A Global Economic Perspective on Selecting Appropriate Mineral Exploration Targets in the Western Canadian Cordillera

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The identification and evaluation of appropriate exploration targets in our contemporary mineral industry is an art fraught with complexity, risk and large doses of courage on the part of practitioners. This paper seeks to provide some understanding of this exercise by describing a suitable conceptual framework and separating what the author regards as fundamental factors from those which are more esoteric in nature. In simple terms, the task is to identify minerals in the Cordillera which explorationists should be looking for in the next few years. To be effective, this task would require the evaluation of a host of complex market and political issues along the lines of periodic exercises conducted by firms such as the Commodities Research Unit, Chase Econometrics and others. The author intends that this paper provide some guidance on the interpretation and influence of factors which he regards as being important to exploration target selection.

The paper starts with an examination of the historical and current supply status of the major western Canadian cordilleran minerals which involves current production, costs of extraction, capacity utilization and related market and pricing data. From this basis, short to medium term market trends are postulated for the major mineral commodities found in this region, i.e., copper, lead, zinc, molybdenum and precious metals. These trends are based on the author's interpretation of key influencing factors pertinent to the conceptual approach framed in the paper. The key factors are seen to be relevant on a global scale and relate as much to emerging geopolitical and technological environments as to emerging economic growth scenarios. The paper concludes with some subjective observations on where exploration efforts might be directed given the short term market outlook developed in the paper.

Bulk-Minable Gold Deposits in Nevada

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Between 1859 and 1962 the recorded gold production in the State of Nevada was slightly more than 27,000,000 ounces. That amount is exceeded by reserves totaling nearly 34,000,000 ounces discovered in the 20 year period from 1962 to 1982.

These new gold discoveries can be subdivided into two main groups by host rock lithology (sediment-hosted and volcanic-hosted), and into subtypes by presumed depositional environment (epithermal, mesothermal, hot spring), and by deposit form (breccia-hosted, stockwork, vein, stratiform). Sediment-hosted deposits can be subdivided into two main categories: carbonate-hosted deposits of epithermal type, typified by the Carlin mine, and contact metasomatic deposits related to a porphyry environment such as the Copper Canyon deposits in the Battle Mountain district. Volcanic-hosted deposits can be subdivided into a variety of deposit types based on such criteria as associated volcanic structure (i.e., caldera, volcanic domes, composite volcano, etc.), alteration mineralogy, major and trace metal content, and total amount of sulfur present.

Approximately two-thirds of the total ounces of gold discovered in Nevada since 1962 occur in carbonate-hosted deposits. These deposits are characterized by host rocks which are typically thin-bedded, calcareous and carbonaceous clastic sediments, by the occurrence of jasperoid, by a geochemical association of Au, As, Sb, Hg, Ba and Tl and by the nearly ubiquitous occurrence of intrusive rocks of dacitic or granodioritic composition.

The largest reserves of gold in a volcanic-hosted deposit occur at the Round Mountain mine, which is located on a caldera margin. The deposit is of low-sulfur type and the host rock is a thick, silicic ignimbrite. The geochemical signature is similar to the carbonate-hosted deposits. Significant amounts of gold also occur in hot-spring deposits associated with volcanic centers; examples include the Buckhorn and Hasbrouck deposits. Mineralization at these two hot-spring deposits occurs in hydrothermal breccias, quartz stockworks, and silicified volcaniclastic rocks.

Further major discoveries in both volcanic and sediment-hosted deposits can be expected as our genetic models for these deposits are refined by ongoing research.

Geology of the Valley Mine

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Casselman, Mike; Cominco Ltd.

The Valley Mine is located in the Highland Valley of British Columbia about 370 km northeast of Vancouver B.C. Reserves are 720 million tonnes of 0.475% Cu and 0.005% Mo.

The mine occurs near the central part of the Guichon Creek Batholith which lies at the south end of the Cordilleran Intermontane belt. The batholith is a semi-concordant dome elongated slightly west of north and is roughly 60 km north-south and 25 km east-west. It is calc-alkaline in composition and consists of several nearly concentric phases (quartz diorite to diorite on the margin to monzodiorite to granodiorite in the core). Isotopic ages are 202 + 8 Ma (K/A) and 205 + 10 (Rb/Sr).

The Valley Mine was discovered by a combination of geological and geophysical techniques. A geological model led to the correct target selection for an IP survey. The resulting IP anomalies were percussion drill tested in 1968 which led to the discovery of the Valley Mine. Preproduction stripping of the orebody started in July 1982 and mining started in January 1983 at a rate of 20,000 tons/day. The ore is trucked 6.5 km to the old Bethlehem mill on the east side of the Highland Valley. The stripping ratio is 0.95:1. A cut off grade of 0.4% Cu is presently providing a head grade of greater than 0.5% Cu. Material between 0.25 & 0.39% Cu is stockpiled for future processing. Grade control and mine design is assisted by computer application.

The Valley Mine is hosted by the Bethsaida phase granodiorite, the central and youngest phase of the batholith. Pre-mineralization granodiorite and quartz diorite porphyries and aplite, syn-mineralization tan felsite porphyry and post-mineralization lamprophyre are common in the deposit.

The mine is located in a zone of intense fracturing near the intersection of the northerly trending Lornex fault and the westerly trending Highland Valley fault. Predominant orientations of faults, fractures and quartz veins in the deposit are parellel to those two regional faults.

Four main alteration types recognized are: propylitic, pervasive and veined sericitic, kaolinitic and K-feldspathic. Minor alteration types recognized are silicic veinlets (mineralized and unmineralized), biotite and post-mineralization gypsum veining. Moderate to strong K-feldspathic, intimately associated with vein and pervasive sericitic and kaolinitic alteration, is dominant in the central deeper part of the deposit. It is enveloped by an extensive zone of moderate to strong vein and pervasive sericitic and kaolinitic alteration, which grades outward into a zone dominated by weak to moderate pervasive sericitic and kaolinitic alteration. This latter zone grades outward into patchy weak to moderate propylitic alteration. Mineralized quartz veinlets are only moderately developed in the deposit but show a similar distribution pattern to the vein sericitic alteration. A well developed silicic zone (barren quartz veinlets) occurs in the southeastern part of the deposit. Biotite alteration and post-mineralization veining (principally gypsum) occur locally.

Bornite, chalcopyrite, digenite, covellite, pyrite and molybdenite are the principal sulphides in their relative order of abundance. Bornite/chalcopyrite ratios show highest values in the central part of the deposit where they exceed 3:1 and decrease toward the fringes of the deposit where chalcopyrite predominates. The copper minerals occur principally with vein sericite alteration and quartz veinlets. Bornite is most abundant with the vein sericite association whereas chalcopyrite is dominant with K-feldspathic alteration.

The 0.3% Cu contour defines the deposit and is roughly oval, 1372 meters by 914 meters, with a broad halo of lower copper grades surrounding it. Molybdenum forms annular, geochemically enriched zones around the deposit. A weakly developed pyrite halo surrounds the deposit.

Hydrothermal alteration has resulted in a geochemical decrease in CaO, Na_2O, MgO, Sr, Ba and Mn and a corresponding increase in K_2O, SiO_2, Rb and TiO_2 from the periphery to the center of the deposit.

The Valley Mine deposit displays many of the characteristics ascribed to better known porphyry copper deposits. The principal differences are the poorly developed propylitic alteration zone and the pyrite halo surrounding the Valley Mine deposit.

CORDILLERAN SECTION

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