Mantle heat found in hydrothermal fluids responsible for carbonate-hosted base metal deposits: Evidence from $^{3}He/^{4}He$ of ore

B. DAVIDHEISER-KROLL*, F. M. STUART AND A. J. BOYCE

Scottish Universities Environmental Research Centre, UK
*b.davidheiser-kroll.1@research.gla.ac.uk

Despite extensive research, there remains no consensus on the tectonic setting and driving mechanism for the genesis of hydrothermal fluids that created the Irish ore field [1-3]. Difficulty in interpreting the origin of the classic Irish ores arises partly from the coincidence of both extensional and compressional features within the deposits. Helium isotopes have been analysed in ore fluids trapped in sulphides from the major deposits of the Irish ore field to test for the involvement of mantle-derived volatiles, which provide tell-tale signs of asthenospheric melting. Helium isotopes of ancient hydrothermal fluids are trapped and preserved in ore minerals and can be used to trace the contribution of mantle volatiles and heat sources in a variety of ore deposit types [4].

Here we report $^{3}He/^{4}He$ ratios that range up to 0.2 R_a, indicating that a small but clear mantle helium contribution is present in the mineralising fluids trapped in galena and marcasite. Sulfides from ore deposits with the highest fluid inclusion temperatures (~200°C) also have the highest $^{3}He/^{4}He$ (> 0.15 R_a), even in samples that had mixed with surface fluids. Similar $^{3}He/^{4}He$ are recorded in fluids from modern continental regions that are undergoing active extension [4]. By analogy we consider that the hydrothermal fluids responsible for the carbonate-hosted Irish base metal mineralization circulated in thinned continental crust, which was undergoing extension, and that the influence of enhanced mantle heat flow may have had a significant role in driving fluid convection.

[1] Russell M.J. (1978) *Trans Ins Min Metall B* **87**:167-171. [2] Leach *et al* (2005) *Econ Geol* **100**:561-607. [3] Wilkinson J.J. and Hitzman M.W. (in press) Econ Geol. [4] Ballentine *et al* (2002) Rev. Mineral. Geochem.