Lithology and Hydrothermal Alteration Control the Distribution of Copper Grade in the Prominent Hill Iron Oxide-Copper-Gold Deposit, Gawler Craton, South Australia

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The Prominent Hill iron oxide-copper-gold (IOCG) deposit is currently the second largest IOCG mine in the Gawler Craton of South Australia. The economically mineralized hematite breccias are hosted in a steeply dipping sedimentary rock package and structurally underlying volcanic rocks. The sedimentary host rock package comprises calcareous, dolomitic, and siliciclastic rocks with a capacity to neutralize fluid acidity.

Hydrothermal alteration and high-grade mineralization occurred after tilting of the host-rock package. Economic copper mineralization is associated with pervasive alteration of intermediate intensity between the hematite-chlorite-sericite ± siderite and intense hematite-quartz alteration. The latter resulted in nearly complete replacement of the formerly calcareous-siliciclastic breccia components and includes the replacement of aluminosilicates predominantly by hematite and quartz. Mine-scale assay data were used to reconstruct the lithostratigraphy outside zones affected by intense hematite-quartz alteration. The reconstruction is based on least-mobile element ratios determined by alteration mass-balance calculations.

The copper mineralization is strata-bound and follows the reconstructed lithostratigraphy but forms a discordant halo around zones of intense hematite-quartz replacement. These zones can be identified using the Hematite Quartz Alteration Index (HMSI-index), which correlates inversely with the copper grade probability. Distinct ranges of K-Na-Al ratios and low HMSI values point toward the best copper grades and may be used as exploration vectors in a variety of host rocks.