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Could the Tritium Precipitation Record be found in Aquifers?

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The Helium Isotope Lab Bremen analysed some hundreds of groundwater samples for ^{3}H (tritium) and ^{3}He, ^{4}He and Ne in order to provide ^{3}H-^{3}He ages. A subset of about 400 samples from shallow wells with short filter screen ($\leq$2m) in sandy aquifers in northern Europe were selected.

From ^{3}H-^{3}He ages the infiltration periods were calculated. For the identified infiltration periods the sum of ^{3}H plus ^{3}He could be compared with the tritium concentration in precipitation at that period. For times after 1975 the concentration of ^{3}H plus ^{3}He in groundwater follows the tritium precipitation record. But for the period of 1960 to 1975 the high tritium concentration in precipitation could not be detected in the aquifers, neither the ^{3}H signal nor the ^{3}He signal. Any supposed magnitude of dispersion for the aquifers does not account for this. It is implausible that water from the 1960 - 1970 period did not enter the aquifers.

Continental pre-bomb tritium records are rare, but state a natural tritium concentration in rain of about 5 TU for the continental northern hemisphere. Hence old groundwater should contain ^{3}He of the equivalent of about 5 TU from natural tritium. Our field studies with old groundwater (^{3}H < 0.2 TU) did not display accumulated ^{3}He from tritium decay in the order of 5 TU (depending on assumed infiltration conditions).

In both cases expected ^{3}He was missing in the water bodies. Explanations about this feature are rare and remain very speculative.

Is there any way for the ^{3}He from tritium decay to escape from the water body?

Is there an effective unsaturated zone of extended thickness affecting the gases differently?

It should be pointed out that in a study of bank filtration the tritium peak from river water of the early 60ies was found, hence ^{3}He was not missing.

This contribution may raise a discussion on the general time evolution of noble gases in aquifers.