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► To cite this version:

Laurence Gourcy, Luc Arnaud, Damien Salquebre. Of the importance of d-excess in understanding recharge process in two case studies of France. International Symposium on Isotope Hydrology: Revisiting Foundations and Exploring Frontiers, May 2015, Vienne, Austria. hal-01100447

HAL Id: hal-01100447

<https://brgm.hal.science/hal-01100447>

Submitted on 6 Jan 2015

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OF THE IMPORTANCE OF D-EXCESS IN UNDERSTANDING RECHARGE PROCESS IN TWO CASE STUDIES OF FRANCE

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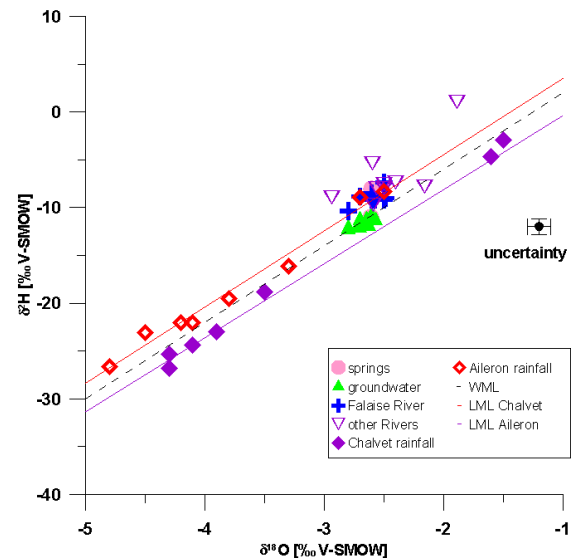
Stable isotopes of water ($\delta^2\text{H}$ and $\delta^{18}\text{O}$) are classical tools for determining hydrogeological parameters ea. recharge area, flow directions, groundwater-surface water exchanges,... (Mook et al. 2008). However the successful use of the isotope techniques depends on local or regional hydrogeological characteristics. Meteorological and hydrological conditions leading to contrasting isotope composition of the water bodies are required.

The relation between these two elements in precipitation from various part of the world is $\delta^2\text{H} = 8\delta^{18}\text{O} + 10$. The so called Global Meteoric Water Line (GMWL) is characterised by a slope of 8 and an intercept with the ^2H axis of 10‰. This intercept is more generally called d-excess and may vary from 10 depending on the humidity and the temperature of the evaporation region. Then depending on the existing conditions during the formation of precipitation (=evaporation) and mostly at the site of sea-air interaction the d-excess may vary. The d-excess is then highly variable from one precipitation station of another and may reflect various so-called “effect” (continental, seasonal, altitude effects) as well as other processes such as re-evaporation of rain droplets...

In two recent studies carried out in south of France and in the Martinique French overseas the d-excess has proven to be a valuable tool giving additional and more evident information than the stand alone $\delta^2\text{H}$ and $\delta^{18}\text{O}$.

In Berre plain, near Marseille, two sampling campaigns were carried out in October and in April. Samples from the deep calcareous aquifer, the alluvial aquifer, the Arc River and the water supply channel were analysed for $\delta^2\text{H}$ and $\delta^{18}\text{O}$. The samples from October (1) plot quite well along the local precipitation line (Gardanne, Celle 2000) having a d-excess between 7,9 and 10‰. Part of the samples from the second sampling campaign (high stage water, 2 in the below figure) has a quite different d-excess, usually close to +16‰.

For the water having a similar d-excess in April and October, the aquifer is considered as less vulnerable as recharge process is quite slow. For the other points, as well as for the River Arc, the seasonal variation can be clearly seen showing high sensitivity to direct recharge processes (by surface water or precipitation).



δ^2H vs $\delta^{18}O$ at Falaise River Basin, Martinique

References:

Gat J., Dansgaard W. (1972) - Stable isotope survey of the fresh water occurrences in Israel and the Northern Jordan Rift System. *Journal of Hydrology*, 16, pp.177-212.