Geology of the Blue River Mining District, Linn and Lane Counties, Oregon

by

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found as disseminated grains and in the ubiquitous quartz veinlets. Stilbite, chabazite, and natrolite, as distinguished by crystal habit, are the prevalent zeolites found in the district where they fill voids and fractures in the propylitized rocks.

Host rocks subjected to phyllic alteration are found in highly fractured areas and around larger veins (Plate 3). The largest area of phyllic alteration is along the shear zone from the southern half of sec. 29 to the southeast quarter of section 32 (Fig. 16). This type of alteration is fracture controlled and the rocks have been highly shattered. Typically, the rock is completely altered to a very fine-grained mixture of quartz, sericite, and kaolinite. Limonite is widespread throughout the outcrops and indicates the former presence of pyrite. Acid solutions formed during the supergene oxidation of pyrite may produce alteration effects similar to those of phyllic alteration (Rose, 1970). Since the rocks have been exposed to the process of weathering, they have very likely been subjected to supergene alteration. Rose (1970) suggests that kaolinite and sericite can both be produced in the supergene environment. Thus, both hypogene and supergene processes may have been responsible for this alteration assemblage.

Trace Element Geochemistry

The concentrations of trace metals (copper, molybdenum, lead,

Figure 16. Intense shearing and phyllic alteration of volcaniclastic rock (SW 1/4, sec. 29).

zinc, and silver) in stream sediment and rock chip samples are listed in Table 4. Stream sediment samples were collected from most of the major drainages in the district. Rock chip samples were collected from representative intrusive and volcanic rocks, and from their most severely altered equivalents. Threshold values for the Pacific Northwest (Field, Jones, and Bruce, 1973) are presented for comparison, and in most cases closely coincide with, or are greater than approximate values for the Blue River District. Threshold values are defined by Levinson (1974, p. 214) as the upper limit of normal background. Background is the "normal range of concentrations for an element, or elements in an area (excluding mineralized samples)" (Levinson, 1974, p. 213). A metal content of two to three times these threshold values can be considered a significant anomaly indicative of potential metallization (Hawkes and Webb, 1962).

Anomalies in samples of stream sediment appear to be related either to nearby zones of alteration or to outcrops of veins. Notable exceptions are samples SS8, SS9, SS10, and SS11 from the drainage of Tidbits Creek (sec. 22). This anomaly is not evident from either proximity to mineralized outcrops or from metal concentrations from nearby rock chip samples. However, these samples contained an inordinantly large amount of organic matter which sometimes preferentially adsorbs metals (Levinson, 1974), and thus they may represent false anomalies.

Table 4. Trace metal contents (ppm) of representative samples of stream sediments, intrusive rocks, flow rocks, and altered volcaniclastic rocks from the Blue River District compared to background values for the Pacific Northwest (Field and others, 1973).[2, 3]

STREAM SEDIMENTS	Cu	Mo	Pb	Zn	Ag
Background Pacific Northwest[1]	50	<1	30	100	<1
Background Blue River District	35	<1	30	85	<1
SS1	35	1	45	130	<1
SS2	25	1	20	65	<1
SS3	35	<1	20	75	<1
SS4	35	<1	45	125	<1
SS5	30	<1	40	125	1.0
SS6	30	<1	35	115	<1
SS7	35	<1	95	85	<1
SS8	60	<1	130	640	<1
SS9	30	2	25	55	<1.0
SS10	30	8	20	60	1.0
SS11	25	4	25	70	1.0
SS13 Lucky Boy powder	40	3	350	290	1.0

ROCK CHIP	Cu	Mo	Pb	Zn	Ag
Background Pacific Northwest[1]	50	<1	20	60	<1
Background Intrusive Rocks Blue River District	50	<1	15	60	<1
31.8	16	<1	15	35	1.0
32.30	25	<1	14	40	<1
32.32	55	<1	10	40	<1
32.5	40	<1	8	25	<1
29.11	25	<1	5	55	<1
28.38	60	<1	5	30	<1
27.1	14	<1	5	30	<1
22.8a	30	<1	7	35	<1
Background Flow Rocks Blue River District	50	<1	20	55	<1
22.1	16	<1	7	50	<1
21.7	35	<1	5	40	<1
28.29	35	<1	6	40	<1
32.24	40	<1	13	55	<1
5.2 Dacite	60	<1	20	55	<1

	Cu	Mo	Pb	Zn	Ag
Background Volcaniclastic Rocks Blue River District	45	<1	20	60	<1
32.19	45	<1	11	60	<1
33.1	11	<1	5	55	<1
32.27	8	<1	12	60	<1
29.21	20	<1	9	55	1.0
28.4	20	<1	11	55	1.0
28.15	35	<1	6	40	<1
27.2	30	<1	5	35	1.0
21.8 altered	30	<1	10	50	<1
22.4 altered, contains pyrite	12	<1	5	50	1.0
21.5 altered	8	<1	6	75	<1
21.1 altered, contains pyrite	30	<1	5	40	1.0
28.45 mine dump sample, contains pyrite	25	<1	12	160	<1
6.2 altered	25	<1	25	25	1.4
31.3 altered	13	<1	12	85	<1
32.34 vein material	16	4	15	10	2.0
32.26 Treasure Mine dump	40	4	20	480	39.7
32.1 Lucky Boy vein	160	<1	140	120	1.5
29.17 altered	12	<1	5	60	<1
29.22 altered	18	<1	12	55	1.0
28.46 altered	25	<1	7	55	<1
32.29 altered material Lucky Boy vein	12	2	12	14	<1

1-Field and others, 1973; 2- Sample locations on Plate 2; 3- Analyses by Chemical and Mineralogical Services.

Very few of the rock chip samples demonstrate anomalous metal values. The more anomalously high metal concentrations were obtained from samples of altered rock collected from mine dumps, or from the actual veins (Plate 4). Thus, they represent the "high grade" or most metal rich samples available. As expected, samples from the Lucky Boy area (sec. 32, T. 15 S., R. 4 E.) are slightly anomalous. They are correlative with an area characterized by intense phyllic alteration and closely spaced fractures. However, samples from other areas of intense alteration (29.17, 28.46, and 21.8) did not give anomalous values. Supergene processes may be responsible for leaching the metals from these rocks.

In addition, a powder sample (SS13) from the Lucky Boy sluice box was analyzed. Metal values are low (40 ppm Cu, 3 ppm Mo, 350 ppm Pb, 290 ppm Zn, and 1 ppm Ag) and thus, are strongly suggestive of the reason for closing this mine.

Evaluation of Future Potential

In view of the low metal values contained in samples collected both from veins and altered rocks, the Blue River District is not considered to be a priority exploration target for the immediate future. In addition to the low metal values, the district lacks breccia pipes, and tourmaline associated with phyllic and potassic alteration which are commonly associated with porphyry copper systems of the

Cascades and elsewhere.

It is widely accepted that porphyry copper deposits are associated with high level calc-alkaline stocks surrounded by concentrically zoned shells of alteration and mineralization. Lowell and Guilbert (1970) used these zones to create a model for vertical and horizontal zoning in porphyry deposits. Unfortunately, their model does not extend into the unmineralized areas above and below the ore bodies. Therefore, the Blue River District cannot be evaluated in terms of their model. Nevertheless, Sillitoe (1973) has proposed a hypothetical model for the uneconomic upward and downward extensions of these deposits (Fig. 17). Underlying the deposit is an unmineralized pluton of large dimensions and dominantly of a phaneritic texture. Upward, a porphyritic phase becomes predominant (generally thought to be a cupola) and which is directly associated with zones of mineralization and alteration. Potassic alteration is predominant in the deeper and central parts of the deposit whereas phyllic and argillic alteration become increasingly important upward. At the levels of most intense argillic and phyllic alteration, smaller intrusions and hydrothermal breccias are common. In many systems, the volcanic superstructure is encountered, in which alteration is distributed irregularly, and is largely fracture-controlled. Silicification and advanced argillic alteration are encountered along with ubiquitous pyrite. Intrusive rocks are dike-like in form, and hydrothermal breccias may be common.

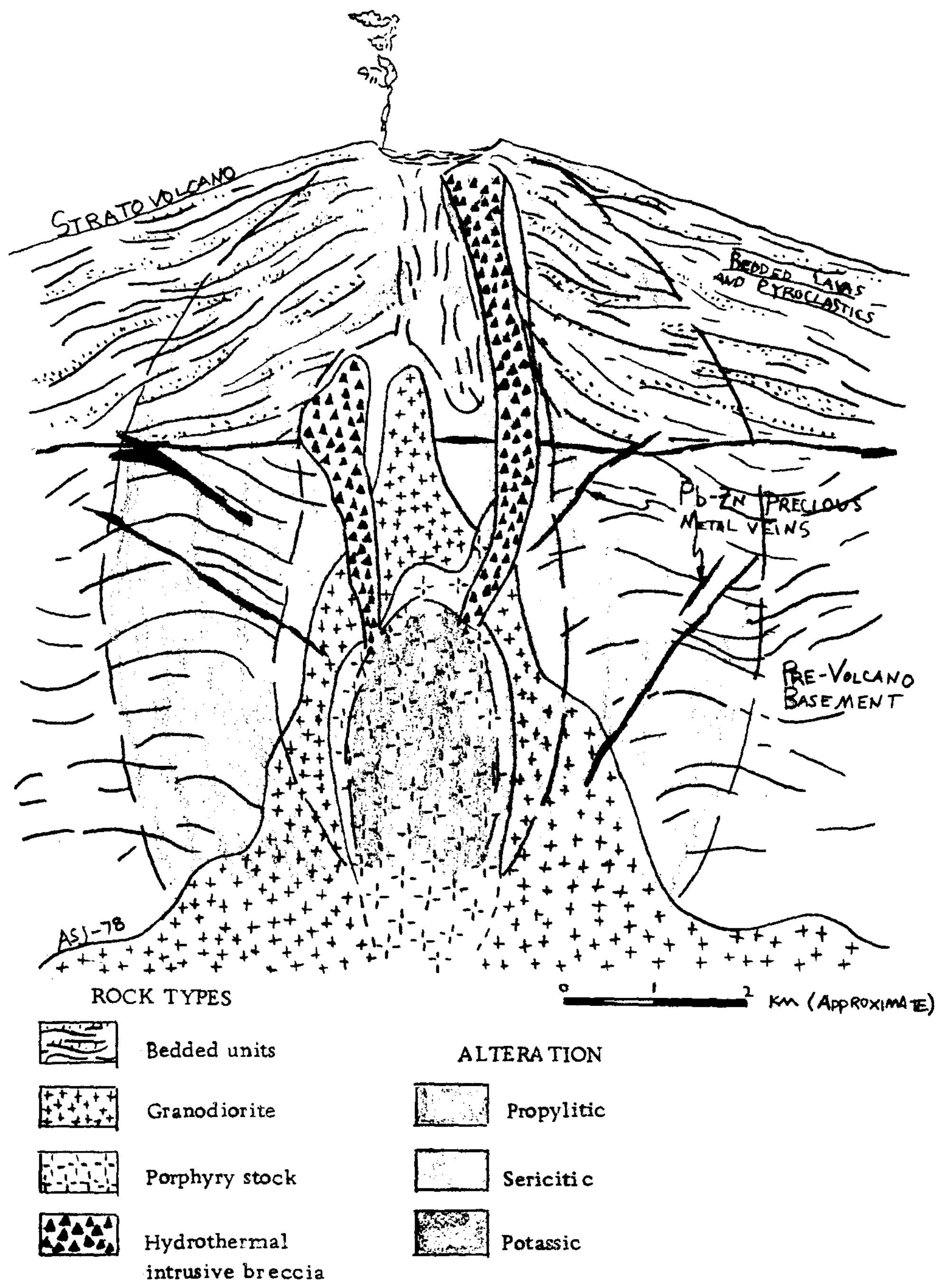

Figure 17. Idealized cross section of a typical, simple porphyry copper deposit (after Sillitoe, 1973).

"Epithermal" veins containing copper, lead, zinc, and precious metals may be present at this level. The "top" of the porphyry system is characterized by fumaroles which deposit native sulfur, and sometimes pyrite and marcasite. The model is, of course, generalized and oversimplified. Nevertheless, it is a useful tool in evaluating the hydrothermal districts of the Cascades.

The districts of the Western Cascades range from those containing only a few small intrusions, small areas of silicification, and virtually lacking in base metals (Fall Creek District, Oregon) to those with abundant base and precious metal veins, intense phyllic alteration (with tourmaline), abundant breccia pipes, and larger stock-sized intrusions (Bohemia District, Oregon). Farther north in the Washington Cascades a deeper level of erosion exposes several porphyries (Glacier Peak, Quartz Creek, Middle Fork, etc. Grant, 1969). Thus, the hydrothermal deposits of the Cascade Range may represent the full spectrum of different levels of erosion in hydrothermal systems associated with porphyry-type deposits.

Based on the Sillitoe (1973) model, the Blue River District is eroded to the depth of abundant pyrite, fracture-controlled alteration, and small dike-like intrusions. If economic mineralization exists in the Blue River District, it may be as deep as 2 to 3 kilometers beneath the present surface of erosion as deduced from geologic and mineralogical criteria suggested by Sillitoe (1973), Rose (1970), and

Lowell and Guilbert (1970). The inferred high-level of exposure for the district is consistent with the small dike and stock-like plutons, predominantly propylitic alteration with minor fracture-controlled phyllic assemblages, and mineralization characterized by small "epithermal" veins and pyrite disseminations.

Because of the high costs associated with exploration, development, and mining of mineral deposits at such a great depth, the Blue River District can, at best, be considered an exploration target and possible resource of the future, and then only if new mining techniques are developed for the extraction of metals from such depths.