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Limited role of early sulfide fractionation in controlling Cu versus Au mineralization endmembers

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Magmatic-hydrothermal systems play a crucial role in enriching the Earth's crust with economic metals copper and gold. An outstanding feature for magmatic-hydrothermal ore deposits is variable metal endowment and ratios: some deposits are exclusively rich in Cu, others exclusively in Au, while many show coupled Cu–Au mineralization, but the controls on their highly variable metal ratios remain poorly understood. Conventional models attribute these disparities to magmatic sulfide fractionation, as they exhibit distinct partition coefficients between sulfide and silicate melts. To test this paradigm, we compared two sulfide-saturated magmatic systems related to giant Au-only and Cu(–Au) deposits in Eastern China, reconstructing the variation in their magmatic Au/Cu ratios via LA-ICP-MS analyses of silicate melt and sulfide inclusions . Both systems experienced mid- to lower-crustal fractionation of monosulfide solid solution sulfides that indeed removed more copper. Counterintuitively, the magmas parental to the Au-only deposits possessed lower or similar gold contents and Au/Cu ratios than the Cu(–Au) system . We thus suggest that the the Cu versus Au mineralization endmembers are not controlled by the metal ratios of melt but the different formation depths and resulted selective Au precipitation at hydrothermal stage.



