Anthropogenic gaseous tracers (SF_6, CFC-12, SF_5CF_3, H-1301) as age indicators of young groundwaters

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The bomb-tritium has been used for several decades now as a tracer of choice to detect recent recharge and to quantify groundwater residence times on time scales extending from several years to several decades. Nowadays, atmospheric concentrations of tritium in precipitation are approaching natural levels in most parts of the world and there is a growing interest in alternative indicators of groundwater age in shallow aquifers.

We present a dedicated GC-based analytical system to determine the concentrations of four anthropogenic gaseous tracers (SF_6, SF_5CF_3, CFC-12, HC-1301) in air and water, with the precision and accuracy sufficiently low do employ them for groundwater dating. The system is also capable to measure concentrations of Ne and Ar in the same water sample. This allows corrections for excess air to be made and calculations of recharge temperatures. Field sampling system is based on a dynamic head-space method. Approximately 100 liters of water has to be pumped through the system before the dynamic equilibrium is reached in the head-space volume.

The system was thoroughly tested in the field and employed for groundwater dating in two aquifer systems in Poland. The results were compared with the tritium data available for the sampled wells. The applied gaseous anthropogenic tracers yield consistent age ranges for groundwater in the studied aquifer systems, comparable with the ages derived from tritium data.