Clumped C-O isotope temperature constraints for carbonate precipitation associated with the Irish-type Lisheen and Navan Zn-Pb orebodies

Steven P. Hollis[1*], Julian F. Menuge[1], Paul Dennis[2], Aileen Doran[1], John Güven[1], Alina Marca[2], Jamie J. Wilkinson[3,4] & Adrian J. Boyce[5]

[1]iCRAG [Irish Centre for Research in Applied Geosciences] and School of Earth Sciences, University College Dublin, Belfield, Dublin 4, Ireland
[2]School of Environmental Sciences, University of East Anglia, Norwich, England, UK
[3]Department of Earth Sciences, Natural History Museum, Cromwell Road, London, UK
[4]Department of Earth Science and Engineering, Imperial College London, UK
[5]Scottish Universities Environmental Research Centre, East Kilbride, Scotland, UK
**steve.hollis@icrag-centre.org*

Mineral C-O isotope values are controlled by crystallization temperature and the isotopic composition of the fluid. However, the heavy isotopes of these two elements are known to bond in carbonate minerals measurably more frequently than expected by stochastic distribution. The extent of this "clumping" appears directly correlated with temperature which, unlike conventional $\delta^{18}O$ values, is independent of fluid $\delta^{18}O$. Measured Δ_{47} – a measure of distance from stochastic behaviour – thus provides an independent measure of crystallization temperatures, with errors at hydrothermal temperatures better than ±20°C. As $\delta^{18}O$ isotope ratios are also simultaneously determined, fluid $\delta^{18}O$ may be directly calculated rather than modelled.

We have measured Δ_{47} in paragenetically-constrained, carbonate generations from both the Lisheen and Navan Zn-Pb deposits. Coarse white dolomite from Lisheen white matrix breccias from the hanging-wall of the Island Pod show significant, non-systematic, temperature variations of ~100 to 170˚C over ~80 m depth range providing calculated fluid $\delta^{18}O$ of 5.7 to 14.8‰. Post-ore pink dolomite at Lisheen and crosscutting calcite veins formed at significantly lower temperatures (~40 to 70˚C) than ore-stage carbonates. Δ_{47} in calcite from sphalerite-bearing veins in the hanging-wall of the Randalstown Fault at Navan yield temperatures of 60-110 ˚C, consistent with existing fluid inclusion constraints[1].

[1] Marks, F.R. (2015) Remote detection of Irish-type orebodies: an investigation of the Navan halo. *Unpublished PhD thesis, University College Dublin.*

Poster Presentation.