Re-Os Geochronology of the Century Pb-Zn-Ag Deposit: Two Stage Genesis with Mantle Input Required

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A Re-Os isotope study of the shale-hosted Century Pb-Zn-Ag ore deposit in Queensland, Australia, has produced an isochron for seven Zn-rich samples and one sample of the immediate host rocks that yields an age of 1451 ± 44 Ma and an initial $^{187}Os/^{188}Os$ = 0.16 ± 0.17. The initial isotopic signature of the Century system implies that the Os in the ores and their immediate host rocks is essentially non-radiogenic and therefore mantle-like in its isotopic character. In addition, the ores have a much higher Os content (average = 0.14 ppb) than that of sediments distal to mineralization (~0.04 ppb).

The Re-Os isotopic character of the Century ores together with their high Os contents are not consistent with commonly accepted genetic models for sediment-hosted Pb-Zn-Ag deposits. The source of the metals in most sediment-hosted Pb-Zn-Ag deposits including Century has usually been attributed to the rocks in the sedimentary basins hosting the deposits [1]; the ore-forming metals are believed to have been scavenged by basinal brines which were propelled by either gravity or compressional forces. For the Century deposit, this model is supported by a Pb isotope study which demonstrated that the Pb has a strong crustal isotopic signature [2]; this Pb isotope study yielded a model Pb-Pb isotope age of 1573 ± 10 Ma and concluded that the mineralization is epigenetic in origin.

The difference in the Os and Pb isotopic ages is attributed to the Century ores being the product of a two-stage ore forming process in which the ore-forming metals were pre-concentrated at 1573 ± 10 Ma and then transported by basinal brines that were propelled by the energy from a mantle-derived magma emplaced at a high level in the crust at 1451 ± 44 Ma. Either this magma or the rocks it formed were the source of the non-radiogenic Os in the Century Pb-Zn-Ag ores. The results of this study imply that mantle input was required for the generation of the Century ores and may have been required for the genesis of other sediment-hosted Pb-Zn-Ag deposits.

References

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