LA-ICP-MS trace-element discrimination for mapping iron sulphides within an Irish-type Zn-Pb deposit, Lisheen mine

O Turner[1], S Hollis[2], S McClenaghan[1], A Doran[3], J Güven[3]

[1]iCRAG, Trinity College Dublin, Ireland; [2]Geological Survey Ireland, Dublin, Ireland;
[3]iCRAG, University College Dublin, Ireland;

Stratiform carbonate replacement Zn-Pb mineralisation in the Irish Midlands is relatively devoid of non-economic sulphide minerals. The notable exception is pyrite, which occurs temporally and spatially throughout deposits, overlying the sphalerite-galena ore body and forms a distal halo in the hanging-wall of fluid-controlling structures. A LA-ICP-MS study has been undertaken to characterise the paragenetically distinct iron sulphide stages present in these systems; early pyrite (Py_1) is spongy in appearance and defined as disseminated aggregated framboids. Py_1 was subsequently recrystallised into disseminated botryoidal pyrite (Py_2). These phases are further recrystallised by latter hydrothermal phases. Distal to feeder structures, LA-ICP-MS data shows these pyrite phases are deficient in elements associated with ore stage mineralisation (Zn-Cd-Cu-As-Tl) within the core. Both have elevated Co, Ni, Mn, Pb and Sb and a further central zone (in preserved framboids) identified by increased Sn. Distal, early-stage pyrite shows evidence of a later rim (Py_4) with distinctively higher As-Tl concentrations associated with minor crystals of sphalerite. Within the ore zone, preserved early pyrite occurs as radiating agglomerated botryoidal forms, subsequently recrystallised into euhedral crystals (Py_3) with additional, fine, massive pyrite (Py_4) replacing the accompanying carbonate phases. As and Co are concentrated in the rims of, early, hydrothermally altered diagenetic pyrite similar to the distal sample; large euhedral recrystallized pyrite concentrates Mn-Cu preferentially. Massive finely-crystalline Py_4 in the proximal sample is As-rich, yet poor in many other trace elements analysed. Bladed marcasite overgrows pyrite and sphalerite phases. Trace-element variations are less certain, Ni is preferably concentrated in pyrite over marcasite; Co and Mn contents are variable with no discernible features. This characterisation can, with appropriate treatment of data, be applied to bulk lithogeochemical data utilising principal component analysis to map dominant pyrite stages at Lisheen mine, thus a new target prioritisation tool for mineral exploration.