Metal extraction from the lower crust and the genesis of the Irish Zn-Pb orefield.

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Shallow (<10 km depth) hydrothermal circulation within low metamorphic grade basement rocks has been proposed [1] as the main metal source for the giant Irish Carboniferous-hosted Zn-Pb orefield. However, several lines of evidence, e.g., from He [2], S [2,3] and Os [4] isotopes, and the possible role of volcanism in some deposits [5] point to deeper sources, including mantle and lower crustal involvement.

The lower crust beneath the orefield is accessible through granulite-facies xenoliths, brought from ~22-28km by Lr Carboniferous alkali basalts and diatremes [6,7], of similar age but likely younger than the mineralization.

In situ electron microprobe and ICPMS analyses and laser-ablation ICPMS mapping of the xenoliths reveal high Zn in biotite and garnet but order of magnitude depletions in their retrograde alteration products. Metal extraction is accompanied by sodic metasomatism (biotite replaced by albite) leaving Ti as possibly the only "immobile" element. Hydrothermal Zn depletion predates melt infiltration (from the host diatremes) and helps to constrain the timing of mineralization. Base metal extraction at ~25km from the lower crust is supported by Sr, Nd and Pb isotopic data from the xenoliths, which correspond to values from gangue calcite and galena Pb [8] from the major ore deposits.

References

[1] Wilkinson, J.J. & Hitzman, M.W. 2015. In: Archibald, S.M. & Piercey, S.J. (eds) *Current Perspectives on Zinc deposits*. IAEG, pp. 59-72; [2] Davidheiser-Kroll, B. *et al.* 2014. *Min. Deposita*, 49, 547–553; [3] Elliott, H. 2015. *Unpubl. PhD thesis*, Univ. Southampton; [4] Hnatyshin, D. *et al.* 2015. *Geology*, 43, 143-146; [5] McCusker, J. & Reed, C. 2013. *Min. Deposita*, 48, 687–695; [6] Van den Berg, R. *et al.* 2005. *Tectonophysics*, 407, 81–99; [7] Hauser, F. *et al.* 2008. *Geophys. J. Int.* 175, 1254-1272; [8] Everett, C.E. *et al.* 2003. *Econ. Geol.*, 98, 31-50 and references therein.