

FIRST WATER – ISOTOPE – MAP ($\delta^{18}\text{O}$, $\delta^2\text{H}$, 3H) OF AUSTRIA: APPLICATIONS, EXTREMES AND TRENDS

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The isotopic ratios of oxygen and hydrogen in water ($^2\text{H}/^1\text{H}$ and $^{18}\text{O}/^{16}\text{O}$) are important tools to characterise waters cycles. Tritium formed by natural cosmic radiation in the upper atmosphere and in the last century by tests of thermonuclear bombs, is an ideal age-marker during the last 60 years.

To determine the origin and mean age of waters in many scientific projects and in those concerning water supply and engineering in the last 45 years on more than 1,350 sites more than 40,000 isotope measurements were performed in Austria.

The median value of oxygen-18 of all sites is $\delta^{18}\text{O}$ -10.7 ‰ and for hydrogen-2 $\delta^2\text{H}$ -75 ‰. As the fractionation is mainly temperature dependent the lowest negative values are observed in winter precipitation (oxygen-18 as low as $\delta^{18}\text{O}$ -23 ‰) and in springs in the mountain regions ($\delta^{18}\text{O}$ -15.1 ‰). In contrast the highest values were observed in summer precipitation (up to $\delta^{18}\text{O}$ - 0.5 ‰) and in shallow lakes in the Seewinkel close to the Hungarian border (up to $\delta^{18}\text{O}$ + 5 ‰).

The median of all deuterium-excess values is d-excess = 9.4 ‰. The lowest negative value of -7.4 ‰ was measured in the surface water sample of a gravel pit in the Leibnitzer Feld (Southern Styria). The highest d-excess value of 15.7 ‰ is documented from a mountain spring at the southern border of Austria.

The median value of all 1,120 sampling sites of decay corrected (2015) tritium measurements is 6.2 tritium units (TU). This is somewhat smaller than the median value of all precipitation stations with 7.2 TU. The tritium concentration increases in the summer up to 10 – 11 TU and decreases in winter down to 3 – 4 TU. A mean tritium concentration in aquifers smaller than approximately 3.5 TU indicates that a large amount of this water is older than 60 years. Waters with approximately more than 12 TU contains still tritium from the 1960s and 1970s originating from thermonuclear bomb experiments in the atmosphere. In Austria the highest tritium values can be observed in the rivers Danube and March which show periodic or permanent tritium contamination up to 70 TU coming from nuclear power plants in the neighbouring countries.