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K-Ar AGES OF PLUTONISM AND MINERALIZATION, WESTERN CASCADES, OREGON AND SOUTHERN WASHINGTON

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The central and northern parts of the Cascade Mountains in Washington host numerous deposits of porphyry-type copper mineralization, illustrated in Figure 1, that are spatially and temporally associated with Tertiary batholithic intrusions (Grant, 1969 and 1976; Field and others, 1974; Armstrong and others, 1976; Hollister, 1979). To the south and into the Southern Cascades of Washington and the Western Cascades of northern and central Oregon, there are systematic changes in both the plutonic host rocks and their associated mineral deposits. The intrusions diminish from batholithic dimensions to stocks, plugs, and smaller tabular bodies, and the textural and compositional characteristics of associated mineralization change from relatively large deposits of disseminated copper (with minor molybdenum) to small and structurally controlled vein-type deposits of polymetallic base (copper, lead, and zinc) and precious (gold and silver) metals (Callahan and Buddington, 1938; Peck and others, 1964; Power and Field, 1981). Locations of these more southerly mining districts are also shown in figure 1, and it should be noted that recent exploration programs have documented the presence of disseminated porphyry-type copper mineralization at depth in the Washougal district of Washington and in the North Santiam district of Oregon (Moen, 1977; Power and Field, 1981).

In this report we present radiometric age determinations for plutonic rocks of the Washougal district (20 m.y.), North Santiam district (13 m.y.), Blue River district (13 m.y.), and the Bohemia district (22 m.y.), and for hydrothermal alteration of the Washougal district (19 m.y.). Peck and others (1964) previously estimated the ages of dioritic plutons in the Western Cascades of Oregon to range from Eocene to late Miocene. The age determinations we report indicate two well-defined episodes of plutonism and associated hydrothermal mineralization at about 13 and 20 m.y., respectively. They are broadly coincident with several episodes of volcanism that culminated at 12, 16, and possibly 22 m.y. in the central Cascade Range of Oregon, according to the data of McBirney and others (1974) and Armstrong (1975), and they fit within the spectrum of ages ranging from 6 to at least 24 m.y. for plutonism and associated porphyry-type mineralization in the Cascade Range of Washington as reported by Field and others (1974), and Armstrong and others (1976). The older episode (about 20 m.y.) that is represented by ages for mineralization and (or) plutonism in the Washougal and Bohemia districts is essentially identical to that of the Glacier Peak porphyry-type deposit (Field and others, 1974) and to early phases of the Tatoosh pluton (Mattinson, 1973) in Washington. The younger episode (13 m.y.), given by ages for intrusions of the North Santiam and Blue River districts, is similar to those ages obtained for later phases of the Tatoosh pluton (Mattinson, 1973). These results document the general contemporaneity of plutonic-hydrothermal events in the Western Cascades of Oregon to their counterparts in Washington. Moreover, they suggest by correlation and inference that porphyry-type copper deposits may be present at depth in the base and precious metal mining districts of the central Oregon Cascades.

Samples were collected by J. P. Olson, S. G. Power, M. P. Schaubs, and A. Schriener, Jr. The K-Ar age determinations were performed at the University of British Columbia. The general procedures for these analyses have been described by Armstrong and others (1976), and the analytical constants used are as follows:

$K_{\lambda\epsilon} = 5.81 \times 10^{-11}$/y; $K_{\lambda\beta} = 4.96 \times 10^{-10}$/y; and $^{40}K = 1.167 \times 10^{-4}$ atom percent.

Argon was determined by isotope dilution and potasium by atomic absorption spectrophotometry. The errors reported are for one standard deviation. Supplemental chemical and petrographic information for these samples may be found in Power and Field (1981) and references cited therein.

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SAMPLE DESCRIPTIONS

1. *WA-058A* K-Ar
Phyllic alteration (1680 ft elev. in Copper Creek near Black Jack Prospect in north-central part of unsurveyed portion of T3N,R5E, Washougal mining district, Skamania Co., WA). Granodiorite completely replaced by quartz, sericite, tourmaline, and pyrite. *Analytical data:* K = 4.62, 4.58%; $^*Ar^{40} = 3.414 \times 10^{-6}$cc/gm (65.1 $\%\Sigma Ar^{40}$).
(whole rock) 19.0 ± 0.7 m.y.

2. *WA-11* K-Ar
"Fresh" granodiorite (200 ft elev. near Black Ledge prospect, north-central part of unsurveyed portion of T3N,R5E, Washougal mining district, Skamania Co., WA). *Analytical data:* K = 1.90, 1.95%; $^*Ar^{40} = 1.476 \times 10^{-6}$cc/gm (25.2$\%\Sigma Ar^{40}$).
(whole rock) 19.6 ± 0.7 m.y.

3. *NS-11* K-Ar
"Fresh" granodiorite (3520 ft elev., SE¼ SE¼ S32,T8S,R5E, North Santiam mining district, Marion Co., OR). *Analytical data:* K = 0.370, 0.368%; $^*Ar^{40} = 0.1928 \times 10^{-6}$cc/gm (13.3$\%\Sigma Ar^{40}$).
(hornblende) 13.4 ± 0.9 m.y.

4. *BR-6* K-Ar
Quartz diorite (4200 ft elev. on ridge NE of Gold Hill, SE¼ NW¼ S32,T15S,R4E, Blue River mining district, Lane Co., OR). *Analytical data:* K = 0.837, 0.829%; $^*Ar^{40} = 0.4358 \times 10^{-6}$cc/gm (10.6$\%\Sigma Ar^{40}$).
(whole rock) 13.4 ± 1.2 m.y.

5. *BO-7* K-Ar
Quartz diorite porphyry (3720 ft elev. in Champion Creek, NE¼ SW¼ S12,T23S,R1E, Bohemia mining district, Lane Co., OR). *Analytical data:* K = 1.38, 1.35%; $^*Ar^{40} = 1.157 \times 10^{-6}$cc/gm (55.9$\%\Sigma Ar^{40}$).
(whole rock) 21.7 ± 0.8 m.y.

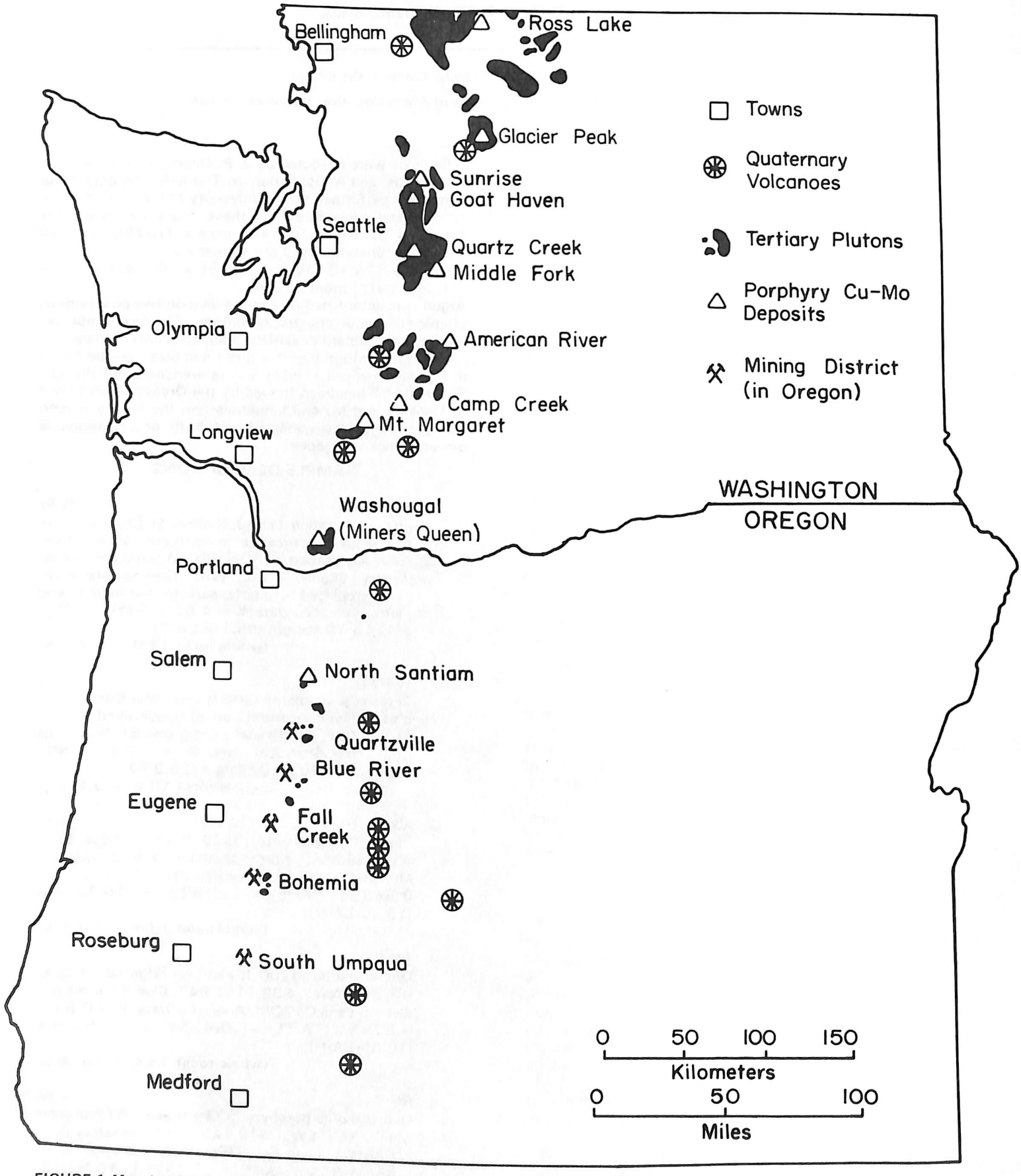

FIGURE 1. Map showing the approximate locations of Tertiary plutonic rocks, porphyry-type copper prospects (from Grant, 1976; Hollister, 1979) and mining districts in the Cascade Range of Oregon and Washington.

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