

*ZINC ISOTOPE VARIATION IN HYDROTHERMAL SYSTEMS:
PRELIMINARY EVIDENCE FROM THE IRISH MIDLANDS ORE FIELD*

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Abstract

Little is known about the range or controls on the zinc isotope composition of terrestrial materials and no systematic studies have been carried out on ore-forming systems. We have obtained zinc isotope data from 19 sphalerite samples, formed over a range of well-constrained precipitation conditions, from the Irish Zn-Pb ore field. The results reveal variation in $\delta^{66}\text{Zn}$ (where $\delta^{66}\text{Zn} = [(^{66}\text{Zn}/^{64}\text{Zn})_{\text{sample}} / (^{66}\text{Zn}/^{64}\text{Zn})_{\text{standard}} - 1] \times 1000$), from -0.17 to 1.33 per mil relative to the Lyon JMC 3-0749L zinc standard. This variation is significant compared to the external reproducibility ($\pm 0.12\%$, 2σ), and the data show very good mass-dependency with $\delta^{67}\text{Zn}$ and $\delta^{68}\text{Zn}$ values. Thus, natural variations in the zinc isotope composition of these ore minerals can be resolved. Our results span the entire range of $\delta^{66}\text{Zn}$ values measured on terrestrial geologic samples to date. The data suggest that variations in the primary source rock composition or precipitation temperature are unlikely to be important controls on the zinc isotope composition of sphalerite in the ore field. We suggest that the variation is most likely due to a kinetic fractionation involving the preferential incorporation of light zinc isotopes in sphalerite precipitated rapidly under disequilibrium conditions. However, we cannot rule out the possibility of mixing of zinc derived from two isotopically distinct sources. The significant variation in zinc isotope compositions we have observed in the Irish ore field confirms that such fractionations can provide new insights into mineralizing processes in the Earth's crust.

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