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In situ determination of Ge isotopic ratio using laser-ablation MR-MC-ICP-MS

SONG WANG

National Institute of Metrology

Presenting Author: wangsong@nim.ac.cn

Gemanium is an attractive element for geoscientist due to its unique siderophile, lithophile, chalcophile and organophile properties in different geologic environments. The development of MC-ICP-MS makes it possible to determine Ge isotope with high presision, revealing that Ge isotopes have great potential to trace temperature-based geochemical processes, biological uptake, equilibrium/kinetic isotopic effects between fluid and minerals, etc. Laser ablation is a powerful sample introdution technique that avoids complex chemical digestion and purification process. However, serious matrix effect and low sensitivity retrict its application for the direct, *in situ*, analysis of mass dependant stable Ge isotope variations.

Herein, we report the *in situ* Ge isotope analysis method for the first time using LA-MC-ICP-MS. As shown in figures below, serious matrix effects caused by isobaric, oxide, and double-charge interferences were observed. Fortunately, a narrow, flat platform could be identified under medium resolution mode. The interferences could be eliminated through carrying out signal acquisition on this platform. The addition of N_2 and trace water vapor were also proved to be effective approches to improve sensitivity, the optimal flow rates were 3 ml/min and 70 ml/min respectively. $^{69}Ga/^{71}Ga$=1.50676 was used for signal normalization, and ^{70}Zn interference was subtracted from ^{68}Zn using $^{70}Zn/^{68}Zn$ =0.03306. Ge isotopic compositions in NIST 610, USGS GSE, MACS-3, and a hematite sample were measured using the established method with good presision (~tens ppm, 2SD).

Subsequentially, wet chemistry double spike method will be performed to futher confirm our results and develop reference material for Ge isotope microanalysis.

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