Evaluation of coupling LA-ICP-MS/MS and collision/reaction cell technique for in-situ zircon analysis

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Determination of U-Th-Pb age and concentration of rare earth elements (REEs) in zircon using laser ablation inductively coupled plasma mass spectrometry (LA-ICP-MS) is versatile tool for geological and geochemical research. However, in dating, the isobaric interference on ^{204}Pb from ^{204}Hg which is derived from the impurity of the argon gas for ICP ion source has been an unsolvable problem and, in quantification of REEs, the polyatomic interference is also a problem for accurate measurement. In this presentation, we would like to demonstrate the effectiveness of coupling tandem quadrupole mass spectrometer (MS/MS) and collision/reaction cell (CRC) for in-situ U-Th-Pb dating and quantitative analysis of REEs of zircons using laser ablation sample introduction technique.

The reduction of isobaric interference from Hg was tested by flowing a small amount of ammonia gas in the CRC. In this case, while the polyatomic ions made by reaction between REEs in zircon and ammonia gas could be overlapped on mass peak of Pb isotopes, the first mass spectrometer (Q1) can effectively remove the REEs and the ammonia gas collides with only isotopes of Hg, Pb, Th and U. In this operational settings, the accurate age from several standard zircons was obtained and the removal of 99% of the Hg-interference was achieved at the same time.

In the quantitative analysis, we used mass shift method by flowing the oxygen gas in the CRC. In mass shift method, it is possible for operational settings to be tuned to maximize the sensitivity while removing the mass interference from polyatomic and multi-charged ions [1]. We carried out the quantification of REEs in standard zircon sample using mass shift method at the condition of the high sensitivity (10 times higher than normal condition) and extremely high oxide formation rate (>100%), and the resulting concentrations of REEs show good agreement with reported values.

In conclusion, the coupling ICP-MS/MS and CRC technique can be not only a great solution for the interference-related problems, but also brings out the potential capability of high sensitivity of LA-ICP-MS.

References

[1] Balcaen et al. (2015) Analytica Chimica Acta, 894, 7-19