This work describes the characterization of the flow system of the fractured aquifer of CEB and its implication on water quality. Isotope techniques (radioactive tracers ^{14}C and ^{3}H) combined with hydrochemistry were used to understand the aquifer dynamics and groundwater dating [1].

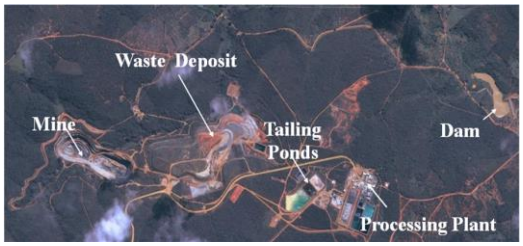

Figure 1. Location of the Caetité Experimental Basin (CEB), with highlight to the area of the Uranium mining and milling facility (URA).

^{3}H content in CEB varied from -0.01 ± 0.27 T.U. to 1.87 ± 0.27. The majority of the groundwater samples (59.52%) shows values <1 T.U (pre-modern water). These values are very similar to the present day ^{3}H precipitation for CEB (1.05 ± 0.25 T.U.) indicating modern recharge influenced by precipitation. $\delta^{13}C$ in Groundwater shows low variability ranging from -15.09 ‰ to -5.86 ‰, with median value of the -12.10 ± 2.05 ‰. ^{14}C values varies between 72.94 ± 0.33 and 105.95 ± 0.55 pmc.

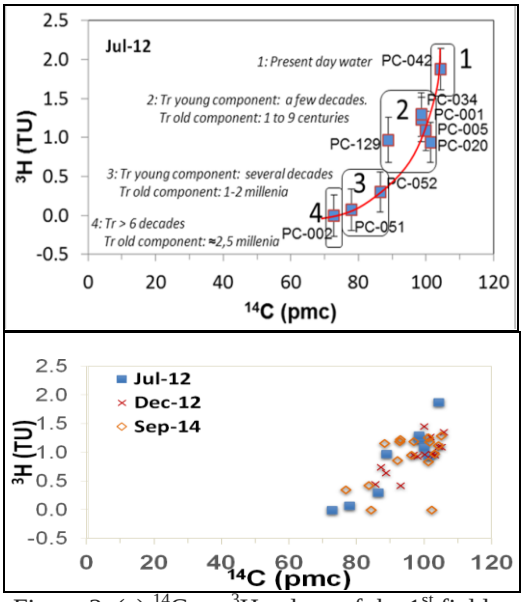

Figure 2. (a) ^{14}C vs. ^{3}H values of the 1st fieldwork, with a qualitative interpretation of transit times (Tr) and (b) ^{14}C vs. ^{3}H values considering all fieldworks. The general trend of the data remains, even though the correlation of the ^{3}H and ^{14}C is not as clear as in the 1st campaign.

Most of the groundwater samples are pre-modern waters with modern recharge influenced by precipitation. The estimated residence times ranged from few decades (modern) to about 2000 years. Most of ^{3}H and ^{14}C results were consistent with each other, suggesting mixtures of waters with different residence times. We suggest that the CEB fractured aquifer presents two flow systems: one characterized by fast recharge and short residence times (more vulnerable to contamination), and another characterized by a slower recharge and longer residence times.

References

[1] FRANKLIN, M. et. al. Use of 3h and 14c to characterize the flow system in a fractured aquifer and their implication on water quality. In: INTERNATIONAL SYMPOSIUM ON ISOTOPE HYDROLOGY, 2015, Vienna. **Anais…** Vienna: International Atomic Energy Agency, mai. 2015. Não paginado.