^{222}Rn as a natural tracer to investigate recharge and groundwater flow dynamics at three Mediterranean karst systems in Southern Spain

Fernández-Ortega, J.[1]; Rovira, J.J.[1]; de la Torre, B. [1]; Barberá, J.A.[1]; Mudarra, M.[1] and Andreo, B.[1]

jaimeortega@uma.es, juanjrm@uma.es, delatorrem@uma.es, jabarbera@uma.es, mudarra@uma.es, andreo@uma.es

[1]Department of Geology and Center of Hydrogeology of University of Malaga (CEHIUMA), Malaga, 29071, Spain.

Abstract

Comprehensive knowledge of groundwater origin and movement into karst aquifers is crucial to establish the adequate management practices. This is of special interest in areas strongly affected by the impact of climate change, such as the Mediterranean region. This work aims to better understand recharge processes determining groundwater flow in 3 mountainous carbonate aquifers in Southern Spain. To achieve this purpose, spring discharge and electrical conductivity data as well as ^{222}Rn activity were measured and interpreted in karst groundwater.

Karst groundwater discharge at the investigated springs varies between 3 and 1400 L/s, while electrical conductivity (EC) values range between 227 and 1929 µS/cm. ^{222}Rn activity data are found between 31-3630 Bq/m^3. The temporal evolution of EC, water temperature and ^{222}Rn showed relatively constant values during dry periods in all examined karst springs but abrupt decreases after intense recharge events. A detailed –daily- control during high waters in the Sierra de Ubrique revealed slight increases in ^{222}Rn activity at the beginning of the rising limb of spring discharge. However, circulation of recently infiltrated rainwater through karst conduits (in turbulent flow regimes) and the mixing with old waters provokes a marked dropping in the measured parameters at karst springs.

The combined -spatial and temporal- analysis of data from the three sites revealed that ^{222}Rn activity in groundwater is directly related to the characteristic mean residence time (and karstification degree) of each study area. Furthermore, the preliminary analysis indicates that the presence of some impervious lithologies, such as clays, might generate a higher contribution of ^{222}Rn activity in groundwater. Long residence times, groundwater–rock interaction or a combination of these processes are also responsible for the highest radon activity measured at in the karst springs. Moreover, the complexity of groundwater flow systems due to tectonical stetting of examined aquifers have direct implications in the transference of ^{222}Rn.