Paper Number: 4858

Geochronology and Nd-Sr-Pb isotopic compositions of Early Cretaceous intrusions and associated porphyry Cu deposits in eastern Alaska

Graham, G.E.[1], Kelley, K.D. [1], Holm-Denoma, C.S.[1], Ayuso, R.A. [2], Kokaly, R.F. [1], Hoefen, T.M. [1], Selby, D. [3]

[1]U.S. Geological Survey, Denver, Colorado, USA (Contact email: ggraham@usgs.gov)
[2]U.S. Geological Survey, Reston, Virginia, USA
[3]Durham University Department of Earth Sciences, Durham, England

---

During the Cretaceous, the southern margin of Alaska experienced terrane accretion, magmatism, and porphyry Cu deposit formation inboard of the accreted composite Peninsular-Alexander-Wrangellia terrane (PAW). Sampling of host igneous rocks near porphyry Cu deposits within the Nabesna and Klein Creek plutons permits modern geochemical and geochronological characterization of Cu deposits in the eastern Alaska Range. Based on whole-rock major and trace element geochemistry, rocks from the Nabesna pluton, host of the Orange Hill and Bond Creek deposits, are oxidized, subalkalic, metaluminous to weakly peraluminous diorite to granodiorite. Samples from the Klein Creek pluton, host of the Baultoff and Horsfeld deposits, are subalkalic to alkalic, metaluminous gabbro to granodiorite. The intrusions are enriched in large-ion lithophile elements (e.g., Rb, Ba, and Sr) and Pb, and are depleted in high-field strength elements (e.g., Nb, Ta, Ti, and P) as shown in mantle-normalized diagrams. Many of the samples display weak negative Eu anomalies. On tectonic affinity diagrams, all samples plot as volcanic arc granites. Porphyry Cu mineralization at Orange Hill and Bond Creek is locally molybdenite-rich, whereas the Baultoff and Horsfeld deposits are lower grade and relatively molybdenite-poor.

New LA-ICP-MS U-Pb zircon age determinations from the Nabesna pluton indicate crystallization ages of 117.6±1.0 to 118.2±0.6 Ma at Orange Hill and 113±0.5 Ma near Bond Creek. While two samples from the Klein Creek pluton have older crystallization ages (126.4±1.0 and 123.4±0.8 Ma), one sample collected at the Horsfeld porphyry prospect yielded a similar age to those in the Nabesna pluton (114.8±1.0 Ma). Rhenium-osmium ages of molybdenite from two samples of quartz-molybdenite±chalcopyrite veins from the Orange Hill deposit have ages of 114.86±0.47 and 115.23±0.46 Ma, supporting a close temporal relationship between plutonism and mineralization in the Nabesna pluton. Preliminary Pb-Sr-Nd isotopic data for the Nabesna pluton ($^{206}Pb/^{204}Pb$: 18.769-19.184; $^{207}Pb/^{204}Pb$: 15.528-15.603; $^{208}Pb/^{204}Pb$: 38.082-39.063; $^{87}Sr/^{86}Sr$ ~0.7040; εNd ~4.0) and the Klein Creek pluton ($^{206}Pb/^{204}Pb$: 18.771-18.998; $^{207}Pb/^{204}Pb$: 15.522-15.577; $^{208}Pb/^{204}Pb$: 38.083-38.374; $^{87}Sr/^{86}Sr$ ~0.7045; εNd ~4.5) show significant overlap, suggesting that the plutons shared similar isotopic sources.

Our geochronological data show that the Klein Creek pluton and Nabesna pluton are older than previously published K-Ar ages of 111 and 105 Ma, respectively [1], and suggest that mineralization at Orange Hill and Horsfeld was part of the same metallogenic event as the nearby Nabesna Cu-Au skarn formation associated with the White Mountain granite ($^{40}Ar/^{39}Ar$ hornblende age of 113.3 ± 1.3 Ma [2]). Our trace and REE element and preliminary isotopic data are similar to those of younger magmatic systems to the west (present-day coordinates), including the ~90 Ma Pebble porphyry Cu-Au deposit [3]. The combined geochronological and geochemical data suggest mantle or lower crustal sources for the magmas, and are consistent with a model of northward propagating accretion of PAW to the North American margin and post-collisional magmatism and porphyry formation during the Cretaceous [3].

References:

[1] Richter et al. (1975) Geol. Soc. Amer. Bull., 86 819-829

[2] Snyder D.C., and Hart, W.K., (2007) GSA Special Paper 431, 379-399.

[3] Goldfarb et al. (2013) Econ. Geol. 108, 405-419