MINERAL DISTRIBUTIONS AND MINERAL-SOLUTION EQUILIBRIA AT AFTON MINES, SOUTHCENTRAL B. C., CANADA

by

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An Abstract submitted to

3rd INTERNATIONAL SYMPOSIUM
ON WATER-ROCK INTERACTION

EDMONTON, CANADA
July, 1980

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Abstract:

The Afton copper deposit in southcentral B.C., Canada is unique among other porphyry copper deposits in its high native copper content and apparent lack of supergene enrichment (Carr and Reed, 1976 and Preto,1973).This paper aims at exploring for an explanation for such unusual phenomena by considering the mineral distributions in terms of mineral-solution equilibria based on thermochemical data.

Geologically, the deposit lies in the northwestern extremity of the Iron Mask pluton emplaced in contemporaneous Upper Triassic Nicola volcanic rocks. The Iron Mask pluton is a multiphase subvolcanic intrusion with composition varying from diorite through monzonite to syenite while the Nicola volcanics consist mainly of tuff, breccia and interbedded flows of predominantly andesitic composition (Northcote,1974). The orebody is truncated to the north by barren Tertiary sedimentary and volcanic rocks.

Whereas the fine-grained, highly fractured and altered nature of the host rocks within the orebody defies easy identification, detailed pit mapping, petrographic studies of over 200 specimens and x-ray diffractometry work on blasthole samples have enabled delineation of zoning patterns of both primary and secondary minerals. Of special interest are the almost ubiquitous presence of albite, the association of gold with native copper along a portion of the Tertiary-Triassic contact and part of a presumably deep-seated fracture trending NW-SE and cutting the orebody into halves, an intense carbonate alteration particularly obvious in the western portion of the orebody and the concentration of magnetite veins in the eastern portion.

The preponderance of albite is interpreted to indicate a sodic metasomatism accompanying the hypogene mineralization. The carbonate alteration is probably pneumatolytic in origin. Its presence could have effectively buffered the pH to the alkaline regime during the supergene event thereby ensuring the stability field of native copper under slightly reducing conditions. Magnetite could conveniently behave as a reducing agent converting primary copper sulphides into native copper while it itself is oxidised to hematite in the process.

About 100 whole rock analyses on samples from the orebody and the different phases of the Iron Mask pluton afford rough estimate of the gross elemental exchange as a result of alteration. They also shed light on the possibility of hypogene mineralization being related to magmatic differentiation and immiscibilities. Electron microprobe analyses on the other hand contribute to the precise determination of mineral compositions and confirm petrographic interpretations.

Having established the nature of hypogene mineralization and the mineral assemblages at various stages of alteration, a thermodynamic approach to the reconstruction of the supergene event could then be attempted making use of available thermochemical data and the water chemistry at Afton Mines. The results will be presented in a series of stability diagrams emphasizing on the change of solution chemistry accompanying the separation of each new mineral phase in the process.

References:

1. Carr, J.M. and Reed, A.J. (1976) Afton: a supergene copper deposit; in A. Sutherland Brown (ed.), Porphyry Deposits of the Canadian Cordillera, Can. Inst. of Min. and Met., Spec. Vol. 15, pp. 376-387.
2. Northcote, K.E.(1974) Geology of the northwest half of Iron Mask batholith, B.C. Dept. of Mines and Petroleum Resources; Geological Field Work, 1974, pp. 22-26.
3. Preto, V.A.(1973) Afton, Pothook, B.C. Dept. of Mines and Petroleum Resources; Geology,Exploration and Mining, 1972, pp.209-220.