Geology and geochemistry of the Kerr-Sulphurets-Mitchell porphyry Cu-Au-Mo district, British Columbia

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The Kerr-Sulphurets-Mitchell (KSM) porphyry Cu-Au-Mo district, located in northwest British Columbia, Canada, hosts one of the world's largest undeveloped reserves of copper and gold. The KSM district features small volumes of calcalkaline intrusions associated with four distinct ore bodies, situated along a roughly northerly trend. From south to north, these deposits are: Kerr, Sulphurets, Mitchell and Iron Cap. All of the KSM deposits are broadly contemporaneous, and were emplaced during the Early Jurassic within basement composed of volcaniclastic and sedimentary strata of the Triassic Stuhini Group and the Jurassic Hazelton Group. Nevertheless, the KSM deposits also display notable variations in several important features, including morphology, size, Cu/Au ratio, amount and nature of quartz veining, composition and mineralogy of pre-mineral to syn-mineral intrusions, and nature of the hydrothermal alteration assemblages present. Structurally, the KSM district features many complexities. Post-mineral normal faulting and major district-scale thrust faulting, associated with the development of the Cretaceous Skeena Fold and Thrust Belt, have dismembered the four KSM deposits. Furthermore, district-scale low greenschist facies metamorphism as well as significant ductile deformation – especially prevalent in zones of strong sericite alteration – have caused widespread mica recrystallization, obscured primary textures due to the development of zones of strong foliation, and resulted in the destruction of fluid inclusions. Due to the substantial post-mineral modification of the district, KSM exemplifies the ubiquitous value and utility of refractory primary minerals in characterizing porphyry magmatic systems. Zircon trace element geochemistry, combined with whole rock geochemistry and petrography of least-deformed specimens, reveal new insights into the magmatic evolution of the KSM district.