



BRIEF STUDIES OF SELECTED GOLD DEPOSITS IN SOUTHERN BRITISH COLUMBIA*

By T. G. Schroeter

INTRODUCTION

As a follow up to studies on gold deposits in northern British Columbia over the last several years, the writer made brief visits to the following gold deposits or areas in southern British Columbia: Abo, Blackdome, Bralorne-Bridge River, Grand Forks-Greenwood, Hedley, Tillicum and Willa. The overall goal is to study the great variety of significant gold-bearing mineral deposits in British Columbia and produce a written summary of "type" deposits, including such topics as: regional and local geology, composition of host rocks, age of host rocks, structural controls, mineralogy of 'ore' and gangue, alteration assemblages, fluid inclusion and isotope data (if available), age of alteration and/or mineralization, classification of deposit and deposit correlations/comparisons including modelling and metallogenesis.

Writing is expected to begin after one more field season with a target completion date in spring 1988.

Some descriptions are longer than others, depending on the availability of expanded write-ups by other authors in past volumes of Geological Fieldwork or this volume.

ABO (ex-RN) — MI 092H/SW-092 (Lat. 49°20'N; Long. 121°45'W; 92H/5)

The Abo gold prospect is located at the southeastern corner of Harrison Lake, 4.5 kilometres northeast of the village of Harrison Hot Springs (Plate 2-1-1). Kerr Addison Mines Ltd., under an option agreement with Abo Oil Corp., is currently exploring for large tonnage, low-grade gold deposits amenable to low cost underground mining.

HISTORY

The Abo property was also known as the RN (pre-November 1984) and the GEO (pre-August 1975). Between 1973 and 1981,

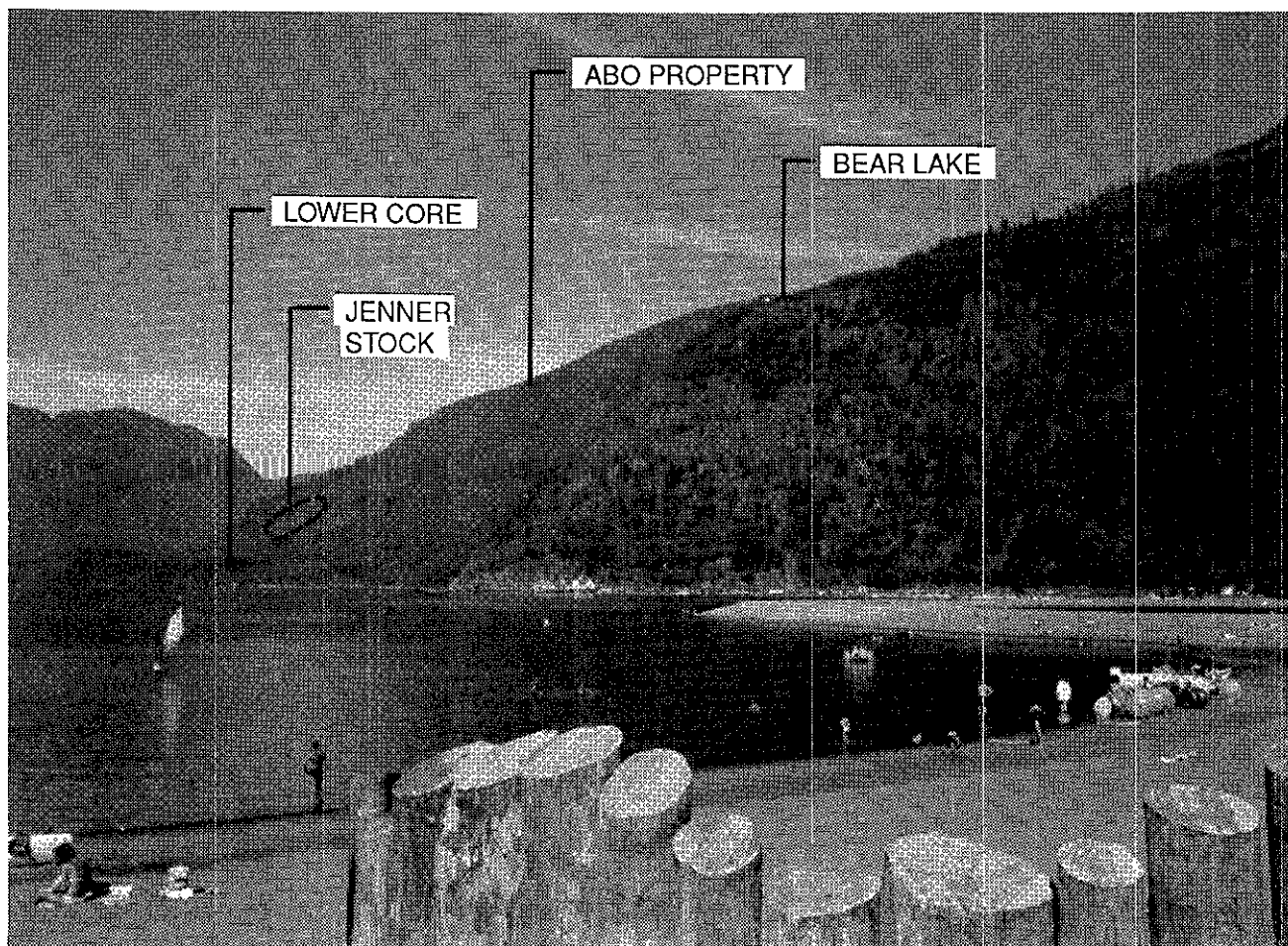


Plate 2-1-1. Looking northeasterly toward Abo property from Harrison Hot Springs.

* This project is a contribution to the Canada/British Columbia Mineral Development Agreement.
British Columbia Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork, 1986, Paper 1987-1.

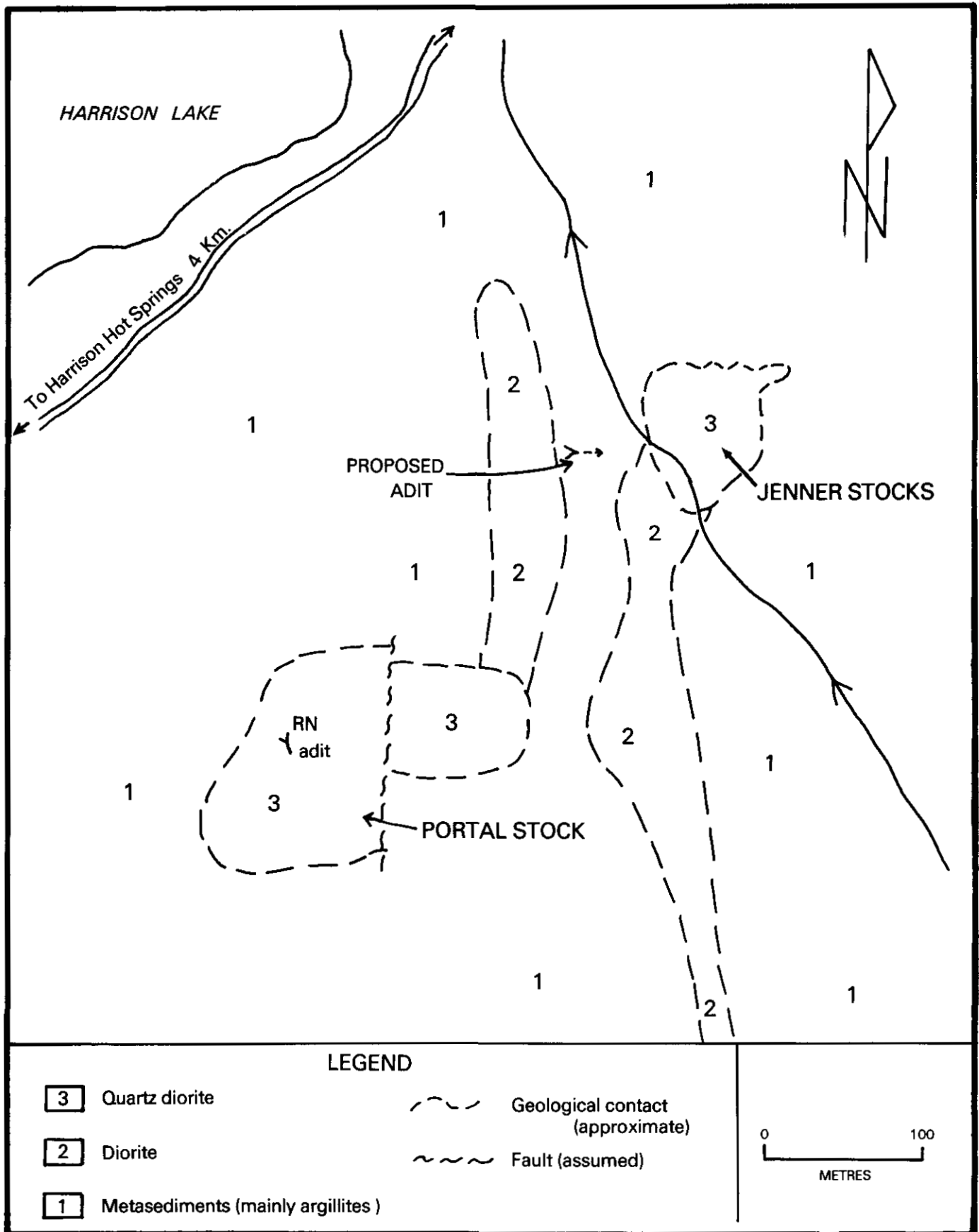


Figure 2-1-1. Geology of Abo gold prospect (after company plans).

642.8 tonnes of ore was mined in a 50-metre-long adit from a pyrrhotite-rich quartz vein 10 to 40 centimetres thick. A total of 30 443 grams of gold and 616 kilograms of copper was recovered. Between 1982 and 1986 geological, geochemical and geophysical surveys and 6075 metres of diamond drilling were carried out on the property. The average grade of eight drill intersections of the vein was 4.8 grams of gold per tonne.

To September 1986, Kerr Addison drilled 1971 metres in fifteen NDB-size diamond-drill holes, twelve in the Jenner stock and three in the Portal stock (Plate 2-1-1).

GEOLOGY

Host rocks in the vicinity of mineralized zones are primarily argillites of the Upper Jurassic Mysterious Creek Formation. They have been intruded and moderately hornfelsed by stocks (apophyses) of quartz diorite related to the mid-Tertiary (Miocene) Hicks Lake stock to the east. Plutons range from 50 to 200 metres in diameter. The Mysterious Creek Formation is separated from the Chilliwack Group to the northeast and southwest by the north-northwest-trending Harrison Lake strike fault. At least four quartz diorite stocks have been identified on the property; the Portal and Jenner stocks have been drilled (Figure 2-1-1).

STRUCTURE

A belt of mineralized and unmineralized quartz dioritic stocks lies within the Harrison Lake fracture system which has been traced for several hundreds of kilometres in a northwesterly direction and is assumed to cross the Abo property.

MINERALIZATION

Gold occurs in a "network" of quartz veinlets, quartz veins and quartz-filled microfractures, believed to have developed through a process of microfaulting and fracturing of subvertical plug-shaped quartz diorite stocks followed by injection of gold-bearing solutions along fractures. Contacts between veins and wallrocks are generally sharp. Quartz veins pinch and swell, ranging in thickness from 1 millimetre to 40 centimetres. They most commonly occupy tension fractures and die out rapidly in argillites.

Total sulphide content averages 5 per cent and includes pyrrhotite and pyrite with minor chalcopyrite, sphalerite, arsenopyrite and trace molybdenite. The gangue minerals are predominantly quartz with minor sericite and adularia. The sericite in the veins gives a potassium-argon age of 24.5 ± 1 million years (Ray *et al.*, 1985) which is accepted as the age of gold mineralization. This date coincides closely with other potassium-argon ages of dioritic plutons along the Harrison Lake fault system.

Native gold and rucklidgeite (a lead-bismuth telluride) appear to have a spatial and possibly a genetic association in quartz veins, both on the Abo property and elsewhere along the fault system. The following microprobe analysis on a telluride specimen submitted by the writer was provided by Dr. Don Harrison at the Geological Survey of Canada: 43.9 per cent bismuth, 9.6 per cent lead, 45.2 per cent tellurium, total 98.7 weight per cent, corresponding to $Pb_{0.52}Bi_{2.38}Te_{4.00}$. This is the third recorded occurrence in Canada, the first being from the Robb Montbray gold deposit in Quebec and the second from the Ashley gold deposit in Ontario.

GEOCHEMISTRY

Gold geochemistry in rocks and soils is effective. There appears to be no enhancement of other elements, including silver.

ORE GENESIS

A synchronous dioritic plutonic and gold mineralizing event is postulated to have occurred along the Harrison Lake fracture system during the period of 19 to 26 million years before present.

ACKNOWLEDGMENTS

I would like to thank Ray Dujardin, Thor Bruland and Art Clendenan of Kerr Addison Mines Ltd. for their hospitality on the property and office discussions concerning the Abo project. Dr. Don Harris very kindly provided microprobe and X-ray analysis data on a telluride sample submitted from the property.

BLACKDOME DEPOSIT — MI 920-050, 051, 052, 053 (Lat. 51°19'N; Long. 122°30'W; 920/7E, 8W)

The Blackdome gold mine commenced production in May 1986 at a rate of approximately 150 tonnes per day; doré bars contain approximately 65 per cent gold and 35 per cent silver. Initial reserves were 184 120 tonnes grading 27.09 grams of gold and 128.9 grams of silver per tonne, based on a cut-off grade of 8.57 grams of gold per tonne and allowing for 21 per cent mining dilution. The total cost of the project is estimated to be \$18 million (\$10 million for mill construction, \$7.5 million on exploration and \$0.5 million on development). Depending on several factors, including the price of gold, the payback period at the mine may be less than two years.

EXPLORATION — DEVELOPMENT

A program of surface and underground exploration in the South mine, completed in May and June 1986, identified an additional 21 770 tonnes of ore grading approximately 60 grams of gold per tonne in the No. 3 oreshoot on the No. 2 vein, increasing gold reserves by nearly 1300 kilograms. The No. 3 shoot was traced by drilling over a strike length of 38 metres and has an average width of 2.27 metres. Drilling along the vein system has tested mineralization to a depth of 125 metres. Surface drilling along the southerly extension of the vein system, across the northwesterly trending fault shown on Figure 13-1 (Faulkner, 1986) has intersected additional ore-grade mineralization.

GEOLOGY

The Blackdome deposit is a high-level explosive epithermal quartz vein and/or quartz breccia system which intruded volcanic rocks of Eocene age. The volcanic sequence consists of a lower andesitic unit (not seen in the mine section) overlain by a flow-banded rhyolite (including ignimbrites with trachytic and pilotaxitic textures) and ash flow tuffs, in turn overlain by an upper andesite with local deposition of a volcanic wacke at its base. Mineralization is primarily hosted by the rhyolite unit but also occurs in the upper andesite. A younger postmineral basalt ($24 \pm .08$ million years) overlies the entire sequence and caps Blackdome Mountain (Plate 2-1-1).

ECONOMIC GEOLOGY

To date 12 quartz veins have been identified all dipping steeply to the northwest (*see* Faulkner, 1986, page 106). The No. 1 and No. 2 veins coalesce toward the southern end of the vein system. Veins have been traced over a strike length in excess of 2500 metres with widths averaging 1.5 to 2 metres (Plate 2-1-2). Cockscomb textures, vugs, and brecciation are common features in "ore". Gangue is chiefly silica with a noticeable lack of carbonate. Total sulphide content is low (less than 0.5 per cent), with native gold the major ore mineral.

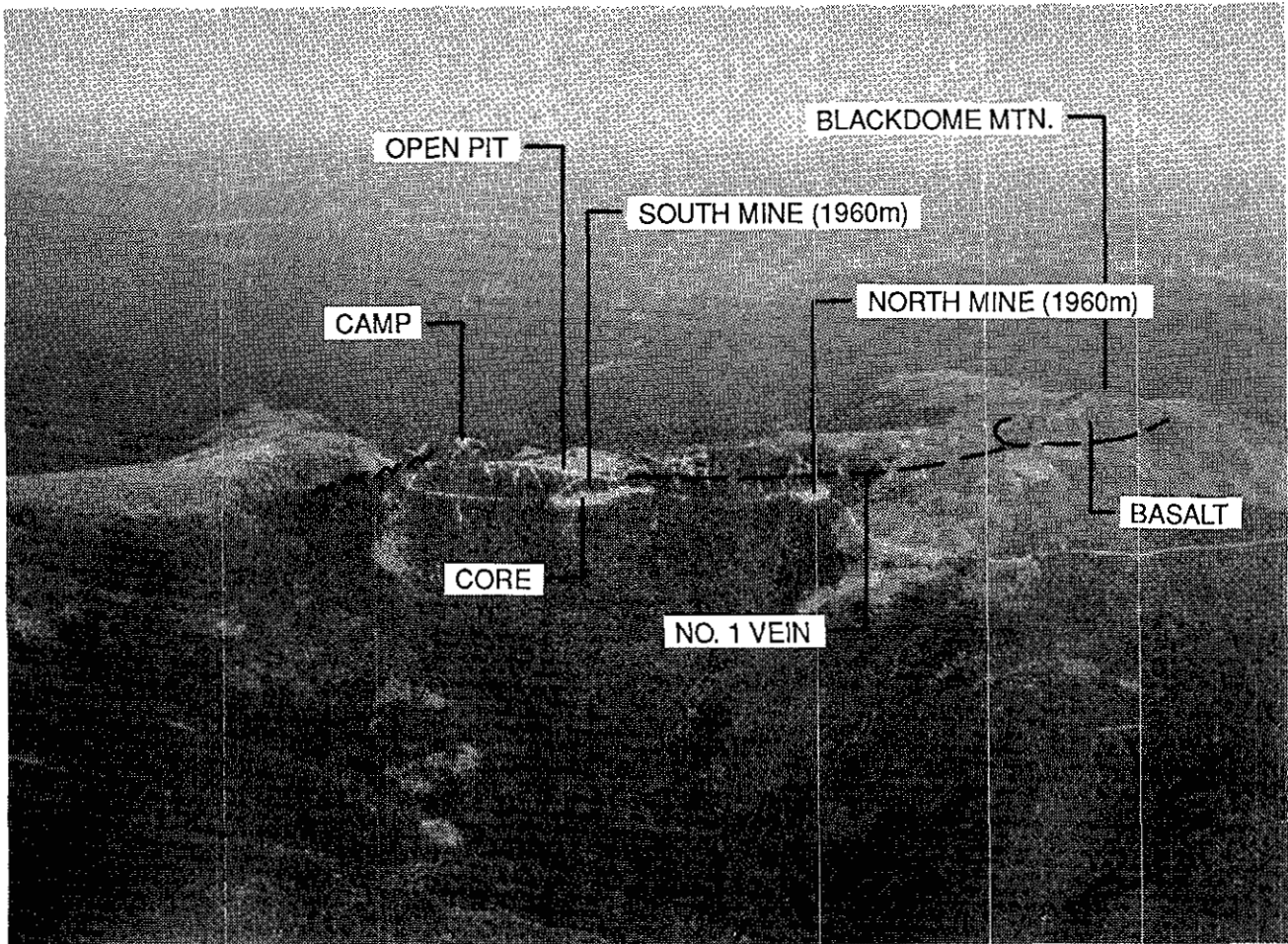


Plate 2-1-2. Looking westerly over Blackdome mine.

GEOCHEMISTRY

A strong correlation between gold, arsenic and antimony exists in wallrock samples.

Gary Vivian at the University of Alberta has identified two selenium-bearing minerals in the ore: aguilarite (Ag_2Se) and naumannite [$\text{Ag}_2(\text{Se},\text{S})$]. Although no barite has been noted to date, Vivian has also identified a barium-rich feldspar (celsian) which may represent a replacement phenomenon. Preliminary oxygen isotope data indicate a very consistent geothermal system dominated by meteoric water ($\sigma^{18}\text{O}\%$ fluid ranges from -7.5 to -8.96) (G. Vivian, private company files, 1985).

ALTERATION

Besides the obvious silicification in rocks adjacent to ore, other alteration minerals identified include: sericite, kaolinite, montmorillonite, illite, chlorite, epidote and adularia.

ORE GENESIS

The Blackdome deposit is postulated to have formed at the top of a large hydrothermal intrusive system similar to the Poison Mountain porphyry copper deposit (estimated reserves at 175 million tonnes averaging 0.33 per cent copper, 0.015 per cent molybdenum and 0.3 grams of gold per tonne) located approximately 20 kilometres to the

south. The intrusive source is postulated to have been anomalous in gold and silver. Metals were deposited as a result of the explosive upward movement of hydrothermal solutions into permeable rhyolitic and, to a lesser extent, andesitic rocks. The Blackdome deposit is considered to be a good example of the "classic" Tertiary bonanza epithermal deposits found in the southwest U.S.A.

PRODUCTION

An increase in the milling rate from 150 to 200 tonnes per day is planned, with feed coming from at least six stopes and surface mining on the No. 1 vein. A glory hole will eventually be developed by stoping to the surface. Milling recovery is estimated at 90 per cent. Some 50 to 60 per cent of the gold is recovered in jig concentrates prior to flotation. Concentrates containing about 30 per cent gold are upgraded by repeated processing across a shaker table.

Production is expected to be approximately 140 kilograms of gold and 700 kilograms of silver per year. The potential for discovery of additional reserves is considered excellent.

ACKNOWLEDGMENTS

The writer thanks Dave Rennie (Mine Geologist) and Bob Roscoe (Mine Manager) for their generous hospitality and valuable discussions on property geology and mining.

BRALORNE-BRIDGE RIVER GOLD CAMP
(Lat. 50°38'N to 50°59'N; Long. 122°32' to 122°57'W;
92J/15)

The Bralorne-Bridge River district ranks as the premier gold camp in British Columbia having produced 143 240 kilograms of gold from some eight million tonnes of ore during the period 1932 to 1971 (Schroeter and Panteleyev, 1986). Evidence of an igneous and hydrothermal "system" has been traced for over 6 kilometres (Leitch and Godwin, 1986). A spatial relationship exists between quartz veins, mineralization and sodic intrusions. Veins range from a few metres to thousands of metres in horizontal and vertical extent with widths averaging between 0.75 to 1.5 metres. They are generally sulphide poor (1 to 3 per cent) and contain native gold with minor pyrite, arsenopyrite and trace sphalerite, galena, chalcopyrite and tetrahedrite. Ribbon textures are common; locally mariposite occurs along vein margins.

Present reserves of "readily available" ore at the Bralorne mine are estimated at 475 000 tonnes grading 8.91 grams of gold per tonne. Total reserves are estimated at 830 174 tonnes grading 8.57 grams of gold per tonne (E&B Explorations Inc., Stage I Report, 1982). Drilling from surface and underground on the 800 level indicates continuity in the Ida May, Alhambra, Alhambra F.W., 809, 51 F.W. and 51 veins.

The historic Bralorne-Pioneer deposits (MI 92J/NE-001 to 004, 006 to 008) are examples of mesothermal or Motherlode-type precious metal deposits.

The Congress deposit (MI 092J/NE-029) contrasts with the Bralorne deposits in that the veins are generally enriched in sulphides and contain significant amounts of stibnite. They may have formed at higher elevations in the hydrothermal system. Reserves at Congress in the Howard, Lou, Congress and Paul zones, are estimated at 607 400 tonnes grading 8.23 grams of gold per tonne in all categories.

References which describe recent work in this camp in more detail include Leitch and Godwin (1986), Harrop and Sinclair (1986), Church (this volume) and Leitch (this volume).

HEDLEY — MI 092H/SE-038, 039
(Lat. 49°22'N; Long. 120°02'W; 92H/8, 82E/5)

A brief surface and underground visit was made to this important district where gold-bearing sulphide-rich skarn deposits are spatially associated with diorite intrusions.

Mascot Gold Mines Limited is preparing the Nickel Plate mine for production at a rate of 2450 tonnes per day. Using a cutoff of 1.714 grams of gold per tonne, open-pit reserves are estimated at 6 429 700 tonnes grading 5.142 grams of gold per tonne with a 9.1:1 stripping ratio. An additional 2 358 200 tonnes of reserves grading 5.49 grams of gold per tonne have been outlined below the design pit bottom.

More detailed descriptions of the Hedley area are included in Ray *et al.* (1986) and Ray and Dawson (this volume).

The management and staff of Mascot Gold Mines are gratefully acknowledged for taking time out of their busy schedule to provide a tour of the property. Gerry Ray very kindly provided a regional overview of the Hedley district.

GRAND FORKS-GREENWOOD
(Lat. 49°05'N; Long. 118°35'W; 82E)

Several gold occurrences in the historic Grand Forks-Greenwood skarn camp were visited:

- (1) **Phoenix** (MI 082E/SE-020) where skarn mineralization has been extensively mined in the past, both underground and by

open pit. Over the period 1900 to 1978 the Phoenix mine produced 28 083 kilograms of gold, 183 036 kilograms of silver and 235 693 tonnes of copper from a little over 13 million tonnes of ore milled.

- (2) **Jewel (Dentonia)** (MI 082E/SE-055) where 117 910 tonnes of ore averaging 10.3 grams of gold and 68.6 grams of silver per tonne were produced from the Jewel and Enterprise orebodies during the period 1895 to 1975. The vein system, containing galena, native gold, chalcopyrite and pyrite in a quartz, calcite and barite gangue, is hosted by granodiorite and has been traced over a strike length of 975 metres.
- (3) **Sylvester K** (MI 082E/SE-046) where a gold-bearing massive sulphide lens has been outlined in a hornfelsed dust tuff and argillite unit. The lens is 305 metres long, averages 9.1 metres in width and has been drilled to a depth of 37 metres. Assays up to 10.3 grams per tonne gold have been obtained over a width of 2.4 metres of massive pyrite-pyrrhotite-chalcopyrite-magnetite mineralization within the broader zone.
- (4) **Rainbow (ex Midway mine)** (MI 082E/SE-128) where altered ultramafic rocks are in faulted contact with high-silica "cap" rocks, a potentially favourable geologic environment for gold deposition.
- (5) **OB** (MI 082E/SE-011) where Skylark Resources Ltd. and Viscount Resources Ltd. have recently completed a 178-metre decline on a narrow silver-rich vein in quartz diorite.

The two significant types of gold-silver deposit in the Grand Forks-Greenwood area are: (1) skarns related to buried intrusive bodies; and (2) epithermal veins controlled by low-angle Tertiary faults (detachment zones?) recently recognized by Dr. J.T. Fyjes.

The hospitality and information provided by George Stewart and Jim Fyles, both with Kettle River Resources Ltd., is gratefully acknowledged.

TILLICUM — MI 082F/NW-234
(Lat. 49°59'N; Long 117°43'W; 82F/13, 82K/4)

PREVIOUS WORK

The geology and geochemistry of the Tillicum Mountain area are discussed in previous reports (Ray and Spence, 1986 and Ray *et al.*, 1986).

During 1985, 58 902 grams of gold were produced from 2902 tonnes of ore processed at the Dankoe mine custom mill near Keremeos. Ore was mined from the Heino-Money pit, which is now 153 metres long, 61 metres deep and averages 2.5 metres in width.

1986 WORK

Surface diamond drilling and underground drifting on the 2130 level (Money drift) resulted in the discovery of a new east-trending high-grade gold shoot crosscutting the Heino-Money zone and extending the Screamer shoot to depth within it. The Screamer shoot, the richest ore shoot discovered to date, is now at least 31 metres deep; raising within it will define new underground reserves and add to the stockpile of high-grade ore. In fall 1986 approximately 1090 tonnes of stockpiled ore, with an average grade of 58.3 grams per tonne gold, was custom milled at the Roberts mine near Greenwood.

MINERALIZATION

Native gold is associated with a chlorite-sericite calc-silicate skarn developed near the contact between metabasalt and meta-argillite. The skarn is pinkish green to light brown in colour, often banded, and sometimes cut by quartz veinlets.

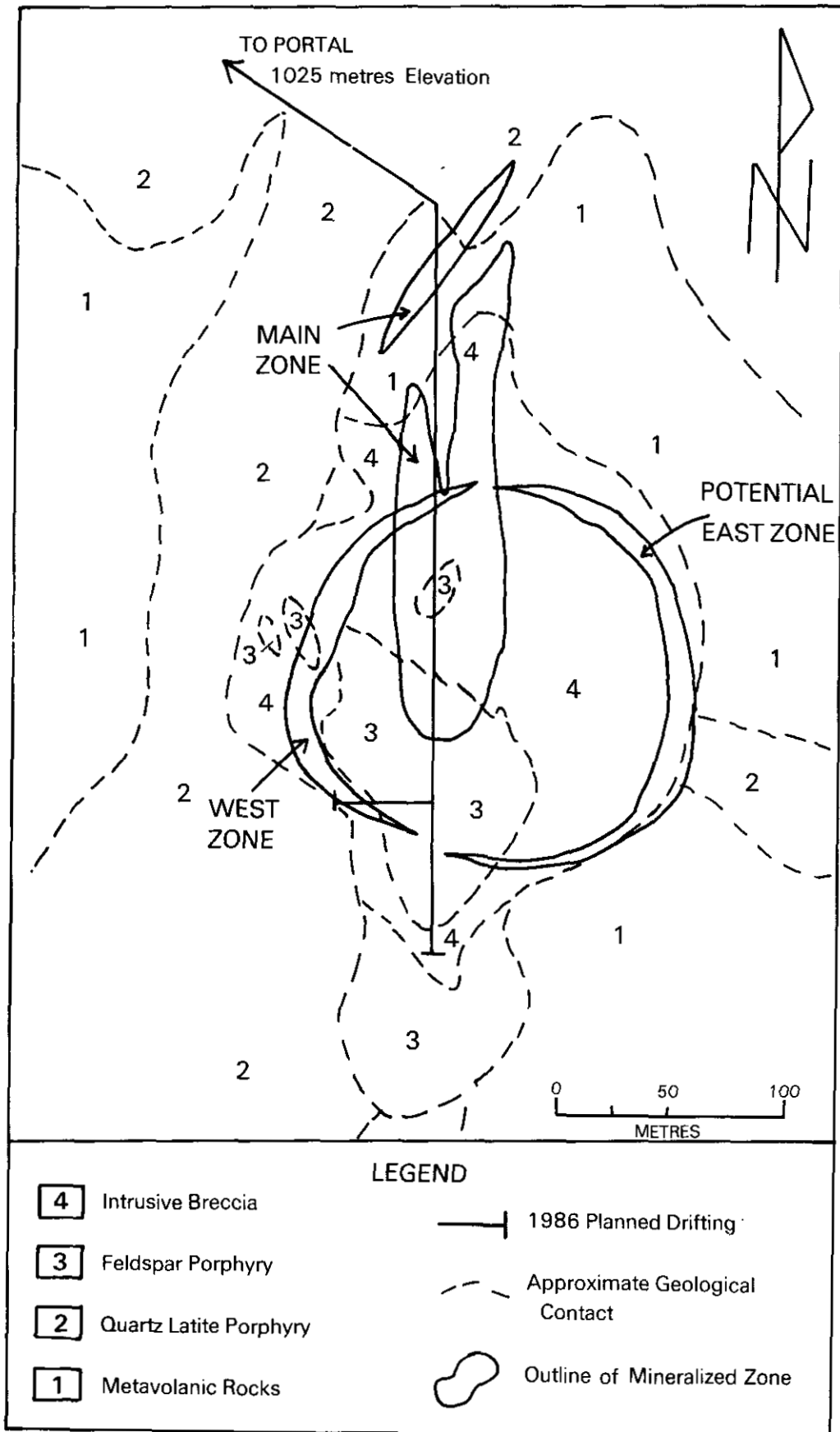


Figure 2-1-2. Geology and planned drifting, Willa prospect (after company plans).

ACKNOWLEDGMENTS

The writer gratefully acknowledges the hospitality and field discussions with Bernie Dewonk, project geologist with Esperanza Exploration Ltd.

WILLA (AYLWIN CREEK) DEPOSIT — MI 082F/NW-070, 071 (Lat. 49°53'N; Long 117°22'; 82F/14)

The Willa gold-copper-silver breccia lies 12 kilometres south of New Denver (Plate 2-1-3). Northair Mines Ltd. holds the property under an option agreement with BP Minerals Ltd. and Rio Algom Exploration Inc. At the end of July 1986, Northair had completed approximately 22 000 metres of surface and underground diamond drilling and 1000 metres of drifting at an estimated cost in excess of \$7 million. Five hundred tonnes of ore from underground have been stockpiled.

GEOLOGY

A steeply dipping, arcuate, heterolithic breccia pipe, with an arc length of 200 metres, an average thickness of 20 metres and a minimum vertical extent of 150 metres, is intrusive into a quartz latite porphyry. The porphyry is host to quartz molybdenite stockwork mineralization and both the pipe and porphyry are contained within a pendant of hornfelsed mafic volcanic rocks of probable Lower Jurassic Rossland Formation (Figure 2-1-2).

MINERALIZATION

Chalcopyrite, pyrite, pyrrhotite and microscopic native gold occur within the intrusive breccia pipe and at its margins. Three zones of gold-bearing mineralization have been identified; in-filling crackle breccia textures are particularly well developed in the West Zone.

As of July 1986 reserves were quoted by the operator at:

- (1) **Near-Surface Main Zone:** Approximately 3.4 million tonnes grading 1.34 grams of gold per tonne gold, 0.32 per cent copper and 4.8 grams of silver per tonne.
- (2) **West Zone:** Approximately 1.8 million tonnes grading 2.93 grams of gold per tonne, 0.56 per cent copper and 9.3 grams of silver per tonne, including a higher grade section of approximately 849 400 tonnes grading 5.49 grams of gold per tonne and 0.82 per cent copper.
- (3) **East Zone:** An east zone has been intersected by underground drilling but reserves are not available.

There appears to be a positive correlation between better gold grades and the presence of anhydrite ± garnet.

Re-evaluation of data and new reserve calculations are currently in progress.

AGE DATING

Samples collected for zircon age dating by Dr. W.J. McMillan of the B.C. Ministry of Energy, Mines and Petroleum Resources are currently being processed.

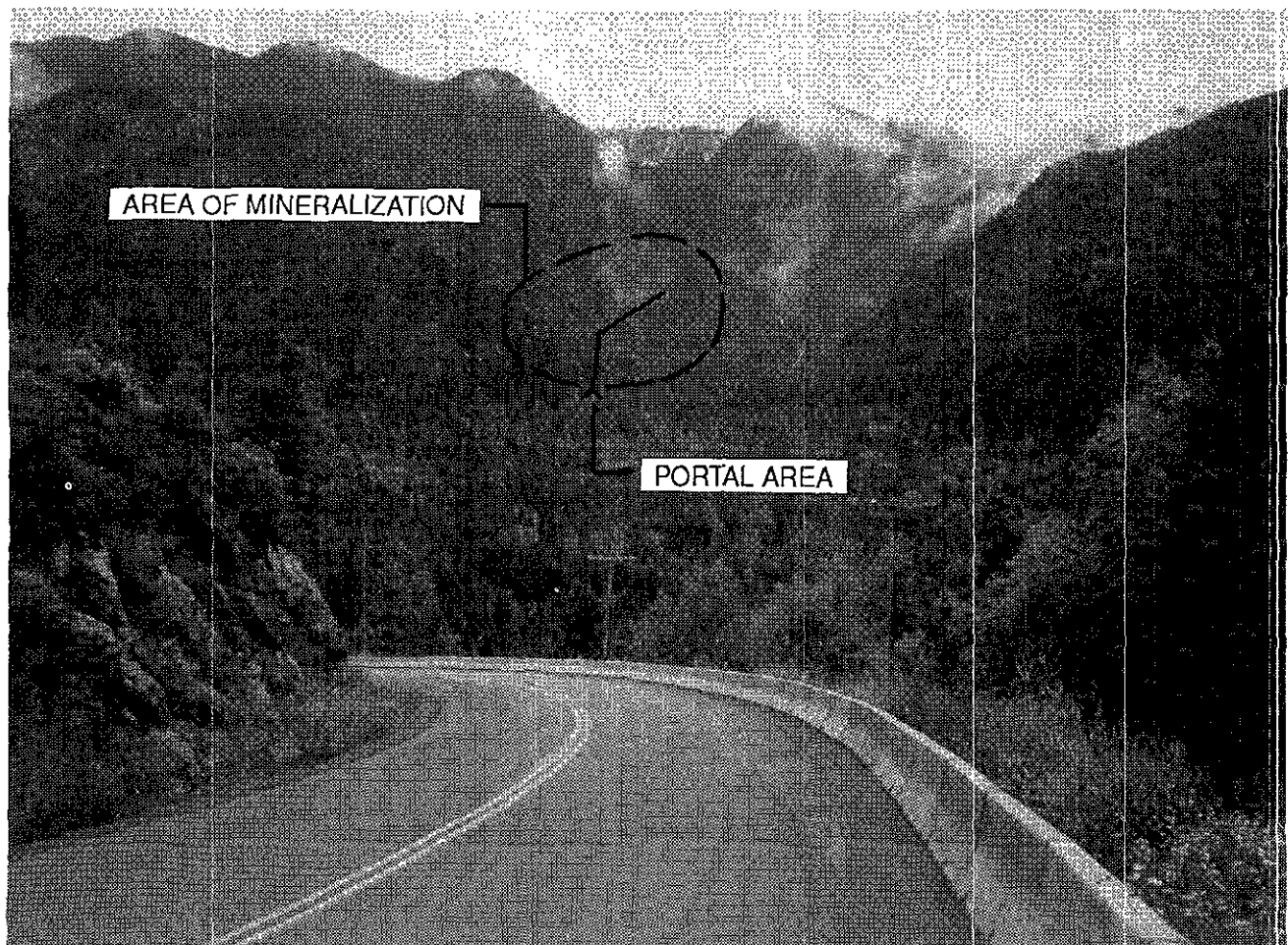


Plate 2-1-3. Looking southeasterly from Highway 6 toward Willa property.

DEPOSIT TYPE

The Willa deposit is thought to represent a hydrothermal, intrusive breccia system of alkaline affinity and containing significant quantities of gold, copper and silver. The nature of the volcanic country rocks, the occurrence of ring and radial dyke complexes and the presence of intrusive breccia suggest a preserved volcanic centre. As suggested by Heather (1985) the Willa system may be the root zone of a gold vein system similar to that at Rossland, one of British Columbia's major gold-producing mining districts.

ACKNOWLEDGMENTS

I am grateful to Len Werner (contract geologist with Northair) for guiding my underground tour and to Fred Hewitt (Northair) and Russ Wong (BP) for office discussions on the Willa project.

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