Transport and Speciation of Trace Metals in Karst Aquifer During a Flood Event

C. CHOLET [1,2], M. STEINMANN [1], S. DENIMAL [1], J.-B. CHARLIER [2], H. CELLE-JEANTON [1]

[1] UMR CNRS 6249 Chrono-environnement, University of Burgundy/Franche-Comté, 25030 Besançon Cedex, France (*correspondence: cybele.cholet@univ-fcomte.fr)

[2] BRGM, 1039 rue de Pinville, 34000 Montpellier, France

About one quarter of the global population is at least partly dependent on drinking water from karst aquifers (Ford and Williams, 2007). However, karst systems are a highly vulnerable water resource because of rapid water flow inside the aquifer through a network of large conduits embedded into a filtering matrix.

The present study is focused on the transport mechanisms of trace metals in karst systems. At present, in most studies only filtered samples are analyzed to characterize trace metal transport in karst aquifers, in spite of the fact that most metals are not soluble at the typically basic pH of karst water. Therefore, the aim of the present study was to assess the relevance of both fractions – solute and particulate matter – for the transport of trace metals into karst systems from the infiltration zone towards the spring.

The study site is a small karst spring used for drinking water supply in the Jura Mountains in eastern France. The recharge area (about 2 km^2) is a cultivated limestone plateau. The spring was sampled every 2 hours during a flood event, and the solute and particulate fractions were separated by filtration at 0.22 μm. Major and trace elements including the rare earth elements (REE) were analyzed on both fractions and combined with high resolution physico-chemical measurements in water from multi-parameter probes (discharge, electrical conductivity, temperature, dissolved organic carbon, turbidity). The data allowed to compare the dynamics of solute and particulate matter transfer, to characterize transport processes, and to distinguish the successive arrival of 2 types of particulate matter during the flood:

- type 1: sediment particles rich in trace metals such as Cd, Co, Cr, U, Zn, REE from inside the aquifer re-mobilized at the beginning of the discharge increase.
- type 2: soil particles (clay-humic aggregates, Fe-Mn oxyhydroxides) mobilized by infiltrating event rain water and arriving at the spring during peak flow. These particles were rich in organic matter and trace metals such as Al, Fe, Mn, As, Cu.

The origin of the contrasting trace metal contents of the particles and the relation with the dynamics of the solute fraction will be discussed in detail at the conference.