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Paragenesis of Upper Devonian polymetallic veins from the Munster Basin, SW Ireland

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The Late Paleozoic Munster Basin of SW Ireland is predominantly composed of the non-marine, siliciclastic-dominated, fine-grained alluvial sediments of the Upper Old Red Sandstone magnafacies. Copper mineralisation in this sedimentary basin is important, either as abundant polymetallic veins or relatively minor sediment-hosted stratiform deposits. In the syn-basinal polymetallic extensional veins, the ore phases include chalcopyrite, tetrahedrite-tennantite, galena, and molybdenite, with gangue minerals commonly quartz, carbonates (siderite-calcite), chlorite (chamosite), barite, and Fe-oxides. Re-Os geochronology on molybdenite revealed a pre-Variscan orogeny vein generation (ca. 367-366 Ma), corresponding to Upper Devonian basinal extension, and a syn-Variscan vein generation (ca. 316-312 Ma). However, the role of these two major geodynamic events on copper mineralisation, a critical mineral, was never studied in detail, such that the vein-hosted copper mineralisation and remobilisation processes are still poorly understood. A collection of mineralised vein samples from the western Munster Basin are characterised using Raman spectroscopy and optical microscopy to better define the mineralised vein paragenesis. We have identified mafic igneous rock-hosted quartz veining. Whereas the localised presence of mafic bodies in the Munster Basin is known, it has never been observed hosting the polymetallic quartz-rich veins. These Na-metasomatised basaltic rocks display an albite-rutile assemblage. Additionally, we have identified a pre-mineralisation chamosite veinlet generation. This generation appears to have been reopened by the quartz-rich polymetallic veins in a syntaxial manner, such that the chamosite rims the polymetallic veins. These veins show evidence of Variscan deformation (i.e., buckling, stylolites, brecciation, tectonic cleavage development). This set of new preliminary observations is critical as 1) the interaction between the hydrothermal fluids and the mafic igneous bodies may be critical to the formation of the pre-Variscan medium-temperature (~100-250°C), high-salinity (~20-30 wt% $NaCl_{eq.}$) fluid inclusions measured in the Munster Basin and 2) the chamosite and polymetallic quartz veins appear to have used the same conduits, which may indicate important physicochemical variations (e.g., T, P, pH, fO_2, etc.) and/or a pivotal switch in the fluid source(s).