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Precious Metals in the Northern Cordillera
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A PRELIMINARY ANALYSIS OF GOLD AND SILVER GRADES OF PORPHYRY-TYPE DEPOSITS IN WESTERN CANADA

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ABSTRACT

Au and Ag average grades of prophyry-type deposits in Western Canada group in a manner surprisingly consistent with existing classifications, *viz.*, depth zone and petrologic affinity of related plutonism. Probability graphs, scatter diagrams and triangular plots are used as data display techniques that lead to some insight to porphyry systems regarding their precious metal average abundances and the use of these abundances in the development of an empirical classification scheme for porphyry-type deposits of the Canadian Cordillera.

INTRODUCTION

A substantial literature exists relating to the implications of the gold contents of porphyry-type deposits. The reported studies mostly deal in a very general way with deposits on a world-wide scale and utilize gold and molybdenum data as a means of classifying porphyry-copper deposits. For example, Kesler (1973) was the first to utilize abundant assay data to suggest that Cu-

Mo and Cu-Au represent two distinctive metal associations within the porphyry copper class of deposits. He concluded that these categories correlated roughly with tectonic environment, *viz.*, continental environments containing mainly Cu-Mo porphyry deposits whereas island arc environments contain mainly Cu-Au porphyry deposits. Hollister (1975) related the Au-rich and Mo-rich categories to the diorite and Lowell-Guilbert models, respectively. More recently, Sillitoe (1979) examined world-wide examples of Au-rich porphyry copper deposits and found them to be characterized by: feldspar stable alteration; correlated Au and Cu grades; lack of correlation between pyrite and Au contents; abundant magnetite; and abundant clear quartz of replacement origin. He defined Au-rich porphyry-copper deposits arbitrarily as those with average grades greater than 0.4 g/t. In addition, Sillitoe (1979) concluded that the following factors had no apparent relation to Au content of porphyry copper deposits: geotectonic setting; age; composition of host intrusions; occurrence of sericitic alteration; deposit size; wallrock composition; and erosion level.

All these studies suffered a number of problems that in general were recognized by the respective authors and included: (1) difficulty of taking mineral zoning into account adequately; (2) grades and tonnages were estimated based on variable cut-offs; (3) supergene and hypogene grade data are not distinguished; and (4) metal recovery is variable and production figures may be strongly biased relative to true metal content, particularly in Mo and Au estimates. We have attempted to overcome these problems as much as possible in examining the precious metal contents of porphyry-type deposits in Western Canada. Our study is more specific than earlier published accounts because it is confined to a specific region and a more restricted range of tectonic environments than most previous studies. On the basis of preliminary gold and silver grades for a small subset of Western Canadian porphyry-type deposits, Drummond and Godwin (1976) conclude that alkaline and calc-alkaline categories "are not discriminated by the amounts of contained gold and silver". Part of the purpose of our study was to test the validity of this statement.

In the following account, the initial section on univariate and bivariate classification is the responsibility of Sinclair and Dawson, whereas the latter section dealing with triangular plots and their implications is the responsibility of Drummond and Carter.

Data Base

We have compiled a comprehensive data base for Cu, Mo and precious metal contents of the 28 principal porphyry-type deposits in the Canadian Cordillera (Table 1). High quality information of this type is essential in order to characterize or classify porphyry-type deposits in terms of various metals as attempted by Kessler (1973) and Sillitoe (1979). Our information

Table 1. Tonnage, metal grades, deposit classification and dominant alteration categ
for principle porphyry-type deposits in the Canadian Cordillera.

	Deposit	tonnes[1]	Cu%	Mo%	Average Grades[2] Au ppm	Ag ppm	Deposit Class[4]	Alteration Class[3]	Source
1.	Bethlehem, Jersey-Iona	54	0.420	0.010	0.010(a)	0.10(a)	PLUT	5	1979 Annual Bethlehem
2.	Bethlehem Lake Zone	190	0.420	0.017	0.010(b)	0.10(b)	PLUT	5	1979 Annual Bethlehem
3.	J.A.	260	0.430	0.017	0.010(b)	0.10(b)	PLUT	5	1979 Annual Bethlehem
4.	Lornex	477	0.410	0.015	0.006(a)	1.20(a)	PLUT	5	Lornex Staff
5.	Valley Copper	800	0.480	0.003	0.006	1.90	PLUT	5	CIM Spec. Vo
6.	Highmont	135	0.280	0.031	0.004(a)	0.90(a)	PLUT	5	CIM Spec. Vo Staff
7.	Brenda	160	0.180	0.050	0.013	0.63	PLUT	3	CIM Spec. Vo
8.	Gibralter	327	0.370	0.010	0.007(b)	1.03(b)	PLUT	5	CIM Spec. Vo
9.	Island Copper	254	0:520	0.018	0.094	0.63	VOLC	5	CIM Spec. Vo
10.	Schaft Creek	330	0.400	0.022	0.320	1.50	VOLC	3	CIM Spec. Vo
11.	Granisle	85	0.430	0.009	0.120	1.12	PHAL	3	
12.	Bell Copper	66	0.480	0.006	0.350	1.00	PHAL	3	CIM Spec. Vo
13.	Morrison	86	0.420	0.017	0.340	1.00	PHAL	4	CIM Spec. Vo
14.	Berg	400	0.400	0.030	0.050(b)	5.00(b)	PHAL	3	CIM Spec. Vo Staff
15.	Huckleberry	85	0.410	0.015	0.025	0.93	PHAL	5	CIM Spec. Vo
16.	Fish Lake	50	0.300	0.002	0.470	2.30	PHAL	4	CIM Spec. Vo Bethlehem
17.	Poison Mountain	175	0.330	0.015	0.300	3.10	PHAL	4	CIM Spec. Vo Lac Min. Ex
18.	Casino	162	0.370	0.023	0.320(b)	1.75(b)	PHAL	3	CIM Spec. Vo Staff
19.	Copper Mountain	142	0.570	0.001	0.170	3.90	VOLC	6	CIM Spec. Vo Newmont S
20.	Ingerbelle	52	0.430	0.002	0.160	0.63	VOLC	6	CIM Spec. Vo Newmont S
21.	Afton	32	1.030	0.001	0.600(a)	4.00(a)	VOLC	6	CIM Spec. Vo Staff
22.	Cariboo-Bell	50	0.490	0.001	0.680	4.50	VOLC	6	CIM Spec. Vo Staff
23.	Galore Creek	125	1.100	0.001	0.400	7.70	VOLC	6	CIM Spec. Vo
24.	Red Chris	41	0.560	0.003	0.320	1.50	VOLC	6	Texas Gulf Sta
25.	Endako	232	0.002(b)	0.081	0.005(b)	0.70(b)	PLUT	3	Placer Staff an Annual Rep
26.	B.C. Moly (Kitsault)	105	0.004	0.120	0.010(b)	4.60	PHAL	3	Amax Staff
27.	Bell Molybdenum	32	0.003	0.066	0.005(b)	0.80	PHAL	3	CIM Spec. Vo Amax Staff
28.	Adanac	101	0.001(a)	0.080	0.010(b)	0.20(b)	PLUT	3	CIM Spec. Vo Staff

1. Millions of tonnes
2. (a) Production
(b) Estimated
3. Alteration: 3 K-spar-Biotite; 4 Biotite; 5 Sericite; 6 K-spar-Biotite/Chlorite (Diorite model type)
4. PHAL = CLASSIC (McMillan and Panteleyev, 1980)

represents porphyry-type deposits in a relatively uniform, large-scale tect
setting in that: (i) nearly all are in or along the fringe of the Intermon
Belt; (ii) tonnages and grades are based mostly on a common cut off grad
about 0.2 percent copper or copper equivalent; and (iii) the reserves in q
tion relate almost exclusively to hypogene ores.

Our data base began with information in CIM (Canadian Institut
Mining and Metallurgy) Special Volume 15 (the "porphyry volume")
most figures were updated through discussions with mine and/or other c
pany personnel. In some cases, doubt existed as to true Au and Ag cont
because only values for related Cu concentrates were available as d
mented in Table 1. In general, data were accepted as supplied by min
exploration personnel without modification. The eventual data base inclu
reserves, Cu and Mo grades as ppm, classification (plutonic, classic (pha
or volcanic), and dominant alteration category (K-spar, biotite, sericite

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UNIVERIATE AND BIVARIATE GRAPHS

'ivariate and Bivariate Plots and their Implications

Our initial study was directed towards recognizing natural groupings or tematic relationships in the average grade data independent of geological ails. Consequently, we examined variables by a variety of simple pro-lures that have been shown elsewhere to be useful (e.g., Sinclair, 1979). ans and standard deviation of raw and log transformed variables are roduced in Table 2. Standard deviation of raw data are of the same order as

Table 2. Statistical Summary.

'ne	No. of Values	Arithmetic Mean	Arithmetic Std. Dev.	Logarithmic Mean	Logarithmic Std. Dev.
Tonnes	28	178.9	168.6	2.101	0.3677
Cu(%)	28	0.4014	0.2504	−0.6878	0.8354
Mo%	28	0.0238	0.0295	−1.970	0.6251
Au(ppm)	28	0.1720	0.2011	−1.284	0.8034
Ag(ppm)	28	1.886	1.585	0.0476	0.5097

ı = Reserves in millions of metric tons
ırithms are to base 10

means indicating that none of the variables have normal distributions. nce, we examined a log probability graph of each variable as a method of mining the forms of density distributions. Results for tonnage, copper molybdenum indicate:

tonnage is lognormally distributed;

mean Cu grades consist of two normal distributions, one of which coincides with porphyry Cu-Mo deposits and the other with porphyry Mo (Cu-Au?) deposits; and

molybdenum values appear to define 3 lognormal populations with thresholds at 0.08, and 0.005% Mo.

Results for gold and silver are of particular interest here and will be con-ered in more detail.

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A probability graph for Au shows the presence of two lognormal popula-s that are separated effectively at a threshold of 0.034 g/t (Fig. 1). The er population consists of all the Highland Valley deposits, Brenda,

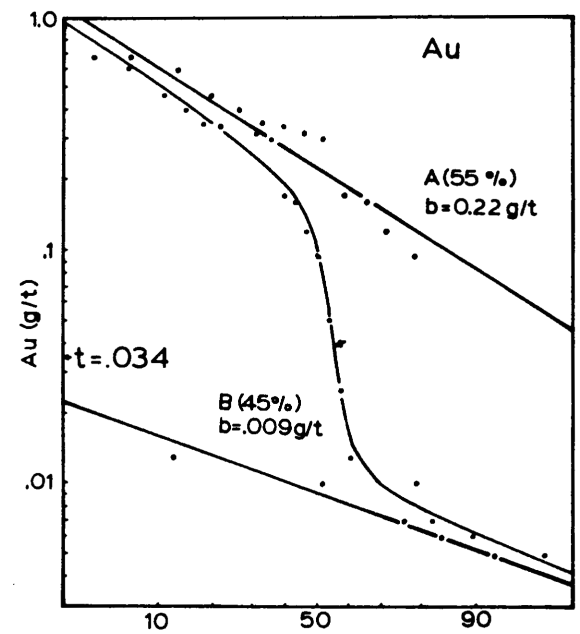


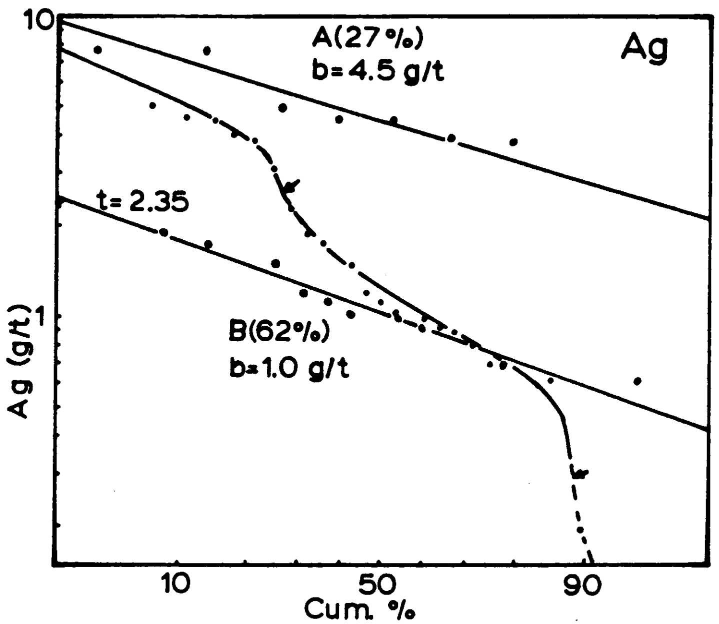
Fig. 1. Log probability graph for average gold grades of Western Canadian porphyry-type deposits. Data from Table 1.

Gibralter, Huckleberry and three of four porphyry molybdenum deposits. Of these 11 deposits only 3 (Huckleberry, B.C. Moly and Bell Molybdenum) are not plutonic. Of the porphyry copper deposits in the group, the one non-plutonic (Huckleberry) is very close to the threshold. It appears that the plutonic category forms a distinctive group low in gold content. The implication of this association is not entirely clear. One possible explanation may lie in the source of gold being the country rock. Classic and volcanic classes of porphyry deposits might be expected to contain more gold than the plutonic class of deposit because of the relatively high gold content expected in associated sedimentary and volcanic rocks in contrast with plutonic rocks.

The remaining group of 16 porphyry copper-molybdenum deposits with relatively high gold values appears to form a single clearly defined population that includes both alkaline and calc-alkaline classes. We have tested a long-standing suggestion that deposits in the alkaline category have higher gold contents than do deposits in the calc-alkaline group. Five alkaline deposits have a mean gold content of 0.40 g/t with a standard deviation of 0.24 g/t. Ten calc-alkaline deposits have a mean gold content of 0.27 g/t with a standard deviation of 0.13 g/t. These two populations can be shown by F and t tests to have indistinguishable dispersions and mean values at the 0.05 level. With present data there seems to be no compelling evidence for higher Au contents in alkaline as opposed to calc-alkaline porphyry deposits in the Canadian Cordillera, providing the plutonic category of deposit is excluded

the comparison. What appears to be a more fundamental feature of gold
:s of porphyry deposits is that the plutonic group of porphyry copper
its plus the porphyry-molybdenum deposits form a category that is
mally low in mean gold contents relative to other types of porphyry
its.

\ probability graph for Ag (Fig. 2) indicates the possibility of three
lations in the proportions 27:62:11. The lower 11 percent is a single set
ee rough estimates from the Highland Valley, the validity of which is
onable. Consequently, here we consider that only two populations of
icance are represented, 27 percent of an upper group and 73 percent of a



Log probability graph for average silver grades in Western Canadian porphyry-type
s. Data from Table 1.

group. The two groups are separated clearly by a threshold at 2.35 g/
All but one of the alkaline group of deposits contains Ag in amounts
: the threshold. The five alkaline deposits have a mean Ag content of
/t with a standard deviation of 2.51. In contrast, 15 porphyry copper-
denum deposits (excluding the three values in the lowest population,
ll porphyry molybdenum deposits) have a mean value of 1.66 g/t with a
ard deviation of 1.12. These mean values are significantly different at
05 level.

Scatter Diagrams

The fact that single variables can be divided readily, if empirically, into sub-populations suggests that clearer separations of groups might emerge if 2- or 3-dimensional plots were examined. In particular, some insight into classification of porphyry-type deposits could result perhaps by the recognition of clustering or compositional trends. As a first attempt we have plotted a scatter diagram for log-transformed values of Cu *vs.* Mo and Au *vs.* Ag compartmentallized on the basis of thresholds recognized previously (figs. 3 and 4). This method of separating fields leads to a nearly perfect division based on existing nomenclature for porphyry-type deposits of the Canadian Cordillera. The Cu *vs.* Mo plot (Fig. 3) provides a clear distinction between porphyry copper and porphyry molybdenum deposits, and emphasizes the fact that the

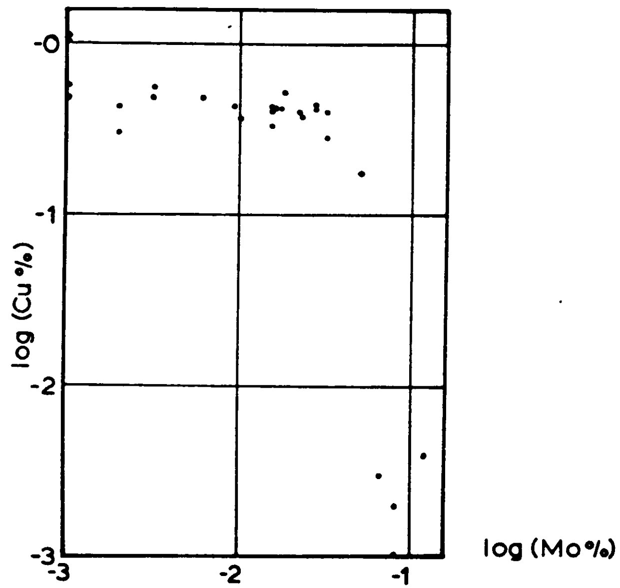
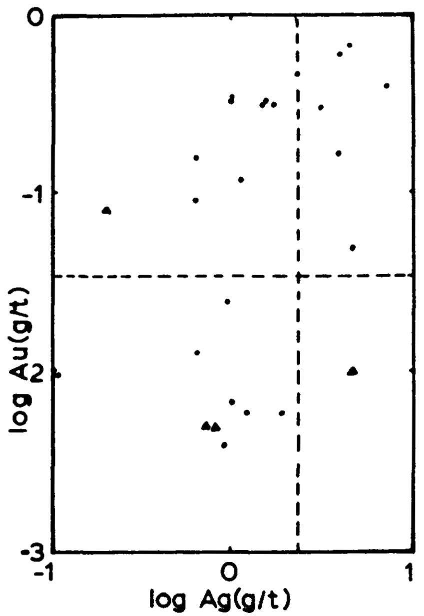


Fig. 3. Scatter diagram of $\log_{10}$ transformed average copper and molybdenum grades for Western Canadian porphyry-type deposits. Raw data from Table 1.

Brenda deposit, commonly considered an intermediate example between the two end members, clearly belongs to the porphyry copper category. The Au *vs.* Ag plot (Fig. 4) is divided into plutonic and non-plutonic fields based purely on absolute gold abundance, and the non-plutonic field is easily subdivided on the basis of Ag abundance into calc-alkaline and alkaline fields.

These two scatter diagrams have fields determined by clustering of compositions of porphyry-type deposits that are remarkably similar to existing classification schemes (i.e., Mo or Cu, plutonic or non-plutonic, alkaline or calc-alkaline) as described by Sutherland Brown (1976) and Ney and Hollister (1976).



;. 4. Scatter diagram of $\log_{10}$ transformed average gold and silver grades for Western Cana-
ın porphyry-type deposits. Raw data from Table 1.

TRIANGULAR DIAGRAMS

Triangular graphs are used routinely to display relative compositions of ımples in terms of three variables. When applied to elements of low abun- :nce levels, indications of *absolute* element abundances are lost; however, :formation on relative abundances is still retained in the diagram. A sec- nd important feature to bear in mind is that because such metal abundances ·mmonly differ by several orders of magnitude, it is common practice to ıultiply one or two of the elements by an appropriate multiplication factor :fter all are in the same units) so that plotted points spread over much of the ·iangular field. This procedure results in a drastic distortion of the ratio :ales that are implicit in such diagrams and the reader should be forewarned í this situation. For example, a line drawn from vertex A to the mid point of :e opposing side BC normally represents a B/C ratio of 1. However, if B has :en multiplied by 10 and C by 10,000, this centrally located line represents a ·ue B/C ratio of 0.001. Finally, it is important to bear in mind that errors in :tios are substantially greater than errors in individual absolute values. For :ample, a relative error of 20% in each of two elements leads to a relative :rror or nearly 30% in the resulting ratio, assuming the two elements are ıdependent and considering random error only.

Cu-Mo-Au-plot

A triangular Cu-Mo-Au plot for porphyry-type deposits in Western Canada is shown in Fig. 5 and is based on multiplication factors for Mo and

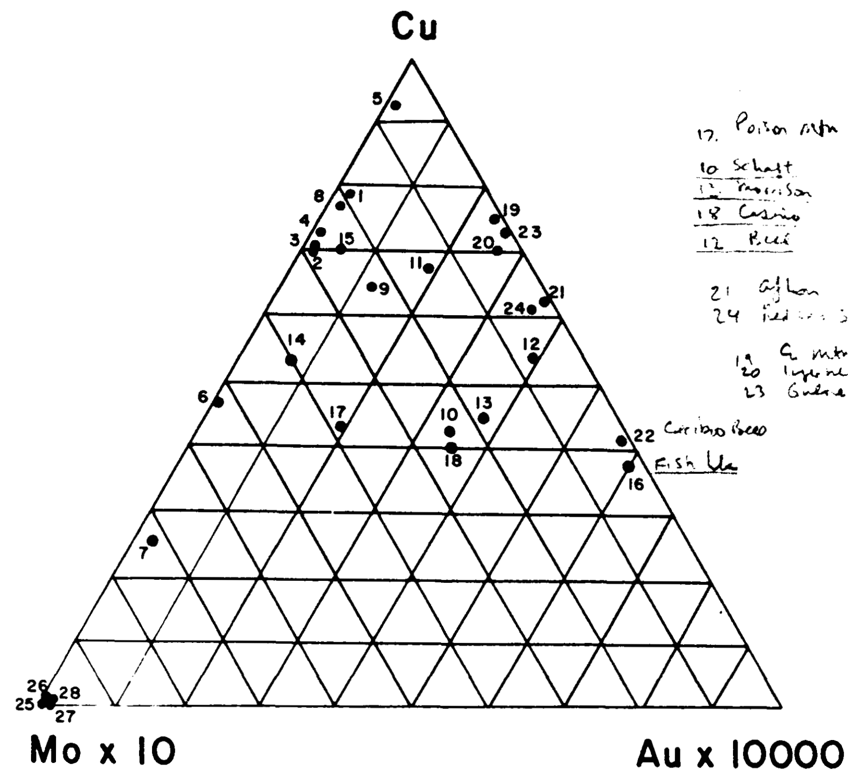
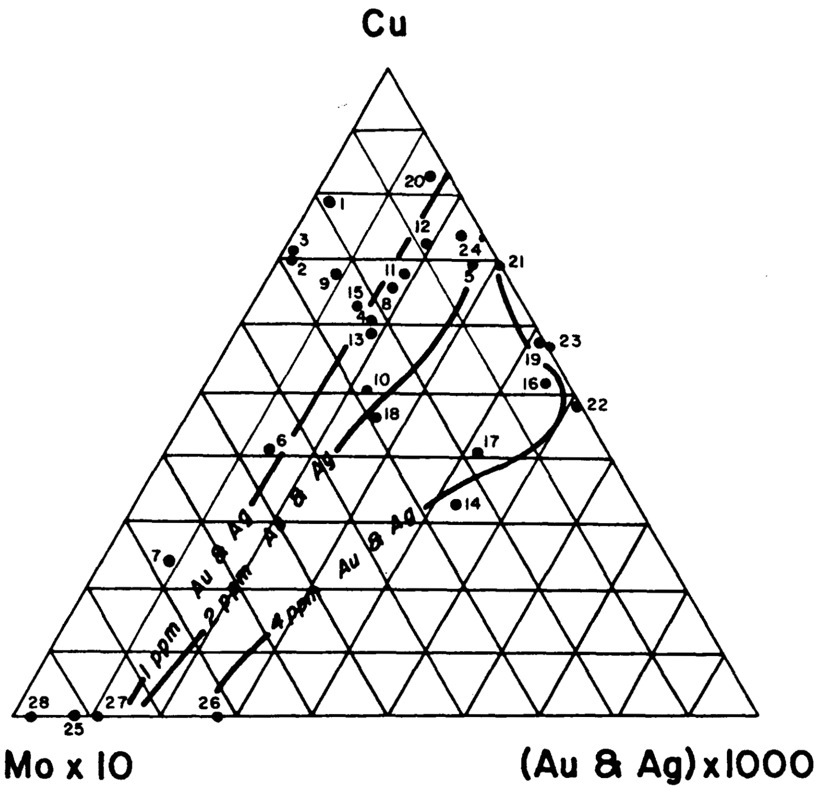


Fig. 5. Copper-molybdenum-gold triangular graph for Western Canadian porphyry-type deposits. Multiplication factors are those of Kesler (1973) for ease of comparison with precious work. Numbers correlate with order of listing in Table 1.

Au of 10 and 10,000 respectively so that the graph is directly comparable to one published earlier by Kesler (1973) for a different but overlapping sub-set of porphyry-type deposits. This figure emphasizes the generally continuous distribution of porphyry copper data over the triangular field as opposed to the bipartite grouping recognized by Kesler using identical plotting procedures (i.e., same multiplication factors).

Cu-Mo-(Au + Ag) plot

One means of taking the Ag grades of porphyry-type deposits into account is illustrated in Fig. 6 which is an attempt to combine 4 elements into a single triangular graph. Note that the multiplication factor for (Au + Ag) is 1000 in this case compared with 10,000 in Fig. 5 in order to disperse plotted



g. 6. Copper-molybdenum-(gold plus silver) triangular graph for Western Canadian porphyry-pe deposits. Note change in multiplication factor for precious metal vertex compared with Fig. Contains one absolute combined (gold plus silver) average grades in g/t (ppm). Numbers are der of listing of deposits in Table 1.

ints as much as possible over the triangular field. In an effort to re-roduce absolute abundance levels into the diagram an attempt was made to nd contour the combined Au and Ag grades for each deposit plotted in Fig. Results are shown as 1, 2 and 4 ppm (g/t) contours that show a surprisingly gular distribution pattern. The diagram shows clearly that for the sub-set of eposits considered here, porphyry deposits containing negligible Mo or neg-gible Cu have relatively low combined Au + Ag values, whereas porphyry opper deposits with at least a small Mo content have the highest combined recious metal contents. Of course, this relationship provides no clue to the u/Ag ratios for the deposits. These data are summarized for various assification schemes in Table 3 and are more-or-less in agreement with the inge of 0.001 to 0.1 tabulated by Boyle (1979, Table 43, p. 202).

Dominant alteration category can also be examined usefully on an ppropriately coded triangular diagram. The alteration categories and results nat we have used are modified only slightly from Dummond and Godwin

Table 3. Summary of average Au/Ag ratios.

Deposit Category	*Average Au/Ag ratio*
A. Porphyry Cu-Mo	
Plutonic (8)*	0.011
Classic + Volcanic (10)	0.13
B. Porphyry Mo	
Plutonic (2)	0.017
Classic (2)	0.003
C. Alkaline (6)	0.105

* Number in bracket is the number of deposits in each category.

(1976): *viz.*, (i) the pair K-feldspar-biotite; (ii) predominantly biotite; (iii) predominantly sericite; and (iv) K-feldspar-biotite-chlorite associated with the alkaline category of deposit. These principal alteration types are coded in Fig. 7 where it is apparent they define distinctive if overlapping fields. One of

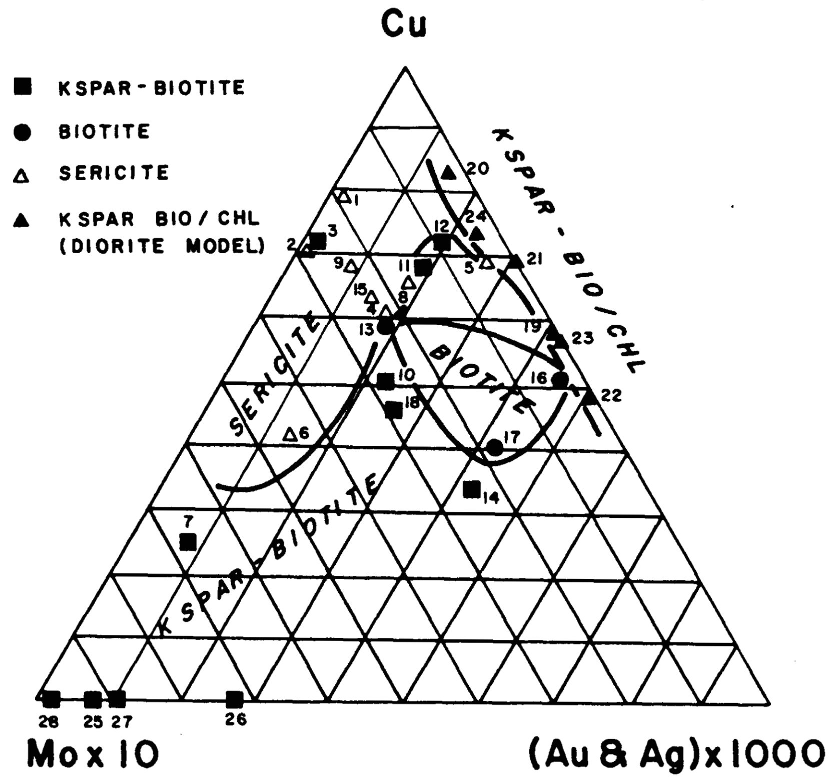
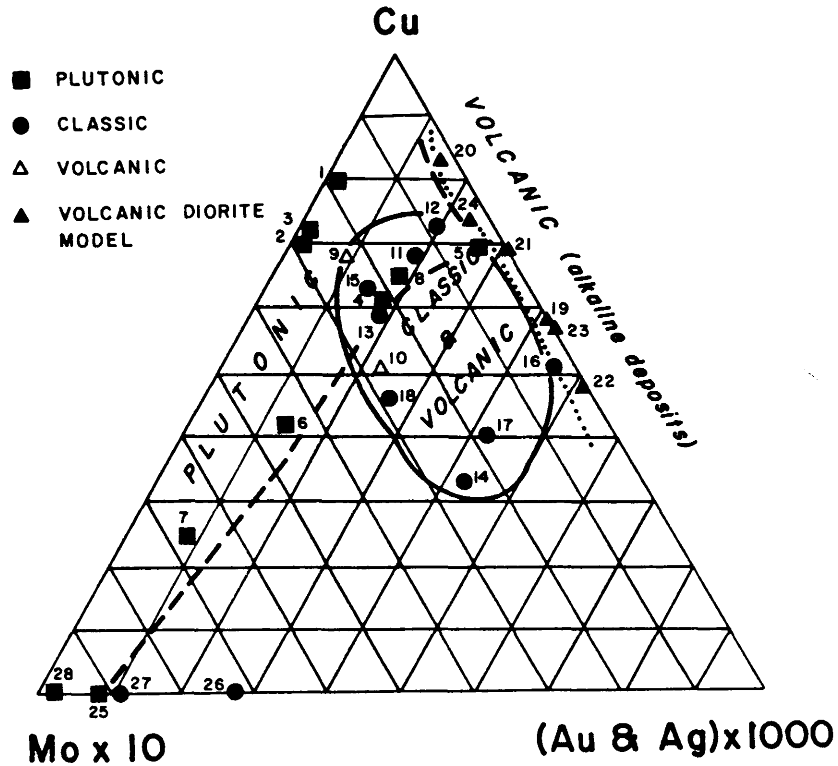


Fig. 7. Copper-molybdenum-(gold plus silver) triangular graph for Western Canadian porphyry-type deposits coded as to characteristic alteration type. Numbers are order of listing of deposits in Table 1.

he most significant observations is that high combined precious metal con-ənts (absolute amounts as contoured in Fig. 6) are centred on the field of otassic alterations including biotite and K-feldspar-biotite. This relation is ɜss clear if Au or Ag alone is considered on such a plot in place of combined Ag + Au).

A triangular plot can also be used as a framework for discussing the lassic-volcanic-plutonic classification scheme (Fig. 8). Volcanic and classic



ɨig. 8. Copper-molybdenum-(gold plus silver) triangular graph for Western Canadian porphyry-ype deposits coded as to depth-zone classification.

calc-alkaline deposits plot as a group that partly overlaps the field of plutonic deposits. Volcanic deposits of alkaline affinity plot in a distinctive field that is notably deficient in Mo relative to other categories. Whether these categories truly represent a depth zone classification is subject to question but what is apparent is the dramatically different Cu-Mo-(Au + Ag) fields that each of these categories define. The most obvious relationship is the low combined precious metal contents of plutonic deposits relative to both classic and volcanic categories. Porphyry-molybdenum deposits have a (Au + Ag) precious metal range closer to the plutonic than the other groups. Average concentrations and ranges of Cu, Mo, Ag and Au are plotted versus an arbitrarily chosen depth scale in Fig. 9 where straight lines labelled by element are

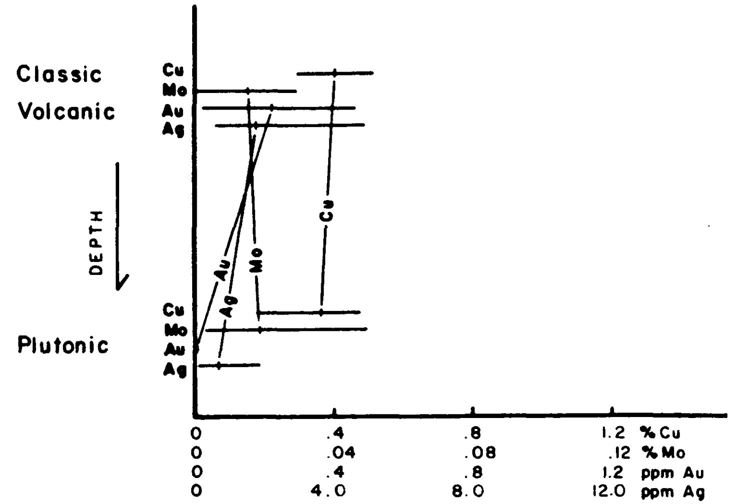


Fig. 9. Variations in mean metal grades as a function of depth-zone category. The "depth" scale is arbitrary. Note that the scale for metal abundances differ for each metal. Plot is for porphyry copper deposits only.

idealized, possible linear depth-concentration models. Such a diagram is highly subjective but indicates the author's biases. It appears that precious metals show a greater proportionate variation as a function of the depth-zone categories than do either Cu of Mo.

DISCUSSION

The foregoing account demonstrates that Western Canadian porphyry-type deposits do not support a clear division into Cu-Mo and Cu-Au categories. Our data show that Au and Ag are commonly present in small but variable amounts in all standard classes of porphyry-type deposits. Simple statistical tests show that two Au populations corresponding to plutonic and non-plutonic categories of Sutherland Brown's (1976) depth-zone classification are clearly separable at a threshold of approximately 0.034 g Au/t. This threshold is an order of magnitude less than the arbitrary lower limit of 0.4 g Au/t selected by Sillitoe (1979). For porphyry deposits of the Canadian Cordillera the 0.034 g Au/t threshold appears to provide a more fundamental division than does the 0.4 g/t value.

Our work has shown that average Au grades are essentially the same in porphyry copper deposits of the calc-alkaline and alkaline classes providing plutonic deposits are omitted from the comparison. A somewhat surprising feature is the importance of Ag in distinguishing deposits of alkaline and calc-alkaline affinities. A threshold of 2.35 g Ag/t clearly separates a relative Ag-rich group of "alkalic" porphyry-copper deposits from lower Ag values for "calc-alkalic" porphyry copper deposits.

A tentative classification scheme for western Canadian porphyry deposits is reproduced in Fig. 10 based on the two thresholds referred to above for Au and Ag respectively.

Our data are consistent with many of the contentions by Sillitoe (1979) in relation to Au-rich porphyry copper deposit with minor modifications to take Ag into account. In particular, Canadian deposits support the generalization that high combined (Au + Ag) grades are most common with deposits characterized by potassic alteration involving biotite-K-feldspar or biotite. Porphyry deposits generally classed as Cu-Mo deposits are highest in combined (Au + Ag) contents compared to Cu-deposits without Mo or Mo

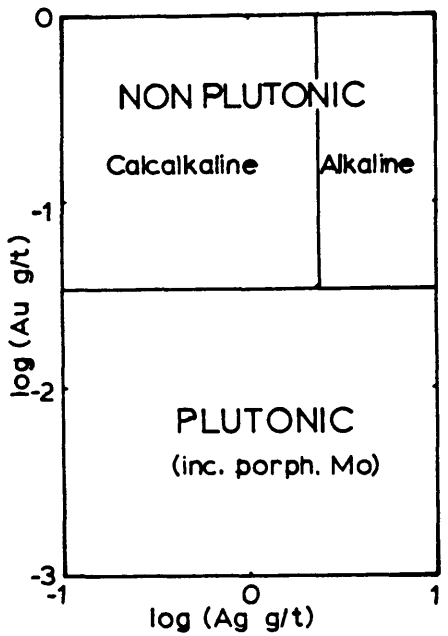


Fig. 10. Tentative empirical two-way classification scheme for Western Canadian porphyry-type deposits based on log transformed mean grades of gold and silver. Field boundaries are the two thresholds defined in Figs. 1 and 2.

deposits without Cu. The so-called depth-zone classification of Sutherland Brown appears to be a fundamental framework within which to categorize porphyry deposits although in our precious metal data we have found no particular support for the depth significance of his morphological classes.

Nor are we able to offer clearcut evidence for a relation between tectonic setting and precious metal content of porphyry deposits. Reference has already been made to our disagreement with Kesler's (1973) division of deposits into clearcut Cu-Au and Cu-Mo classes. We have found a complete and somewhat gradational range of relative values on a Cu-Mo-Au plot. Titley (1978) recognized a broad distribution of values on a Cu-Mo-Au plot for porphyry Cu deposits of the southwestern and western Pacific. In our case, it would appear that the "depth zone" classes, in representing local

environments of formation of porphyry-type deposits, has exerted a controlling influence on the precious metal contents of Western Canadian deposits. If local environments are a principal factor related to precious metal content, one is led to suspect that metals may have been derived locally, at least in part.

CONCLUSIONS

Available data for porphyry-type deposits of the Canadian Cordillera indicate a remarkably successful classification scheme based on mean grades of gold and silver. In combination with a more traditional Cu-Mo plot it appears that such two-dimensional classification schemes provide an adequate means of grouping porphyry-type deposits, and support the validity of existing classifications in terms of the chemistry of associated plutonic rocks, and the so-called depth zone classifications. A Ag-Au diagram is particularly useful in classifying major porphyry-type deposits in the Canadian Cordillera. Statistical tests with available quantitative data indicate that the gold contents of alkaline and calc-alkaline porphyry-copper deposits are similar providing representatives of the plutonic class are not included in the comparison.

New assay data and changing economics have renewed interest in the precious metal contents of all classes of porphyry-type deposits. This paper has shown that silver is an integral part of the precious metal equation and as such must be included in the definition of the various deposit types. The role of precious metals in the porphyry environment has developed intermittently during the last ten years. Our paper is but another review to assist in the understanding of the various "porphyry" environments.

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APPLICATION OF EXPLORATION CRITERIA FOI GOLD DEPOSITS IN THE SUPERIOR PROVINCE C THE CANADIAN SHIELD TO GOLD EXPLORATION THE CORDILLERA

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ABSTRACT

A comparison of the geological characteristics of the main past- and curr producing gold mining camps and deposits in the Superior Province and the dillera of Canada suggest that the most important geological criterion for area tion at the camp scale in both areas is a mafic volcanic rock sequence with asso ultramafic rocks within or near the proposed exploration area. A sedime volcanic sequence contact is present in almost all major camps in the Superior ince, and all major camps in the Cordillera and, therefore, is also an importa terion at the regional scale of area selection. Major faults, on the other hand, to be a less important criterion. At the mining property scale of area selectio presence of felsic intrusive and/or extrusive rocks is important, as is alte (dominantly carbonate-dominated in the Shield and prophylitic, clay and silicifi in the Cordillera) and structural complexity. Lithogeochemical surveys may a used to select mining properties, although there are few published case histor the orebody scale of exploration, structure is the most important feature to co in both the Shield and Cordillera.

INTRODUCTION

Most Canadian gold production has come from the large, "gold- deposits of the Canadian Shield, in particular the Superior Province Canadian Shield. Although these deposits are geologically variable, and (perhaps most) contain orebodies that formed at different times, a different processes (i.e., are polygenetic), they have a number of imp common geological features. These common features, and those of th ing camps in which the deposits occur, constitute useful geological gui exploration (Hodgson and MacGeehan, 1981). The lode gold deposits Canadian Cordillera are much less economically important than the de