The use of isotopes for karst water research in the northern Calcareous Alps

Pfleiderer, S., Reitner, H., Heinrich, M. & Rank, D.
Geological Survey of Austria, Vienna, Austria & University of Vienna, Austria

The 18O content of precipitation (e.g. ANIP data from Breitenau station, 30km west of the study area) serves as input signal for the groundwater system. Wet summer months are generally characterized by low d18O values whereas rain fall during dry winter months is more depleted in 18O.

Compared to the local meteoric water line for the Breitenau station, the d18O- and d2H-values of all groundwater samples show offsets which can easily be explained by meteoric effects. Many springs display annual variations with a 3-4 months delay compared to rain fall. However, some springs exhibit constant isotopic composition.

Several karst research projects have studied the isotopic composition of groundwater in the northern Calcareous Alps at the border between Upper and Lower Austria. Since 1995, dolostone and limestone aquifers have been intensively sampled and altogether 968 isotope analyses (523 δ18O-values, 39 δ2H-values and 40 δ3H-values) have been interpreted with respect to the location and size of recharge areas as well as groundwater age and aquifer dynamics. Sample locations shown on the map are color coded with respect to the mean altitude of the recharge area.

Groundwater dating with Tritium

Tritium values range from 9 to 17 TU signifying base flow ages of up to 15 years.

Seasonal and short-term variations of 18O-content indicate that base flow is superimposed by flow components with short residence times (hours / days).

The δ18O-content of spring waters is used to derive the mean altitude of recharge areas. A decrease of 0.33 ‰ 18O per 100 m altitude is typical for the study area.

The correlation of deuterium excess and altitude is not sharply defined. Only a vague trend can be observed and outliers exist.

Seasonal variation of a spring in dolomitic karst

Reithbach spring base discharge: 3x10^6 m^3/a
precipitation: 1800 mm/a

Combining rain fall, base discharge, groundwater recharge and mean altitude, the recharge area can be pinned down in a geographic information system (GIS).