TECTONICS AND WORLD-CLASS GOLD DEPOSITS: ADVANCES IN UNDERSTANDING OF DEPOSITS IN THE WESTERN UNITED STATES AND CENTRAL ASIA

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The western Cordillera of the United States is endowed with numerous gold deposits of many different styles, including some sufficiently large to be world-class in the context of Singer (1995; *Econ. Geol.*). A world-class gold deposit is one with gold reserves and production within the top 10% of values for all styles of gold deposits world-wide. Homestake, Goldstrike, Round Mountain, and Bingham Canyon in the United States and Muruntau in Uzbekistan are examples of world-class gold deposits. The common attributes of these world-class gold deposits are the effective focusing of substantial amounts of fluid into a confined volume and the coupling of fluid-flow and chemical reactions to the mechanics of fault processes. These gold deposits occur within or associated with reactivated, older fault structures and other deformation-related permeabilities.

At the Homestake, South Dakota, meso- to hypozonal gold-bearing quartz vein deposit, premineralization diagenesis and metamorphism resulted in a reactive, carbonaceous iron-rich formation that was later mineralized during fault-related deformation and intrusive activity in the region. At the genetically similar Muruntau deposit, Uzbekistan, premineralization structural fabrics in a carbonaceous iron-rich siliciclastic formation control permeability during syndeformation mineralization along a left-lateral fault system. Faults transverse to earlier faulting caused both a focusing of fluid-flow and additional permeabilities. Synmineralization granitic rocks were emplaced into both fault systems.

Carlin-style gold deposits such as Goldstrike and Carlin are made up of siliceous carbonate-replacement Au-As-Sb-Hg ores. In the Carlin region, a large, reactivated regional-scale north-northwest-striking shear system served to focus fluid-flow at ≈140°-±200°C in the vicinity of shallow crustal heat sources. In the Getchell area, gold mineralization is also related to reactivated faults. Paleozoic and Mesozoic thrusts were partially reactivated as lateral faults concurrent with the emplacement of Late Cretaceous granitic intrusions and reactivated again in the early Tertiary during gold mineralization.

The world-class Comstock Lode epithermal-style Au-Ag deposit formed along an active, regionally extensive fault zone where this zone crosses an underlying, transverse fracture system in the basement. The Comstock fault system bounded a lake-filled basin; the lake being important in providing large volumes of fluid to the thermal system, contributing to the focusing of fluid-flow in the system, and affecting ore-fluid chemistry and deposition mechanisms.

In the Bingham Canyon, Utah, porphyry copper deposit, gold is an important by-product commodity, sufficiently so to make it a world-class gold resource. Geologic relations at Bingham indicate that the deposit was formed in the left-step between two northeast-striking left-lateral faults. The left-stepping occurs at the intersection with a northwest-striking fault zone. A Precambrian, crustal-scale shear zone is in the basement below the deposit. Repeated magma emplacement and magmatic-hydrothermal fluid-flow were focused into the same structurally restricted zone, resulting in the very large deposit.