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An integrated genetic model for the Kangdian IOCG deposits, southwest China: Implications for ore genesis of Precambrian IOCG deposits

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Precambrian iron oxide-copper-gold (IOCG) deposits have formed mainly in extensional tectonic settings, possibly related to mantle-derived magmatism and associated hydrothermal activity. However, sources of metals and ore-forming fluids for IOCG deposits are still debated. In many cases, fluid inclusion, isotope, and halogen studies of IOCG deposits provide evidence for the mixing of two or more fluids. Some workers believe that the ore-forming fluids were predominantly magmatic in origin, whereas others invoke non-magmatic fluids, particularly from an evaporitic source, as being necessary for the formation of economic IOCG deposits.

The IOCG deposits in Kangdian are hosted in the late Paleoproterozoic (1.74 to 1.68 Ga) meta-sedimentary and meta-volcanic rocks. The ore-hosting strata contain basal conglomerates and sandstones with minor tuffaceous and mafic volcanic rocks, which gradually change to interbedded dolostone and mudstone. They are fluvial to intertidal facies sedimentary-volcanic successions in a rift-related basin at the continental margin of the late Paleoproterozoic Yangtze Block. Orebodies are generally stratabound and/or structurally controlled. They are spatially associated with slightly younger 1.69 to 1.65 Ga mafic intrusions and various sizes of breccia bodies. The paragenetic sequence of the deposits includes pre-ore Na-(Ca-Fe) alteration (stage I), Fe-oxide mineralization dominated by magnetite and siderite with subsidiary apatite (stage II), and Cu-sulfide mineralization with chalcopyrite, ankerite, biotite, chlorite, with possible bornite and REE minerals (stage III). Fluid inclusions, stable and radiogenic isotopes studies have shown that the early stage ore fluids are dominately magmatic in origin, possibly derived from deep-seated magmas, however, non-magmatic fluids were involved at various degrees in the formation of Cu-(Au-REE) ores. Fluid wallrock interactions and fluid mixing are important mechanism for the trigger of precipitation of ore minerals.

The Kangdian IOCG deposits were likely formed in an intracratonic rift setting that underplating of mafic magmas, possibly plus basin inversion, induced large-scale fluid circulation and pervasive sodic-calcic metasomatism in the country rocks. Hydrothermal brecciation of the country rocks formed at the top of the igneous intrusions and along zones of weakness within the country rocks owning to overpressure imposed by the ore-forming fluids. Magnetite and hematite precipitated early along the main fluid channels, whereas Cu sulfides are mainly hosted within structures of the country rocks where sulfide saturation is favored. This genetic model may be widely applicable to Precambrian IOCG deposits elsewhere that formed in intracratonic rift settings.