



## **Combined application of 85-Kr, 39-Ar with CFCs in contaminated aquifers**

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CFCs (11, 12, 113) and SF<sub>6</sub> have been used for age dating of recent groundwater (<50 years). It is known that in reducing environments degradation of CFCs occurs. The application of CFCs and SF<sub>6</sub> as age indicators in highly industrialized areas of South-Western Germany has shown that in combination with hydro-chemically robust trace gases (SF<sub>6</sub>) and additional age dating methods (85-Kr, 39-Ar, 3H in-growth method) CFCs and CFC ratios can also be helpful in characterizing the contamination sources and hydro-chemical aquifer conditions. CFC ratios may reveal different sources of contaminations and help characterizing their source type directly. The change of concentrations and of ratios compared to benchmark tracers of mean residence time also provide information on relative CFC reduction. Multi-tracer studies from the Upper Rhein Graben demonstrate the combination of CFC/SF<sub>6</sub> analysis with additional residence time indicators, stable isotope and hydrochemical data. While source areas and different flow components can be derived from stable isotopes and hydrochemical data, trace-element chemistry was used to define and characterize redox conditions. Residence time determination with hydrochemically inert tracers (39-Ar, 85-Kr, 3H) provided information on mean residence times that could be used as a scale for CFC reduction. In combination the multi-tracer study helped to derive a semi-quantitative flow model based on environmental tracers.