Giant IOCG Deposits Formed in Late Paleoproterozoic to Early Mesoproterozoic Rift Basins After the Assembly of the Columbia Supercontinent

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The late Paleoproterozoic to early Mesoproterozoic is often regarded as the onset of the "boring billion," characterized by tectonic quiescence and subdued magmatism. However, this period is also characterized by the formation of giant iron oxide-copper-gold (IOCG) deposits globally. In this study, we document multiple 1.66–1.65 Ga IOCG deposits in the Kangdian region of South China, where mineralization is spatially and temporally associated with 1.69–1.65 Ga diabase intrusions and variable-sized hydrothermal breccia bodies. The paragenetic sequence of these deposits typically comprises: (I) pre-ore Na-(Ca) alteration dominated by albite (with local amphibole); (II) Fe-(REE) mineralization marked by magnetite, siderite, and subordinate REE-enriched apatite; and (III) Cu-(Au-REE) mineralization featuring chalcopyrite, ankerite, biotite, K-feldspar, sericite, chlorite, and locally bornite and LREE minerals. The deposits underwent multiple tectonic and magmatic events
These deposits are hosted within the 1.74–1.68 Ga metavolcanic–metasedimentary sequences of the Dahongshan, Hekou, and Dongchuan Groups, which represent fluvial to intertidal sedimentary–volcanic successions deposited in a late Paleoproterozoic rift basin on the western margin of the Yangtze Block. The stratigraphy transitions from basal conglomerates and sandstones with minor tuffaceous and mafic volcanic rocks to interbedded carbonates. Notably, this rift succession in the southwestern Yangtze Block exhibits striking similarities to contemporaneous sequences in north-eastern Australia and the Wernecke supergroup in north-western Laurentia. Given the coeval occurrence of IOCG deposits across these continents, we propose that these deposits formed by the conversion of continental rift basins following the assembly of the Columbia supercontinent. We further suggest that the formation of giant IOCG deposits requires a combination of critical factors: (1) thick sedimentary-volcanic sequences, (2) upwelling mafic magmas derived from the asthenospheric mantle, and (3) large-scale hydrothermal fluid circulation under elevated geothermal conditions.