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We report five K-Ar dates from the Valley Copper and Lornex porphyry-type deposits of the Guichon Batholith in south central British Columbia. Minerals of both magmatic and hydrothermal origin have been dated. They were separated from plutonic host rock and ore samples that were collected in conjunction with detailed geologic mapping of outcrops, mine exposures, and diamond drill core during the summers of 1969, 1970, and 1971. The radiometric and geologic data collectively demonstrate the temporal and spatial coincidence of hydrothermal mineralization to late-stage silicic plutonism in the core of the batholith.

The K-Ar age determinations were performed by Donald J. Parker of Oregon State University at the Kline Geological Laboratory of Yale University and under the direction of R. L. Armstrong. Constants used in the reduction of analytical data were: $\lambda_\epsilon = 5.84 \times 10^{-11}$/yr; $\lambda_\beta = 4.72 \times 10^{-10}$/yr; and $K^{40}/K = 1.19 \times 10^{-4}$ atoms/atom. Potassium was determined by atomic absorption and argon by isotope dilution (Armstrong, 1970). The geochronometry laboratory of Yale University is supported by NSF Grant GA-26025. Field work was supported by research grants from Cominco Limited and Lornex Mining Corporation Limited of Canada.

GEOLOGIC DISCUSSION

The Guichon Creek Batholith is in the southern part of the Intermontane tectonic province of British Columbia; about 120 miles north of the Canada-U. S. border and 140 miles northeast of Vancouver. It occupies approximately 400 square miles and is 36 by 20 miles in maximum north-south and east-west dimensions. Principal geologic relationships of the batholith and a part of the Highland Valley district are illustrated in Figure 1 (Northcote, 1969; McMillan, 1971; Field and others, 1973).

The Guichon Creek Batholith is a composite and concentrically zoned intrusion. Major plutonic phases range from diorite and quartz diorite at the peripheral margin to relatively younger granodiorite and silicic porphyry dikes in the central core. The batholith intrudes eugeosynclinal assemblages of metasedimentary and metavolcanic rocks of the Devonian to Permian Cache Creek Group and the Late Triassic (Karnian and Norian) Nicola Group. Unmetamorphosed shallow marine clastics of the Jurassic Thompson and Ashcroft Series overlie the batholith unconformably. These stratigraphic and intrusive relationships suggest that the batholith was emplaced in a sub-oceanic (island arc) environment. The age of the Guichon Creek Batholith and its emplacement relative to stratified country rocks is also of importance with respect to the geologic time-scale. According to Tozer (1964), both Holmes and Kulp used earlier radiometric data for this batholith (180 m.y.) to date the Triassic-Jurassic boundary. Frebold and Tipper (1969) bracket emplacement of the batholith between Late Triassic and Early Jurassic (Rhaetian to Hettangian) time from paleontological and stratigraphic evidence. More recent studies by Armstrong and Besancon (1970), and references cited therein, suggest an age of 210 m.y. for this boundary. Northcote (1969) reports an average age of 198±8 m.y. for the Guichon Creek Batholith on the basis of 26 K-Ar determinations. Individual plutonic phases of the batholith, however, were not radiometrically distinguishable within the limits of analytical error. Chrismas and others (1969) obtained a Rb-Sr isochron of 200±2 m.y. from samples of batholithic host rocks and hydrothermal gangue. Our results are consistent with the 198 to 200 m.y. dates reported by Northcote (1969) and Chrismas and others (1969).

Both the Valley Copper and Lornex porphyry copper-molybdenum deposits are in the central core of the batholith (Figure 1). Their close proximity, structural boundaries, and asymmetry of ore and gangue minerals suggest that they are faulted segments of a single deposit. The dominant host rock at Valley Copper is the porphyritic Bethsaida Granodiorite, the youngest major plutonic phase of the batholith, whereas that at Lornex is the Bethlehem (locally designated Skeena) Quartz Diorite, the next to youngest major plutonic phase. The host

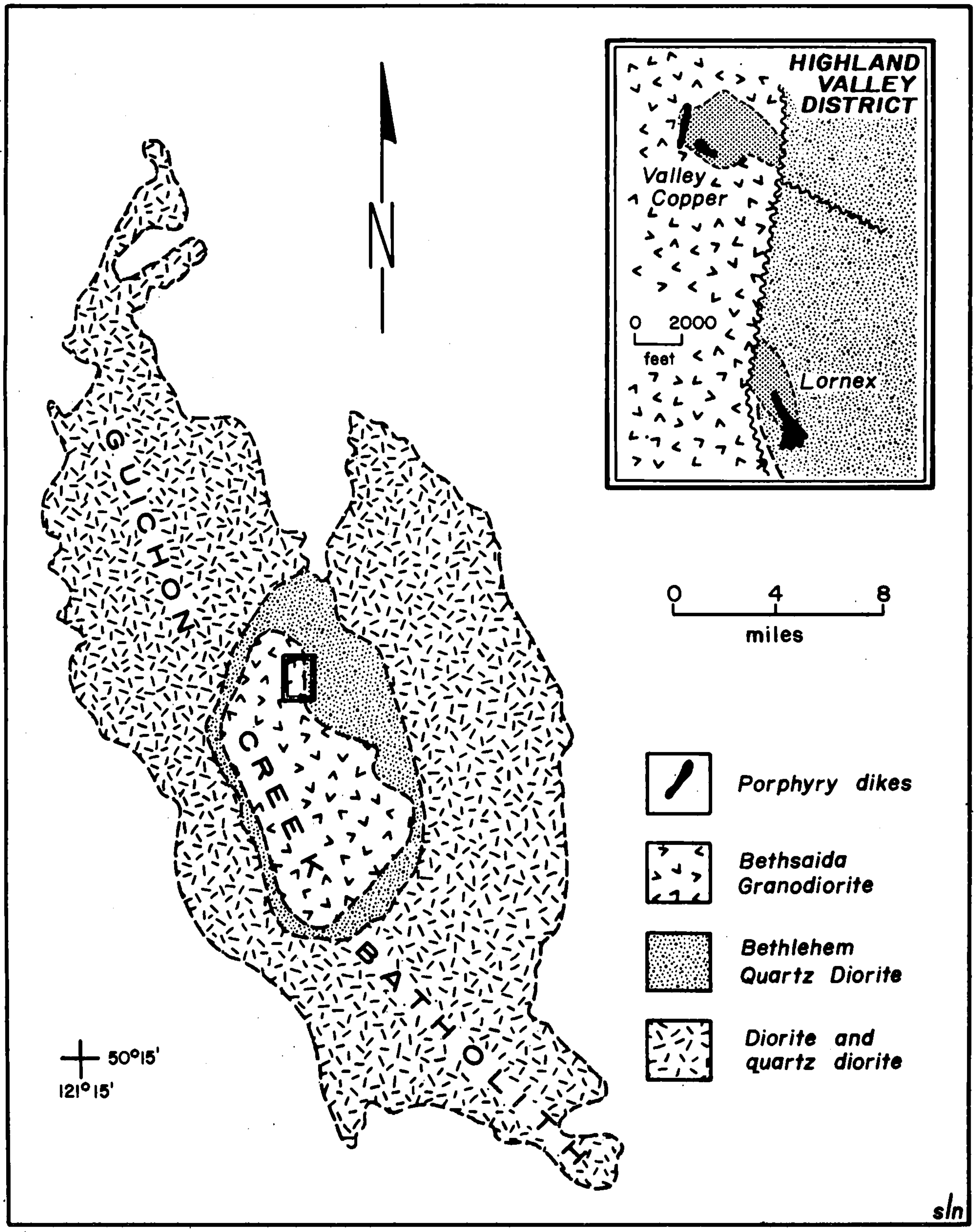

Figure 1. Geology of the Guichon Creek Batholith, British Columbia, Canada.

rocks at both properties are intruded by minor pre-mineralization quartz-feldspar porphyry dikes. We have dated biotite in the Bethlehem (Skeena) Quartz Diorite of Lornex at 190±4 m.y. At Valley Copper our dates are 204±4 m.y. for biotite in a quartz latite porphyry (porphyritic phase of the Bethsaida Granodiorite) dike; 202±4 m.y. for sericite (2M1 muscovite) in a quartz-molybdenite veinlet; 198±4 m.y. for sericite in a quartz-bornite veinlet; and 132±3 m.y. for phlogopite in a post-mineralization lamprophyre (vogesite) dike.

Our radiometric data and those of Northcote (1969) and Chrismas and others (1969) collectively indicate that major phases of batholithic plutonism, emplacement of late porphyry dikes, and subsequent hydrothermal mineralization occurred at 200 m.y. These events are largely indistinguishable within the limits of analytical error. The coincidence of hydrothermal activity to plutonism in time, and to geologically younger silicic and porphyritic intrusive phases in space, imply a genetic relationship between late-stage evolution of the Guichon Creek Batholith and ore formation. The post-mineralization lamprophyre dike (132 m.y.) is clearly younger than all major and minor batholithic intrusive phases and is probably unrelated to Guichon plutonism. We have equated the quartz diorite (Skeena) host at Lornex to the Bethlehem phase of the batholith on the basis of close spatial and nearly identical textural, mineralogical, and chemical similarities. Because it is geologically older than the Bethsaida Granodiorite and porphyry dikes, we are uncertain as to the cause of its somewhat younger (190 m.y.) radiometric age. Although chloritic alteration might account for the rather low potassium content of the biotite and its young "apparent" age, this effect was not observed either in hand specimens or in thin sections.

The mineral deposits of Valley Copper, Lornex, and Craigmont (Chrismas and others, 1969) have 200 m.y. ages that are among the oldest for hydrothermal deposits of the western Cordillera and that are similar to those of Galore Creek and Ingerbelle-Copper Mountain elsewhere in British Columbia as summarized by Field and others (1973). Moreover, they are comparable in age and geologic setting to similar deposits of the Cuddy Mountain and Iron Mountain-Mineral districts of western Idaho (Henricksen and others, 1972; Field and others, 1972, 1973). The 200 m.y. age is analogous to the Lee Vining (195-210 m.y.) intrusive epoch for the eastern part of the Sierra Nevada Batholith as defined by Evernden and Kistler (1970).

SAMPLE DESCRIPTIONS

1. YU-Lnx 510-1-ld — K-Ar — (biotite) 190±4 m.y.

Bethlehem (Skeena) Quartz Diorite. Medium-grained equigranular quartz diorite (50°27′06″N, 121°02′36″ W; 5100′ mine bench, E end, traverse no. 1, 0 ft mark, Aug 1971; Lornex Mine, British Columbia, Canada) composed of 23.1% quartz, 11.2% orthoclase, 60.5% plagioclase (An 28-30), 1.0% hornblende, 3,8% biotite, and minor apatite, sphene, magnetite, clay, epidote, and sericite. Analytical data: K = 5.00%; $\overset{*}{Ar}{}^{40}$ = 39.87 x 10^{-6} cc/gm (92% ΣAr^{40}). Collected by: R. A. Schmuck and C. W. Field, Oregon State Univ.

2. YU-MJ-147 — K-Ar — (biotite) 204±4 m.y.

Porphyritic phase of the Bethsaida Granodiorite. Quartz latite porphyry (50°29′12″N, 121°03′18″W; from 147 ft in diamond drill hole 27 drilled in 1968, Valley Copper deposit, British Columbia, Canada) composed of 48% quartz-feldspar matrix and 12% phenocrysts of plagioclase, 31% kaolinite-sericite after plagioclase, 7% quartz, 0.7% biotite, 0.3% chlorite-clay after plagioclase, and 1% others. Analytical data: K = 4.4[illegible]%; $\overset{*}{Ar}{}^{40}$ = 38.27 x 10^{-6} cc/gm (61% ΣAr^{40}). Collected by: M. B. Jones, Oregon State Univ.

3. YU-MJ-449 — K-Ar — (sericite) 202±4 m.y.

Quartz-sericite-molybdenite vein (50°29′12″N, 121°03′18″W; from 449 ft in diamond drill hole 2 drilled in 1968, Valley Copper deposit, British Columbia, Canada) with traces of bornite; sericite (2M1 muscovite) flakes 1-2 mm in size and intergrown with molybdenite flakes; composed of 74% quartz, 19% sericite, and 7% molybdenite. Analytical data: K = 8.54%; $\overset{*}{Ar}{}^{40}$ = 72.65 x 10^{-6} cc/gm (95% ΣAr^{40}). Collected by: M. B. Jones, Oregon State Univ.

4. YU-MJ-477 K-Ar (sericite) 198±4 m.y.

Sericite-quartz bornite vein (50°29'12"N, 121°03'18"W; from 477 ft in diamond drill hole 10 drilled in 1968, Valley Copper deposit, British Columbia, Canada) with sericite (2M1 muscovite) flakes up to 1 mm in size. Analytical data: K = 8.70, 8.70%; $^{*}Ar^{40}$ = 73.26 x 10^{-6} cc/gm (95% $^{*}Ar^{40}$) & 71.57 x 10^{-6} cc/gm (94% $^{*}Ar^{40}$). Collected by: M. B. Jones, Oregon State Univ.

5. YU-MJ-69 K-Ar (phlogopite) 132±3 m.y.

Lamprophyre (vogesite) dike (50°29'12"N, 121°03'18"W; from 402 ft in diamond drill hole 4 drilled in 1969, Valley Copper deposit, British Columbia, Canada) composed of 12% feldspars, 37% augite, 23% phlogopite, 15% chlorite, 6% calcite, and 7% others; chemical analysis SiO_2 = 46.18%, TiO_2 = 1.77%, Al_2O_3 = 10.27%, Fe_2O_3 = 1.68%, FeO = 6.45%, MgO = 11.86%, CaO = 12.92%, Na_2O = 2.15%, K_2O = 2.36%. Analytical data: K = 6.22, 6.22%; $^{*}Ar^{40}$ = 33.90 x 10^{-6} cc/gm (85% $^{*}Ar^{40}$) & 33.78 x 10^{-6} cc/gm (91% $^{*}Ar^{40}$). Collected by: M. B. Jones, Oregon State Univ.

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