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The stable isotope composition along the river Rhine as characterized by its individual catchment areas

W. Stichler (1), P. Trimborn (1) U. Schotterer (2), M. Leuenberger (2) R. Kozel (3), and M. Schürch (3)

(1) GSF - Research Center of Environment and Health, Institute of Hydrology, Neuherberg, Germany, (2) Division of Climate and Environmental Physics and Departement of Chemistry, University of Bern, Switzerland, (3) Federal Office for Water and Geology, Hydrogeology Section, Bern, Switzerland

River water originates from many sources with different isotopic composition. Depending on precipitation distribution, infiltration characteristics, residence time or altitude, the contributing water components are traced differently by the tritium, deuterium, and oxygen-18.

The catchment area of the Rhine system covers 159 800 km3, the mean yearly discharge is 2470*106 m3. The observation of the isotopes of the water molecule (2H, 3H, 18O) within this river system is one of the tasks of the Swiss (NISOT) and German isotope networks.

The Rhine water follows in general a seasonal cycle influenced by snowmelt with isotope minima in late spring. The long term climate signal in precipitation can be measured with a certain delay in the river water. The water components from higher catchments are still dominant in river Rhine also at lowlands. This significant alpine signal of river Rhine allows separating the influence of local tributaries.

The examples of Rhine river system demonstrate the use of isotopes as a diagnostic tool for a better understanding of basic processes within river basins. The fact that the isotopes of the water molecule trace pathways of different water sources and changes in the composition of ground water and river run-off opens new possibilities for dynamic changes in water resources if hydrological models are developed through the combined use of hydrodynamic parameters, geochemical tracers and water isotopes.