Logging for the structure of groundwater age with passive samplers

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Groundwater dating has retained great attention of hydrogeologists over the past fifty years, as it provides essential answers for determining recharge rates, complex flowpaths, or to infer about the dynamic portions of the groundwater resource with depth. But the determination of groundwater age distribution with multitracing and LPMs usually requires relatively high scientific and time investment and remains difficult to address. This usually hampers its use for industrial applications, although groundwater age distribution is always a highly valuable information for stakeholders about groundwater resource management.

The aim of this work is to establish the age structure of groundwater for municipal water supply wells. Its principle is to couple the groundwater inflows distribution in the wellbore with the sequential sampling of temporal tracers and hydrogechemistry with depth. Inflows distribution is obtained from microvelocimetry and high resolution temperature logging, and allowed adequate placement of passive samplers at depths. This procedure was tested to characterize the age structure and hydrogeochemical profile of a 100 m deep wellbore completed in a fractured aquifer in southern Quebec, Canada. The tracing involved CFCs and SF_6 for providing the distribution of modern water into the wellbore. Some ^{14}C samples were also analyzed to identify the presence of ancient water at greatest depth. The results obtained raise the question of the representativity of the passive sampling to represent the regional flow in the fractured aquifer formation, because ambient flows in wellbore could intervene. Age structure nevertheleiss allowed a linkage with hydrogeochemical patterns driven by water-rock interactions. It also provided pertinent data regarding the estimation of groundwater vulnerability by determining the proportion of the resource potentially affected by anthropogenic contamination related to the beginning of the industrial era.