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Regional Fluid Flow and Gold Mineralization in the Dalradian of the Sperrin Mountains, Northern Ireland

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Abstract

Gold vein mineralization occurs in the metamorphosed and deformed Dalradian (Neoproterozoic) rocks of the Sperrin Mountains, Northern Ireland. Two structures exerted a control on the location of the mineralization; the north-south Omagh lineament and the west-northwest-east-southeast Curraghinalt lateral ramp in the footwall of the northeast-southwest Omagh thrust. These are Caledonian structures resulting from the thrusting of Dalradian rocks over a possibly still active Ordovician arc.

Cathodoluminescence microscopy distinguishes four phases of vein quartz in the Curraghinalt gold prospect. Fluid inclusion studies and stable isotope geochemistry have defined the probable fluids responsible for the precipitation of each quartz phase and associated sulfide and precious metal mineralization. The initial phase (Q1) appears to have been associated with the main Caledonian metamorphic event (ca. 470 Ma) and is nonauriferous. The second phase (Q2) forms an extensive cement to brecciated early quartz and is believed to have involved a fluid (~15 wt % CO_2, 10 wt % NaCl + KCl equiv) with a significant magmatic component of 470 to 400 Ma, which underwent phase separation and dilution with a cooler formation water. This process resulted in precipitation of the main phase of gold mineralization characterized by an assemblage of electrum, pyrite, arsenopyrite, chalcopyrite, tennantite-tetrahedrite, and various tellurides. Similar fluids are observed on a regional scale, concentrated within the hanging wall of the Omagh thrust, indicating an extensive fluid-flow event. The relative abundance of

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gold at the Curraghinalt and Cavanacaw prospects is thought to be due to higher fluid fluxes in favorable zones of dilation and closer proximity to the fluid source.

The deposit was subsequently reactivated with the precipitation of later quartz (Q3-Q4) from a formation water believed to be resident in the Dalradian metasediments, which mixed with a low-temperature, high-salinity basinal brine, probably during Carboniferous basin inversion. Brine flow resulted in the remobilization of earlier electrum, reducing its fineness, and also introduced base metal sulfides, carbonates, and barite. Again, brine flow is localized by the Omagh thrust, indicating the long-lived role of this structure in controlling regional fluid migration.