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Granite Molybdenite Systems

Stockwork molybdenite deposits in the western conterminous United States may be divided into two groups based on the chemistry of the source pluton: granodiorite systems and granite systems. These two groups show significant differences in age, tectonic setting at time of formation, and orebody geometry.

Granite molybdenite systems develop in, and adjacent to, epizonal plutons that meet Tuttle and Bowen's (1958) definition of granite. Cenozoic source plutons for these systems were emplaced in the eastern Rockies and Great Basin coincident with, or just prior to, regional extensional tectonism. Mineralization and alteration patterns in granite molybdenite systems generally conform to those described at the Climax and Henderson deposits.

Major element data displayed on Ab-Or-Q and A-F-K plots can characterize potassic, quartz-sericite, argillic, and silicic alteration assemblages and lead to evaluation of the probable depth to mineralization in prospects. Observed alteration reflects hydrogen and alkali metasomatism in fluorine-rich systems. Minor elements concentrated in granite molybdenite systems include Be, Cs, F, Li, Mo, Nb, Rb, Sn, Ta, Th, U, and W.

Geophysical and geological evidence indicates that the cylindrical source plutons associated with known granite molybdenite systems are cupolas on the tops of batholiths, suggesting a genetic link between batholiths and ore. A granite molybdenite system appears to be the result of the following: lithophile element concentration by convection-aided thermogravitational diffusion in the upper part of a batholithic magma chamber; transfer of the resulting high-silica, volatile-rich magma from the roof zone of the batholith to a high-level cylindrical cupola; establishment of thermogravitational diffusion in the cupola causing further lithophile element concentration; formation of potassic alteration and an ore shell as a result of volatile saturation, resurgent boiling, hydrofracturing, and boiling; and the evolution of peripheral alteration assemblages as meteoric waters enter the magmatic fluid plume above the cupola. Stacked orebodies represent discrete episodes of resurgent boiling, hydrofracturing, and mineralization.

Computer-assisted evaluation of major element analyses of igneous rocks, using chemical criteria developed from known granite molybdenite systems, may locate areas with a high exploration potential. These techniques suggest that several late Precambrian bimodal basalt-rhyolite terrains in the eastern United States and Canada have exploration potential for molybdenite.