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The Endako Batholith: Episodic Plutonism Culminating in Formation of the Endako Porphyry Molybdenite Deposit, North-Central British Columbia

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Abstract

The Endako batholith is a composite batholith that consists of early foliated hornblende ± biotite diorites, intermediate-age unfoliated hornblende ± biotite diorites, and late granodiorites to monzogranites. These latter plutons host the Endako molybdenite deposit, a major porphyry deposit located in the central Canadian Cordillera. Extensive K-Ar dating on the batholith had given relatively reproducible ages centered on 140 Ma, indicating a short life span for magmatic activity. However, a combined U-Pb and $^{40}Ar/^{39}Ar$ study has resulted in a substantial reappraisal of the age and time span of intrusive activity and its association with molybdenite mineralization. The new data show that the batholith had a protracted emplacement history, covering ~75 m.y., with clear evidence for periods of magmatic quiescence. The oldest magmatic suite of the Endako batholith, the Stern Creek suite, is dated at ~220 Ma and comprises foliated gabbros and diorites. Mafic to intermediate plutons of the Stag Lake suite range in age from 180 Ma to 161 Ma. The Francois Lake suite is divided into two subsuites: the Glenannan subsuite dated at 157 Ma to ~155 Ma and the 149 to 145 Ma Endako subsuite that hosts the Endako molybdenite deposit. $^{40}Ar/^{39}Ar$ dating of hydrothermal biotite indicates molybdenite mineralization is genetically associated with terminal stages of magmatic activity. Biotite within the mine had its $^{40}Ar/^{39}Ar$ systematics reset at ~145 Ma by hydrothermal fluids with temperatures in excess of 300°C. This resetting is associated with intrusion of the 145.1 ± 0.2 Ma Casey phase monzogranite, the youngest phase within the Endako subsuite. A further partial resetting of biotite is interpreted to be coeval with Eocene intrusion of the high-level, miarolitic Sam Ross Creek phase and numerous mafic dikes that cut through the region. Hydrothermal fluids associated with this latter event were below biotite closure temperature and do not appear to have any relationship to molybdenite mineralization within the Endako deposit.

The new geochronologic data, coupled with detailed mapping, show a general age progression from mafic plutonism at the margins to a central core of high-level granodiorite to monzogranite. The data document the existence of a long-lived, relatively stationary magmatic center. Pulsed magmatism, evident even within individual magmatic suites, may play a major role in concentrating and ultimately depositing molybdenite in some porphyry systems. At Endako, molybdenite would have formed within the higher level portions of the batholith, a position that would normally have rendered the deposit prone to erosional removal. However, subsequent Eocene extensional block faulting may explain the preservation of this Jurassic deposit, which is the oldest economic molybdenite deposit in the Cordillera of North America.