SIMULTANEOUS PB-ISOTOPE AND TRACE-ELEMENT CHARACTERIZATION OF GALENA BY QUADRUPOLE-BASED LA-ICP-MS

Highlights

- Pb-isotope measured by LA-quadropole-ICP-MS in galena
- Matrix-matched calibration using Broken Hill, NSW galena
- Precision better than 0.1% achieved with 60 μm craters and n=20 spots per sample
- Accuracy demonstrated relative to conventional TIMS data
- Long-term reproducibility demonstrated
- Extended range of elements enabled by fast-switched Q-filer
- Recommission-standard Pb isotopes in 20 minutes

Materials studied

1. Tynagh, Galway, Ireland
2. Telluride, Colorado
3. Bathurst, New Brunswick
4. Keno Hill, Yukon
5. Bathurst, New Brunswick
7. Walton and Jubilee, Nova Scotia
8. Mackenzie Gulch skarn, New Brunswick

LA-ICP-MS conditions

- Laser: Agilent 7700x
- Ion Source: PlasmaSize 1
- Monitor: ICP-MS (7700x)
- Collision Cell: NO
- Analysed elements: Ag, Tl, Pb, Bi
- Matrix-matched calibration using Broken Hill, NSW galena
- Accuracy demonstrated relative to conventional TIMS data
- Long-term reproducibility demonstrated
- Extended range of elements enabled by fast-switched Q-filer
- Reconnaissance-standard Pb isotopes in 20 minutes

LA-ICP-MS signals were typically 40-60 seconds at 2.5 Hz with 40 seconds of background collection. No pre-ablation was used, but the data were cropped offline to exclude the first two seconds of signal rise time.

Accuracy & Precision

A piece of galena from Broken Hill, NSW, was used as the primary reference standard with Pb isotope ratio values taken from Stacey et al. (1969; EPSL), Dixon et al. (1990; J. Geol. Soc 147, 121-132).

Concentrations of Ag, In, Sn, Sb, Te, TI and Bi were measured by LA-ICP-MS in-house using USGS MASS-1 for calibration and an internal standard of 86 Wt% Pb. Accuracy of the data was checked by replica analysis of USGS GSE1-G pass distributed throughout the ablation sequence.

A typical session comprised at least 20 ablations for each sample. Using single large grains or disseminated multi-grain populations, Laser and ICP-MS conditions were set to optimized conditions. At least 15 Broken Hill galena ablations were obtained and distributed throughout the run to correct for instrument drift and mass bias. Ablations were typically 40-60 seconds at 2.5 Hz with 40 seconds of background collection. No pre-ablation was used, but the data were cropped offline to exclude the first two seconds of signal rise time.

Data reduction

Data were reduced using a modified version of the VisualAge data reduction scheme (DRS) in IsoIsle V3.32. The DRS was modified to apply a drift correction (auto spline) to Pb isotope ratios based on the measured BH Galena standard.

Establish method for minerals with lower Pb concentrations
- Fully calibrate fluoride response
- Extend to other isotope systems such as TI
- Assess intergranular Pb isotopic heterogeneity relative to chemical variations

Future work

- Confirm Pb isotopic and trace element values in galena
- Establish matrix-matched Pb isotope calibration
- Conduct detailed trace element analysis
- Compare Pb isotope results with other techniques

Special thanks

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Matrix-matched calibration

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A mass bias correction was then applied based on the measured/true isotope ratios for BH Galena defined in the standard file.

Simultaneous characterization of trace elements in galena can provide additional criteria to augment the Pb-Pb tracer isotope system.

Reproducibility

Four analytical sessions between July and September 2016 yield demonstrably reproducible data.

Trace element variations

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