Pyrite Re-Os geochronology: Lessons from the Irish orefield

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The Irish Zn-Pb orefield is one of the world's largest hydrothermal Zn-Pb ore districts, but uncertainty in the timing of mineralization made distinguishing between different potential genetic models for ore formation difficult. Three main proposals for the timing of mineralization have been suggested. The first model is that the deposits formed in the shallow subsurface shortly after or during deposition of the host rocks (~350Ma). The second is that these deposits formed after significant burial (<340Ma), and the third is that they formed during the Variscan orogeny (310-290 Ma). Distinguishing between these different possibilities is possible using pyrite Re-Os isochron methods. Hnatyshin et al. (2015) [1] determined robust Re-Os ages for the Lisheen Main Zone (346.6 ± 3.0 Ma, MSWD = 1.6) and the Silvermines B-zone (334 ± 6.1 Ma, MSWD = 19).

However, some pyrite samples fromt the Irish deposits produced isochrons that show a greater amount of complexity. In particular, the high quality results produced by the Lisheen Main Zone are not replicated using samples from the Lisheen Bog Zone. Whereas a very similar age is produced (345 ± 11 Ma) the scatter in the data is much higher (MSWD = 80). To determine the source of the scatter a variety of different techniques were used to characterize both sets of samples, including petrographic imaging, back-scattered electron imaging, trace element mapping, in-situ sulfur isotope measurements, as well as acid leaching experiments. The results show that the Bog Zone samples contain a much more complicated suite of intergrown sulphide minerals and contain multigenerational pyrite showing distinct textural and chemical differences, likely resulting in the excess scatter observed in the Re-Os data. Ultimately, these results suggest that screening out excessively complicated samples is required when trying to produce precise and accurate ages using pyrite Re-Os geochronology.

[1] Hnatyshin. *et al*. 2015, *Geology,* v. **43**, p. 143-146.