

Geology, paragenesis, and alteration patterns of the E1 Group of iron oxide-Cu-Au deposits, Cloncurry district, northwest Queensland, Australia*

Corresponding author: George N.D. Case, Economic Geology Research Unit, James Cook University, george.case@my.jcu.edu.au

Co-authors:

Zhaoshan Chang, Economic Geology Research Unit, James Cook University, zhaoshan.chang@jcu.edu.au
Richard Lilly, Mount Isa Mines, richard.lilly@glencore.com.au
Thomas Blenkinsop, Cardiff University, BlenkinsopT@cardiff.ac.uk
Jan Marten Huizenga, Economic Geology Research Unit, James Cook University, jan.huizenga@jcu.edu.au

The Proterozoic E1 Group of iron oxide-Cu-Au deposits, composed of E1 North, East, and South, is located 8 km east of the world-class Ernest Henry IOCG deposit in the Cloncurry district of northwest Queensland, and contains estimated resources of 48 Mt averaging 0.72% Cu and 0.21 g/t Au. The E1 Group has been recently discovered below 20-50 m of Mesozoic sedimentary rocks near the world-class Ernest Henry IOCG, but its relationship to that deposit is not clear. Modelling of drill data indicates that the orebody is stratigraphically controlled within a series of folded, discontinuous metatuff, metasilstone, marble and metapsammite lenses intercalated with metabasalt and glomerophyric metaandesite. The metaandesite is likely equivalent to the intermediate volcanic rocks hosting the Ernest Henry deposit.

The E1 North orebody is controlled by a NW-plunging antiform, with mineralization occurring in a single major, discontinuous metatuff lens on the east limb, and in two discontinuous metatuff lenses on the west limb. The west limb of the antiform is truncated by Corella Breccia, and the east limb continues to the southeast to form the west limb of the E1 South synform. The E1 South orebody is comprised of three discontinuous lenses within this synform, with the upper lenses hosted in metasilstone and the lowermost lens hosted in metatuff continuing from the E1 North antiform east limb. The uppermost ore lens of E1 South grades into barren carbonaceous metapelite, and the entire E1 South system is truncated to the southeast by the Mount Margaret Fault Zone. E1 East ores are hosted in two steeply east-dipping lenses of metasilts intercalated with metabasalt and surrounded by Corella Breccia.

E1 Group mineralization is characterized dominantly by fine (0.05 mm) to coarse (3 mm)-grained layer-controlled magnetite-chalcopyrite-pyrite±Fe-Mn-carbonate±barite±fluorite±biotite±albite±chlorite±apatite±arsenopyrite±pyrrhotite±monazite (tr.) ±coffinite (tr.) ±uraninite(tr.) replacement of layered metatuff and metasil, and matrix-controlled replacement of volcanoclastic metatuff, associated with Fe-Mn-carbonate-quartz-barite-fluorite-albite-chalcopyrite-magnetite-biotite-chlorite-apatite veining. Very high-grade ores (>2% Cu) typically exhibit a massive texture which completely overprints earlier layering. This replacement-dominated mineralization style is substantially different from that of the hydrothermal breccia-hosted Ernest Henry orebody.

The E1 paragenetic sequence is comprised of four major stages: 1) Sodic-calcic: albite-quartz-hematite±actinolite±magnetite; 2) Potassic(-Fe): K-feldspar-biotite-magnetite; 3) Ore stage A:

magnetite-Fe-carbonate-chalcopyrite-pyrite-quartz-barite-fluorite-biotite (±Ba-Cl)-chlorite-apatite-muscovite (±Ba)-monazite; and 4) Ore stage B: Mn-(Fe)-carbonate-barite-fluorite-chalcopyrite-pyrite-quartz-sericite-arsenopyrite-pyrrhotite. Stage 1 and 2 alterations are heavily overprinted by mineralization, and are most visible immediately outside the orebody and within and proximal to the Corella Breccia. Stages 3-4 carbonate veins, accompanied by chlorite and sericite alteration, are widespread throughout the mine lease, but are most prevalent outside the orebody in the more brittle metabasalts, metaandesites and Corella Breccia. In the west limb of the E1 North antiform the carbonate veins contain abundant apatite, magnetite, and pyrite, forming a magnetic and Fe-P-rich geochemical anomaly extending 150-200m southwest from the orebody.

The E1 Group and Ernest Henry share a similar paragenetic sequence of early sodic (-Ca), intermediate potassic (-Fe), and late mineralization alteration, suggesting a similar genetic origin. The reason(s) for differing mineralization styles between the two systems, despite being hosted in similar rock types, is under investigation.