1.3.P01

In-situ sulfur isotope ratio measurements by laser ablation high resolution MC-ICP-MS

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Sulfur isotope ratios are important geochemical tracers and vary significantly in nature ($\delta^{34}S$ more than 90‰). As a new analytical tool, the high-resolution ability of a multi-collector ICP-MS (Neptune, Finnigan™) together with a laser ablation system (LUV213nm, NewWave™) has been tested for sulfur isotopes measurements on magmatic sulfides. ^{32}S and ^{34}S suffer mainly from polyatomic oxygen species interferences generated by the ICP source. These main spectral interferences can be resolved easily by applying a mass resolution of $m/\Delta m = 4000$ although they are greatly reduced by using a "dry" sample introduction system such as laser ablation [1]. The ^{35}Cl-^{37}Cl isotopes were tested as an internal standard but the main $^{36}Ar^{1}H$ interferences could not be fully resolved. A straightforward sample-standard bracketing technique relative to a large pyrite crystal of known sulfur isotopic composition has been used instead. A variety of sulfide minerals (pentlandite, pyrite, pyrrhotite and chalcopyrite) of known isotopic composition were analysed in order to test the potential matrix effects related to the laser ablation system. The sulfides were ablated using 200 by 60 µm lines, a repetition rate of 10 Hz and an energy of 0.15-0.2 mJ. The data were acquired for 3min, after a baseline and blank measurement for the ^{34}S, ^{33}S and ^{32}S isotopic species. Average internal precision is about 0.2‰ (2σ) based on repeated measurements of the pyrite standard. External reproducibility based on the repeated measurements of the four main sulfide minerals is 0.26‰ (2σ).

This technique has been used to measure the isotopic composition of magmatic sulfides associated with NiS mineralisation from Kambalda (Western Australia) and Alexo (Canada) on 1mm thick sections. These isotopic compositions are within 1‰ variation and similar to those from sulfides in sedimentary units, as shown in previous studies [2].

A hydrothermal sulfide mineralisation has also been studied and reveals a complex zonation. This in-situ and fine scale study casts some interesting new light on the dynamics of this particular mineralisation process.

References

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1.3.P02

Sr isotope analysis by Multiple Ion Counting - ICPMS (MIC-ICPMS)

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Strontium isotopes have been used for several decades to study geological processes ranging from planet evolution to paleoclimate changes. New research directions in the earth sciences require smaller and smaller sample sizes and also in-situ analyses by Laser Ablation.

MC-ICPMS (whether or not in combination with Laser Ablation) analyses of Sr isotopes have been hampered by the low Sr contents in most minerals of interest and isobaric interferences of Krypton and Rubidium.

Because of the low Sr content of many samples, the noise level of the Faraday detectors is a major limitation. Moreover, for high precision in-situ analysis by Laser Ablation, multi collection is absolutely necessary, since the laser produces transient signals. At Thermo Electron in Bremen, miniaturized ion counters have been developed that overcome the noise limitation of conventional Faraday detectors. These ion counters are identical in size and interchangeable with the Faraday detectors of the multicollector array of the Finnigan NEPTUNE.

This study reports the first Sr isotope data obtained by multiple ion counting on a Finnigan NEPTUNE. A dynamic measurement procedure has been used to cross calibrate the ion counters and correct for mass bias. In this way, we were able to analyse $^{87}Sr/^{86}Sr$ ratios with a precision of ~1‰ on a routine basis in wet plasma conditions. Typical sensitivity of ^{88}Sr is better than 100,000 cps per 100 ppt Sr (NIST SRM-987). The analytical difficulties are mainly related to interferences from Kr and Rb. Kr interferences are in the range of ~3,000 cps ^{83}Kr and strongly dependent on the flow rate and purity of the Ar sample gas. Interferences from Rb are obviously strongly related to the Rb content of the samples, but in the NIST SRM-987 solution <1,000 cps ^{85}Rb.

Possible applications of Sr isotope analyses using multiple ion counting ICPMS in combination with Laser Ablation include the investigation of the Sr isotope variations in fish bones to trace biological and paleoclimate changes and the examination of Sr isotope compositions in clinopyroxene and plagioclase minerals to study magmatic processes.