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Oxygen, hydrogen and strontium isotopes to define groundwater origin and chemical evolution in flysch

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The groundwater origin and chemical evolution in fractured flysch rocks is a difficult task due to the complex geometry of the joint network, the highly variable persistence of the joints and the geometry of the sandstone-pelite layers.
With this research we aimed to define the groundwater origin, flow path and evolution in a fractured volcanoclastic flysch slab of hundreds of meters in the Northern Apennines, laterally delimited by evaporite and clayey geological formations. Multi-temporal ions and water stable isotopes (d18O, dD), in addition to Tritium and 87Sr/86Sr ratios, were analyzed in superficial water and groundwater samples. d18O and dD results showed that the groundwater sampled along the joints was originated from local precipitation and torrents, and that no active superficial evaporation processes affected the water before infiltration into the bedrock. Ions content has highlighted two groundwater types in the fractured flysch: a shallow Ca-bicarbonate type (short travel path inside the joints) and a deep Na-bicarbonate type (long travel path inside the joints). The latter was also enriched in Cl-. Tritium content suggests that the Na-bicarbonate water evolved starting from the Ca-bicarbonate type. The 87Sr/86Sr ratios did not carry any evidence of groundwater derived from the evaporite formations and, as a consequence, no Na+ and Cl- derived from Halite dissolution.
This research has proven the effectiveness of the use of a water multi-isotope approach for the correct definition of particular groundwater processes in fractured and fissured rocks.