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Online analysis of chlorine stable isotopes in chlorinated ethylenes: an inter-laboratory study

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In the last decade, compound-specific stable isotopes analysis of groundwater pollutants became an important tool to identify different sources of the same pollutant and for tracking natural attenuating processes in the sub-surface. It has been shown that trends in the isotopic composition of the target compounds can shed light on in-situ processes that are otherwise difficult to track. Analytical methods of carbon, nitrogen and hydrogen were established and are by now frequently used for a variety of organic pollutants. Yet, the motivation of introducing analytical methods for new isotopes is emerging. This motivation is further enhanced, as advantages of using two or more stable isotopes for gaining better insight on degradation pathways are well accepted. One important element which demands the development of appropriate analytical methods is chlorine, which is found in various groups of organic pollutants, among them the chlorinated ethylenes. Chlorinated ethylenes are considered as high priority environmental pollutants, and the development of suitable chlorine isotope methods for this group of pollutants is highly desired. Ideally, stable isotope techniques should have the capability to determine the isotopic composition of and individual target compound in a non-pure mixture, without the requirement of a laborious off-line treatment. Indeed, in the last years two different concepts for on-line chlorine isotope analysis methods were introduced, by using either a standard quadrapole GC/MS (Sakaguchi-Söder et al., 2007) or by using a GC/IRMS (Shouakar-Stash et al., 2006). We present a comparison of the performances of two concepts, carried out in five different laboratories: Waterloo (GC/IRMS), Neuchâtel (GC/MS), Darmstadt (GC/MS), Tübingen (GC/MS) and Munich (GC/IRMS). This comparison was performed on pure trichloroethylene and dichloroethylene products of different manufactures, as well as trichloroethylene and dichloroethylene samples that were exposed to biodegradation. This study sets standards for further application of these techniques to distinguish sources and track degradation processes in the sub-surface.