High precision Pb isotopic analysis of sulfides by femtosecond laser-ablation MC-ICP-MS

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An in-situ microanalysis of Pb isotopic compositions in sulfide minerals is carried out by using femtosecond laser-ablation multi-collector inductively coupled plasma mass spectrometry (fsLA-MC-ICP-MS). Both high-temperature-activated carbon and gold coated multi-stage filter were used to filter Hg contained in the carrier gas and laser ablated aerosal, which reduced the Hg background signal by 98% and also lowered the detection limit of the analysis. Fractionation and mass discrimination effects existing in the ICP-MS analytical processes were corrected using an internal reference Tl in conjunction with an external reference NIST SRM 610. The proposed method was used to analyze the Pb isotopic compositions of chalcopyrite, pyrite, and sphalerite from the Dulong Sn-Zn-In polymetallic ore district. The in-situ analysis of Pb isotopic composition agreed well with the results obtained by conventional chemical methods within 2s measurement uncertainties, indicating that the data obtained by fsLA-MC-ICP-MS are reliable. The results showed that in this ore district, the sulfide minerals and different grains of the same sulfide mineral show a large variation in Pb content up to 1000-fold. The studied pyrites show relatively higher Pb contents and homogeneous Pb isotopic compositions, whereas the sphalerites have low Pb contents but most variable Pb isotopic compositions. It is suggested that the large variation of Pb isotopic composition may reflect a late hydrothermal superimposition on the primary sulfide formation.