

## Late and Mid-Cretaceous Mineralization in the Northern Canadian Cordillera: Constraints from Re-Os Molybdenite Dates

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### Abstract

New Re-Os molybdenite dates are presented from three deposits (Casino, Cash, and Mt. Nansen) in the Dawson Range, Yukon, northern Canadian Cordillera. The Re-Os molybdenite dates provide constraints on the timing of sulfide mineralization, and together with  $^{40}\text{Ar}/^{39}\text{Ar}$  and K-Ar mineral dates yield estimates for the longevity of the porphyry hydrothermal system. At the Casino deposit, Re-Os molybdenite dates associated with the potassic ( $75.05 \pm 0.28$ ;  $74.69 \pm 0.28$  Ma) alteration are nominally older to overlapping with Re-Os molybdenite dates ( $\sim 74.4 \pm 0.28$  Ma,  $n = 2$ ) with phyllic alteration and suggest that it is likely that potassic and phyllic mineralization-alteration was contemporaneous. The Re-Os molybdenite dates are significantly older than hydrothermal K feldspar  $^{40}\text{Ar}/^{39}\text{Ar}$  and K-Ar biotite dates ( $\sim 72$  Ma), which most likely reflect the cessation of the porphyry hydrothermal system. The molybdenite age data combined with silicate hydrothermal mineral dates suggest a porphyry hydrothermal system longevity of 4.16 to 1.94 (Casino), 8.66 to 6.44 (Cash), and 2.47 to 1.48 Ma (Mt. Nansen). These longevity estimates for porphyry hydrothermal systems are greater than previously proposed ( $\sim 1$  Ma) and it is suggested that a prolonged high geothermal gradient ( $>50^\circ\text{C}/\text{km}$ ) may control the disparate Re-Os molybdenite and  $^{40}\text{Ar}/^{39}\text{Ar}$  K feldspar dates of the porphyry systems of this study. The contrasting Re-Os and  $^{40}\text{Ar}/^{39}\text{Ar}$  dates clearly show the Re-Os isotope system in molybdenite is resistant to prolonged ( $\sim 1$  Ma) interaction with a high-temperature ( $400^\circ\text{--}500^\circ\text{C}$ ) hydrothermal fluid, and that the Re-Os isotope systematics in molybdenite unambiguously record directly the timing of sulfide mineralization. This ability to directly date sulfide mineralization has identified mid- (Pattison, Idaho Creek,  $\sim 102\text{--}104$  Ma) and Late Cretaceous (Zappa-Koffee,  $\sim 74.5$  Ma) mineralization, which is hosted by the mid-Cretaceous ( $\sim 104\text{--}102$  Ma) Casino Plutonic Suite. The Late Cretaceous date is very similar to that for molybdenite mineralization at Casino, and we suggest that the Zappa-Koffee mineralization is an area of Late Cretaceous porphyry mineralization, for which the host pluton has not yet been discovered.