Compound-specific chlorine isotope analysis of aliphatic hydrocarbons using gas chromatography hyphenated with multiple- collector inductively coupled plasma mass spectrometry

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Chlorinated hydrocarbons are priority pollutants in groundwater and soil as well as in the atmosphere where some of them contribute to ozone depletion and climate warming. Isotope analysis has become an indispensable technique to study transformation mechanisms and to delineate sources and sinks of these compounds. Chlorine isotope analysis of organic compounds has considerably developed within the last decade due to increased interest in multi-dimensional isotope analysis. Existing methods, however, still suffer from large sample needs (thermal ionisation mass spectrometry), mediocre precision (gas chromatography quadrupol mass spectrometry) or limitation to a few compounds only (gas source isotope ratio mass spectrometry). Here we present a method for chlorine isotope analysis of aliphatic hydrocarbons that overcomes the limitations of previous techniques combining universality, low detection limits and excellent precision. Using multiple collector inductively coupled plasma mass spectrometry (MC-ICP-MS) for chlorine isotopes has been considered challenging due to isobaric interference of the $^{36}ArH^{+}$ dimer with ^{37}Cl. We demonstrate that this interference is negligible if certain conditions are met. Consequently, isotopic detection limits of 2-4 nmol Cl are achieved for chloromethane, trichloroethene and tetrachloroethene. The precision (σ) at detection limit is 0.1‰. Measured $\delta^{37}Cl$ of several organic standards consistently agree with previously published offline characterized values of these standards if a two-point calibration is applied. This universal method considerably simplifies $\delta^{37}Cl$ determination of mixtures of halogenated organic compounds and may be easily adapted to other GC-MC-ICP-MS systems.