Characteristics of Geology, Mineralization, and Alteration of the Khan Altai Gold Deposit, Mongolia

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The Khan Altai deposit, which is the largest gold deposit in Mongolia with 85.4 tons of gold, is located in southwest Mongolia on the northern margin of the Neoproterozoic-Cambrian Lake terrain. The host rocks are potentially Cambrian in age and have been strongly deformed and metamorphosed to lower greenschist facies. The host rocks consist of rhyolitic volcaniclastics interbedded with laminated siltstone, overlain by basaltic andesite, and faulted against dolomite. Two types of gold mineralization were identified: (a) low-grade mineralization associated with disseminated pyrite (2-10% by volume), mainly in rhyolitic volcanic and laminated siltstone with quartz veins; and (b) high-grade mineralization (up to 183 ppm Au over 1 m) related to centimetre-wide quartz-native Au-pyrite veins. Additionally, the Au mineralized zone includes VMS mineralization (currently minor), characterized by massive pyrite-sphalerite lenses and quartz-chalcopyrite stringer zones. The main alteration is quartz-white mica-albite, and gold mineralization is correlated with zones of strong tectonic foliation and the formation of metamorphic mica (phengitic-illite and phengite), which exhibit an outward zonation to muscovite and paragonite. Pyrite is typically euhedral and exhibits concentric growth zones as well as quartz pressure shadows to the enclosing foliation, consistent with syngenetic growth during metamorphism and deformation. Other sulfides include arsenopyrite, sphalerite, and possibly marcasite. Preliminary laser ablation-ICPMS mapping shows that pyrite rims are enriched in Au, As, Co, Cu, Ni, Pb, Ag, Mo, and Se, whereas the pyrite core is enriched in Co, Bi, Te, and the host rock in K, Ba, V, and Tl. Whole-rock geochemistry of basaltic andesite to rhyolite shows N-MORB characteristics for basaltic andesite as well as a subduction signature for all rocks, and high MgO (_8%) and TiO2 (_1%) and low Ni, Cr content in basalt, compatible with a back-arc tectonic setting.