Analysis of stable chlorine isotope composition with high accuracy

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Chlorine is the second element of the halogen group and has two stable isotopes ^{35}Cl and ^{37}Cl. The ^{35}Cl isotope has an abundance of 75.76% while the ^{37}Cl consist of the remaining 24.24%. The halogen elements are relatively rare in the Earth, the most common being chlorine with a concentration of 10.5 ppm for Earth. The halogen elements are however among the most volatile ones and they are they have a low compatibility with most of rock types. Especially chlorine is volatile and prefer to concentrate in fluid phases meaning that it is concentrated in the oceans as well as in evaporates.

The most common method used in the chlorine isotope ratio analysis employs the conversion of a chlorine sample to chloromethane (CH_3Cl) prior to the mass spectrometric analysis. For CH_3Cl preparation the exchange reaction between the iodomethane (CH_3I) and silver chloride (AgCl) is applied. We followed the procedure described by Eggenkamp (2004) with some modifications: (1) the aliquot of iodomethane is added to the preparation line by using the pipete connected to a container with pure liquid CH_3I, thereby the injection of iodomethene through a septum is eliminated; (2) the conversion of AgCl to CH_3Cl is performed in glass ampoules with Teflon stopcocks sealed with elastomer O-rings, thereby cracking tubes are eliminated; and (3) the obtained chloromethane is cryogenically separated from iodomethane using three traps (one with butyl acetate and two with trimethylpentane) connected in series.

The obtained chloromethane is then analyzed by the isotope ratio mass spectrometry (IRMS). For this purpose we have used a negative ion mass spectrometer which retains all the best features of IRMS, including dual inlet system with changeover valve, dual collector assembly and CH3Cl gas as analyte. In the modified ion source we have replaced the ionization chamber with electron beam by a metal tube with a hot metal filament inside. Within this tube the $^{35}Cl^-$ and $^{37}Cl^-$ ions are generated. No other ionic species were found in the mass spectrum except of traces of CN^- and CO^-. The method's precision is better than 0.01‰ (Pelc *et al*., 2008; Hałas and Pelc, 2009).

REFERENCES

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