Advances in field noble gas measurements towards operational hydrology

ELIOT CHATTON[1], THIERRY LABASQUE[1], AURÉLIE GUILLOU[1] AND LUC AQUILINA[1]

[1] Géosciences Rennes, University of Rennes, 263 avenue du général Leclerc, France. Email: eliot.chatton@gmail.com

In natural waters, noble gas concentrations are governed by a diversity of relatively simple and well-studied physical processes. As a result, noble gas measurements provide important information on various phenomena such as groundwater residence time distribution (^{4}He, ^{21}Ne, ^{37}Ar, ^{39}Ar, ^{40}Ar, ^{85}Kr, ^{81}Kr), aquifer recharge conditions (temperature, elevation …) or aquifer-river exchange (^{222}Rn).

However, despite their interest, noble gas data remain relatively scarce and punctual owing to the complexity and costs of their production. In view of the spatial and temporal variety and variability of the Hydrosphere dynamics a new investigation method is needed.

This study approaches the concept of "operational hydrology" aiming to enhance both the spatio-temporal distribution and the quality of environmental data for a thorough exploration of the Hydrosphere.

In this perspective, we developed a new analytical tool based on membrane inlet mass spectrometry (MIMS) allowing the continuous measurement of dissolved gases (Chatton et al., 2017).

To illustrate our approach, we present atmospheric and radiogenic noble gas data (He, Ne, Ar, Kr, Xe) measured in situ with a CF-MIMS (Chatton et al, 2017) installed in a mobile laboratory arranged in an all-terrain truck (CRITEX-Lab). This ongoing work focuses on groundwater and the field investigation of residence time distribution, recharge processes, water flow paths and mixing.

Chatton, E., Labasque, T., de La Bernardie, J., Guihéneuf, N., Bour, O. and Aquilina, L.; Field Continuous Measurement of Dissolved Gases with a CF-MIMS: Applications to the Physics and Biogeochemistry of Groundwater Flow, Environ. Sci. Technol. 2017, 51, 846−854, DOI: 10.1021/acs.est.6b03706.