Pyrite Re-Os Geochronology: What are we actually measuring?

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Pyrite Re-Os geochronology can produce geologically reasonable ages with high precision for many types of ore deposits. However, it is still a bulk analysis method and imprecise results with high scatter are known to exist. In such cases, interpretation of the Re-Os age data is challenging.

LA-ICPMS methods can now quantify and spatially map Re distribution in pyrite down to the low ppb level. We use this ability to test the linkages between the spatial/mineralogical Re distribution of pyrite and the quality of age data from Re-Os isotopic analysis. In one example, a massive pyrite sample used to produce a precise, low-scatter isochron (346.6 ± 3.0 Ma, MSWD = 1.6) [1] shows a simple, semi-homogenous distribution of Re within pyrite. A second sample from the same deposit is associated with an imprecise, younger age with high scatter (322 ± 11 Ma, MSWD = 206). Here, ore stage pyrite and sphalerite have low Re abundances, whereas micron-scale molybdenite crystals and silicate-rich, fractured zones contribute a significant portion to the Re budget of the bulk sulphide analysis. As such, the imprecise, younger age does not reflect the timing of pyrite mineralization. A third dataset [2] from a single MVT ore sample produced pyrite Re-Os Model Ages that spanned more than 600 Myr. LA-ICPMS mapping reveals pyrite cores with very low abundances of Re and other trace elements, and paragenetically younger, fractured pyrite are highly enriched in Re. The two pyrite types have different magnetic response, allowing bulk separation of each zone for Re-Os analysis, which reveals events at both ca. 1100Ma and ca. 420 Ma for this deposit. This study emphasizes the importance of linking Re-Os age data to the mineralogical location and distribution of Re.

[1] Hnatyshin. *et al*. 2015, *Geology,* v. 43, p. 143-146.
[2] Hnatyshin. *et al*. 2016, *Ore Geology Reviews,* v. 79, p. 189-217.