Schweitenkirchen, April 2013

Tritium (^3H)

Tritium (^3H) is a natural isotope of hydrogen. As a part of the water molecule H_2O it takes part in the water cycle. Tritium is a radioactive isotope with a half-life of 12.43 years. Tritium concentrations are measured in TU (tritium units). One TU in water corresponds to 1 ^3H-atom on 10^{18} hydrogen atoms or about 0.119 Bq/L.

Tritium is constantly produced by the influence of cosmic radiation on nitrogen atoms in the upper atmosphere. That way, the ^3H-amount in precipitation is 4 -10 TU approximately. The natural total amount of tritium in the atmosphere is estimated at 3.6 kg.

Today, the majority of available tritium has been caused anthropogenically. Particularly within the 1950s, tritium entered the atmosphere by nuclear bomb testing. The release during that time is estimated to sum up to 60 kg. 75% were released on the Northern Hemisphere and let the tritium concentration in precipitation rose to about 6000 TU.

Since nuclear bomb testing in the atmosphere has been stopped, the tritium content sinks steadily. This is primarily explained by the radioactive disintegration and the short half-life besides the dilution effects.

The release of this „bomb-tritium“ to the atmosphere leads to an increase of tritium concentrations in groundwater. There, in the simplest way, the tritium reduces only by radioactive disintegration. Hence, for young groundwater, the time of groundwater recharge can be determined through determination of its tritium content. The young water component can be determined by using an additional tracer (e. g. SF6 or krypton-85) in mixed water with an old and young groundwater component. Furthermore, using the tritium content, statements about the natural shield of groundwater can be made.

Nowadays, tritium is particularly used by the nuclear industry, which provides sewages and exhaust fumes into the environment. Furthermore, tritium is used in fluorescent colours and gaseous light sources. The disposal of products containing ^3H on waste dumps leads evidently to pollution of the seepage water and therefore can be named as a reason for radioactivity in groundwater near such locations.

Since the concentrations of tritium are usually very little in water, no direct measurements of absolute concentrations or isotopic ratios can be carried out. The ^3H content is therefore determined by measuring its radioactivity. Hydroisotop GmbH measures tritium accredited after an electrolytic enrichment using liquid scintillation spectrometry.