Host-rock paragenesis at the high-grade Kakula copper deposit, Democratic Republic of Congo

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The Kakula deposit is a high-grade sedimentary-rock-hosted copper deposit (349 Mt, 3.23% at 1% cut-off) closely associated with the world-class Kamoa deposit (752 Mt, 2.67% Cu at 1% cut-off) in the central African copperbelt, Democratic Republic of Congo. Copper-sulphide ore at Kamoa-Kakula is predominantly in the matrix of the Sturtian “grand conglomérat” (~ 715 Ma), which is thought to have represented a redox front that was vital for copper-sulphide precipitation from oxidized metalliferous fluid. Understanding the fine-grained Kakula diamictite matrix components is critical to understanding the timing and movement of copper-bearing fluids relative to deposition, diagenesis, later alteration, and deformation of the host succession. A provisional paragenesis for the matrix has been produced and scanning electron microscope chemical analyses were used to compare composition in different stratigraphic levels and in areas of “aligned” versus “non-aligned” matrix. Diamictite deposition from subaqueous sediment-gravity-flows was followed by a protracted series of events recorded in the matrix paragenesis. In chronological order, as demonstrated by relative-dating relationships among matrix components, these events include dolomite overgrowth, diagenetic pyrite precipitation, chlorite recrystallization and replacement, copper-sulphide mineralization (chalcopyrite – bornite – chalcocite), hematization, and potassium alteration (muscovite ± biotite; K-feldspar). Finely crystalline copper-sulphide grains are ubiquitously disseminated in the matrix of the host interval, and are commonly enclosed by well-developed muscovite crystals, suggesting that ore mineralisation may have been relatively early. Compositional analyses show a decrease in copper concentration moving up-section as well as substantially lower copper concentrations in “aligned” versus “non-aligned” matrix at a given stratigraphic level. The compositional data and provisional paragenesis provide an important framework for evaluating: (a) the timing of mineralisation and possible remobilisation; (b) the influence of matrix characteristics on the copper mineralizing event; (c) the influence of the copper mineralizing event on the matrix, and; (d) the different ore characteristics at Kakula versus Kamoa.