Recognizing Intrusive Phases at the Red Chris Au-Cu Porphyry Deposit Using Integrated Chemical and Geological Drill Core Data Sets

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The Red Chris porphyry deposit in northern British Columbia, Canada, has a combined ore reserve and mineral resource estimate of 20 Moz gold and 5.7 Mt copper at an average grade of 0.30 g/t Au and 0.35% Cu (Newcrest Annual Report, 2022). The deposit is hosted in the Late Triassic (212-202 Ma) Red Stock which comprises a series of nested porphyry intrusions that display structurally reactivated contact relationships (Zhu et al., 2018). At least three porphyry families (P1, P2, and P3; Rees et al., 2015) have been identified based on subtle compositional and textural differences, truncated veins, and crosscutting relationships. Of the three porphyry families, the best copper and gold mineralization is focused within abundant quartz-sulfide stockwork veins in P2, leading to the interpretation that P2 is the causative intrusive phase (Riedell et al., 2020). The deposit is dissected by late- and post-mineral faults (Rees et al., 2015). However, with the exception of the P3 porphyries, the visual similarities of intrusive phases make reconciling the displacement along these structures challenging. The integration of systematic downhole 4-acid multi-element geochemistry with detailed logging, shortwave infrared, and X-ray fluorescence data sets provides an opportunity to refine the mineralogical and geochemical signatures of the porphyry intrusions at Red Chris. The improved recognition of the spatial and temporal relationships of the porphyry phases has significant exploration implications. Identifying least- and moderately altered P2 and understanding its footprint to mineralization could provide an additional mineral exploration vector. In addition, better understanding of the P1 phases, which are pre-mineral host rocks, combined with traditional magmatic-hydrothermal alteration mineralogical and geochemical vectors (e.g., Halley, 2020) could improve mineral prospectivity and lead to further discovery in the district.