The Phoenix-Greenwood Mining District

Main information sources:

B. N. Church et al., Copper Mountain - Phoenix Tour, Apr. 1982, Cordilleran Section, GAC.

H. W. Little, Geology of the Greenwood Map-Area, B. C., GSC Paper 79-29, 1983. The GSC map lists 54 mineral deposits in the area.

I. The Phoenix Camp

1. Location, access, topography: Phoenix is located about 6 km east of Greenwood in south-central B.C. (49°06' lat, 118°36' long., NTS reference 82E/2E). Access is by good gravel roads from Highway 3 about 12 km to the east and also from Greenwood. Elevations range from 1340 to 1425 m above sea level with generally moderate topographic relief.

2. History: The word PHOENIX, derived from Egyptian mythology, refers to a beautiful, lone bird which lived in the Arabian desert for 600 years and then consumed itself in fire, rising renewed from the ashes to start another long life: a symbol of immortality.

   Placer mining in the Phoenix area started in 1860, and the main copper deposits were all staked by 1891. The Granby smelter, at that time the largest non-ferrous smelter in the British Empire, started up in August 1900, and two additional smelters were built in nearby Greenwood and Boundary Falls.

   Underground operations, augmented by glory holes, continued until 1919. Minor production occurred during the late 1930's, but the real revival - Phoenix rising from the ashes - occurred in 1959, when Granby Mining Corporation returned to build a 540 tpd mill (later increased to 2500 tpd). Open pit mining continued until August 1976, and the mill processed stockpiled ore until Oct. 1978.

   What was once a large town is now totally covered over by tailings.

3. Production figures: Source: Mining in B.C., Vol. II, 1975-80, BCMMPR.

1900-19:	12,5 mill t mined - containing:	163 550 t of Cu	(1.3%)
		130 t of Ag	
		30 t of Au	
1959-78:	9,1 mill t mined - containing:	71 587 t of Cu	(0.55%)
		52 t of Ag	(4g/t)
		7 t of Au	(0.5g/t)

4. General geology: see Table of Formations
   (1) Late Proterozoic gneises and schists are the oldest rocks in the Greenwood area.
   (2) Penn-Perm rocks (Knob Hill Grp) are predominantly chert and andesite, highly contorted and moderately metamorphosed. Tectonically emplaced ultramafics (probably Permian) are common in the area, containing minor platinum, chromium and nickel showings.
   (3) Unconformably overlying the Upper Paleozoic rocks are Middle to Upper Triassic rocks of the Brooklyn Fm - the host of the major ore deposits. The main rock types are: chert breccia (SHARPSTONE); shale; limestone; volcanic conglomerate, red diamictite (puddingstone); and sub-volcanic microdiorite.

   The rock units are commonly interbedded and have a lenticular

nature with abundant fault contacts and disconformities. Metamorphism has produced marbles and calc-silicate rocks.

(4) Overlying the Brooklyn Fm. are andesitic volcanic rocks of Jurassic age. The Nelson Intrusions and Valhalla Intrusions of Jurassic or Cretaceous age have either created or just metamorphosed the Cu-Au-Ag deposits of the Phoenix area.

There is, however, no intrusive contact exposed in the Phoenix area. Associated with the Nelson intrusions are numerous mineralized veins of Cretaceous age elsewhere in the Greenwood area. Seven deposits have produced gold and silver.

(5) During Tertiary times, deposition of clastic sediments, volcanic flows and the intrusion of acidic to basic igneous rocks accompanied "graben-like" normal faulting.

5. Phoenix mine geology: see Geological map by R. H. Seraphim
According to Seraphim, the copper orebodies are replacements of limestone or impure limy rock at or near contacts with other rocks, none of them, however, plutonic. Gilmour, in a report for Kettle River Resources, "supports the view, suggested by Peatfield and Fyles, that sediments, commonly calcareous, were originally rich in copper and iron and were later metamorphosed to produce the copper-iron skarn deposits." (See appendix I: Tempelman-Kluit's Diatreme hypothesis)
Chalcopyrite is the ore mineral; other metallic minerals are pyrite, specular hematite and magnetite. Non-metallic minerals are chlorite, epidote, carbonate, amphibole, quartz, garnet, pyroxene and some earthy hematite. Bedding, indicated by bands with varying concentration of these minerals, is well preserved locally. Almost all deposits, particularly those which are flat-lying, have a hanging wall of skarn as much as 60 m thick.

The Knob Hill-Ironsides-Victoria orebody was the major producer in the area. In plan, the mineralized zone forms a U with the open end to the north. The west limb of this U dips easterly at about 60 degrees near surface, but flattens to 10 degrees a hundred meter or so down dip. (see X-sections).

II. A brief overview of other interesting deposits in the Greenwood area:

A. The Oro Denoro Mine: Early production, before 1919, was 136 000 t of 1.4% Cu. Granby carried out open pit mining in 1975. The Oro Denoro mine (see Map) is at the center of a 2.4 km long alignment of skarn deposits. Host rock for all of these is, again, the Brooklyn limestone member. Mineralization is straightforward: pockets of Py, Cpy and Mag in a garnetite skarn. The intrusion responsible for the mineralization is believed to be the Lion Creek granodiorite stock.

B. Central (Whites) Camp: The camp includes 3 deposits in Canada - called the No. 7, Mable, Lexington, and City of Paris - and one in the US - called the Lone Star. What makes them interesting is relatively high gold content in quartz veins - between 0.1 to 0.4 oz/t. On the Lone Star property, drilling indicated over 2 mil t grading 1.6% Cu. Several hundred thousand tonnes were open-pitted and milled at Granby's Phoenix mill in 1978, but recoveries were less than 1% Cu and about 0.02 oz/t Au.

C. Robert Mines (Skomac Mine): recently revived small gold and silver operation 5.5 km SW of Greenwood. Quartz vein system, first developed 1894. New mill started up in 1982. Seven adits on four vein systems. The main break transsecting the property is about 180 m long, with an average dip of 50°NE and a somewhat variable SE strike, consisting of thickened, mineralized quartz lenses (thought to be the result of regional shearing stress deflected into and taken up by incompetent formations along a diorite contact). "From an estimated total of 7500 tonnes mined, 1688 tones of crude ore have been shipped yielding 16.4 kg gold, 653 kg silver, 43.6 tonnes of lead and 23.9 tonnes of zinc."

D. Deadwood Camp (Motherlode-Sunset): Second most productive camp in the district. Prior to 1919: almost 4 mill t mined, 0.9% Cu, 0.042 oz/t Au and 0.17 oz/t Ag, recovered at the B.C. Copper Company smelter in Greenwood. Various operations since: Woodgreen Mines installed a 1000 tpd mill in 1957, which operated on and off till April 1962, milling 644 000 t. The ore is hosted by the Brooklyn formation (skarn underlain by conglomerate).

E. The Sylvester K property (Kettle River Resources Ltd.)
The immediate future of the area lies in precious metals. The most interesting discovery so far, by Kettle River Resources, is a stratabound massive to semi-massive pyrite-pyrrhotite-calcopyrite horizon at the contact of argillite with calcareous sediments in the Brooklyn Fm., just a km or so north of the Phoenix open pit.
The area has been extensively trenched and drilled. The gold results are in the range of 0.2 to 0.35 oz/t over a length of 65 m and a width of 2.6 m. The copper and silver content of the massive sulphide horizon ranges up to 0.4% and 0.5 oz/t respectively.
A volcanogenic model for this deposit, orginally promoted by Kettle River Resources, has been dismissed by K. Dawson and B.N. Church.

EXPLORATION PARAMETERS for the Phoenix-Greenwood area:

1. Tempelman-Kluit's diatreme hypothesis, if correct, implies that all areas where there are sharpstone breccias are favorable ground, because they may be in a diatreme or close to one - a diatreme that may have had a gas jet late in its history that introduced metals (or this may not have happened of course).
2. The Nicola volcanics, which are time-equivalent, have this type of breccia in lots of places. If these are volcanic necks shooting through from below, maybe there are mineral deposits further down: "extensive deep drilling..."
3. Kettle River Resources discovered the massive sulphide lens on their Sylvester K property using the VLF (very low frequency) electromagnetic method over an area that had been extensively prospected before. Anomalous magnetic readings were obtained as well, but the massive sulphide zone "would likely be missed if the reading interval was greater than 10 m." Despite the till and ferricrete cover, the gold soil geochemistry outlined an anomalous area, averaging 318 ppb gold within the massive sulphide zone.
4. Skarn deposits, which contain magnetite as well as massive sulphides, respond well to mag surveys, EM, gravity or IP methods.

Appendix I: IS THE PHOENIX DEPOSIT part of a DIATREME?

The most striking lithology in the Phoenix camp is a chert-breccia rock, first interpreted by LeRoy (1913) as JASPEROID (a siliceous rock formed from replacement of limestone). It was interpreted by Seraphim (1956) as SHARPSTONE CONGLOMERATE (a conglomerate formed from stones predominantly angular) and most recently, it was interpreted by Dirk Tempelman-Kluit of the GSC (1984) as a breccia formed in a pipelike diatreme.

Tempelman-Kluit sees his idea as one that still needs testing, but that has at least as many things going for it as any other ideas that have come out on the Phoenix camp. (Pers. comm., 26 March 1984)

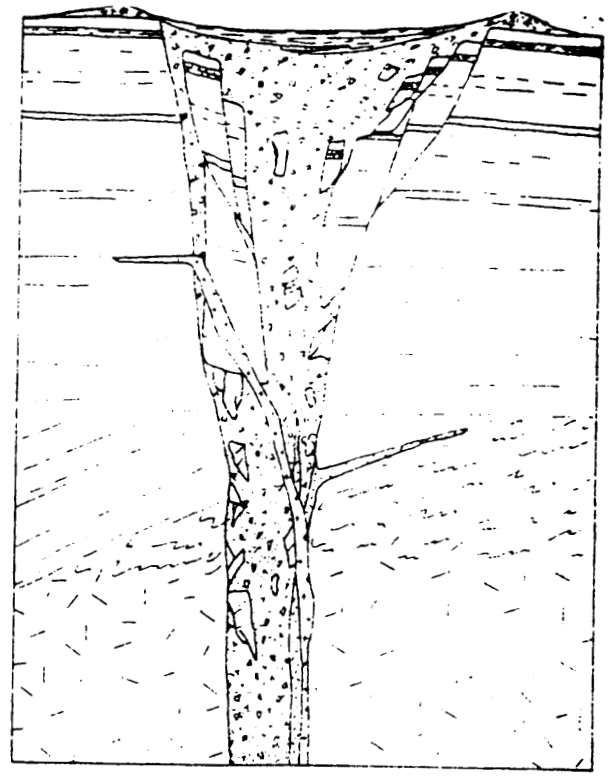

Figure 6-6 Idealized diatreme terminating in a maar at the surface. The maar is surrounded by a tuff ring and is partly filled with lake sediments and alluvium. Note inward-dipping stratification near the top of the diatreme, caved fragments of wall rock and late magmatic dikes. The horizontal scale is greatly exaggerated relative to the vertical.

Tempelman-Kluit thinks that the Phoenix deposit is not sitting in a syncline (as shown on Seraphim's cross sections), but rather in an unusually large chlorite breccia pipe, about 4 km across. What suggested this idea is

(i) the roundish outcrop geometry of Brooklyn Fm. rocks which host the ore(see Seraphim's map);

(ii) the fact that the dominant rock type of the Brooklyn Fm., the so-called SHARPSTONE CONGLOMERATE, closely resembles rocks observed in diatremes in the Yukon and elsewhere;

(iii) the presence of skarn minerals in the complete absence of any granitic intrusions anywhere nearby.

The layering observed in the sharpstone, which Seraphim regarded as proof of a sedimentary origin, can easily be explained as flow-layering within a breccia pipe. Chert fragments, greenstone fragments, jasper and limestone fragments and other fragments form as these pipes penetrate the various strata and tear pieces of rock off the wall. The more one gets toward the middle of the pipe, the more mixed the fragments are; the boundary of the pipe is, in contrast, quite fuzzy.

The ore deposits are not in limestone that has been skarnified, according to Tempelman-Kluit, but largely in the sharpstone and finer-grained equivalents, whose limy matrix has been introduced by CO_2-rich gas. The ore, therefore, is hosted, not by limestone, but by carbonatite.

The skarn mineralogy developed during the formation of the diatreme, not by later metamorphism. It is common in diatremes to find extensive chloritization, in places going to garnets, as well as epidote, hematite and chalcopyrite, with or without gold. The Phoenix chlorite pipe which contains the orebodies is a Triassic event. We may be looking at the throat of a relatively large volcano in an arc - the Nicola arc.

Robert Mines (Skomac Mine)

C.