

Geochemistry and Mineral Potential of Granite-related Mineral Systems in the Northern Cordillera in Alaska, USA

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The Northern Cordillera in Alaska hosts numerous granite-related mineral systems, including districts historically mined for Sn and W. Recent exploration and assessments have targeted critical minerals such as Li and Ta, but existing data on the abundance and distribution of these elements within granite-related systems are sparse. New and legacy rock samples from prospects across the state were geochemically analyzed using major and trace elements to characterize their metal tenor and magmatic-hydrothermal evolution. Granite-related deposits comprise multiple belts ranging in age from ca. 80 Ma in the Arctic Alaska-Chukotka terrane (Kougarok, Lost River, Tin Creek), to 61-55 Ma in the Yukon-Tanana terrane and Kuskokwim belt (Mount Prindle, Lime Peak, Sleitat), to ca. 15 Ma in southeast Alaska (Groundhog Basin). Results in whole-rock samples indicate moderately enriched (~5X average crustal abundance [ACA]) Sn, Li, Rb, Be and Ta at Puzzle Gulch, Groundhog Basin, Mount Prindle and Lime Peak occurrences. At Groundhog Basin, mineralization is characterized by zinnwaldite (Li-mica) granite with polymetallic Sn-Pb-Zn veins and carbonate replacements. In contrast, Lime Peak represents a more deeply exhumed granite complex, dominated by biotite granite with a small (~0.25 km²) zinnwaldite granite body and Li-Sn exogreisen. The most enriched systems (>10X ACA) are at Sleitat, Tin Creek, Kougarok, and Lost River. They are characterized by preservation of apical endogreisen (quartz-Li mica-topaz-fluorite) zones up to 300 m deep. The latter two deposits are enriched 50X ACA in Ta, 50-100X in Li and Sn, 30-50X in F, and 20-30X in Cs and Rb. Cesium, F, and Rb/K correlate strongly ($r^2 > 0.7$) with Li concentrations. Tin, Li, W, F, and Be are most abundant in greisen, underscoring the role of late-stage magmatic-hydrothermal alteration of the granites in generating ore grades. Our results refine exploration criteria and mineral potential of granite-related systems in Alaska.