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Helium-isotope data of 380 mainly shallow and deep groundwater in and around the Easter Alps (Austria, Europe)

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The enrichment of radiogenic helium (^{4}He) derived from the decay of U and Th in deep groundwater has been used to calculate groundwater residence time. ^{4}He has potential to date water over timescales of thousands to millions of years. However, external ^{4}He sources to aquifers (basal fluxes entering the bottom of aquifers) and difficulties with the quantification of He release rates from host rock to water have hampered its use. Thus, the ^{4}He method requires 'calibration' using other radionuclides. Until recently, ^{4}He ages were calibrated using ^{14}C ages, but the shorter half-life of ^{14}C often leads to inaccurate age estimates in groundwater older than ~35,000 yrs.

Tritium/helium-3 and tracer gases (CFC, SF_6) investigations were performed in several areas of the Eastern European Alps to estimate the generally young (0 - 40 yrs) groundwater ages in shallow Alpine aquifers. Helium-4 and ^{3}He/^{4}He-ratio measurements as a by-product indicated the admixture of old water in some shallow and very old groundwater in deep (>100 m) wells.

Parallel to the more than 380 helium isotope measurements only very few ^{14}C- and ^{81}Kr-measurements exist. Not enough to 'calibrate' ^{4}He-measurements. The existent of elevated ^{4}He-concentrations in aquifers with background U and Th-content are good indicators of the admixture of old groundwater. The ^{4}He concentrations range from air-equilibrium up to 1.6E-03 (cm^3 STP /kg). The ^{3}He/^{4}He- ratio decreases down to 8.0E-08. Correlations of the ^{4}He-data with well depth and major tectonic fault zones were studied. Clear indications of the admixture of mantle helium were discovered at the end of Eastern Alps toward the western border of the Pannonian Basin.