Multi-element Geochemistry and Hydrothermal Alteration at the Pajingo Low Sulfidation Epithermal Gold Deposit

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The Pajingo low-sulfidation epithermal (Au-Ag) deposit is situated 140 km SSW of Townsville, NE Queensland, Australia, at the northern end of the Paleozoic Drummond Basin. Numerous veins have been mined since 1996, with total production plus resources totaling ~5 Moz. The Pajingo epithermal system is hosted within the Early Carboniferous Mount Janet Andesite, a sequence of andesitic lavas and volcaniclastic rocks formed in an interpreted back arc rift setting. The Mount Janet Andesite overlies the Molly Darling Sandstone and is overlain by volcanogenic sedimentary rocks, felsic volcanic rocks, and Doongara Formation sedimentary rocks. Gold is hosted in banded quartz-carbonate veins within the SW-dipping Vera-Nancy Fault (VNF) and on associated E-W splay structures. Veining is associated with proximal quartz-illite-pyrite-carbonate alteration, outer argillic alteration (smectite-illite-carbonate-pyrite ± kaolinite ± dickite ± chlorite) and propylitic alteration (chlorite-calcite-smectite ± albite ± illite ± pyrite).

Application of multi-element geochemistry and SWIR hyperspectral analysis have allowed new understandings of zoning patterns within the Pajingo epithermal system. These patterns provide useful exploration vectors that may be applied to other low sulfidation epithermal prospects.

At the scale of the Pajingo epithermal system (~8 km across), clear patterns exist in pathfinder element concentrations. A ~3-km-wide zone of elevated Te, Bi, Mo, As, Pb, W, and Sb accompanies quartz-illite-pyrite alteration around an interpreted paleo-volcanic center at Mt Janet. A smaller zone of elevated Te, Bi, Mo, Pb, and As occurs in the hanging wall to Vera South and Jandam, the largest and most vertically extensive orebodies known in the field. Major element geochemistry and hyperspectral analysis also record a broad zone of feldspar-destructive argillic alteration extending >1 km into the hanging wall of the VNF. In the footwall to the VNF, alteration assemblages are much less extensive and confined to steeply dipping fault zones. Where overlying volcanogenic sedimentary rocks are preserved, they are strongly elevated in Sb and As and host sinter deposits in places, suggesting a paleo-surficial environment at the time of hydrothermal activity.

In all orebodies from which multi-element data has been collected, a strong spatial correlation exists between gold-bearing veins and elevated Mo, Sb and Sb/As. The intensity and extent of argillic alteration, abundance of pyrite, and the concentrations of Te and Bi are greatest in the hanging wall to Vera South and Jandam, and decrease laterally to the NW and SE along strike. Kaolinite and dickite are common alteration minerals on gold-bearing structures, occurring in vugs and bands within epithermal veining and in carbonate-clay veins that crosscut gold-bearing veins to >1 km below the current surface. In contrast to Vera South and Jandam, veining at the Moonlight and Camembert prospects is associated with more restricted hydrothermal alteration, less kaolinite and dickite, lower Te and S, and elevated K/Al associated with adularia and phengitic illite.

Overall patterns in geochemistry and alteration minerals highlight the association of larger ore zones with volcanic centres and possible magmatic contribution to ore fluids. Such patterns may prove invaluable for prioritization of exploration targets in other low sulfidation systems.