Preface to volume IV

The interpretation of isotope hydrological data is not straightforward. Many field studies lead to a conclusion that the origin of groundwater and the chemical and isotopic processes in groundwater systems can only be studied successfully, if a composition of isotopic, chemical, geological and hydrogeological data is available for interpretation.

Following the previous volumes on isotopic principles, precipitation and surface waters, this volume is dealing with the application of isotope hydrological methods in groundwater studies. It conveys basic knowledge in geohydraulics and hydrogeology required for a consistent interpretation of isotope hydrological data.

This volume starts with a brief discussion of the characteristics and behaviour of groundwater as a medium of mass transport for gases, dissolved constituents and colloids. The geohydraulic aspects of groundwater flow under steady-state conditions are described in combination with an explanation of the most important terms related to isotope hydrology (e.g. transit time, turn-over time, mean residence time, water age). Non-steady state flow conditions caused by palaeoclimatic variations and anthropogenic activities such as overexploitation or groundwater mining seriously affect the interpretation of isotope hydrological data. Also water-rock interactions may modify the isotope composition of a carbonate rock environment, especially in high-temperature systems.

Environmental isotope techniques are pre-eminently suitable for studying the unsaturated and saturated zone, the latter particularly concerning the stable and radioactive natural isotopes. Stable isotope data preferentially yield information on the origin of groundwater. Radioactive isotopes allow groundwater to be "dated" in support of geohydraulic investigations. In undisturbed high-temperature systems isotopic geothermometry, i.e. the study of the temperature effect of stable isotopic abundances, is applied for gaining information on water mixing as well as the origin and history of fluids. Anthropogenic changes due to steam loss, underground liquid-vapour separation and the impact of re-injection of waste water are also traced by the isotopic composition of geothermal fluids. Last but not least, a brief outline is given on the planning and performance of environmental multi-isotope studies, as well as the interpretation of the corresponding results.

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