

$\delta^{18}\text{O}/\delta^2\text{H}$ AND $^{87}\text{Sr}/^{86}\text{Sr}$ IN SUPPORTING UNDERSTANDING A COMPLEX KARSTIC SYSTEM LINKED TO SURFACE WATER – THE LOIRET SYSTEM, FRANCE

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Abstract: The project CENARI-O aimed at improving knowledge on groundwater-surface water exchanges in a complex karstic area modified by hydraulic infrastructures combining various tools. The results obtained using $\delta^{18}\text{O}/\delta^2\text{H}$ and $^{87}\text{Sr}/^{86}\text{Sr}$ were compared to in situ conductivity and temperature measurements in order to complete the information. The Loiret River is mainly fed by groundwater along its flow path. This very particular flow system is more complex and various tools were needed to improve surface-groundwater knowledge.

1. INTRODUCTION

The Loiret River, begins at the Bouillon spring and end, 13 kms later, in the Loire River. This short river has a basin of 500 km and is of main interest for the residents enjoying the proximity to this crystalline river but facing drought, flood and algae invasion. The Loiret system is directly linked to the Loire River (Binet et al., 2017). The CENARI-O project, funded by the Center & Val de Loire Region, aimed at better understanding the surface water – groundwater relations for a better management of this fluvio-karstic system. Various tools were implemented, chemical and isotope ones being presented in this paper.

2. METHODS

Two main sampling campaigns were implemented at similar hydrological conditions, in September 2020 and 2021 including the Loire River, the Loiret River at 9 sites, the three main local and regional aquifers, five of the main springs feeding the Loiret River. The springs are sometimes flowing below Loiret River level and a mixing between surface water and groundwater is possible during sampling procedures. At the same time in situ measurements (conductivity, temperature, pH, dissolved O_2) were taken from a boat along the 13kms of the Loiret River (Figure 1).

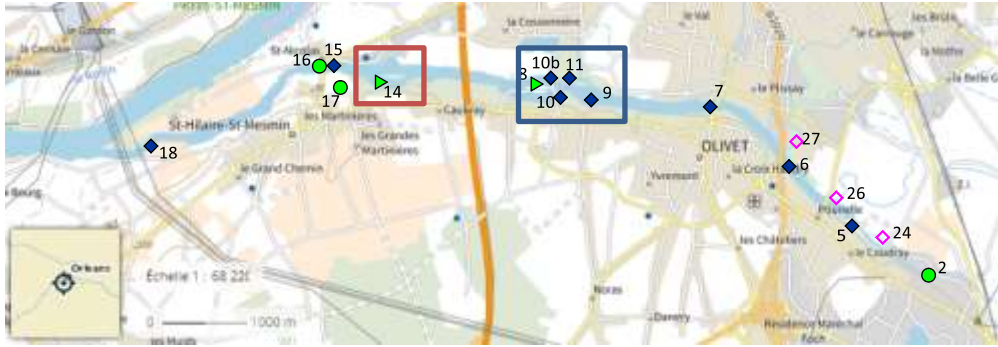


Figure 1. Water sample sites (tributaries in purple, red rectangle Tacreniers basin, blue rectangle La Mothe/StSamson Basins).

3. RESULTS

The basins located halfway (blue rectangle in fig.1) played an important role in water chemistry and stable isotopes both due to biotic and abiotic/physical processes (photosynthesis, evaporation). In the first part of the river, there is a clear decrease of the $\delta^{18}\text{O}/\delta^2\text{H}$ and $^{87}\text{Sr}/^{86}\text{Sr}$ while conductivity remained stable (Fig.2). This is attributed to an increasing contribution of surrounding groundwater through various springs. The Bouillon spring, starting point of the Loiret presented a different signature, influenced by the Loire River. The surrounding aquifer has a more stable isotope signature with time than the Bouillon. The second part of the watercourse (after sampling point 12) is quite stable in both isotope tools. The decrease in conductivity may be due to biotic activities and calcium precipitation in the Tacreniers basin area (as for the first basins area).

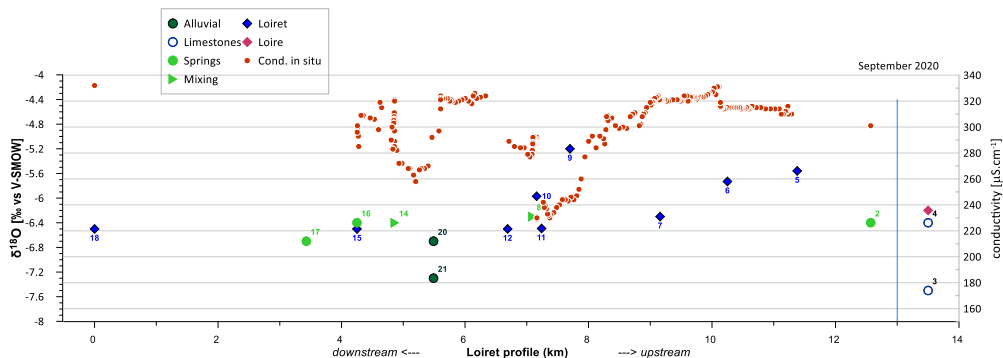


Figure 2. Evolution of $\delta^{18}\text{O}/\delta^2\text{H}$ and conductivity along the Loiret River (the vertical bar is the beginning of the Loiret River system, on the right the Loire and regional aquifers data).

4. CONCLUSIONS

The second sampling campaigns showed a quite different pattern as recent precipitation in the area influenced both chemistry and isotopes signal demonstrating, if necessary, that even using various tools (pumping tests, chemistry, isotopes, artificial tracers, temperature,...) the Loiret system has a complex hydro(geo)logical functioning.

REFERENCES

- [1] BINET, S., JOIGNEAUX, E., PAUWELS, H., et al. "Water exchange, mixing and transient storage between a saturated karstic conduit and the surrounding aquifer: groundwater flow modeling and inputs from stable water isotopes", *Journal of Hydrology* **544** (2017) 278.