AN UPDATE FROM THE BLACKDOME MINE, CLINTON, B. C.

ABSTRACT

The Blackdome gold-silver mine, located 250 kilometres north of Vancouver, B. C. began production in May of 1986. The ore deposits there are epithermal quartz veins and breccias emplaced along steeply dipping, northeasterly striking fault zones in Eocene volcanic rocks. The host rocks are relatively flat-lying rhyolitic to andesitic flows and tuffs which have been sheared, then hydrothermally altered and strongly silicified. Disseminations of fine- to medium-grained native gold, electrum, acanthite, aguilarite and silver sulphosalts constitute the economic minerals, and these occur with accessory pyrite, covellite, chalcocite, arsenopyrite, sphalerite and galena. Ore bodies consist of small shoots in the order of 12 to 70 metres in strike length, measuring up to 80 metres vertically and up to 3.5 metres thick.

To date, few structural, lithological or geochemical characteristics have emerged that act as dependable clues to locating ore. This, coupled with the small size of the ore shoots, makes exploration particularly difficult and expensive. However, reasonably reliable procedures have been developed over the years. Close-spaced geochemical soil sampling for gold, followed by extensive surface trenching is most effective for finding the ahear zones which host the quartz veins. This is succeeded by methodical diamond drilling on 25 metre centres to develope drifting targets.

At start-up, geologic reserves in all categories were 221,455 tonnes grading 22.62 gm Au/t and 107.3 gm Ag/t. From that time to December 31, 1987, the mine has operated continuously, yielding 2891.9 kg (76,505 oz) of gold and 7763.4 kg (205,380 oz) of silver from 108,944 tonnes (119838 tons) of ore. Property exploration has kept pace with production such that at December 31, reserves were 222,820 tonnes grading 25.51 gm Au/t and 74.04 gm Ag/t. An aggressive exploration program is recognized as vital to the continuing success of the mine, and a significant portion of the mine operating budget is allocated each year for this purpose.

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INTRODUCTION

The Blackdome mine is located 67 kilometres west-northwest of Clinton, B. C., and 250 air-kilometres north of Vancouver (Figure 1). It is a small, 200 t.p.d. operation that began production in May of 1986. The ore shoots are small, high-grade bonanza deposits and, although the daily throughout is small, the mill-head grades are among the highest of any mine in the country.

Gold mineralization was first discovered on the property in 1947 by Lawrence Frenier who staked the original claims. From the early 1950's to the 1970's, exploration work consisting of prospecting, trenching, diamond drilling and underground development was done by two companies: Silver Standard Mines Ltd. and Empire Valley Gold Mines Ltd. In 1977, Barrier Reef Resources Ltd. staked the surrounding ground and consolidated all the claims under a new company called Blackdome Exploration Ltd. From that time, until 1984, extensive geochemical sampling, trenching, geological mapping, geophysical work, diamond drilling and drifting was carried out over the property by both Blackdome and Heath Steele Mines Ltd. By the end of 1984, cut and diluted ore reserves in all categories stood at 221,455 tonnes grading 22.62 gm Au/t and 107.3 gm Ag/t, and the decision was made to take the deposit into production.

Construction of a mill and camp facility was started in May of 1985 and the mine began operation in May of 1986, following an expenditure of $10,000,000. At the present time, production is

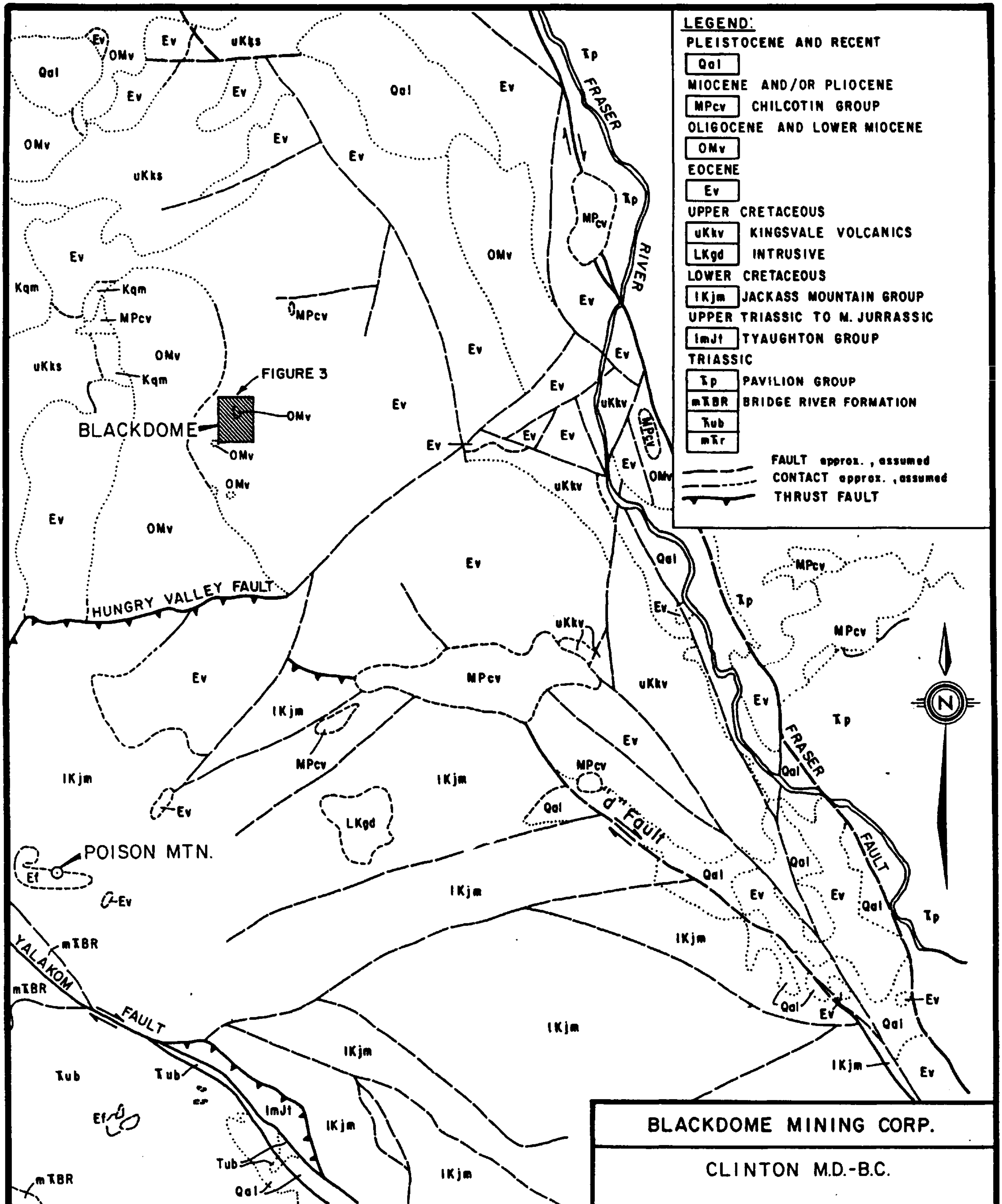
BLACKDOME MINING CORP.
CLINTON M.D., B.C.
LOCATION MAP
DATE: APRIL, 1988 — FIGURE: 1

underway at 200 tonnes per day and the mine employs some 135 people, depending on the season. Gold production for 1987 was 1765.2 kg (46,698 oz) gold and 4782.5 kg (126,520 oz) silver. Ore reserves in all categories at the end of 1987 were 222,820 tonnes grading 25.51 gm Au/t and 74.04 gm Ag/t.

REGIONAL GEOLOGY

The Blackdome Property lies in an area that is underlain by rocks of Tertiary to Triassic age (Figure 2). The oldest rocks in the vicinity of the mine are the Triassic Pavilion Group, which outcrop on the east bank of the Fraser River, some 16 kilometres east of the mine. Also, ultra-basic rocks of apparent Triassic age have been mapped by Tipper (1978) along the Yalakom Fault, 30 kilometres south of the property. These are underlain by a unit which has recently been correlated with the Lower Cretaceous Jackass Mountain Group and Upper Cretaceous Spences Bridge or Kingsvale Formations (Richardson and Carlyle, 1981; Mathews and Rouse, 1984).

Overlying the Cretaceous strata are sediments, tuffs and flows of Eocene age. Near Blackdome Mountain, the rocks are comprised of subaerial welded ash, possibly ash-flow, and lapilli tuffs, as well as lava flows and debris-flow deposits, all of which vary in composition from andesite to rhyolite. The entire sequence of sedimentary and volcanic rocks has been correlated with the Kamloops Group which occurs on the Ashcroft and Nicola map sheets many miles to the south and east of the Blackdome area (Duffell



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FROM TIPPER, 1978, GSC. OPEN FILE Nº. 534

BLACKDOME MINING CORP.

CLINTON M.D.-B.C.

REGIONAL GEOLOGY

DATE: APRIL, 1988

BY: D.R. / r.w.r.

FIGURE 2

and McTaggart, 1952; Mathew and Rouse, 1984; Ewing, 1981). Unconformably capping the Eocene rocks are basalt flows of Early Miocene or Late Oligocene age (Church, 1980).

Major and trace element studies of the Eocene rocks carried out by Vivian (personal communication, 1984) have shown that they are derived from a calc-alkaline magma in a volcanic arc-type of tectonic setting. Eocene quartz monzonite stocks at Poison Mountain, located 22 km southwest of Blackdome Mountain, are host to an auriferous porphyry copper-molybdenum deposit. They could represent the source magma of a volcanic system similar to the one at Blackdome.

The region is transected by four major fault zones: the Fraser, "d", Hungry Valley and Yalakom Faults (Tipper, 1978; Trettin, 1961). The Fraser Fault lies to the east of Blackdome Mountain and is the zone of weakness responsible for the formation of the Fraser Canyon. The "d" fault is a northwesterly-striking branch of the Fraser Fault which has undergone strike-slip displacement of unknown magnitude. It is related to the Hungry Valley Fault which is a thrust fault along which Lower Cretaceous sediments have been thrust onto Upper Cretaceous and Tertiary rocks. Further to the south is the Yalakom fault, a right-lateral strike-slip fault that strikes northwesterly, roughly parallel to the Hungry Valley Fault. It, too, is a branch of the Fraser Fault.

Several minor faults have been mapped in the area by Tipper

(1978) and are probably related to the above-mentioned structures.

PROPERTY GEOLOGY

Rock units that have been observed and mapped on the Blackdome Property, to date, are Cretaceous and Eocene intermediate to felsic volcanics and Oligocene to Lower Miocene basalts (Figure 3). The gold-silver mineralization has been found only in the Eocene volcanic rocks and the basalts are known to be post-ore. It is not known whether ore-bearing vein systems exist in the Cretaceous strata as exploration has not been carried out to sufficient depth.

The Eocene rocks have been grouped into four sub-units, which are (lowermost to uppermost): a series of predominantly andesitic flows and pyroclastics called the Lower Andesite, a dacite flow unit, a sequence of mainly rhyolitic tuffs, lavas and debris-flow deposits known locally as the Rhyolite Unit and another series of andesite to dacitic andesite flows called the Upper Andesite (see Figures 3 and 4). All these units are fairly flat-lying with dips seldom in excess of 25 degrees to the southeast and northwest.

The structural geology near the mine is fairly simple as deformation of the post-Cretaceous rocks is generally moderate. Folds observed on the property are broad, open flexes which, in some localities, may reflect the topography of the depositional

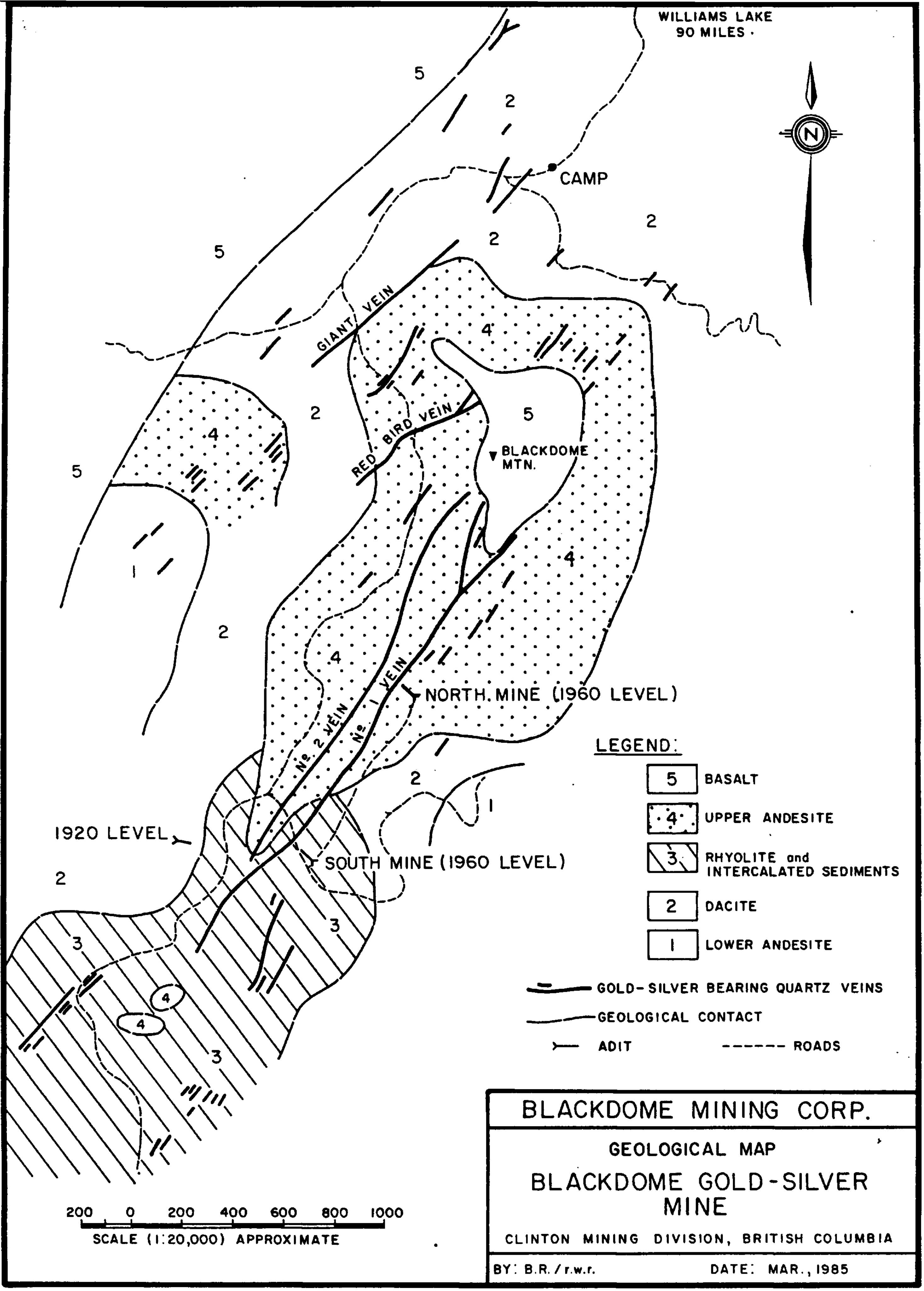
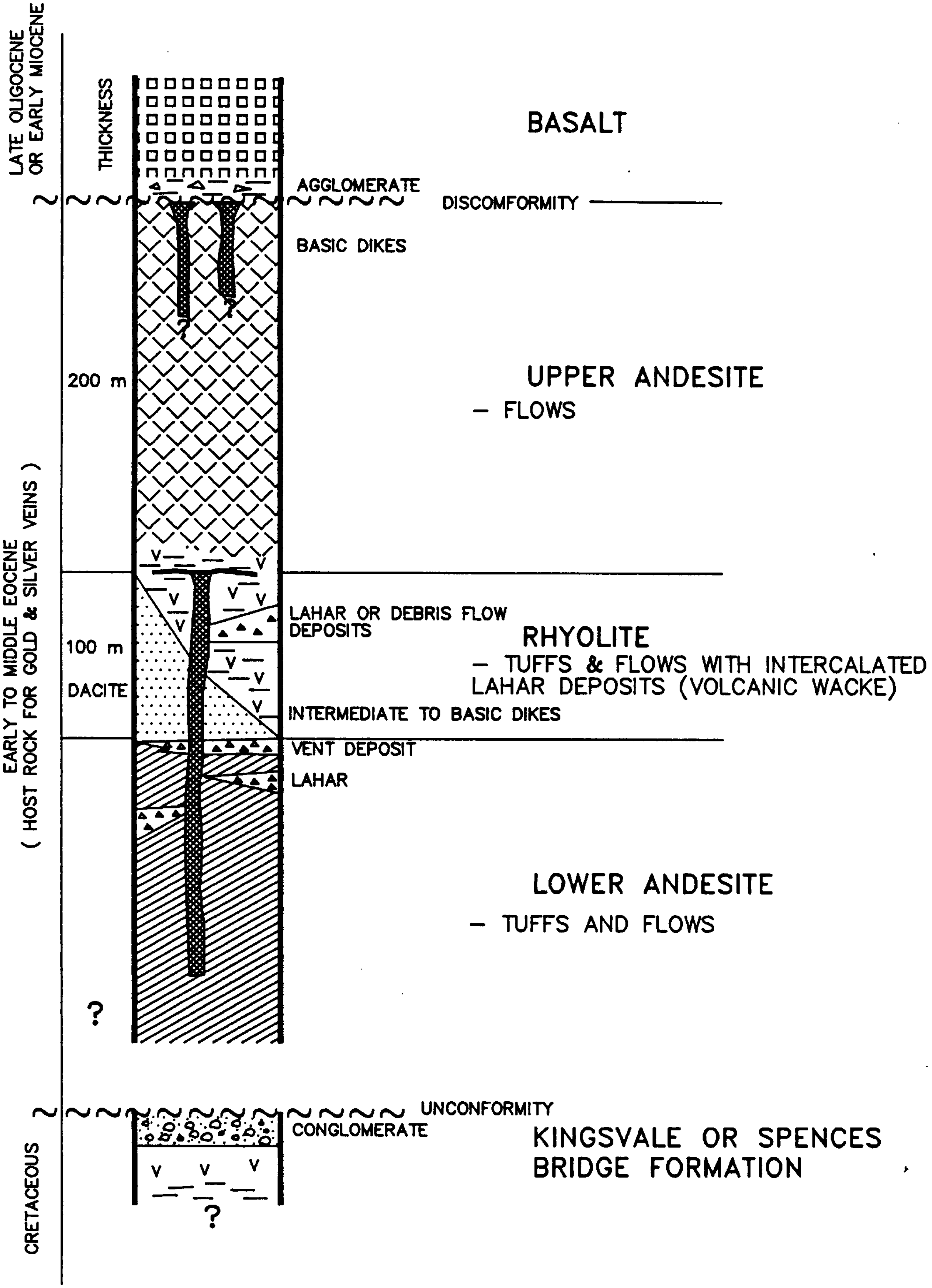

WILLIAMS LAKE
90 MILES
CAMP
5
2
GIANT VEIN
4
RED BIRD VEIN
BLACKDOME MTN.
No. 2 VEIN
No. 1 VEIN
NORTH MINE (1960 LEVEL)
1920 LEVEL
SOUTH MINE (1960 LEVEL)
3
1
LEGEND:
5 BASALT
4 UPPER ANDESITE
3 RHYOLITE and INTERCALATED SEDIMENTS
2 DACITE
1 LOWER ANDESITE
GOLD-SILVER BEARING QUARTZ VEINS
GEOLOGICAL CONTACT
ADIT
ROADS
200 0 200 400 600 800 1000
SCALE (1:20,000) APPROXIMATE
BLACKDOME MINING CORP.
GEOLOGICAL MAP
BLACKDOME GOLD-SILVER MINE
CLINTON MINING DIVISION, BRITISH COLUMBIA
BY: B.R./r.w.r.
DATE: MAR., 1985

FIGURE: 4

BLACKDOME MINING CORP.

BLACKDOME PROPERTY

STRATIGRAPHIC COLUMN



surface. There is strong evidence of a large anticline, plunging shallowly to the northeast. The axis of this fold lies parallel to the faults that control ore mineralization and the two structures are thought to be related to doming which occurred during the volcanism (Dawson, 1979).

ECONOMIC GEOLOGY

The gold and silver mineralization occurs in quartz veins and siliceous breccias situated along roughly parallel faults. Most of the exploration work completed so far has been on two quartz vein systems called the No. 1 and No. 2 Veins. However, there are several other gold-bearing structures on the property. The Nos. 1 and 2 faults have sinuous surface traces, strike approximately 040 degrees and dip at angles between 55 and 75 degrees to the northwest (see Figure 3). The other vein systems strike in approximately the same direction but vary in dip from 45 degrees northwest to 70 degrees southeast. There has been dip-slip displacement across both the No. 1 and 2 faults systems in excess of 20 and, in some cases, as much as 50 metres.

Ore minerals consist of native gold, electrum, silver, aguilarite, acanthite, freibergite and several unidentified silver sulphosalts (Vivian, pers. comm., 1985). Accessory sulphide minerals that occur in minor amounts are pyrite, pyhrrhotite, marcasite, digenite, chalcopyrite, bornite, covellite, chalcocite, arsenopyrite, sphalerite and galena. The mode of occurrence of the these minerals is medium- to fine-grained disseminations and fracture-fillings of euhedral to anhedral grains. Some crystalline gold has also been observed. Overall, the metallic minerals are sparsely distributed and represent 1% or less of the total vein material. Base metals are present in geochemically significant amounts but are not economically important.

The deposit is believed to have been precipitated from upward moving hot meteoric waters in a Middle to Late Eocene, or, possibly, Early Oligocene epithermal system. Fluid inclusion studies by Vivian, et al. (1987) indicate that the temperature of deposition was approximately 285 degree C., at a depth of 0.5 to 1.1 km. This places it fairly low down in the system, at or below the so-called "boiling level" described at many other epithermal deposits.

Alteration associated with the veins is characterized by the introduction of potassium feldspar, sericite, clay minerals and, most importantly, silica. Silicification is most intense within 1 metre of the fault zones, and often the quartz content of these zones is over 90%. Within the strongly silicified bodies are zones with a bleached appearance which have undergone leaching by acidic fluids. This low-pH alteration facies is usually confined to within 1 to 2 metres of a fault or fracture. Weak propylitic alteration is often seen, especially in the andesites and is characterised by fine- to medium-grained epidote, chlorite, calcite and pyrite fracture-fillings. Propylitic alteration is more widespread and can occur as much as 15 metres from the veins. Weathering products such as limonite and pyrolusite are present throughout the faults to a depth of at least 100 metres below surface.

The ore occurs as steeply to moderately plunging, elongate "bonanza" shoots within the more silicified sections of the fault zones. They exist adjacent to, or in the milled rock of the fault zones themselves and average up to 3.5 metres thick. The ore-shoots can be up to 70 metres long and 80 metres high, although the lower boundaries of some shoots have not yet been determined. The plunge of the ore-bodies, where apparent, is variable.

The grade of the vein material changes along strike from waste to ore over intervals as short as 1 to 3 metres. Within the ore shoots, the grade varies widely and it is not uncommon to obtain assays over minable widths in the hundreds or even thousands of grams gold per tonne with sub-ore-grade material 1.5 metres along the vein. The boundary of the ore across the strike of the veins is even more abrupt, with the change from mineralized to barren rock occurring over a space of a few centimetres. Very little gold and silver occur in the walls of the veins.

Silicification is always present in the ore zones but an abundance of quartz does not mean that gold and silver mineralization is present. Visible gold and silver minerals occur in hand specimens and in drill core but, most often, they are so fine-grained as to be nearly impossible to spot with the naked eye or hand lens. However, the ore is nuggety, as evidenced by the number of gold grains greater than 0.5 mm in diameter that report to the gravity concentrate in the mill. For this reason, much detailed sampling and assaying must be done on every newly exposed portion of a vein and the ore boundaries defined by this information alone.

EXPLORATION APPROACH

During the period 1977 to 1986, a number of exploration methods were implemented on the Blackdome Property. Soil geochemical programs for gold and silver, particularly gold, together with rock geochemistry and careful prospecting were found to be the most useful tools in the early stages. Samples taken at 10-metre intervals over lines 100 metres apart were required, as soil anomalies associated with the veins, although often registering in the thousands of ppb, were frequently very narrow. Quartz float could be found all over the property and, often, traced back to the source. From there, bulldozer trenching and diamond drilling outlined targets for underground work.

The small size of the ore shoots makes it mandatory to employ closely spaced intersections, in the order of 25 metres apart. Even then, the uneven distribution of gold in the ore makes exploration diamond drilling difficult to interpret. Also, core recovery in the veins averages 75% but is often as low as 20%. More than once, diamond drill holes have pierced what was eventually found to be ore and did not return ore-grade assays. Good samples are almost impossible to obtain in drill core and ore reserve estimates based on drilling without trench or drift information are unreliable. Drilling does, however, provide indications that there are anomalous amounts of precious metals in a particular zone and so is useful in guiding detailed exploration. It is also worthwhile for establishing the location and strike of quartz-bearing structures.

Geophysical surveys involving VLF-EM and magnetometer were tried on various occasions without success. Neither the ore zones or the faults that host them are particularly conductive and they do not possess any unique magnetic properties, so these methods are not of much use. Consequently, to date, "blind" ore bodies can only be detected by diamond drilling and underground drifting.

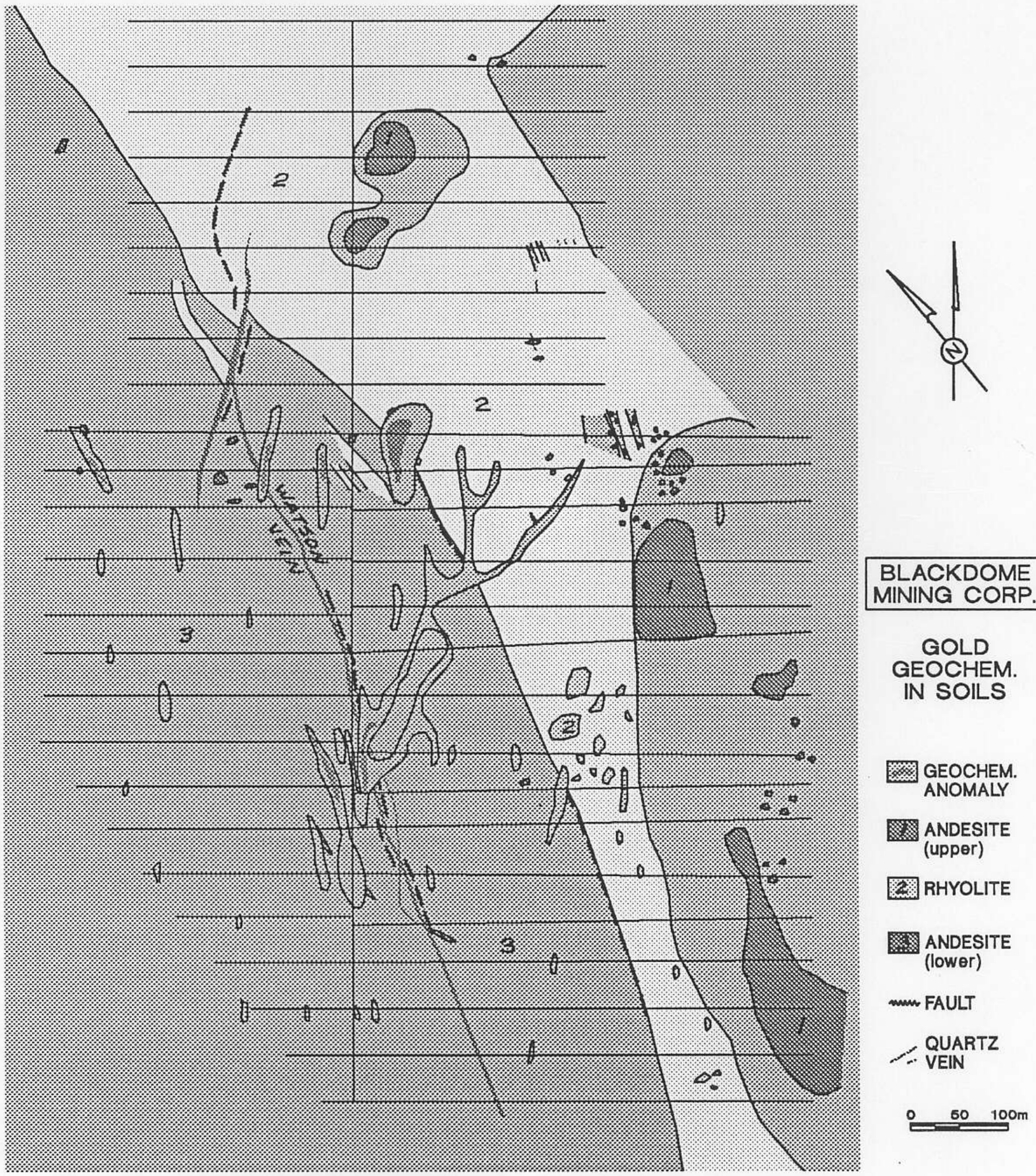
In 1987, an attempt was made to develope some better techniques for discovering new ore at Blackdome. It was hoped that methods could be devised that would reduce the amount of drilling that had to be done by locating ore bodies that do not respond to gold geochemistry. These would be ore shoots that were too deeply buried by overburden or that were situated too deeply on the fault zones for the gold to makes its way into the soil near surface.

Geochemical analyses performed on a suite of ore samples from the Nos. 1 and 2 Veins suggest, not surprisingly, that a very close correlation exists between gold and silver. In addition, strong to moderate correlations were found to exist between gold and lead, arsenic, antimony, copper and molybdenum. It seemed possible, then, that these elements could be useful as geochemical pathfinders, and, in a soil sampling program carried out over a portion of the property in the fall of 1987 (see Figures 5, 6 and 7), analyses were carried out for gold, silver, antimony, copper and arsenic.

It became apparent quite early on in the program that the lead, silver and antimony were of limited use. All three elements displayed a very flat and unimpressive range of values, from which it was difficult to define anomalous samples. Relatively few silver values were higher then 0.5 ppm and these did not seem to be related to any structural feature or geochemical highs for other elements. Similarly, lead ranged between 2 and 49 ppm and antimony between 1 and 10 ppm.

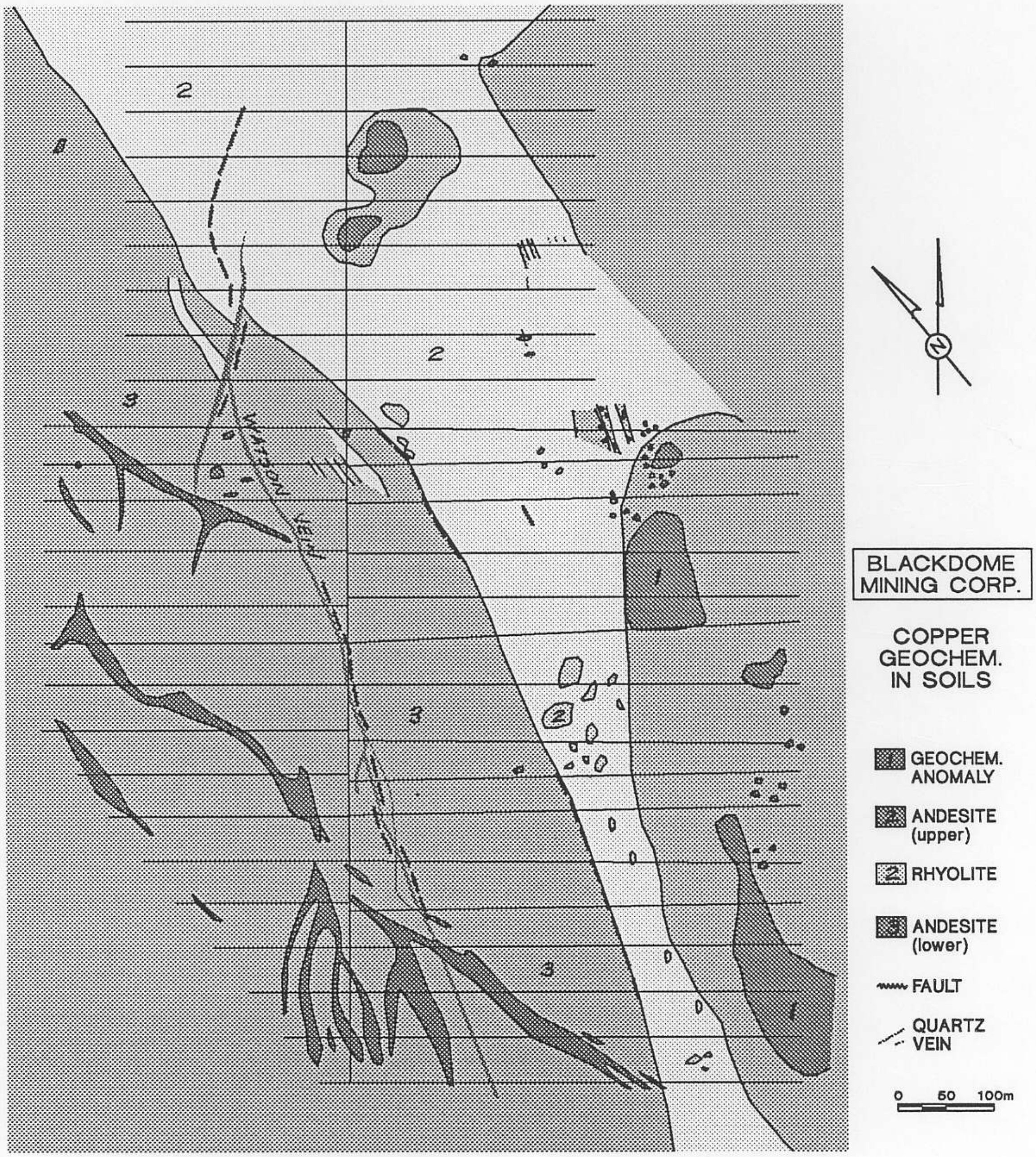
Gold, on the other hand, displayed definite anomalies, with analyses as high as 2905 ppb (Figure 5) in spite of overburden depths up to 3 metres. When the best of these anomalies were trenched, a quartz vein system was discovered with gold values as high as 80 gm/tonne over 1 metre. This vein, called the Watson Vein, wae completely covered by overburden and was entirely unexpected. Detailed trenching on it eventually defined a 75 metre-long zone that, on surface, grades 12.70 gm Au/t and 13.66 gm Ag/t over an average width of 3.5 metres.

Apparently anomalous values for copper and arsenic, associated



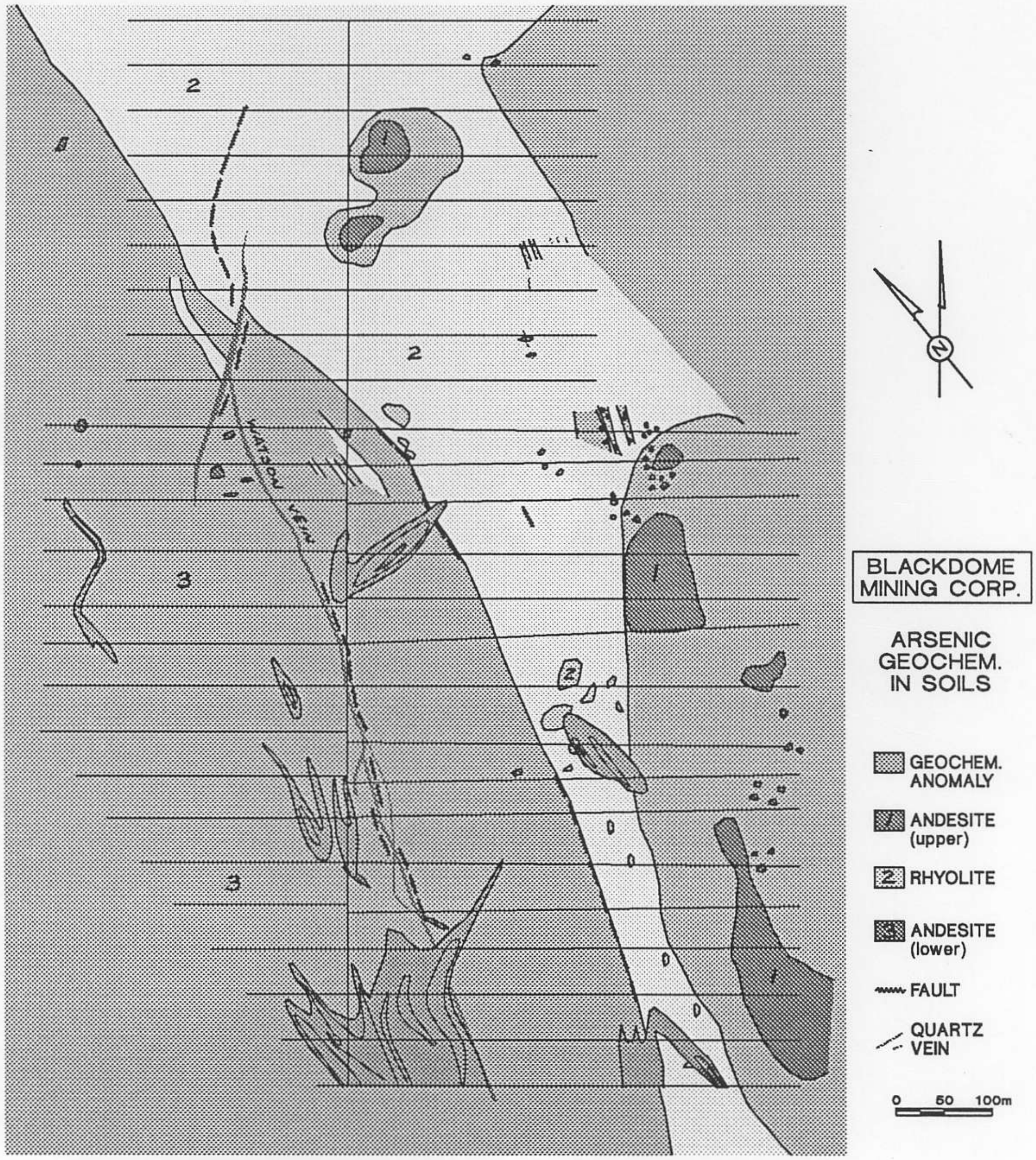
BLACKDOME
MINING CORP.
GOLD
GEOCHEM.
IN SOILS
GEOCHEM.
ANOMALY
ANDESITE
(upper)
RHYOLITE
ANDESITE
(lower)
FAULT
QUARTZ
VEIN
0 50 100m
WATSON
VEIN

FIGURE 5.



BLACKDOME MINING CORP.
COPPER GEOCHEM. IN SOILS
GEOCHEM. ANOMALY
ANDESITE (upper)
RHYOLITE
ANDESITE (lower)
FAULT
QUARTZ VEIN
0 50 100m
WATSON VEIN

FIGURE 6.



2
2
1
3
3
WATSON VEIN
N
BLACKDOME MINING CORP.
ARSENIC GEOCHEM. IN SOILS
GEOCHEM. ANOMALY
ANDESITE (upper)
RHYOLITE
ANDESITE (lower)
FAULT
QUARTZ VEIN
0 50 100m

FIGURE 7.

with the gold anomalies, were found as well (Figure 6 and 7). However, they were weak and it is debatable whether they would have led to the discovery of the Watson Vein by themselves. Trenching was done over some of the arsenic anomalies that did not have good gold geochemistry associated with them and no underlying structures were found at all. There still exists one area at the southernmost end of the grid that has widespread geochemical anomalies in both oopper and arsenic. However, they occur in a section of the property with many springs and swampy ground. Ground-water discharge, and not an ore body, could be responsible for concentrating these metals in the soil. This is supported by the fact that the cneeks have a ooincident copper high associated with them. In any case, trenching is planned for this area in 1988.

Another method that was tried in the 1987 program was VLF-EM/resistivity. It was hoped that the VLF-EM would outline any shear zones and that the resistivity would isolate quartz bodies along them. VLF-EM had been tried without success in previous years, but there had been some speculation that the transmitting station employed during that survey was not well oriented for the strike of the Blackdome veins. The station in Hawaii, which is very well situated with respect to the strike of the known veins on the property, was used for the 1987 survey.

Several lines were run over known ore bodies in order to determine if the instrument, a Geonics EM-16R, could detect them.

It did not. In fact, the response was so flat that it was thought that the instrument was not functioning properly, and it was sent back to the dealer to be checked. Once it was determined that there was nothing wrong with the instrument, a preliminary survey was run over the grid area. No response was recorded over the Watson Vein, and trenching done over those anomalies that were recorded did not reveal any underlying structural features.

CONCLUSIONS

The ore bodies at Blackdome are small, high-grade shoots that are difficult to find and evaluate. In the first stages of exploration, geochemical soil sampling on closely spaced intervals along lines 100 metres apart has been found to be quite effective. Gold analyses are most useful, although copper and arsenic provide a response which may confirm the gold anomalies. Careful prospecting and geological mapping are very important and complement the geochemistry very well. Together, these methods are effective in defining targets for trenching and diamond drilling.

Trenching and drifting remain the only reliable techniques for determining ore reserves. Diamond drilling, at best, can provide some information concerning grade and, at the very least, structural data and indications of the presence of anomalous amounts of precious metals. Due to poor recovery and the coarseness of the gold in the ore, drilling is unable to reliably evaluate reserves.

The 1987 program confirmed that the exploration methods developed at Blackdome over the past 10 years are fairly sound. The known strike-length of the new vein, dubbed the Watson Vein, is now over 500 metres and it is open-ended to the north and south and at depth. Diamond drilling has defined extensions to the gold and silver mineralization for a vertical distance of at least 90 metres. Drifting is presently underway to investigate these drill intersections.

ACKNOWLEDGEMENTS

The writer would like to acknowledge the hard work and diligence of the exploration crew employed by Blackdome under contract from Ivor Watson Associates Ltd. In particular, the efforts of field manager, John Bucholz, and geologist, Les Westerveldt are to be singled out as exemplary and most responsible for the success of the Watson Vein program.

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