

Geochemical conditions and source fluid composition of Cu-Pb-Zn sulfide mineralization in the Lón District, Southeastern Iceland

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Hydrothermal Cu-Pb-Zn mineralization is rare in Iceland, which is a landward extension of the Mid-Atlantic Ridge. One exception is the Lón District of southeastern Iceland [1], where intrusive rhyolitic breccias host Cu-Pb-Zn sulfide minerals. We performed petrographic, electron-probe, fluid inclusion, stable isotope, and U/Pb zircon dating analyses on samples collected in Lón to constrain the conditions and timing of sulfide mineral formation. Our results show that although anatectic melting of altered basalt has produced millions of years of felsic magmatism in southeastern Iceland [2-4], only the youngest melts have had Cu-Pb-Zn in significant concentrations to expel hydrothermal fluids rich in metals.

Based on outcrop and hand sample observations, hydrothermal fluids precipitated chalcopyrite, sphalerite, galena, quartz, epidote, chlorite and carbonate minerals in rhyolitic breccia and adjacent basalt flows. The mean trapping temperature of liquid-dominated multi-phase fluid inclusions in quartz coeval with chalcopyrite is 332°C, a value corroborated by $\delta^{34}\text{S}$ geothermometry of galena (-1.4 to -0.6‰) and chalcopyrite (0.5 to 1.1‰). The calculated $\delta^{18}\text{O}$ and δD values of fluids in equilibrium with epidote coeval with chalcopyrite range from -5.2 to $-2.7 \pm 0.1\text{‰}$ and from -11.0 to $-2.6 \pm 0.1\text{‰}$, respectively. The calculated $\delta^{18}\text{O}$ values of fluids in equilibrium with quartz coeval with chalcopyrite are up to 5‰ greater than those of fluids in equilibrium with quartz precipitated after chalcopyrite. The U/Pb crystallization age of magmatic zircons in the rhyolite breccia is 2.63 ± 0.14 Ma, significantly younger than the proximal 3.7 [3] to 6.4 Ma [4] silicic intrusions of southeastern Iceland.

Collectively, fluid inclusion and stable isotope analyses indicate that early-stage aqueous fluids derived from a mixture of meteoric waters and of magmatic waters exsolved from an evolved anatectically produced melt and that late-stage fluids were meteoric.

- [1] Jankovic (1970a) *Some of the mineral occurrences in Iceland*, U.N. Technical Assistance. [2] Pope *et al.* (2013) *EPSL* **374**, 47-59. [3] Martin *et al.* (2011) *EPSL* **311**, 28-38. [4] Padilla *et al.* (2014) GSA Abstract 75-14.