888295 → Scottie Gold



*by Dani Alldrick and Trygve Hoy, BC Geological Survey*

David Rhys completed his M.Sc. study of the Snip mine in 1993. His professional career has been particularly focused on intrusion-related gold deposits, including work as an exploration geologist at the large Red Mountain deposit and as a consulting geologist at the Johnny Mountain mine and at properties within the Rossland mining camp. His comments reflect extensive experience with this deposit type and we welcome these contributions. His willingness to share important proprietary company data is particularly appreciated.

The typical pattern of debate generated by development of new ore deposit models - a general agreement on the geological features, but strongly divergent interpretations - is reversed here. Rhys acknowledges a general agreement with the deposit classification and with the interpreted genetic association with a highly specific, localized, and time-constrained geologic setting, but points out inaccuracies with a number of facts used to develop the interpretive model. These differences are in part due to the hasty preparation of our report; additional figures would have done much to ensure clearer communication.

Some of the apparently contradictory evidence presented in these two articles derive from observations made during different periods. BCGS studies of the Scottie Gold, Johnny Mountain and Snip mines were completed between 1982 and 1989. During this period Scottie Gold mine opened and closed (1981-1985), Johnny Mountain mine went from surface trenching (1982) to production (1988-90), and Snip mine evolved from an exploration target to underground exploration developments for pre-production feasibility studies. David Rhys' work on these deposits began in 1991, shortly after the opening of the Snip mine.

In 1989, the deposits at the producing Johnny Mountain mine consisted of four veins plus the Zephrin zone, a mineralized fault zone. The Victoria vein, then known from two drill intersections, was little more than a gleam in Paul Metcalfe's eye. Changes to names of mineral zones is an unusual problem that is also related to the different periods of our sequential studies. At Johnny Mountain mine, the term "Zephrin" has changed in name, character and location over the life of the mine. Discovered during a 1987 surface drilling program designed to located an offset vein, drill core recovered a highly disrupted, foliated and mineralized fault zone - the fault which offset the two parts of the vein. At this time, and up to initial underground development and production from the zone (1989), this mineralized and relithified fault material was termed the Zephrin zone. As Rhys indicates, it was subsequently discovered that the eastward continuation of the vein was a relatively small fault-bounded block, and the term "Zephrin" was then re-defined, re-located and re-applied to this adjacent fault-bounded vein segment, the Zephrin vein.

Geologists should be familiar with, and should be prepared to make allowances for, the variability in textures, mineralogy and modal abundances for observations and samples acquired in different parts of an ore deposit. There are unavoidable limitations to mapping and sampling within a 'mined-out' deposit, and the reported differences in the abundance of pyrite in the quartz veins at Johnny Mountain mine may be an important indication of an inverse relationship between pyrite and gold abundance, since the higher pyrite contents reported by Rhys were documented after the mine ceased production.

Johnny Mountain hosts: two "Intrusion-Related Gold ± Copper" vein systems or sets (Johnny Mountain and Snip mines); a recently discovered, large porphyry copper-gold deposit (Bronson Slope); and a small but significant molybdenite-bearing skarn. Rhys correctly points out that no hotspring-type deposits are known on the mountain. However, the regionally distributed continuation of the distinctive felsic volcanic package that underlies the Eskay Creek ore deposits ("shallow exhalative" or "shallow subaqueous hotspring" deposits) are exposed at higher elevations on Johnny Mountain. Given the geological setting of intermediate to proximal facies volcanic rocks and their coeval subvolcanic pluton documented at Johnny Mountain, and the presence of this regionally prospective felsic volcanic horizon - and recognizing that exploration programs are sometimes designed to target a single deposit type - we repeat our recommendation that "the exploration focus must be expanded to include the search for porphyry, epithermal, skarn and hotspring deposit types" in any exploration program conducted on Johnny Mountain.

A cross-sectional sketch or clearer description from us would have eliminated the need for a discussion that derives from the unusual form of the Twin vein at the Snip mine. We failed to indicate the scale over which gradational changes in vein mineralogy occur. The Twin vein, dipping at an average of 50° and split lengthwise down the middle by a post-ore dyke, has "upper" (shallower mine levels) and "lower" (deeper mine levels) parts when viewed on the large scale (entire mine scale), but also has "upper" (hangingwall vein segment) and "lower" (footwall vein segment) parts when viewed on the small scale (individual mine level scale). The large scale geometrical relationships and the quartz versus sulphide distributions which vary strongly over the full extent of the vein (Alldrick and Hoy), are not evident on a smaller scale as Rhys indicates.

Rhys' observation that the highest gold grades at the Snip mine have come from well-sheared calcite+quartz+chlorite+biotite+pyrite veins is followed by a comment that the Twin vein has a potassic alteration envelope and the implication that propylitic alteration is absent. A further evaluation of these concepts could be useful.

Everyone interested in understanding and exploring for these deposits needs to know why magnetometer surveys over the pyrrhotite-rich parts of both the Johnny Mountain and Snip mines yield no discernible magnetic signature if the pyrrhotite is strongly magnetic. The recent discovery of important early magnetometer surveys of the Rossland Camp is described as information which has been established in exploration for over forty years. Since these maps have been stored in the archives of Cominco Limited for decades, they could also be described as "long-forgotten" with equal accuracy.

We thank David Rhys for his thorough review and comments on our article, and hope that readers are better informed about this new deposit model because of the time and effort he has invested in preparing his discussion. We extend our invitation to work together to prepare a joint paper which will be more comprehensive and satisfactory to both readers and authors.

## Comment on "Intrusion-Related Gold-Pyrrhotite Veins" by Dani Alldrick and Trygve Hoy, The Gangue, Issue 55, February 1997

*by David A. Rhys, Panterra Geoservices Inc., Surrey BC*

The recent article by Alldrick and Hoy discusses a small, although economically significant, group of gold deposits in British Columbia that are of similar age and character. Although I agree with the classification of these deposits as a distinctive group, and with the general conclusion that they are spatially and genetically associated with subvolcanic Eary Jurassic intrusions, there are numerous errors in the deposit descriptions which could have adverse affects on explortion. The discussion presented here is intended to correct only factual errors, and does not attempt to address further fundamental theoretical problems with the structural geologic setting and style of the deposits that are proposed in the article.

The four deposits - Rossland, Snip, Johnny Mountain and Scottie Gold - are described as massive pyrrhotite-pyrite or bull quartz veins, with pyrrhotite as either the dominant mineral or the most abundant sulphide. However, pyrrhotite is rare in economic veins at Johnny Mountain and is subordinate to pyrite (approximately 6:1 pyrite:pyrrhotite) at Snip (Rhys, 1993). Gangue minerals at Snip (calcite, quartz, chlorite, biotite) account for approximately 75% of the veins there, while quartz at Johnny Mountain comprises 20-80% of the veins. Thus, the name proposed for this set of deposits as "gold-pyrrhotite veins" is not accurate for two of the four deposits. Since copper (from chalcopyrite) was an important by-product of the mining at Rossland (approximately 1%) and Johnny Mountain (0.4%), and chalcopyrite is common at Snip, a more suitable name may be "Intrusion-Related Gold ± Copper Veins".

Individual descriptions by Alldrick and Hoy of the veins at Snip and Johnny Mountain convey several inaccuracies, which include:

1. Three, not four, parallel veins occur at Johnny Mountain. These are (i) the 16 vein, and its displaced continuations (the Zephrin and Discovery veins), which together produced 90% of the ore, (ii) the Pickaxe - Gold Rush vein, from which minor production occurred, and (iii) the unmined Victoria vein;
2. Average sulphide (pyrite, with minor chalcopyrite and sphalerite) content in economic veins at Johnny Mountain, although variable along strike, is significantly greater than suggested, and is generally between 15 and 60%;
3. Johnny Mountain is not a "hotspring-type" deposit, although a typographical error at the end of the second paragraph on page 9 alludes to this;
4. Multiple faults displace veins at Johnny Mountain, and displaced segments of vein between faults have been mined, but at no time was any stope developed on lithified fault gouge, as has been suggested by Alldrick and Hoy;
5. At Snip, the "closely overlapping veins" are not different structures; they comprise a single shear vein that is cut down its centre by a post-mineral dike that locally splits the vein into two separate portions, hence its name the "Twin Zone". Another vein, the 150 vein, splays off the footwall of the Twin Zone and has provided about 20% of the ore at Snip, but it was never considered part of the Twin Zone.
6. There is no difference in the ore above and below the dike in the Twin Zone at Snip (their 'upper' and 'lower' veins), as is suggested by Alldrick and Hoy. Ore on both sides is composed of laminated calcite-chlorite-biotite shear veins and subordinate quartz-pyrite ± pyrrhotite veins;
7. Although gold grades are high (commonly >60% g/t) in sulphide-rich veins, the highest gold grades at Snip have come from low sulphide (<2%), chlorite-rich vein material with pink calcite tinted by fine-grained biotite;
8. In reference to the statement in 'Economic Factors' on page 10, Snip is not the largest gold producer in British Columbia; it was surpassed by Eskay Creek two years ago.

Perhaps the most glaring error to exploration geologists is the assertion by Alldrick and Hoy that these veins are characterized by strongly anomalous magnetometer lows due to (i) the ubiquitous presence of non-magnetic pyrrhotite, and (ii) the destruction of magnetite in the propylitic envelopes to the veins.

In actual fact:

1. At Snip, Rossland, and where present at Johnny Mountain, pyrrhotite is *strongly magnetic*.
2. The alteration envelopes to veins at both Snip and Johnny Mountain are potassic, and characterized by the presence of biotite, K-feldspar, and pyrite, and locally disseminated *magnetite*. Magnetite is also present in veins at Snip, Johnny Mountain and Rossland (Drysdale, 1915).
3. Where magnetite surveys have been conducted over veins at Snip, Johnny Mountain and Rossland, veins either have no discernable magnetic signature or produce *positive* magnetometer anomalies; Veins at Rossland and Johnny Mountain also appear as positive linear anomalies with Fraser filtered VLF-EM data.

In closing, a point that was briefly mentioned by Alldrick and Hoy deserves further elaboration, and may provide an important exploration tool. One of the best exploration guides for vein deposits of this type is camp scale metal and alteration zoning. For example, at Snip, vein systems are zoned from Au ± Cu -rich shear veins with potassic alteration envelopes proximal to a porphyry Au-Cu system (the Red Bluff porphyry system) to Zn-Pb enriched veins with phyllic alteration more distal to the porphyry (Rhys, 1993). A similar metal zonation occurs at Rossland, where Zn-Pb enriched veins are also peripheral to the Au-Cu bearing veins (Thorpe, 1967). Individual veins may also display lateral or vertical zonation of metals that mimics that developed at the camp scale (*e.g.*, Johnny Mountain). At both Rossland and in the Snip-Johnny Mountain areas, deposits occur within broad contact metamorphic aureoles comprising widespread, pervasive disseminated bitotite and/or calcsilicate skarn alteration. Composition of associated intrusions may also be genetically important; at all four deposits, associated intrusions range in composition between quartz diorite, monzodiorite and granodiorite.

With so few deposits of this type known, care must be taken when generalizing to distinguish common features from the specific features of each deposit, and not to ignore the latter. A deposit type definition has limited usefulness if it does not accurately portray the characteristics of the deposits that it has been made to represent, and may as a consequence misguide exploration. The four significant deposits of this type that are currently known in British Columbia occur over a broad geographical range, and the abundance of potential host volcanic and intrusive rocks of Early Jurassic age in the Cordillera suggests that other deposits of this type may be found elsewhere in the province.

### Acknowledgments

I thank David Yeager of International Skyline Gold Corp. and Peter Lewis of Lewis Geoscience Services Inc. for their comments and suggestions.

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