A Geological Report

on the

Herd Dome Property

Omineca Mining Division, British Columbia

NTS 93L - 4 & 5

Latitude: 54° 15'N

Longitude 127° 39'W

September 1992

G.D. Delane, P.Eng.

Placer Dome Inc.

Vancouver, B.C.

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1.0 SUMMARY

The HD claims #1-8 were staked by prospector, Frank Onucki, in July 1991 to cover known and suspected copper-silver-gold mineral occurrences near Herd Dome Mountain in central British Columbia. These claims, composed of 60 claim units were optioned by F. Onucki to Placer Dome Inc. who immediately arranged for the staking of additional claims (152 units in HD 9-18) to protect the "core claims". The claims are located on map sheets 93L 4&5 and are centred approximately at 54° 15'N latitude and 127° 39'W longitude.

During August and September of 1991, Placer Dome personnel carried out prospecting, rock sampling and geologic mapping on the property. In addition, heavy mineral stream sediment sampling was carried out in drainages which drain the periphery of the property.

The objective of this field work was to first investigate the area in the vicinity of a sub-circular "pipe" or a ring-like structure where the prospector had in earlier days located well-mineralized float rock samples which carried significant values in copper, silver and gold. In addition, prospecting in other areas was planned in an attempt to locate and to investigate other areas of mineralization.

The results of this work confirmed the presence of copper mineralization in the brecciated or fragmental volcanic rocks in the vicinity of the "pipe" and also in two areas peripheral to it. A total of 103 rock samples were collected for ICP and assay analysis.

It is recommended that more follow-up work should be carried out on these mineralized occurrences to evaluate their potential for bulk tonnage copper-precious metal deposits. Large areas of the property are unexplored and continuation of prospecting of these areas is also recommended.

2.0 INTRODUCTION

This report summarizes the exploration work which was carried out by Placer Dome Inc. on the HD claims in the Omineca Mining Division in the fall of 1991.

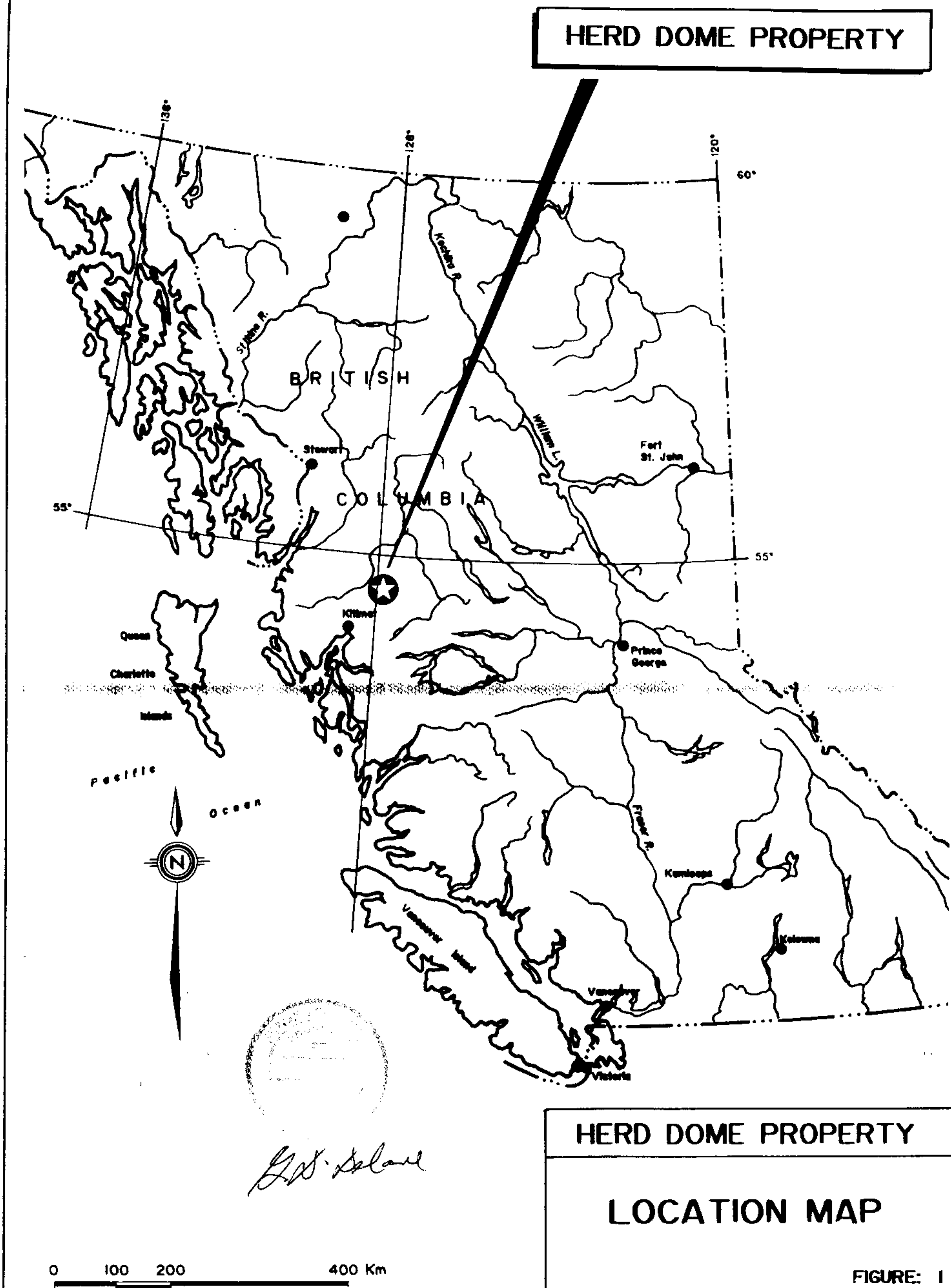
The Herd Dome property consists of 18 contiguous claims totalling 208 units which are located about 68 km southwest of Houston, B.C. The property is presently only accessible by helicopter.

Frank Onucki, prospector, staked the DH #1-8 claims in July 1991 to cover copper-silver-gold mineralized occurrences that he had first observed in the early 1970's. He optioned the claims to Placer Dome Inc. on August 7, 1991 who followed up with the staking of additional claims, HD #9-18.

It is believed that the claim area has undergone only a minor amount of prospecting work and that the mineralization has never been tested by drilling. This may have been due in part to the rugged mountain terrain and the presence of snowfields on some of the ridge tops, in the canyons and valleys which tend to inhibit exploration activities.

3.0 LOCATION & ACCESS, AND TOPOGRAPHY

The Herd Dome property is located on the east flank of the Coast Mountains in west-central British Columbia. The claims are centred at approximately 54° 15'N latitude and 127° 39'W longitude. Access to the property is by helicopter from Houston, 68 km to the east-northeast or from Smithers which is 70 km to the north-northeast. An all-weather gravel road from Houston and along the Morice River and Morice Lake logging roads provides road access to staging areas which lie within 10 km of the north and east boundaries of the Herd Dome property.



HERD DOME PROPERTY

LOCATION MAP

FIGURE: 1

SCALE : NOTED

NTS : 93L/4 & 5

The local terrain is mountainous and is characterized by rugged peaks, U-shaped valleys with steep sides and ridges and alpine plateaux. A large ice field covers the westerly flank of the Herd Dome Mountain and snow fields remain year round in the upper portions of many of the canyons. Elevations on the property range form about 915 m (3,000 ft.) to the peak of Herd Dome mountain at 1,951.5 m (6,401 ft.). Surface exploration is generally restricted to the months of about mid-July to mid-September at which time snow squalls, white-outs and violent wind storms may suddenly appear.

Small spruce, pine and alder are present in the valleys and the tree line is at approximately 1,400 metres elevation. Extensive talus fields cover the lower portions of the flanks of the ridges.

4.0 PROPERTY

The HD claims #1-8 are located about 68 km SW of Houston, B.C. in the Omineca Mining Division. The property straddles map sheets 93 L - 4&5, and it is centred approximately at 54° 15'N latitude and 127° 39'W longitude.

The property presently consists of 14 claim blocks and four two-post claims. Claims DH #1-8 are held by Placer Dome Inc. under option from prospector, Frank Onucki and claims HD #9-18 were staked by Placer Dome Inc.

The claims are listed and described as follows:

Claim Name	No. of Units	Record Number	Record Date	Expiry Date *
HD-1	16	302320	July 24, 1991	July 18, 1997
HD-2	16	302321	July 24, 1991	July 16, 1997
HD-3	12	302322	July 24, 1991	July 15, 1997
HD-4	12	302323	July 24, 1991	July 16, 1997
HD-5	1	302324	July 24, 1991	July 18, 1997
HD-6	1	302325	July 24, 1991	July 18, 1997

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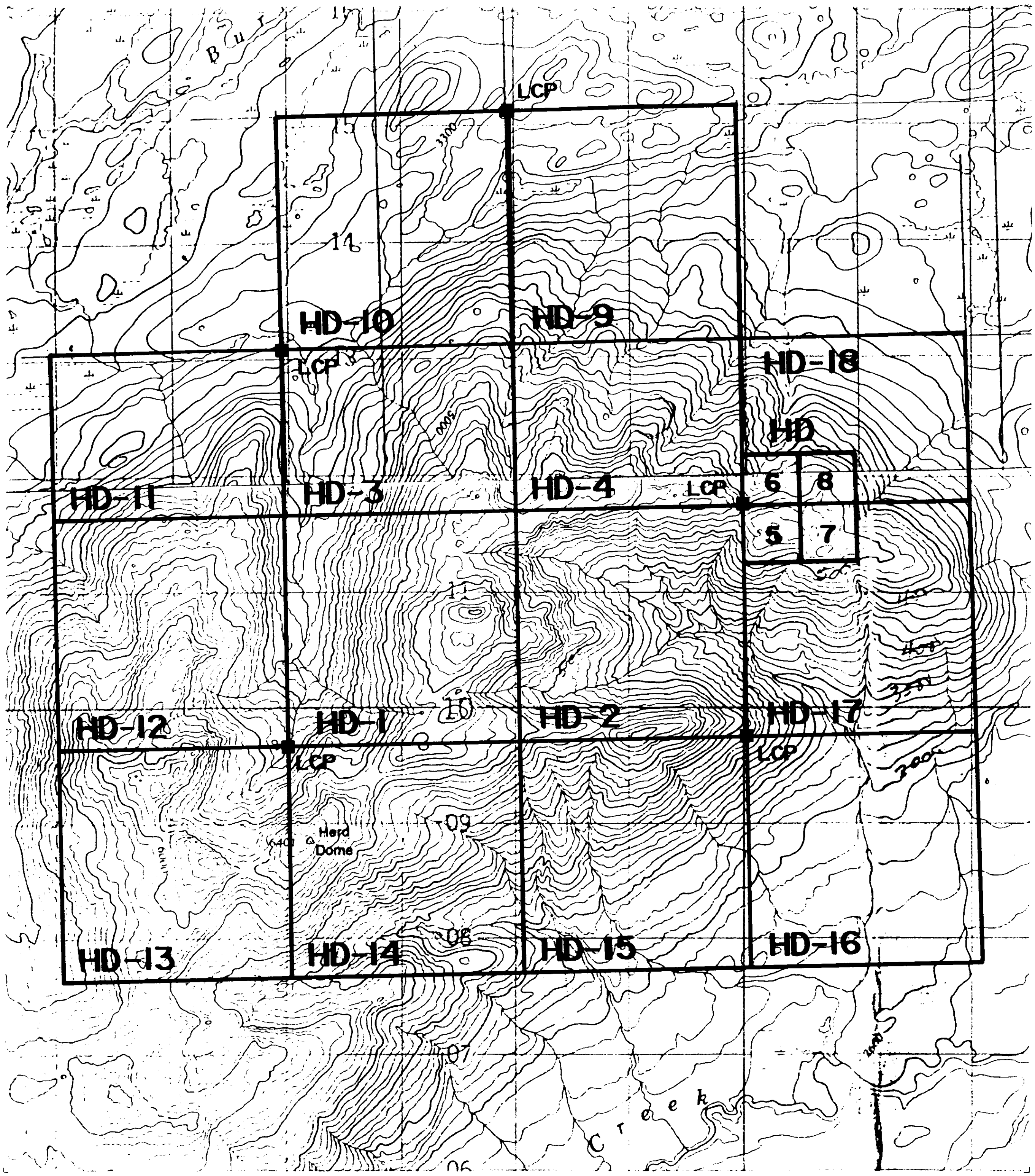

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METRES

HERD DOME PROPERTY

CLAIM MAP

FIGURE: 2

SCALE : 1 : 50 000 | NTS : 93L/4 & 5

Claim Name	No. of Units	Record Number	Record Date	Expiry Date
HD-7	1	302326	July 24, 1991	July 18, 1997
HD-8	1	302327	July 24, 1991	July 18, 1997
HD-9	16	303969	Sept. 13, 1991	Sept. 2, 1994
HD-10	16	303970	Sept. 13, 1991	Sept. 2, 1994
HD-11	12	303971	Sept. 13, 1991	Sept. 5, 1994
HD-12	16	303979	Sept. 13, 1991	Sept. 6, 1993
HD-13	16	303972	Sept. 13, 1991	Sept. 6, 1993
HD-14	16	303973	Sept. 13, 1991	Sept. 6, 1994
HD-15	16	303974	Sept. 13, 1991	Sept. 4, 1994
HD-16	16	303975	Sept. 13, 1991	Sept. 4, 1994
HD-17	16	303976	Sept. 13, 1991	Sept. 3, 1994
HD-18	12	303977	Sept. 13, 1991	Sept. 3, 1994

Total of 208 units

* new expiry dates after approval of Statements of Work which were filed on July 15, 1992.

5.0 HISTORY

The Herd Dome area was prospected by Frank Onucki in the early 1970's when he was employed as a prospector by El Paso Mining & Milling Co., but no follow-up work was carried out by them nor did they stake the ground. During that period, Onucki discovered copper mineralization in volcanic breccias and flows of the Hazelton Group in an area northeasterly from the peak of Herd Dome Mtn.

In 1980, Onucki returned to the area and staked the HDM claims to cover the mineralization. In 1981, he discovered chalcopyrite, bornite, covellite and minor amounts of chalcocite in silicified volcanic breccias and fragmental rocks while prospecting near a sub-circular structure which he interpreted to be a volcanic pipe or neck located near the central part of his property.

The copper mineralization near the Pipe was examined and sampled in the fall of 1981 by a geologist employed by Utah Mines Ltd. and also by Noranda Mines in 1983. Onucki's claims were allowed to lapse in 1983 and the ground remained dormant and unexplored until July 1991 when portions of the original property were re-staked by Onucki as the HD # 1-8 claims.

Placer Dome Inc. optioned the claims from Onucki on August 7, 1991 after examining assay reports and mineralized rock samples obtained from the Pipe area and determining that there may be a potential for bulk tonnage copper and precious metals deposits. On August 13 and 14, 1991, Placer Dome geologists, K. Edwards and G. Delane, accompanied by Onucki, flew to the Herd Dome property to prospect and to sample some of the mineralization in the vicinity of the Pipe and also to select a suitable location for a base camp.

Camp construction crews, lumber, fuel, field personnel, camp supplies and equipment, were airlifted by helicopter into the campsite commencing on August 28. Concurrent with the camp construction activities, staking of additional claims, HD #9-18, was carried out by contractors from Smithers.

During September, Placer Dome's crews, which consisted of two geologists, two assistants, and two prospectors, carried out exploration work which included geologic mapping, prospecting, and outcrop sampling in the vicinity of Pipe Area. The Pipe Area was observed to be almost completely composed of outcrop, literally, a mountain of basaltic bedrock. A total of 103 chip, panel and grab rock samples were collected from mineralized outcrops on the claims. Most of these samples were obtained from the Pipe Area and the remainder from outcrops near Bragg Lake, the Camp Lake gossanous area and from the Onucki Zone, where chalcopyrite was discovered near the sheer cliffs located about 1 km ENE of camp.

Prospecting and mapping traverses by the crew members in the high areas southwest of the peak of Herd Dome Mountain failed to locate any signs of mineralization.

Prospectors Frank Onucki and Don Bragg set up a fly camp about 3 km northeast of the base camp and spent four days prospecting portions of HD claims #4-8, and 18. They discovered at least two copper showings consisting of malachite, pyrite and chalcopyrite in andesitic rocks and although the occurrences initially appear to be small, the area should warrant some follow up work to determine if other showings are present in the vicinity, which would suggest that a larger potential may exist.

The exploration field work was suspended prematurely when the crews experienced several consecutive days of inclement weather (strong winds, heavy fog, white-out conditions, and cold weather) which hampered the progress and continuity of the work program from the base camp. Fuel and some camp equipment were placed in secure storage on site, the camp was dismantled and demobilized by helicopter on Sept. 16 to a staging area on a logging road near Holland Lakes for transport by truck to Smithers. Two more days of exploration and prospecting were carried out subsequent to closure of the field camp by helicopter - day trips from Smithers.

Numerous samples illustrating the rock types observed were collected during the geologists' and prospectors' traverses. These samples were examined and the rock types recorded on the traverse maps, and 20 of the samples were selected and retained for petrographic analyses and studies.

6.0 GEOLOGY

Much of the region south of Smithers is underlain by rocks of Early to Mid-Jurassic Hazelton Group in proximity to the Coast Plutonic Complex. The rocks of the Hazelton Group consist primarily of sub-aerial, intermediate to felsic volcanics with a few intra-volcanic sedimentary units of lacustrine origin.

The Hazelton Group is considered to be part of the Smithers, the Nilkitkwa, and the Telkwa Formations (Figure 4). The volcanic rocks consist of basalts, andesites, rhyolites, trachytes, and related breccias, tuffs, and fragmentals. Regionally, they have been cut by Cretaceous or Tertiary intrusive bodies which consist of plugs or stocks of granite-granodiorite composition and more locally often by a variety of mafic, felsic, or aplite dykes.

The Herd Dome claims are underlain by well-layered volcanic rocks of the Telkwa Formation. Reddish-maroon coloured basalts ("red volcanics") are the most abundant rock units on the property and they are well-exposed on most of the higher ridges and peaks and occasionally on some of the plateau areas. The red volcanic lavas usually occur as massive flows of varying thicknesses or as breccias, tuffs, and fragmentals. Locally, the flows may be vesicular or amygdaloidal and zeolite minerals such as laumontite and prehnite, calcite, epidote, and quartz have been observed in vesicles, as veinlets, as fracture coatings, or as a matrix component in the fragmental volcanic rocks. The dips of the flow banding in the basalts are extremely variable and the debris shed from the flows tends to form extensive fields of talus and rubble along the flanks of the ridges.

Thin-bedded, silver-grey ash or lapilli tuff flows are exposed on the higher parts of some of the ridges and peaks where the beds have been observed to overlie the relatively thicker flows of red volcanics and related tuffs. The ash tuffs

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GEOLOGICAL LEGEND

STRATIFIED ROCKS

TERTIARY

MIOCENE AND PLIOCENE

MPvb	*Olivine basalt flows, breccia, tuff, andesite*

OLIGOCENE AND MIOCENE

OMe	**ENDAKO GROUP:** *Andesite, basalt, dacite, breccia (includes* **BUCK CREEK VOLCANICS***)*

UPPER CRETACEOUS AND LOWER TERTIARY

KTOL	**OOTSA LAKE GROUP:** *Rhyolite, dacite, tuff, breccia, trachyte, sandstone, shale, conglomerate (includes* **GOOSLY LAKE VOLCANICS***)*
KTs	**SUSTUT GROUP:** *Conglomerate, shale, greywacke*

CRETACEOUS

LATE LOWER AND (?) EARLY UPPER CRETACEOUS

KASALKA GROUP

KBB	**BRIAN BORU AND TIP TOP HILL FORMATIONS:** *Andesitic to rhyolite tuff, breccia, flows*

SKEENA GROUP

KRR	**RED ROSE FORMATION:** *Shale, greywacke, conglomerate, coal*

LOWER CRETACEOUS

lKs	**SKEENA GROUP:** *Conglomerate, greywacke, shale, coal, volcanic breccia*

JURASSIC

HAZELTON GROUP

MIDDLE AND UPPER JURASSIC

mJSA	**SMITHERS AND ASHMAN FORMATIONS:** *Shale, greywacke, breccia, tuff, conglomerate*

LOWER JURASSIC

lJTN	**TELKWA AND NILKITKWA FORMATIONS:** *Basalt, andesite, breccia, tuff, shale, siltstone*

UPPER TRIASSIC AND LOWER JURASSIC

TRJT	**TAKLA GROUP:** *Andesite, basalt, tuff, breccia, conglomerate, greywacke, shale, limestone*

UPPER PALEOZOIC AND (?) YOUNGER OR OLDER

Ps	*Metasediments, schist*

PLUTONIC ROCKS

TERTIARY

EARLY TERTIARY (Mainly)

ETg	*Quartz monzonite, granodiorite, quartz diorite*
ETgd	*Granodiorite*
ETb	*Gabbro*

CRETACEOUS AND/OR TERTIARY

KTg	**QUANCHUS AND NANIKA INTRUSIONS:** *Granodiorite, quartz diorite, diorite, granite*

CRETACEOUS

LATE CRETACEOUS

LKg	*Quartz monzonite, granodiorite, quartz diorite, porphyritic and aphanitic equivalents (includes* **BULKLEY INTRUSIONS***)*

JURASSIC

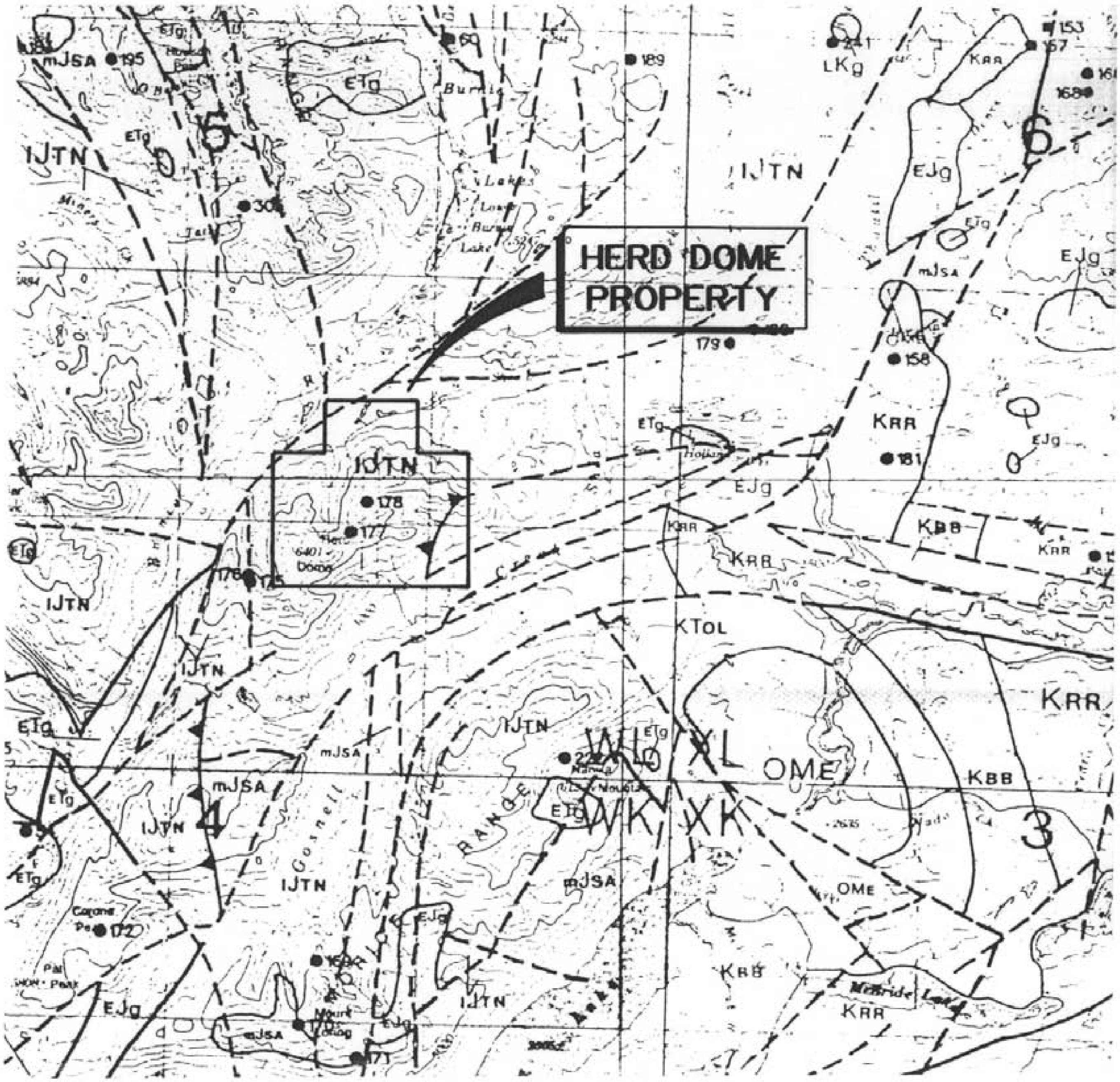
EARLY JURASSIC

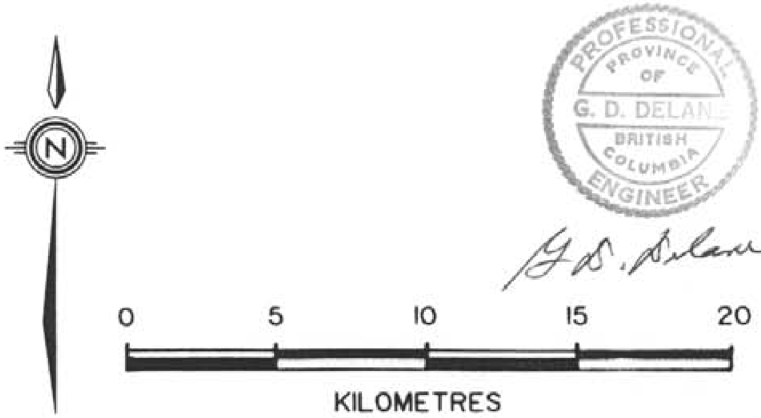
EJg	**TOPLEY INTRUSIONS:** *Quartz monzonite, granodiorite*

Geological legend and base derived from:

Tipper, H.W., R.B. Campbell, G.C. Taylor and D.F. Stott (compilers) (1974): *Parsnip River, Sheet 93;* Geological Survey of Canada, Map 1424A, 1:1,000,000

MacIntyre, D.G., P. Desjardins and P. Tercier (1989): *Jurassic Stratigraphic Relationships in the Babine and Telkwa Ranges;* B.C. Ministry of Energy, Mines and Petroleum Resources, Geological Fieldwork 1988, Paper 1989-1, pages 195-208





Geology derived from: G.S.C. Map 1424A
H.W. Tipper, R.B. Campbell, G.C. Taylor, D.F. Scott.

HERD DOME PROPERTY

REGIONAL GEOLOGY

FIGURE: 3

SCALE : 1:250 000

NTS : 93L/4 & 5

FORMATIONS, MEMBERS, AND FACIES OF THE HAZELTON GROUP

Unit	Lithology	Thickness (m)	Age
Smithers Formation	Greywacke, argillite, siltstone, sandstone, sharpstone, conglomerate, glauconitic sandstone, ash-fall tuff, tuffaceous sediments	40 - 800	Middle Toarcian to Lower Callovian
Bait Member	Argillite, siltstone, fine-grained greywacke, limestone, sharpstone conglomerate, tuff and tuffaceous sediments	30 - 450	Middle Toarcian to Middle Bajocian
Yuen Member	Siltstone, tuffaceous siltstone, reddish tuff, fine tuff-aceous greywacke	780	Toarcian to Middle Bajocian
Nilkitkwa Formation	Shale, siltstone, greywacke, limy shale, limestone, rhyo-dacite airfall tuff and breccia, basalt	30 - 1200	Early Pliensbachian to Middle Toarcian
Carruthers Member	Pillow basalt, aquagene tuff, breccia, minor flows and limestone	60	Late Pliensbachian to Early Toarcian
Ankwell Member	Subaerial and subaqueous alkali olivine basalt, minor basalt, minor sandstone and limestone	10 - 1000	Middle Toarcian
Red Tuff Member	Subaerial airfall tuff, lapilli tuff, rhyolite to basalt flow breccia and tuff, minor subaqueous volcanics	50 - 300	Middle and ? Late Toarcian
Telkwa Formation			Late Sinemurian to Early Pliensbachian
Howson sub-aerial facies	Calc-alkaline basalt to rhyolite flows; breccia, tuff; intravolcanic sediments; minor marl	1000 - 2500	
Babine shelf facies	Calc-alkaline basalt to rhyolite; subaerial and subaq-eous flow, breccia, and tuff; limestone, greywacke, siltstone, and shale	1000 ?	
Kotsine subaqueous facies	Calc-alkaline basalt and rhyolite; subaqueous flow, breccia, tuff, pillow breccia; limestone, greywacke, siltstone and shale	30 - 1500	
Bear Lake subaerial facies	Calc-alkaline basalt to rhyolite flow, breccia, and tuff; and intravolcanic sediments	2000	
Sikanni clas-tic-volcanic facies	Subaerial conglomerate, sandstone, mudstone, lahar, rhyo-dacite flow, breccia, basalt, andesite; minor shallow-marine sandstone and conglomerate	200 - 1000	

Source: Tipper & Richards, GSC Bulletin 270, 1976

Figure 4

were observed to be unmineralized and are exposed on the ridge immediately south of the base camp and also near the peak of Herd Dome Mountain.

On the northeasterly flank of Frank's Peak, which more or less coincides with the centre of the Pipe, are exposures of andesitic or dacitic flow rocks which are typically fragmental, brecciated, or tuffaceous in appearance. Many of these outcrops are stained by malachite and azurite, and contain varying amounts of chalcopyrite and pyrite mineralization as veinlets and disseminations. These mineralized rock units have been identified in two other zones, namely, the Bragg Lake and the Onucki Zones and also in three small copper showings on claim HD #4 which were noted by prospectors during traverses originating from their fly camp.

A few dykes have been observed in the vicinity of the Pipe area to cross cut the flows. Most of them appear to be of a trachyte composition, up to 50 cm wide and are completely barren of sulfides. Near the Onucki Mineral Zone, two chloritized and epidotized diorite dykes were noted to have a high magnetite content but their relationship to copper occurrences present in the vicinity is not presently understood.

No faults have been positively identified on the explored parts of the Herd Dome property, however, there is some suggestion that a linear striking about 060° may follow a conspicuous gossanous zone towards observed diorite dykes and sulfide mineralization on the southeasterly flank of the Pipe area.

Alteration in the volcanics has been observed to be generally local and randomly distributed in the Pipe area. Epidotization, chloritization, hematization were conspicuous in some portions of the basalt flows and zeolite minerals as fracture coatings and vesicle fillings were occasionally observed.

7.0 MINERALIZATION

Only a relatively small portion of the Herd Dome property has undergone prospecting, sampling, and geologic mapping. However, Placer Dome personnel have succeeded in identifying three areas within the central part of the property which contain copper and silver mineralization. These are the Pipe Area Mineral Zone, the Onucki Mineral Zone, and the Bragg Lake Mineral Zone, with the Pipe Zone area having received most of the attention to date. Results of rock chip sampling in these three mineralized zones are plotted on Figure 6.

In the Pipe Area mineral zone, copper and silver minerals have been found in brecciated or in fragmental volcanic flow rocks, mainly of andesitic to dacitic composition. Petrographic studies have identified the favoured host rock as an albite-quartz-chlorite-pyrite altered dacitic porphyry or a dacitic coarse lapilli tuff or breccia. Chalcopyrite is the main copper mineral which occurs as discontinuous veinlets, blebs, specks, disseminations, in vesicles or in small shears. Bornite, covellite, and chalcocite have also been identified in the dacitic flows in the Pipe area, and malachite - azurite stains and coatings are conspicuous on some outcroppings on cliff faces. Pyrite is fairly common as minute specks or as disseminations and has also been observed to be associated with finely-disseminated chalcopyrite in some of the hematized andesitic fragments which are often surrounded by a quartz-calcite matrix. Chip and panel sampling of one mineralized outcrop returned 0.55% Cu and 12 ppm Ag over an interval of 6 m and grab samples obtained from other outcrops have returned values of up to 1.65% Cu.

About 40 outcrop rock chip or panel samples were collected by Placer Dome geologists for assaying and geochemical analysis from an area measuring approximately 250 m x 250 m in the Pipe Zone. The limits of the mineralization are not precisely defined because much more work is required and also because

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extensions of mineralization appear to be concealed by talus cover and snow, or may be abruptly cut-off by steep cliff faces.

The copper and pyrite mineralization in the Onucki Mineral Zone (located about 1 km east of the Pipe Zone) was discovered fairly late in the season and consequently was only examined and sampled in a cursory fashion. The chalcopyrite-pyrite-silver mineralization in this locality appears to be associated with andesitic tuffaceous rocks and assay results from samples collected here suggest that the copper and precious metal values are lower than those in the Pipe area. Two chlorite-epidote, magnetite-rich, diorite dykes were also noted in the vicinity and their relationship, if any, to observed mineralization has not been determined.

Chalcopyrite-pyrite-malachite mineralization has been observed as fracture fillings and as veinlets in porphyritic and fragmental andesitic outcrops in the vicinity of Bragg Lake. This mineralization appears to be localized and restricted in size but prospectors have reported some signs of copper mineralization occurring in similar rocks lying proximal to the southwest. This area requires follow up work to determine if extensions or continuity of mineralization can be established.

Prospecting and mapping of an area southwest of Herd Dome Mountain failed to locate any signs of copper mineralization although the amount of rock outcrop exposure was considered excellent.

The prospectors, operating out of a fly camp located near the southeast corner of claim HD-#4, discovered three pyrite-chalcopyrite-malachite stained showings. These showings, although appearing to be local and small, were observed to occur within fragmental or brecciated andesite-dacite flows and would warrant some follow-up work in view of their similarity to the mode of copper occurrences in the Pipe Zone area.

CONCLUSIONS AND RECOMMENDATIONS

Although the length of the 1991 work program carried out on Herd Dome was unexpectedly shortened by inclement weather conditions, a significant number of mineralized occurrences were identified by the prospecting crews.

The main zone, the Pipe Zone, is the largest copper-bearing area found to date on the Herd Dome property and consequently it has received most of the attention from the Placer Dome prospectors and geologists. The Pipe Zone warrants more exploration work including detailed mapping and sampling. The assistance of rock-climbers with ropes, etc., would be required to enable geologists to access, map, and sample the malachite-stained cliffs and the other precipitous portions of the Pipe Zone, to help to determine the extent of the observed mineralization.

More prospecting, sampling and mapping is required on the Bragg Lake and Onucki Zones, as well as in the vicinity of few, new showings discovered by the prospectors during their fly camp traverses. Since much of the property remains unexplored, there may be a possibility that several undiscovered copper occurrences may yet be found by diligent and thorough prospecting.

It is recommended that follow-up work on the Herd Dome property should be planned to commence in mid-July in order to allow sufficient time and favourable weather conditions to complete the work more efficiently and effectively.

Placer Dome Inc.

G. D. Delane, P. Eng.

September 1992

REFERENCES

Diakow, L.J., Geological Fieldwork 1989, Paper 1990-1, B.C. Ministry of Energy, Mines and Petroleum Resources

F. Onucki and D.K. Bragg, Feb. 10, 1982, Prospecting Report on the HDM 2,3,4,5,6 Claims in the Omineca Mining Division

Tipper and Richards, 1977: Jurassic Stratigraphy and History of North Central British Columbia, G.S.C. Bulletin 270

Tipper, H.W., Lower Jurassic Volcanic Rocks of the West Half of Smithers map Area, B.C. (93L), 1971

Minfile map 93L - Smithers, revised Sept. 1969, B.C. Ministry of Energy, Mines and Petroleum Resources

STATEMENT OF QUALIFICATIONS OF FRANK ONUCKI

I have worked in the Mineral Exploration Industry since 1961.

1961 prospected on my own in the Omineca between McLeod Lake and Manson Creek.

1976 prospected on my own in the Cariboo.

1968-1969 worked as a prospector for Utah mines in the Port Hardy area.

1970, 1971, 1972 worked as an independent prospector for El Paso Mining and Milling Co. in the Cariboo, Manson Creek and Smithers-Houston area.

1973 worked as an independent prospector for El Paso Mining and Milling Co. in Cariboo area.

1974 worked as a prospector for Serem Ltd. in the McKenzie Mt. area N.W.T.

1975 prospected on my own and for Utah Mines in the Smithers-Houston area.

In 1982 I prospected in the Atikokan area in Ontario.

From 1983 - present I prospected in B.C.

In 1987 I prospected in the Whitehorse area of Yukon Territory.

In 1991, I was employed by Placer Dome Inc. to prospect the Herd Dome property.

I have no academic training other than Grade School.

Frank Onucki
#209 - 2040 Barclay St.
Vancouver, B.C.
V6G 1L5

Frank Onucki

Frank Onucki

<u>STATEMENT OF QUALIFICATIONS OF DONALD K. BRAGG</u>

Graduated Armstrong High School, Armstrong, B.C. 1951

Attended U.B.C. from 1958 to 1962 in the faculty of Arts and Science, in Honours Geology.

Has worked in the mineral exploration industry since 1956 to the present.

Worked for Kennco Explorations during the summers of 1956, 1957, and 1959 in the Yukon and northern B.C. as an assistant prospector and geochem sampler under the direction of Dr. R. Campbell and R. Woodcock.

Worked as head prospector for the Nahanni 60 Syndicate in the Northwest Territories in 1960 under the direction of Doug Wilmont.

Worked as head prospector in the Yukon for Dualco in 1961 under the supervision of E. Wozniak.

Worked as head prospector for Mining Corp. of Canada in southwest B.C. in 1962 under J.S. Scott and Dr. K. Northcote.

Worked as head prospector during the summer of 1963 for the Francis River Syndicate, in the central Yukon, under the direction of Dr. A. Aho.

Worked as field geologist in the Greenwood area of B.C. for Scurry Rainbow Oil in 1965 under the direction of Bill Quinn.

Worked as a field geologist in the Greenwood area of B.C. for Scurry Rainbow Oil in 1965 under the direction of Bill Quinn.

Worked as a field supervisor for Alrae Explorations Ltd. from Sept. 1965 to April 1967 under the direction of Rae Jury.

Since 1956 has also worked as a self employed contractor, working for various mining companies in the following fields: prospecting, property examination, staking, line cutting, topographical mapping, geological reconnaissance and mapping, mineral sampler, draughting, air photo interpretation, geochemistry, geophysics and supervising property exploration programs.

Since 1956 has been a self employed prospector working in various areas in B.C. on numerous properties.

Has worked in the Rossland camp since 1971 as a miner on the Snowdrop and Blue Bird claims. Has spent considerable time in the camp as a prospector and mining exploration contractor.

Has received the B.C. Provincial Grubstake for the years 1964, 1968, 1969, 1970, 1980, 1981 to 1989.

Has been self-employed working on his own claims since 1981.

Was employed as a prospector by Placer Dome Inc. on the Herd Dome property for about 4 weeks in 1991.

Donald K. Bragg
1362 East 41st Ave.
Vancouver, B.C.
V5W 1R8

D. K. Bragg

Donald K. Bragg

STATEMENT OF QUALIFICATION - KELLY EDWARDS

I, Kelly Edwards, of 750 Barnham Road, West Vancouver, British Columbia, do hereby certify that:

1. I graduated from the University of Saskatchewan, Saskatoon, Saskatchewan, with a B.Sc. Honours degree in Geology in 1989.

2. I am a member of the Geological Association of Canada.

3. From 1986 to the present, I have been studying and/or working in the field of Geology both in Canada and internationally.

4. I worked continuously for Placer Dome from April, 1990 to June, 1992.

5. I have assisted with the 1991 field work and data compilation for the Herd Dome Mineral claims, located in the Omineca Mining District.

Respectfully Submitted,

Kelly Edwards

Kelly Edwards, B.Sc.

04 September 92

Date

CERTIFICATE

I, Gerald Dennis Delane, of 1178 West 26th Avenue, Vancouver, B.C., hereby certify that:

1. I am a geologist employed by Placer Dome Inc. of Vancouver, B.C.

2. I am a graduate of the University of British Columbia with a degree of Bachelor of Science in Geology and Geophysics (1961)

3. I have been practising my profession continuously since graduation, including 18 years as Senior Geologist with Newmont Exploration of Canada Ltd. and Getty Minerals Ltd.

4. I am a registered member in good standing of the Association of Professional Engineers of British Columbia, the Geological Association of Canada, the Society of Mining Engineers of A.I.M.E., and the Canadian Institute of Mining and Metallurgy.

5. This report is based upon:

    a. My personal knowledge gained as a geologist for Placer Dome Inc. in supervision of the project.

    b. An examination of company reports on the other properties in the general region, and available government information and maps.

    c. My personal knowledge of the general area gained from regional studies and field examinations in the general vicinity of the property when I was employed by Getty Minerals and Newmont Exploration.

Dated at Vancouver British Columbia, this 1st day of June, 1992.

G.D. Delane, P. Eng.

COST STATEMENT FOR THE 1991 HERD DOME PROJECT

1. Labour

Name	Position	Work Dates	No. of Days	Daily Rate	Total Wages
K. Edwards	Geologist	Aug. 13-15 Aug. 29-Sept. 18	24	380	$ 9,120.00
C. Woolverton	Assistant	Aug. 28-Sept. 18	22	215	4,730.00
A. Woolverton	Assistant	Aug. 28-Sept. 6	10	215	2,150.00
E. McKay	Camp Cook & First Aid Attendant	Aug. 28-Sept. 16	20	325	6,500.00
F. Onucki	Prospector	Aug. 13-15, Aug. 26-Sept. 20	29	325	9,425.00
D. Bragg	Prospector	Aug. 28-Sept. 20	24	325	7,800.00
T. Robinson	Assistant	Sept. 7-17	11	215	2,365.00
G. Delane	Project Geologist	Aug. 13-15, 26-31 Sept. 1-20	29	540	15,660.00
TOTAL LABOUR COST					**$ 57,750.00**

2. Camp Construction

By Dave Pellows Construction Co., Smithers, B.C. 29,600.00

3. Expediting Charges

Smithers Expediting Services Ltd. 862.00

4. Transportation

(a)	Helicopter Charters Northern Mtn. Helicopters, Smithers (42.7 hrs @ $595/hr plus fuel & GST)	28,709.00
(b)	Airline travels from Vancouver & Kamloops to Smithers and return	5,266.00
(c)	Truck Rentals Smithers Truck Rentals, Smithers Cana Rentals, Vancouver	2,000.00

5. Freight Charges

via Canadian Freightways, Loomis, Canadian Airlines, Central Mtn. Airlines	843.00

6. Communication

Radio licence, field radio rentals	347.00

7. Assaying Charges & Petrographic Studies

103 rock samples to PDI Laboratories for 28-element ICP analysis and 20 rock specimens for petrograhic studies sent to Craig H.B. Leitch, Ph.D., P.Eng., and to Ken Northcote, Ph.D., P.Eng.	3,653.00

8. Maps, Aerophotos & Reproduction Charges

Vancal Reproduction, Nadir Mapping Corporation	2,293.00

9. Camp Supplies, Fuel and Food

Smithers Super Valu, Chevron Oil, Deakin Equipment, ICG Propane, etc.	15,150.00

10. Travel Food & Accommodation

Aspen Motor Inn, Smithers, etc.	3,307.00

11. Report Preparation

Includes drafting, reproduction, typing	9,000.00
TOTAL COST	**$ 158,780.00**

G.D. Delane, P.Eng.
Placer Dome Inc.
July 1992

APPENDIX A

Petrographic Reports on 20 Herd Dome Rock Samples
by Craig H.B. Leitch, Ph.D., Eng.
and by Ken Northcote, Ph.D., P.Eng.

PETROGRAPHIC REPORT ON SIXTEEN SPECIMENS FROM THE HERD DOME PROJECT, CENTRAL B.C.

Report for: Gerry Delane, P. Eng. Invoice attached
Geologist
Placer Dome Inc.
1600-1055 Dunsmuir Street
Vancouver, B.C.
V7X 1P1. Dec. 17, 1991

Samples submitted: 6833, 6834, 6836, GD-11, GD-13, FB-7, Delta G, 14113, 14135, 14141, 14145 - 14150.

SUMMARY:
This is a suite of felsic to intermediate volcanic rocks of possibly dacitic to andesitic composition, that can be roughly divided as follows:

Porphyritic ?flow rocks (6836, GD-11, GD-13) composed of about 10-15% euhedral 2.5 mm plagioclase phenocrysts and 10% 1 mm remnant altered mafic crystals (?possibly formerly pyroxene, now chlorite) in a fine felsic groundmass. Quartz phenocrysts are rare; K-feldspar appears mainly absent.

Lapilli tuff, fine to medium-grained (FB-7, Delta G, 14113, 14135, 14141, 14150) composed of subangular to subrounded clasts up to 1.5 cm in diameter in a fine quartzo-feldspathic matrix that is partly secondary. The clasts are generally either crowded porphyries similar in composition to those described above, or fine plagioclase microlitic volcanics with trachytic texture. A distinctly separate group of intensely quartz-sericite altered felsic tuffs, some layered and some grading to breccia, include the series 14145-14149. They are also distinguished from the rest of this suite by an almost total absence of sulfide, lacking even pyrite.

Volcanic breccia (6833, 6834, ?14148) are similar to the lapilli tuffs but contain coarser angular to subangular clasts, up to 3 cm across in an altered siliceous matrix.

Alteration in these rocks can be divided into two groups:

Albite-quartz-chlorite ± sericite-calcite (6833-36, GD-11 and 13, FB-7, Delta G, 14113, 14135, 14141, or rarely with ankerite: 14150). This is accompanied by disseminated to fracture-controlled pyrite and chalcopyrite, partly oxidized to limonite and malachite. No Ag-bearing minerals were seen.

Quartz-sericite (14145-14149): intense alteration but without accompanying sulfides.

Craig H.B. Leitch, Ph.D., P. Eng.
(604) 666-4902 or 921-8780

6833: ALBITE-MINOR SERICITE-PYRITE ALTERED BRECCIA

Breccia, consisting of pinkish-brown angular fragments to 1.5 cm diameter in a buff-coloured matrix. Minor sulfides and spots of green ?malachite are present; the rock is not magnetic. In polished thin section, the modal mineralogy is approximately:

Plagioclase (albite)	60%
Quartz (partly secondary)	25%
Sericite	7%
Chlorite	3%
Pyrite	3%
Limonite (goethite, hematite)	1%
Chalcopyrite	<1%
Malachite	<1%
Apatite	<1%

The fragments in this rock are primarily made up of plagioclase feldspar, which takes two forms: phenocrysts and groundmass. The phenocrysts are subhedral to euhedral and up to 2 mm long; albite twinning in them has an extinction angle of about 14°, and the refractive index is less than that of quartz, suggesting the composition is albitic (about An_7). The groundmass consists of fine (about 0.1 mm long) subhedral microlites that also display albite twinning and are probably of similar composition to the phenocrysts. The textures of the plagioclase (vague twinning, flecking by fine 20 μm sericite) indicates that it is all secondary, i.e. that the primary composition was probably more calcic. Plagioclase also forms somewhat broken crystals in the breccia matrix. No K-feldspar can be positively identified in this section.

Quartz forms scattered subhedral broken phenocrysts to 1 mm across in the breccia matrix (it is not seen in the lithic fragments). The quartz is clear, unstrained and lacks fluid inclusions. Modest amounts of very fine (5-20 μm diameter) anhedral quartz are postulated in the breccia matrix due to its refractive index being generally higher than that of the albite. Much of the matrix is made up of comminuted material similar to that of the fragments, i.e. fine (50 μm) plagioclase shards; a few miarolitic cavities filled with albite and quartz suggest the matrix is partly hydrothermal and the presence of fine sulfide confirms this. The sulfide is mainly fine 0.05-0.1 mm) euhedral cubes of pyrite, partly to completely oxidized to limonite (goehtite and hematite as subhedral grains aggegating to 0.5 mm across). A few grains of chalcopyrite to 0.2 mm diameter are present, with associated pitch limonite and subhedral grains of malachite to 0.05 mm across. Chalcopyrite is found in both clasts and matrix, and is associated with pyrite, but does not occur with the common disseminated cubic pyrite.

There are a few patches of dark green chlorite up to 2.5 mm across, composed of very fine (5-15 μm) anhedral flakes. The overall impression is of an albite-sericite-pyrite altered, felsic plagioclase-rich volcanic breccia.

<u>6834: ALBITE-MINOR SERICITE-CHLORITE ALTERED VOLCANIC BRECCIA CUT BY MINOR QUARTZ, MALACHITE FRACTURES</u>

Purple to pinkish breccia similar to 6833 but perhaps less sericitized (more primary hematite giving it the purple colour). White feldspar laths are evident in both clasts (angular, up to 2 cm across) and matrix. Most sulfides are oxidized to limonite and minor green malachite and black waxy spots of neotocite (Cu oxides) are present along fractures and in voids. In polished thin section, the modal mineralogy is:

Plagioclase feldspar (albite)	65%
Quartz (partly secondary)	20%
Sericite	5%
Chlorite	5%
Limonite (goethitic mainly)	3%
Malachite	1%
Chalcopyrite	<1%
Apatite	tr

The clasts in this rock are mainly of porphyritic volcanic rock, and are either crowded (phenocryst-rich) or phenocryst poor varieties. In both the principal phnenocryst phase is subhedral to euhedral plagioclase up to 2 mm long, with extinction angles of up to 17° and index less than quartz indicating almost pure albite, An_5. As in 6833, textures of this albite (presence in miarolitic cavities, radiating rosettes and vague veinlets) indicate it is probably a secondary alkali feldspar. No K-feldspar can be identified, and quartz phenocrysts are rare. Scattered patches to 0.5 mm diameter with subhedral outlines of fine (25 μm) chlorite or sericite (gnerally not mixed) probably represent former mafic phenocrysts. The groundmass of the crowded porphyries consists of subedral to anhedral 0.05-0.1 mm albite grains and minor finer anhedral quartz; in the other porphyries the plagioclase consists of 0.1 mm subhedral microlites with a trachytic texture.

The matrix consists of scattered somewhat broken plagioclase phenocrysts (shards) set in very fine (10-20 μm) highly interlocking albite and quartz. There are scattered, highly irregular patches up to 0.3 mm across composed of very fine (<20 μm) anhedral pale green chlorite or sericite flakes, which may have been former mafics. Disseminated patches of limonite are likely after former sulfides, probably mainly chalcopyrite (in contrast to the abundant pyrite in 6833). Malachite forms patches and veinlets of subhedral grains up to 0.1 mm across, and the whole rock is traversed by highly irregular, anastamose thin veinlets of quartz up to 0.2 mm thick.

Apatite, as in 6833, forms fine (50 μm long) prismatic crystals found mainly in the clasts. In reflected light, the main opaques are limonite (patly goethite and partly pitch limonite replacing or surrounding chalcopyrite). Chalcopyrite forms subhedral grains up to 0.2 mm across; there is apparently no pyrite. This is a slightly less felsic and more mafic volcanic breccia than 6833.

<u>6836: ALBITE-QUARTZ-CHLORITE-PYRITE ALTERED, INTERMEDIATE VOLCANIC PORPHYRY WITH QUARTZ-PYRITE-CALCITE VEINING</u>

Grey, fine-grained, strongly altered and pyritic rock characterized by irregular patches and veinlets of carbonate that react vigorously to cold dilute HCl, and scattered white phenocrysts of feldspar. The rock is not magnetic. In polished thin section, the modal mineralogy is:

Plagioclase feldspar (albitic)	50%
Quartz (partly secondary)	30%
Chlorite	7%
Carbonate ((calcite)	5%
Pyrite	5%
Sericite	2%
Fe-Ti oxides (limonite, rutile)	1%
Chalcopyrite	<1%

This is a moderately altered porphyritic volcanic rock, composed of about 10-15% plagioclase phenocrysts and 10% remnant altered mafic crystals in a fine felsic groundmass. The plagioclase phenocrysts are euhedral, up to 2.5 mm long, and are composed of albite with minor flecking by chlorite and rare sericite. Former mafic phenocrysts are smaller, rarely as much as 1 mm diameter, with subhedral outlines suggestive of pyroxene. They are pseudomorphed mainly by fine-grained subhedral chlorite flakes of 10-20 μm diameter, with cores of anhedral secondary quartz grains to 0.1 mm and cubes of pyrite to 0.2 mm diameter.

There are also 2-3 mm long irregular-shaped patches of calcite, which forms anhedral grains up to 1 mm across. These patches are generally surrounded by irregular veinlet-like secondary quartz, suggesting the calcite forms part of a hydrothermal alteration rather than former calcite amygdules. The quartz of the veins (which are up to 0.5 mm thick) forms clear, unstrained anhedral interlocking grains rarely over 0.1 mm in diameter. Sulfides associated with these vein-like areas include abundant pyrite, as cubic grains rarely over 0.25 mm (although aggregating to over 1 mm in places) and chalcopyrite as subhedral grains to 0.35 mm diameter. Parts of both pyrite and chalcopyrite are oxidized to goethitic limonite. One (0.4 mm long) subhedral grain of sphalerite, with chalcopyrite disease, was seen associated with chalcopyrite in a quartz vein.

The groundmass is composed of fine (0.05-0.1 mm) anhedral plagioclase crystals and very fine (25 μm) interstitial quartz and minor chlorite. Most of the quartz and chlorite is secondary. The groundmass is also heavily pyritized with small cubes about 25-50 μm across; rare Fe-Ti oxides such as rutile or leucoxene are also present, mainly replacing the former mafic crystals.

This appears to have originally been a volcanic porphyry of intermediate composition, possibly andesite to dacite, containing plagioclase and ?pyroxene phenocrysts. It has undergone quartz-calcite-sulfide veining and moderate alteration to albite and chlorite; there is very little sericite.

GD-11: ALBITE-QUARTZ-CHLORITE-PYRITE-CALCITE ALTERED, INTERMEDIATE VOLCANIC PORPHYRY

Dark grey, strongly altered volcanic porphyry similar to 6836 with scattered white plagioclase phenocrysts and abundant fine pyrite. The rock is weakly magnetic. The modal mineralogy in polished thin section is:

Plagioclase (albite)	50%
Quartz (partly secondary)	25%
Chlorite	15%
Pyrite	5%
Calcite	3%
Chalcopyrite	1%
Fe-Ti oxides (rutile, sphene)	<1%
Limonite (?after magnetite)	<1%
Apatite	tr

This is a similar, but more mafic porphyritic volcanic rock than 6836, composed of scattered (10%) plagioclase and 10-20 % relict mafic phenocrysts in an altered felsic groundmass. Plagioclase phenocrysts are euhedral and up to 2 mm long, with twinning extinction angles up to 17° indicating albitic (secondary) compositions. Rims of crystals are further altered by very fine quartz where in contact with the groundmass, and there is minor alteration to calcite and very rare flakes of sericite. Mafic phenocrysts are represented by patches with euhedral outlines up to 2 mm across pseudomorphed by bright green, anomalous-blue Fe-chlorite as subhedral flakes up to 0.1 mm plus minor carbonate (calcite) as anhedral grains to 0.1 mm across, euhedral sphene to 50 μm, and sulfides. The mafic mineral may have been pyroxene rather than hornblende. Rare fine (50 μm) prismatic aptatite needles are found in both plagioclase and relict mafic sites.

The groundmass consists of subhedral to anhedral grains of alkali feldspar up to 0.2 mm long, with abundant anhedral to subhedral interlocking quartz up to 0.2 mm diameter (mainly secondary) and rounded patches of chlorite after former mafics. Patches of calcite up to 1 mm across are also found, mixed with quartz and sulfides. This groundmass is highly altered, and although the alteration is similar to 6836, it is pervasive rather than vein-controlled.

Pyrite forms euhedral cubic to subhedral grains up to 0.5 mm across, in places with associated anhedral grains of chalcopyrite up to 0.1 mm across. There are also some euhedral grains of limonite up to 0.1 mm across, either with pyrite or separate, that may be the result of oxidation of pyrite or of ?magnetite. Chalcopyrite is also found as extremely fine (5-10 μm thick) infilling microfractures in pyrite (this material would be difficult to recover by conventional milling processes, but it probably only accounts for 10% of the copper in the specimen). In places the sulfides are associated with patches of Ti-oxides up to 0.2 mm across, probably leucoxene or rutile as fine (10 μm) grains after ilmenite.

<u>GD-13: ALBITE-QUARTZ-CHLORITE-CALCITE ALTERED INTERMEDIATE VOLCANIC PORPHYRY CONTAINING BLEBS OF CHALCOPYRITE</u>

Dark grey, strongly altered mafic intermediate volcanic porphyry similar to GD-11 characterized by large white plagioclase phenocrysts and blebs of chalcopyrite. It is also weakly magnetic and reacts to cold dilute HCl. Mineralogy in polished thin section is as follows:

Plagioclase (albitic)	45%
Quartz (partly secondary)	20%
Chlorite	15%
K-feldspar (?primary)	?5%
Carbonate (calcite)	10%
Chalcopyrite	2%
Pyrite	2%
Fe-Ti oxides (sphene, rutile)	1%

This rock is a sparse porphyry similar to GD-11, but appears to contain about 5% 0.5 mm euhedral K-feldspar phenocrysts in addition to the larger, more abundant (10%) 1-2 mm plagioclase phenocrysts and 1 mm mafic relicts. It may thus be more intermediate in composition, perhaps dacitic, lthough the alteration has obscured the original composition. The identification of K-feldspar is based on refractive index only and should be confirmed, if necessary, by staining with sodium cobaltinitrite.

Plagioclase phenocrysts are euhedral and albitic in present composition, showing extinction angles Y^010 about 15° and relief less than that of quartz. They show a tendency to glomeratic grouping in places, and only very minor alteration to sericite, quartz and included needles of apatite.

Remnant mafic sites are replaced by fine Fe-chlorite as in GD-11, with some calcite, quartz, sulfides and Fe-Ti oxides. The chlorite forms subhedral flakes to 0.1 mm long with anomalous blue interference colours; calcite forms anhedral grains up to 0.3 mm across. Fe-Ti oxides include euhedral rutile and subhedral sphene to 50 μm.

The groundmass is composed of fine, interlocking anhedral 0.05-0.1 mm alkali feldspar grains, probably mostly albite but possibly including some K-feldspar, with interstitial very fine (20 μm) chlorite. The groundmass is altered by slightly coarser (0.1 mm) aggregates of quartz that appear to be mainly secondary, but could be partly primary.

Sulfides are mostly chalcopyrite, forming sub- to anhedral grains up to 0.5 mm across, although aggregating to more than 1 mm long. They are generally found in altered mafic sites or else with patches/irregular veinlet-like masses of quartz in the matrix. Pyrite forms subhedral grains to 0.5 mm diameter, generally separate from chalcopyrite but in places with the same fine chalcopyrite microfractures as seen in GD-11. Some (perhaps 20%) of the chalcopyrite in this specimen is found as very fine (5-20 μm) grains disseminated in gangues that might be difficult to recover by conventional milling methods.

FB-7: ALBITE-QUARTZ-CHLORITE-PYRITE ALTERED INTERMEDIATE FRAGMENTAL VOLCANIC (?DACITIC COARSE LAPILLI TUFF TO BRECCIA

Pale grey-green, fine-grained fragmental volcanic rock with abundant disseminated pyrite. Clasts are sub-rounded and up to 3 cm in diameter. The rock is slightly magnetic and reacts vigorously to cold dilute HCl; mineralogy in polished thin section is approximately:

Plagioclase (albitic)	50%
Quartz (mainly secondary)	25%
Chlorite	15%
Sericite	3%
Pyrite	3%
K-feldspar (?primary)	?2%
Limonite (after pyrite)	1%
Carbonate (calcite)	1%
Apatite	tr

This is a fragmental volcanic composed of about 90% rounded to subrounded clasts in 10% highly altered matrix. The clasts are varied in character, ranging from porphyritic volcanics similar to those described above to fine non-porphyritic lithologies.

Phenocrysts include 1-2 mm euhedral plagioclase and relict mafic sites, and 0.5-1 mm euedral quartz and subhedral (broken) ?K-feldspar. The plagioclase is mainly albitized, or altered to minor quartz, carbonate and sericite. Relict mafic sites are mainly altered to chlorite, sulfide and Fe-Ti oxides; rarely carbonate and quartz may also be found in the alteration products. The chlorite is distinct from that found in the GD-series rocks, being a non-anomalous variety with higher birefringence and a brownish-green colour typical of "hydrobiotite". It forms fine subhedral flakes to 30 μm diameter, mixed with fine pyrite and minor ?hematite and leucoxene. Calcite forms anhedral grains up to 0.1 mm across; secondary quartz is subhedral and of similar size. In places, mafics are completely replaced by quartz with only thin rims of chlorite.

Quartz phenocrysts are rare (<5%) but there are also rounded patches of quartz up to 2 mm across that could have been amygdules or recrystalized phenocrysts. K-feldspar is not positively identified, but form subhedral crystals with low relief and no twinning in contrast to the plagioclase.

The matrix to the phenocrysts is composed of fine (<0.05 mm) ragged alkali feldspar grains and interstitial chlorite, largely overprinted by abundant pervasive ?secondary quartz as anhedral interlocking grains about 0.05-0.1 mm in diameter. The matrix to the clasts (possibly hydrothermal, or merely highly altered) consists of coarser (recrystallized) quartz, alkali feldspar, calcite, chlorite and sulfides.

Pyrite is found as disseminated eu- to subhedral cubic grains rarely up to 0.25 mm in diameter. In places it is rimmed or partly replaced by goethitic limonite. No chalcopyrite was seen in this specimen.

<u>DELTA G: CHLORITE ALTERED ?DACITIC LAPILLI TUFF CONTAINING DISSEMINATED CHALCOPYRITE</u>

Light grey-green, fine-grained volcanic rock characterized by what look like coarse pink K-feldspar crystals. The rock is not magnetic, but white ?amygdules or patches react vigorously to cold dilute HCl. There are scattered sulfides and minor malachite. In the polished thin section, however, the pink areas are seen not to be K-spar; instead, they are hematite-stained lithic fragments. Thus the modal mineralogy is approximately:

Alkali feldspar (albitic?)	45%
Quartz (largely primary?)	30%
Chlorite	15%
Carbonate (calcite)	3%
(malachite)	<1%
Sulfide (chalcopyrite)	2%
(pyrite)	1%
Oxides (hematite)	2%
(goethite)	1%
Sericite	1%
Apatite	tr

This is a fragmental volcanic rock, composed of about 60% angular to sub-angular clasts up to about 7 mm in diameter in a very fine ?comminuted matrix of similar material. Some fragments are themselves fragmental (contain clasts). There is a wide variety of lithotypes represented, ranging from porphyritic types to monominerallic plagioclase-rich types with trachytic texture to some that may be plutonic. In addition, broken phenocrysts of both quartz and feldspar are found, as well as a few relict altered mafic crystals. The patches of calcite are up to 5 mm long, and are composed of anhedral grains up to 2 mm across; some have associated sulfides, and appear to be hydrothermal, not amygdules.

Quartz phenocrysts are subhedral or broken and up to 1 mm diameter; they are clear and unstrained. There are also fragments composed of very fine-grained (10-20 μm) quartz. Plagioclase phenocrysts are subhedral and up to 1 mm long; they are albitized and rarely replaced by fine-grained (20 μm) sericite or chlorite. They contain rare slender needles of apatite to 150 μm long. Relict mafic phenocrysts have euhedral outlines suggestive of pyroxene, and are now pseudomorphed by deep green chlorite, minor calcite, quartz, and opaques (sulfides and/or oxides). The chlorite forms subhedral flakes rarely over 20 μm in diameter. The matrix consists of fine (25 μm) quartz, alkali feldspar, chlorite and Fe-Ti oxides (hematite and leucoxene). This is a felsic fine lapilli tuff, as suggested by the abundant quartz, of possible dacitic composition, altered mainly to chlorite.

Sulfides include chalcopyrite as anhedral grains aggregating to about 1 mm across, in places with associated subhedral to euhedral pyrite to0.3 mm diameter. Both sulfides are largely oxidized at their rims to goethite, and are found associated with the calcite or altered mafics. The copper in this specimen would be easily recoverable.

<u>14113: ALBITE-CHLORITE ALTERED, PYRITIZED FELSIC LAPILLI TUFF OF POSSIBLE ANDESITE TO DACITE COMPOSITION</u>

Dark grey-green, fine fragmental volcanic rock probably of similar nature to the preceeding slide (it also contains pinkish hematite-stained clasts) but there is only pyrite; no chalcopyrite. The rock reacts to cold dilute HCl and is weakly magnetic. Mineralogy in polished thin section is:

Plagioclase (?albitic)	40%
Chlorite	25%
Quartz (largely primary?)	20%
Pyrite	5%
Carbonate (calcite)	3%
Fe-Ti oxides (hematite, leucoxene)	3%
?K-feldspar	3%
Sphene	1%
Apatite	tr

As in the previous slide, fragments in this specimen range from coarse porphyries with fine microlitic groundmass to crowded, fine porphyries. There are also large glomeratic or broken phenocrysts of plagioclase and possibly small K-feldspar, but no free quartz crystals (in contrast to sample G). Plagioclase forms eu- to subhedral crystals up to 3 mm long with twinning (extinction angles of up to 18° and relief less than quartz) indicating albitic (altered) compositions around An_3. Possible K-feldspar crystals are finer, about 0.5 mm long, and are only Carlsbad twinned. Possible former mafic crystals are suggested by euhedral-shaped areas of calcite with very thin rims of quartz, or patches of chlorite and quartz, up to 3 mm across; the outlines suggest pyroxene. Most of the chlorite is a length-fast magnesian variety, but there is also a bright green Fe-variety with anomalous birefringence.

Some larger (to 2 cm) fragments are composed mainly of fine, highly interlocking anhedral quartz grains of about 10-50 μm diameter, containing phenocrysts of ?K-feldspar. These are more felsic than the bulk of the rock.

The matrix to the fragments is itself largely volcanic, consisting of very fine (0.05-0.1 mm long) microlites of plagioclase set in a fine mesh of quartz, chlorite and lesser Fe-Ti oxide grains up to about 20 μm in diameter. There are also scattered subhedral grains of sphene up to 0.1 mm across disseminated and in altered mafic sites.

Calcite forms subhedral to anhedral grains up to 1 mm across, mainly in the altered mafic sites; apatite is found as slender to stubby prisms mainly in plagioclase crystals. Pyrite forms euhedral cubic grains scattered throughout the rock; there is no chalcopyrite in this specimen.

Alteration is principally to chlorite and albite (this is a more mafic rock than the previous slide, as evidenced by the lack of free quartz, and more abundant chlorite). It could be andesitic in composition, and the fragments generally up to 1.5 cm in diameter and a vague foliation suggest a fine to medium lapilli tuff.

14135: ALBITE-QUARTZ-CHLORITE-CALCITE ALTERED ?DACITIC LAPILLI TUFF WITH DISSEMINATED CHALCOPYRITE

Pink and green, fine fragmental volcanic rock of felsic to intermediate (siliceous) composition, characterized by sub-rounded clasts to 7 mm diameter and patches of green malachite. Polished thin section mineralogy is:

Plagioclase (albitic)	40%
Quartz (?partly secondary)	25%
Chlorite	20%
Carbonate (calcite)	5%
(malachite)	<1%
?K-feldspar	?3%
Sericite	2%
Chalcopyrite	2%
Remnant Fe-Ti oxides (?sphene, rutile)	1%
Limonite (goethite and pitch)	1%

Clasts in this lapilli tuff are heterolithic, ranging from fine-grained to porphyritic with a trachytic-textured groundmass; both tend to be highly altered (siliceous). Most clasts are subrounded to subangular. There are also somewhat broken phenocrysts (shards) of quartz and plagioclase feldspar. Large irregular patches of calcite are up to 7 mm across; they could represent altered clasts else be amygdules. Matrix forms about 40% of the rock.

Quartz forms <5% scattered anhedral (broken) crystals less than 1 mm across. The quartz is clear and unstrained. It is also found as anhedral grains of about 0.1 mm diameter in fine-grained fragments, and as extremely fine (10-20 μm) grains in the matrix of the rock, where it occurs with chlorite of similar size and possibly a little alkali feldspar (albitic plagioclase or K-feldspar). Tiny (5-10 μm) grains of relict Fe-Ti oxides (?sphene or rutile) are also found in the matrix.

Plagioclase forms 10-15% subhedral crystals up to 1.5 mm long which display irregular twinnng. The composition is likely albitic judging by the relief, which is less than that of quartz. Plagioclase is also found as abundant subhedral microlites or anhedral interlocking grains averaging about 0.1 mm long in the groundmass of certain fragments. There may be a few phenocrysts of K-feldspar (uncertain without staining tests) that are up to 0.5 mm diameter; mafic sites may be represented by calcite and sulfides. Sulfides are almost entirely chalcopyrite, forming disseminated grains up to 1 mm in diameter mainly in (but not restricted to) the matrix. The grains are partly to in places completely replaced by limonite (goethite and ?pitch limonite). No silver-bearing minerals were seen.

There is more quartz in this specimen than most of the preceeding slides; part of this is primary (phenocrysts) although much of the finer-grained quartz has a secondary look. Thus the composition is decidedly felsic; depending on how much K-feldspar is actually present, it could be termed a dacitic lapilli tuff. Alteration is to albite, silica and chlorite, and is pervasive.

<u>14141: ALBITE-QUARTZ-CHLORITE ALTERED ?DACITIC LAPILLI TUFF CONTAINING DISSEMINATED PYRITE AND CHALCOPYRITE</u>

Dark grey to pinkish fragmental volcanic rock, containing sub-angular clasts averaging a little larger (up to 1.2 cm) of variably porphyritic volcanics. Sulfides are largely confined to a diffuse fracture network, and there are patches of malachite especially in vugs. There is no reaction to cold dilute HCl; dark clats are magnetic. Modal mineralogy in polished thin section is:

Alkali feldspar (?albitic)	40%
Quartz (partly secondary)	30%
Chlorite	20%
Fe-Ti oxides (hematite, rutile)	3%
Limonite	2%
Sericite	2%
Pyrite	1%
Chalcopyrite	1%
Malachite	1%

There is considerably more quartz and less feldspar in this specimen than in 14135 (except for certain strongly feldspar porphyritic clasts). These same clasts are also rich in limonite, probably after sulfides that formed in mafic mineral sites. The matrix also makes up more of the rock (as much as 30%) and shows more definite hydrothermal alteration to irregular patches or thin veinlets of qaurtz (which are vuggy in places).

Quartz phenocrysts are more common than in 14135, and are up to 1.5 mm long, found mainly in the matrix. They are subhedral to broken, and show evidence of resorption (corroded) and alteration along fractures to chlorite. They contain trails of two-phase (liquid and small vapour bubble, abut 5% by volume) secondary fluid inclusions that would homogenize at low temperatures, possibly 200-250°C.

Plagioclase phenocrysts are mainly confined to the fragments, are subhedral to euhedral and up to 2 mm in diameter. They are flecked by minor fine sericite, and vaguely twinned, making determination of composition difficult, but have slightly negative relief compared to the quartz-rich groundmass, and so are likely albitic. Altered mafic relics are up to 1.2 mm long, and are replaced by dark green chlorite, opaques (sulfides and limonite) and minor quartz. Their euhedral outlines suggest they were probably pyroxene. The chlorite in this rock varies slightly to a more birefringent type that might be called "hydrobiotite" (or Fe-smectite).

The matrix consists largely of secondary quartz and ?secondary alkali feldspar, as anhedral interlocking grains of about 10-50 μm diameter. Both have veinlet- to miarolitic cavity-like textures, and are associated with sulfides, suggesting they are hydrothermal. In places there is considerable chlorite, probably after former mafic minerals. Sulfides include euhedral pyrite and subhedral chalcopyrite grains up to 0.7 mm across, both partly oxidized to goethitic limonite.

<u>14145: SERICITE-QUARTZ ALTERED INTERLAYERED FINE ?FELSIC TUFF AND LAPILLI TUFF</u>

Very fine-grained, pale creamy-greenish, laminated ?volcanic rock, with conformable layers of coarser-grained texture. Vaguely-defined, elongate (?flattened phenocrysts are scattered through the rock, which is very hard (siliceous), non-magnetic and does not react to cold dilute HCl. Modal mineralogy in thin section is approximately:

Sericite	45%
Quartz (?partly secondary)	30%
Relict alkali feldspar	20%
Opaque (?Fe-Ti oxides)	5%

Sericite (or illite; the crystals are very fine, of the order of 5-10 μm) pseudomorphs former ?phenocrysts or shards and whle ?fragments up to 3 mm long. Some of these are highly foliate and elongate, suggesting flattened ?fiamme in an original air-fall tuff. Rare larger flakes of sericite (or clay, possibly ?smectite) up to 0.5 mm across could represent altered biotite books.

Quartz forms wispy concentrations (vein-like in places) of anhedral interlocking grains up to 25 μm in diameter as well as even finer anhedral grains intimately mixed with the sericite and feldspar in the body of the rock. The coarser quartz is clearly secondary; the latter may be secondary also.

Feldspar forms abundant very fine (10-20 μm) anhedral grains in the matrix of the rock, as well as being found in anhedral to rounded patches up to 1 mm long that are heavily altered at margins and on fractures by sericite. Vague twinning in the latter suggests an alkali feldspar such as microcline or more likely albite; relief is lower than that of the enclosing quartz-sericite matrix. These patches probably represent former plagioclase phenocrysts which formed about 5-10% of the rock.

There are also subhedral patches of sericite and abundant Fe-Ti oxides (sphene, rutile) that probably represent former mafic crystals that were up to 1 mm long. Rounded, elongate patches of similar material up to 3 mm long look more like lithic fragments, however. Minor limonite due to weathering is found along cross-cutting fractures.

The mineralogy of this specimen is simple, being largely reduced from quartz-feldspar-minor mafic to sericite-quartz by alteration. The texture is that of a ?flow-banded felsic volcanic or interbanded fine tuff and ?crystal tuff, although the alteration has obscured this. It is hard to judge the original compositio except that it probably was felsic, possibly dacitic. In contrast to the specimens previously described, it is extremely lacking in sulfides.

<u>14146: INTENSELY QUARTZ-SERICITE ALTERED, ?FELSIC LAPILLI TUFF, NOTABLY LACKING IN SULFIDE CONTENT</u>

Pale grey to greenish-cream, vaguely porphyritic volcanic rock characterized by buff patches after ?altered phenocrysts up to 2 mm across. The rock is similar to 14145 in its altered appearance and lack of sulfide; it is harder than steel, non-magnetic and does not react to cold dilute HCl. In thin section, the mineralogy is as follows:

Quartz (?largely secondary)	45%
(phenocrysts)	5%
Sericite	40%
Relict alkali feldspar	5%
Opaques (Fe-Ti oxides)	5%
Limonite	tr

Sericite forms very fine (10-20 μm) to relatively coarse (up to 0.05 mm) euhedral to subhedral crystals that occur as pervasive replacements of the body of the rock or former phenocrysts, respectively. The coarser material may properly be called muscovite.

Quartz forms anhedral 10-15 μm diameter grains mostly restricted to patches up to 1 cm long that could represent altered fragments or matrix. In places the grains are coarser (up to 25 μm) where associated with coarser sericite. There are rare scattered subhedral phenocrysts with rounded (?corroded) outlines. These are clear and unstrained, but contain trails of secondary fluid inclusions with slightly higher vapour/liquid ratios (about 10%) that might homogenize about 250°C.

Opaque grains are either relatively coarse (up to 0.2 mm) and euhedral ?limonite, possibly after rare pyrite, or else more abundant, sub- to anhedral, fine grains of relict Fe-Ti oxides such as sphene and/or rutile (leucoxene). The latter are concentrated with the coarser sericite and may represent altered mafic grains and altered mafic fragments that were up to 2 mm in diameter.

In places fine anhedral grains with a ?lower relief than the quartz and sericite suggests there may be remnants of feldspar left in this specimen. It is impossible to judge the composition of this feldspar, but it is probably albitic (staining tests woulf be needed to confirm this).

This is a thoroughly quartz-sericite altered rock that barely preserves a fragmental texture. In thin section, these fragments are seen to be sub-angular and up to 10 mm in diameter. There are traces of porphyritic texture remaining, similar to the textures of the fragmental rocks described above (14135, 14141) although the alteration of this specimen is markedly different.

<u>14147: INTENSELY QUARTZ-SERICITE ALTERED, FRAGMENTAL VOLCANIC ROCK (?DACITIC LAPILLI TUFF)</u>

Creamy-buff and pinkish, fine-grained, apparently fragmental volcanic rock with a vaguely defined layering. The reddish colouration is caused by hematite. As for the 14145-14149 series, it is hard (siliceous), non-magnetic, and does not react to cold dilute HCl. In thin section, the modal mineralogy is approximately:

Quartz (partly secondary)	50%
Sericite	45%
Fe-Ti oxides (hematite, sphene, rutile)	5%
Opaque (?pyrite)	<1%

The bulk of this rock consists of fine, subhedral flakes of sericite averaging about 10-20 μm in diameter and anhedral quartz grains up to about 25 μm diameter. There are also abundant, but very fine, semi-opaque oxide grains and rare scattered opaque grains. Most of the semi-opaque material is probably sphene and rutile, found as subhedral 10-20 μm grains formed by the alteration of original ?ilmenite in the volcanic rock. Its distribution is highly irregular, however, being distinctly concentrated in certain clasts (these appear white or buff in both hand specimen and thin section). These may have been more mafic fragments. The opaque grains have euhedral cubic outlines and are probably pyrite. Hematite forms 5-10 μm subhedral grains.

As in 14146, there are rare subhedral quartz phenocrysts scattered in the matrix of the rock, and also rare patches of coarse muscovite (anhedral grains to 0.2 mm diameter). These may have originally been biotite books. There are thin quartz veinlets rarely over 0.1 mm thick, and suggestions of ramifying vague sericite veinlets.

The mineralogy is once again (as in 14145 and 46) very simple, due to intense quartz-sericite alteration. This alteration has obscured the original mineralogy of the specimen, but enough of the texture is intact to discern the outlines of fragments up to 7 mm long, mainly aligned with long axes parallel defining the layering. The clasts are subangular and have a range of appearances similar to those in most of the other specimens: porphyritic and aphyric. The porphyritic clasts appear to have contained about 40% subhedral 1 mm plagioclase and perhaps 10% 0.5 mm subhedral mafic phenocrysts. The aphyric clasts have an indeterminate original composition due to the replacement by quartz and sericite.

Matrix forms about 30-40% of this rock, and it contains about 30-40% lithic fragments (some themselves containing clasts) and the balance of altered ?feldspar and quartz phenocrysts. It was probably originally a felsic-intermediate lapilli tuff, possibly of andesitic or dacitic composition. The intense alteration does not seem to be associated with significant sulfide, and certainly no copper mineralization.

14148: INTENSELY QUARTZ-SERICITE ALTERED, ?BRECCIA OF QUARTZ RICH CLASTS IN FELSIC TUFFACEOUS MATRIX

This specimen consists of white to pale grey areas (?clasts) up to 3 cm long in a creamy to pale greenish rock. The latter contains 2-3 mm patches of a green alteration mineral, likely sericite, after ?plagioclase, and has a somewhat foliated, ?tuffaceous texture. The ?clasts are themselves fragmental. Overall, the rock is hard and siliceous, non-magnetic and lacks reaction to HCl. In thin section, the mineralogy is:

Quartz (largely secondary?)	40%
Sericite (possibly ± clay)	35%
Relict alkali feldspar (?albitic)	20%
Semi-opaque oxides (hematite, rutile)	5%
Limonite (?after pyrite)	<1%

There are no quartz phenocrysts in this rock, in either the clasts or matrix. However, the "clasts" are rich in what appear to be ?amygdules of quartz. These consist of patches up to 2 mm long of subhedral, crystal-clear quartz grains up to 0.5 mm in diameter, generally with rims of spherulitic sericite rosettes of 0.1 mm diameter. Some of the quartz is attacked by the sericite. Many of these quartz areas are joined by thin (0.1 mm) anastamosing quartz veinlets, some with sericite, and these cross into the matrix part of the rock. There are also ?remnant mafic phenocrysts up to 2 mm long, now completely replaced by sericite as subhedral flakes up to 0.2 mm diameter, and patches of fine quartz and/or sericite with euhedral outlines up to 0.5 mm long that may have been plagioclase crystals.

The "matrix" portion of the rock consists of highly sericite-altered phenocrysts, shards of phenocrysts and lithic fragments, most with a prominent elongation and aligned parallel to the elongation so as to define a foliation. The fragments range up to about 2.5 mm long, and consist essentially of fine-grained, subhedral sericite flakes of about 10 μm diameter. However, there are other fragments (up to about 1 cm in diameter) that are made up of fine-grained 20 μm anhedral quartz as a matrix containing 0.25 mm diameter patches of subhedral 0.05 mm relict alkali feldspar. The relief of these is just slightly lower than quartz, suggesting albite rather than K-feldspar.

Throughout both portions of the rock, opaque and semi-opaque grains of Fe-Ti oxides are abundant, in places concentrated into laminae that also define the foliation. Although too fine (5-20 μm) for positive identification, they are probably hematite, rutile, and possibly sphene. Much larger (up to 0.2 mm) opaques appear to be limonite, possibly after pyrite as suggested by their cubic outlines.

This appears to have been a felsic (?to intermediate) breccia or coarse tuff with angular, siliceous clasts that are tuffaceous in a tuffaceous matrix. Intense quartz-sericite alteration is not associated with significant sulfides.

<u>14149: INTENSELY QUARTZ-SERICIE ALTERED, FINE LAPILLI TUFF CONTAINING ABUNDANT QUARTZ ?AMYGDULES</u>

Pale grey-white, hard, siliceous, finely fragmental volcanic rock characterized by scattered brownish-purple (?hematitic) 0.5 cm fragments. The rock is non-magnetic and unreactive to cold dilute HCl. In thin section, the mineralogy is approximately:

Quartz (partly secondary)	45%
Sericite	45%
Opaques (Fe-Ti oxides)	5%
Relict alkali feldspar (?albitic)	5%

This is an intensely quartz-sericite altered rock that nevertheless preserves its original fragmental volcanic texture, with about 60% subrounded clasts up to 5 mm in diameter but averaging about 2.5 mm, set in a siliceous altered matrix.

Quartz is found as either masses of very fine, anhedral grains (5-20 μm) or patches up to 0.5 cm in diameter of coarse, subhedral to anhedral clear grains up to 3 mm long. These patches are similar to those in 14148, and are rimmed by the same rosettes of sericite, plus bands of opaque ?Fe-oxides such as limonite or hematite. These quartz grains are clear except for trails of pseudosecondary and rare primary fluid inclusions (1-4 μm, vapour/liquid = about 5-10%, homogenization temperatures in the 200-250°C range). The patches are like amygdules, but are connected in places by thin anastamose veinlets of quartz and minor sericite.

Many fragments are completely replaced by very fine-grained 10-20 μm sericite, in places mixed with a little quartz. However, a few fragments are composed of ragged to subhedral 0.1-0.2 mm crystals of alkali feldspar, or less commonly of feldspar and quartz. The feldspar has no twinning, but the index of refraction is close to quartz, suggesting albite rather than K-feldspar.

Opaque and semi-opaque oxide grains in this specimen tend to be concentrated in and around the quartz-rich patches, suggesting hydrothermal remobilization of ?hematite, rutile and possibly some sphene. Most grains are anhedral to subhedral and up to 0.05 mm in diameter, but there are also aggregates up to 0.5 mm across.

In summary, this rock might be classed as a felsic fine lapilli tuff that has undergone significant hydrothermal alteration to quartz and sericite. The original composition is indeterminate, since although the abundance of Fe-Ti oxide material suggests intermediate rather than felsic compositions, some of the oxides may be hydrothermally introduced. Most importantly, significant sulfide concentrations appear to be absent with this alteration.

<u>14150: QUARTZ-ALBITE-ANKERITE±SERICITE ALTERED, QUARTZ VEINED AND PYRITIZED MEDIUM-GRAINED LAPILLI TUFF</u>

Pale reddish-brown, strongly altered fine-grained volcanic rock that is non-magnetic and does not react to cold dilute HCl. It is also very hard and siliceous, but unlike the rest of the 14145-14150 series it contains significant sulfide (pyrite only) distributed along fractures. Oxidation has produced the reddish stain due to limonites. In polished thin section, the mineralogy is:

Quartz (largely secondary)	45%
Alkali feldspar (?albite)	25%
Carbonate (dolomite or ankerite)	15%
Sericite	10%
Pyrite	3%
Limonite, hematite	2%
Apatite	<1%

In thin section, this is revealed to be a fragmental rock composed of about 30% rounded to subrounded clasts up to 0.5 cm in diameter in a fine, highly siliceous (?altered) matrix. The clasts are mainly remnant porphyries, consisting of perhaps 10-20% relict plagioclase phenocrysts in a strongly carbonate-quartz altered groundmass (the carbonate could also be after former mafics). The plagioclase crystals are slender, euhedral and up to 1 mm long; their twinning and relief against that of quartz suggests they are albite. The carbonate forms euhedral to subhedral crystals up to 0.5 mm across; lack of reaction to HCl suggests it is dolomite or more likely ankerite judging by the iron staining caused by oxidation. Quartz is found as very fine anhedral grains (10-15 μm) in the matrix and as euhedral to subhedral, clear crystals in patches with sulfide. Minor sericite as subhedral flakes up to 0.05 mm diameter is also associated with these patches in places.

The matrix consists principally of fine-grained (about 0.05 mm) tightly interlocking, anhedral quartz. In places there are a few plagioclase crystals or carbonate and pyrite grains. There may be minor, very fine (20 μm) alkali feldspar grains mixed with the quartz. Rare stubby prisms of apatite up to 0.1 mm long are found in the matrix (and even finer needles in the plagioclase crystals).

In reflected light, pyrite is the only sulfide found, as anhedral to subhedral grains up to 1 mm in diameter. It is concentrated in the altered clasts rather than in the matrix, although some patches also occur in the matrix. In places, especially along fractures and thin anastamosing veinlets of quartz, ankerite and sericite, the pyrite is oxidized to goethitic limonite.

The original composition of this rock is difficult to determine due to the intensity of quartz-ankerite alteration but it probably was felsic (note the lack of abundant Fe-Ti oxides seen in the series 14145-14149). There is, however, no copper mineralization accompanying the significant pyritization.

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Dec. 17, 1991

Gerry D. Delane, P. Eng.
Placer Dome Inc.
1600-1055 Dunsmuir St.
Vancouver, B.C.
V7X 1P1.

Dear Gerry,

RE: INVOICE FOR PETROGRAPHIC WORK ON **HERD DOME PROPERTY** (PROJECT #299)

This invoice, for a total of $1100.00, is for attached petrographic work completed on samples from the Herd Dome property, as detailed below:

Thin section examinations, 16 @ 60.00 each ...	$960.00
Reflected light examination, 8 @ $ 7.50 each .	$60.00
Report preparation, 2 hrs @ $40.00	$80.00

	$1100.00

I hope that this petrographic work will assist you in sorting out the alteration at the Herd Dome property. I regret that no Ag minerals could be found in the polished sections; the locus of Ag values is an important issue and should be followed up, probably by making a preconcentrate from the specimen with highest Ag values before making a polished section of the grain mount and sending it to me.

Should you have any need of further petrographic studies in the future, please do not hesitate to contact me again.

Craig Leitch

Craig H.B. Leitch, Ph.D, P.Eng.

(604) 921-8780 or 666-4902

CC-1

Mineralized (copper), brecciated trachytic lithic breccia

General description

Host rock

Brecciated trachytic lithic breccia. High fragment to matrix ratio. Ghost-like lithic fragments, although of similar mineralogy, show textural, subtle grain-size and colour differences. Probable polymictic volcanic origin (crystal tuffs and possible flows).

Lithic fragments are composed of partially altered plagioclase crystal fragments/phenocrysts and glomerophenocrysts and widely scattered (<1%) microcrystalline quartz fragments. Plagioclase phenocrysts show partial alteration to sericite, and red-brown alteration dusting. The lithic fragment matrix is microgranular/microcrystalline K-feldspar-rich (confirmed in stained slab) with varied abundance of weakly foliated plagioclase microcrystals. Some lithic fragments contain conspicuous grains and clusters of grains of very fine-grained quartz. Both flow and tuffaceous textures are suspected. The matrix is obscured by reddish brown alteration dusting and iron-staining. Small clusters of microgranular chlorite and and epidote (?) alteration affects specific lithic fragments.

The protolith breccia matrix between lithic fragments is inconspicuous because of overprints of successive stages of fracturing, fracture filling and impregnation. The matrix is composed of microgranular (tuffaceous) material similar to lithic fragments which locally has a layered appearance.

Crackle brecciation (superimposed)

Very irregular multistage crackle brecciation, with some dislocation of wall rock fragments. Infilling of succesive stages is by K-feldspar, followed by quartz, followed by about 10% copper sulphides (in this section) accompanied by some quartz and minor sericite. Late fracturing (brecciation) is infilled with additional quartz, secondary copper minerals (including covellite), and hematite. CC-3 contains carbonate in late fractures with remobilized secondary copper minerals.

Mineralization: 10%

Copper mineralization has strong fracture (breccia) control but does show some fine disseminated sulphides (bornite, diginite, covellite) extending a few millimetres from breccia matrix out into wall-rock. The lithic fragments are not uniformly altered and mineralized. In approximate order of abundance the sulphides include chalcopyrite and bornite with lesser digenite. Secondary minerals include covellite which rims and veins primary sulphides and is intergrown with malachite, azurite (present) and hematite (and associated iron-stain).

CC-1 (Continued)

Reflected light

Opaques; 10%, Strong fracture controlled with very minor disseminated impregnation (to <0.5 cm) of wall rock adjacent to fracture systems. Mineralized fracture systems are almost entirely sulphides with some associated quartz and weak sericite. Lesser secondary(?) sulphides are associated with late carbonate in other sections.

Primary

Chalcopyrite; <5%, anhedral, (<.01 to masses >3.0 mm) with bornite and veined by bornite, covellite. Fracture controlled and associated with quartz gangue.

Bornite; <5%, anhedral, (<.01 to aggregates of grains >0.5 mm). Irregular masses associated with chalcopyrite, overlapping and post chalcopyrite deposition. Strong fracture control. Weak disseminated impregnation for a few mm into wall rock. Associated quartz gangue.

Digenite; <<1%, anhedral, (<.01 to 0.1 mm), irregular grains in fractures, cutting bornite and limited dissemination as for bornite in wall rock.

Secondary

Chalcocite, secondary; <<1%, anhedral (<.01 to masses 0.2 mm) Fracture controlled. felted intergrowths of covellite.

Covellite; <1%, anhedral, (<.01 to .05 mm) felted clusters rimming and veining bornite chalcopyrite and digenite. Fracture control and weak dissemination replacing digenite and bornite. Felted intergrowths with chalcocite.

Malachite; fracture filling.

Azurite; very minor fracture filling.

Hematite and iron stain; conspicuous fracture filling.

Note: no silver-bearing minerals were noted in this section.

CC-1A
As for CC-1. Polishes section containes the same opaque mineral assemblage and in approximately the same proportions as CC-1. The presence of tetrahdrite was anticipated but not detected.

Note: no silver-bearing minerals were noted in this section.

CC-2
Mineralized (copper brecciated trachyte/trachyandesite lithic breccia

General description

Host rock

Brecciated trachyandesite lithic breccia. High fragment to matrix ratio. Ghost-like lithic fragments very indistinct outlines. Stained slab and thin section illustrates polymictic nature of lithic fragments showing textural differences (felted flow and fragmental tuff fragments), differences in colour and mineralogy (including original K-feldspar-rich and plagioclase-rich).

Similar to CC-1 except polymictic lithic fragments more conspicuous. Alteration weak sericite, very weak chlorite, and epidote(?) as for CC-1. Microgranular breccia matrix more conspicuous than in CC-1.

Superimposed multistage crackle brecciation and infilling appears similar to that described for CC-1. Early stage fracturing introduced K-feldspar in addition to the original K-feldspar present in most lithic fragments. One of the crackle brecciation stages controlled copper mineralization and was accompanied by quartz as for CC-1. Relative abundance of copper minerals as for CC-1. Shows more abundant diffuse disseminated mineralization into wall rock adjacent to crackle brecciation (to several mm) with selective impregnation of certain fragments. Thin section and hand specimen shows late quartz veining and silicification unaccompanied by mineralization.

Reflected light

As for CC-1 with a total of 5% sulphides. Shows bornite with exsolved(?) chalcopyrite and partial replacement by digenite and felted covellite.

Suggested paragenesis

Chalcopyrite

Bornite

Digenite

Covellite

Sphalerite/galena

CC-3 Large slab

Mineralized, multistage brecciated, lithic breccia

Macroscopic description

The rock has had a complex history of brecciation, simple fracturing, infilling with gangue and mineralization. A suggested sequence of events is as follows:

The first period of brecciation was accompanied by K-feldspar infilling/impregnation. Subsequently there was refracturing with quartz veining followed by additional fracturing, mineralization by copper sulphides with minor quartz. This was followed by additional quartz veining and late fracturing filled with secondary copper minerals, copper carbonates, hematite and scattered carbonate.

The protolith is a polymictic lithic breccia composed of subrounded to subangular lithic fragments ranging in size (>5.0 cm with most 0.5 to 2.0 cm). The breccia has high fragment to matrix ratio. The original breccia matrix, where discernable, is composed of lithic fragment material grading downwards to <1 mm.

Most of the coarse breccia fragments are of similar texture, weak to moderate fine crystal fragments (phenocrysts(?)) in a microgranular (aphanitic) matrix. Some fragments have the irregular laminated textures of laminated felsites (welded?). Colour ranges widely through shades of grey, grey-brown, red-brown, orange brown etc. Stained slabs from CC-1 and CC-2 have strong K-feldspar content in most fragments with a few conspicuous plagioclase-rich, K-feldspar deficient fragments. CC-3 contains one fragment (approximately 1 cm diameter) which is microgranular epidotized.

Portions of the polished slab CC-3 show areas where the matrix between coarser lithic fragments are composed of similar but smaller lithic fragments grading downwards (to <1 mm). The remainder of the breccia matrix is impregnated and obscured by K-feldspar and siliceous (?) impregnation.

A subsequent episode of strong crackle brecciation was accompanied by chalcopyrite-bornite-digenite mineralization of breccia voids (fractures) with lesser fine disseminated mineralization in adjacent wall rock. This stage of mineralization was accompanied by coarse quartz infilling. Secondary digenite-covellite occurs as rims around the earlier copper minerals and in late fractures commonly accompanied by hematite, lesser malachite. Patchy carbonate fracture filling appears to be very late and contains lesser blebs of secondary or remobilized mineralization.

Scanning Electron Microscope Analyses

It was anticipated that, in this mineral assemblage, Ag values the order of 130 ppm (>3 oz/ton) would be conspicuous as silver-bearing tetrahedrite, argentite etc. However none of these were detected in polished thin sections.

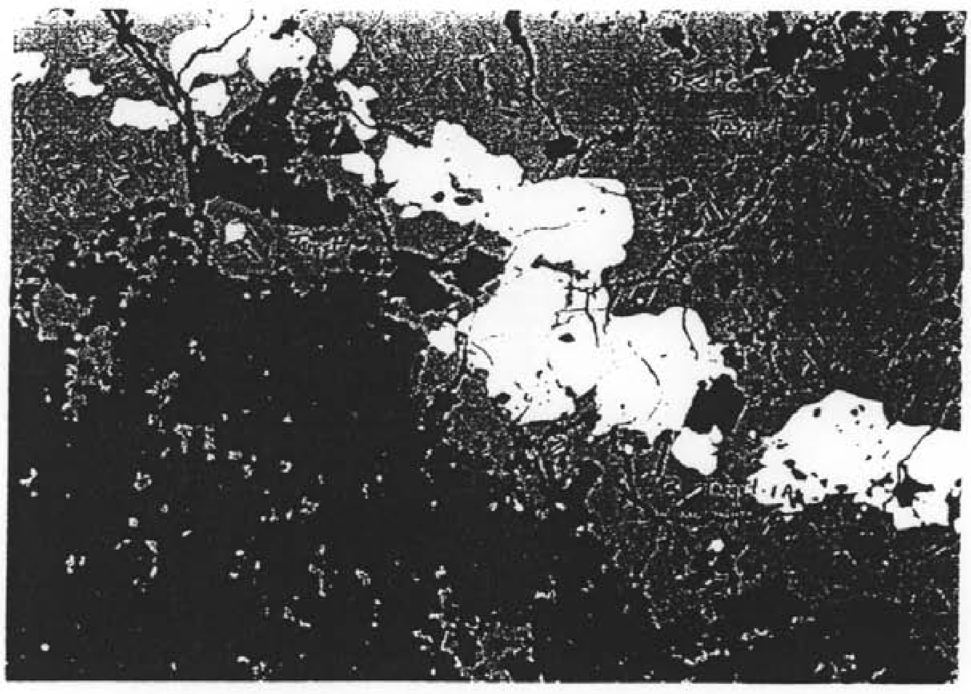
In an attempt to locate Ag values the metallic minerals occurring in Section 2B were tested in a number of areas by SEM at Cominco Research Laboratories, Vancouver. Section 2B contains the complement of metallic minerals observed in all 5 polished thin sections.

Results: No Ag minerals or Ag values were detected.

Jim McLeod, mineralogist at Cominco Research Laboratories, said that it is possible that silver values of this magnitude >130 ppm) may be dispersed among the lattices of the copper minerals.

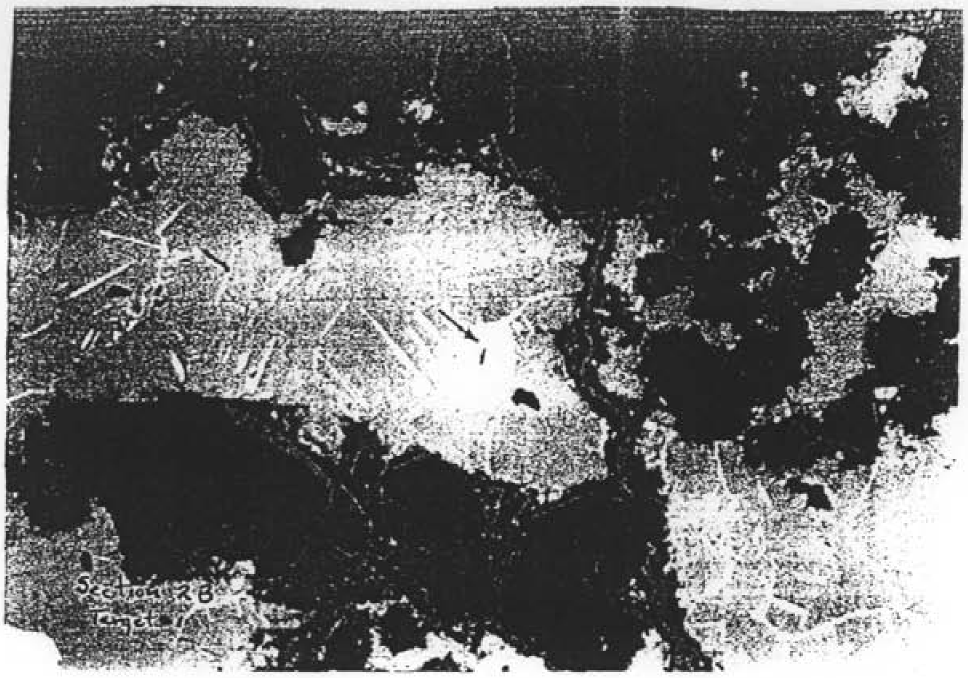
However, the presence of specific Ag-bearing minerals in this suite still seems more likely. This means either we missed seeing the Ag-bearing mineral in polished section or we were extremely unlucky not to obtain the Ag-bearing mineral in 5 sections.!!!

Photomicrographs of the target areas are provided on the following pages.



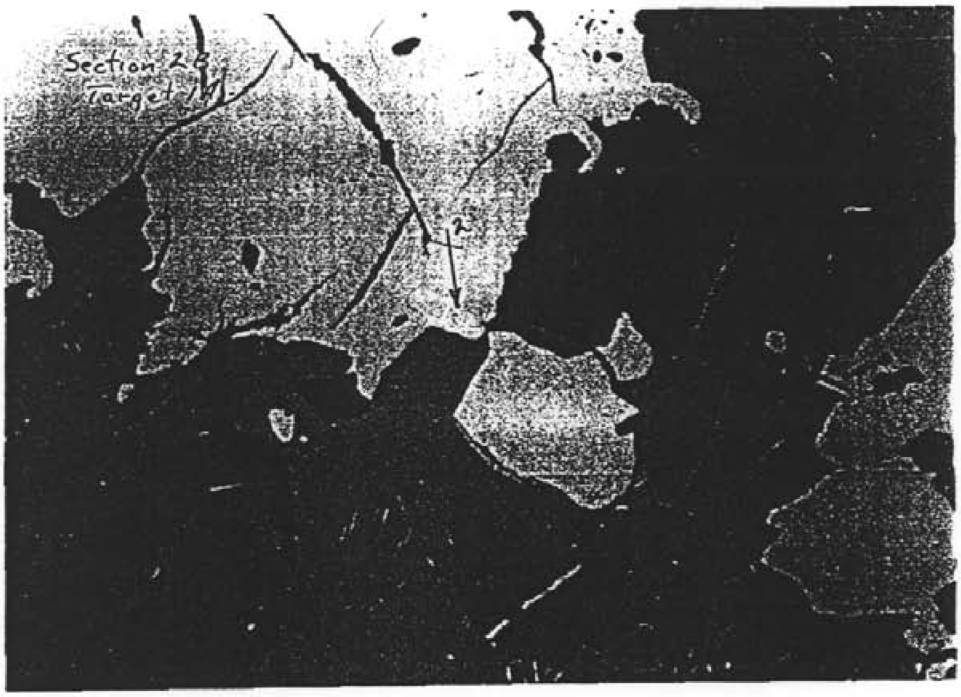
Section 2B Target areas 1 and 1A 0.1 mm

Bornite purplish brown; chalcopyrite yellow; digenite pale blue; covellite dark blue; galena white.



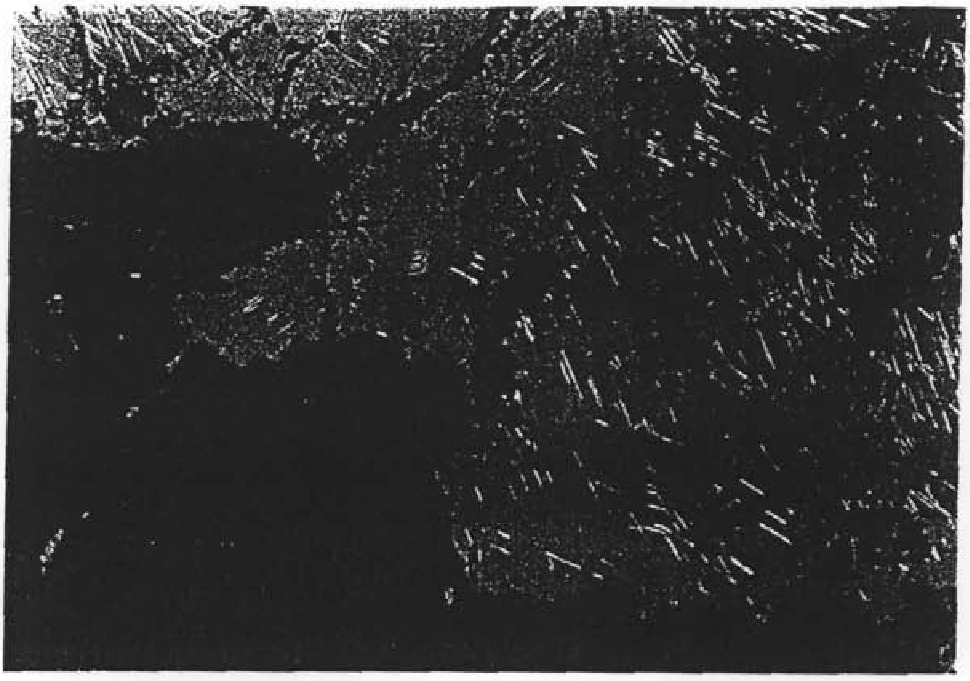
Section 2B Target Area 1 0.1 mm

Bornite purplish brown, rimmed and veined by digenite, covellite. hematite. Chalcopyrite "exsolution" laths. SEM target #1. Galena white SEM = Pb S. (Size .02 mm). #3 Digenite SEM = Cu S. (Size <.01 to 0.1 mm)



Section 2B Target Area 1A 0.1 mm

Bornite purplish brown, exsolved chalcopyrite, digenite rims, veined and rimmed by digenite-covellite. Chalcopyrite yellow, veined by digenite-covellite. Digenite-covellite veins in gangue. #2 Galena SEM = Pb S. (Size .02 mm)

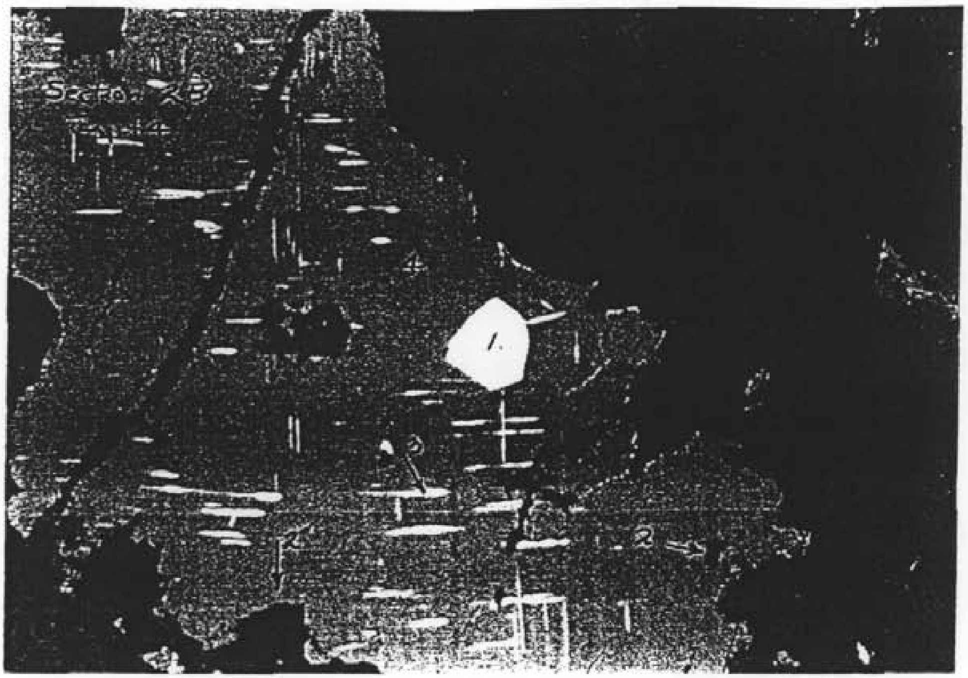


Section 2B Target area 2 0.1 mm

Bornite purplish brown, with exsolved chalcopyrite yellow, veined and rimmed by digenite, covellite, hematite. Hematite targets #1 and #2. SEM = Fe
Bornite target #3, SEM = Cu > Fe S
Chalcopyrite target #4, SEM = Cu Fe S.
Target #5 scan across mixed zone
SEM = Cu S and Cu S and Fe. No Ag.

Section 2B Target area 3 No photomicrograph

Bornite SEM = Cu > Fe S
Sphalerite SEM = Zn S (Size .05 mm)

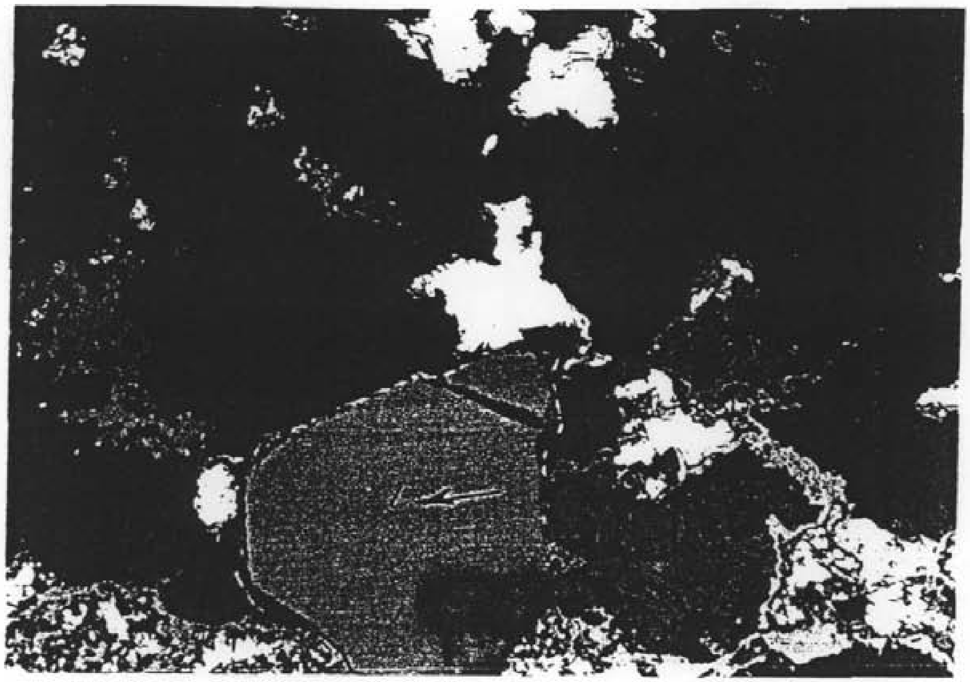


Section 2B Target area 4 0. 1 mm

Galena, Target #1 SEM Pb S (Size .02 mm)
Digenite, Target #2 SEM Cu S
Chalcopyrite, Target #3 SEM Cu Fe S (covellite rims)
Bornite, Target #4 SEM Cu > Fe S

Section 2B Target area 5 No photomicrograph

Spinel (2 grains) SEM = Fe Cr Al (oxide) (Size 0.1 mm)



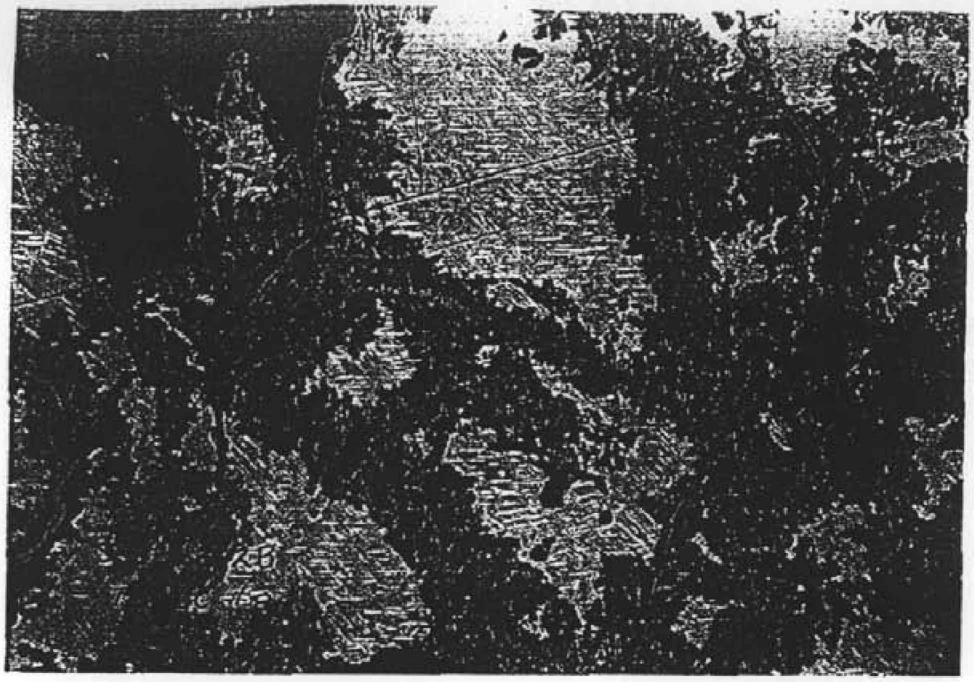
Section 2B Target area 6 0.1 mm

Target #1 Spinel SEM = Fe Cr Al (oxide) (Size 0.1 mm)

Section 2B Target area #7 No photomicrograph

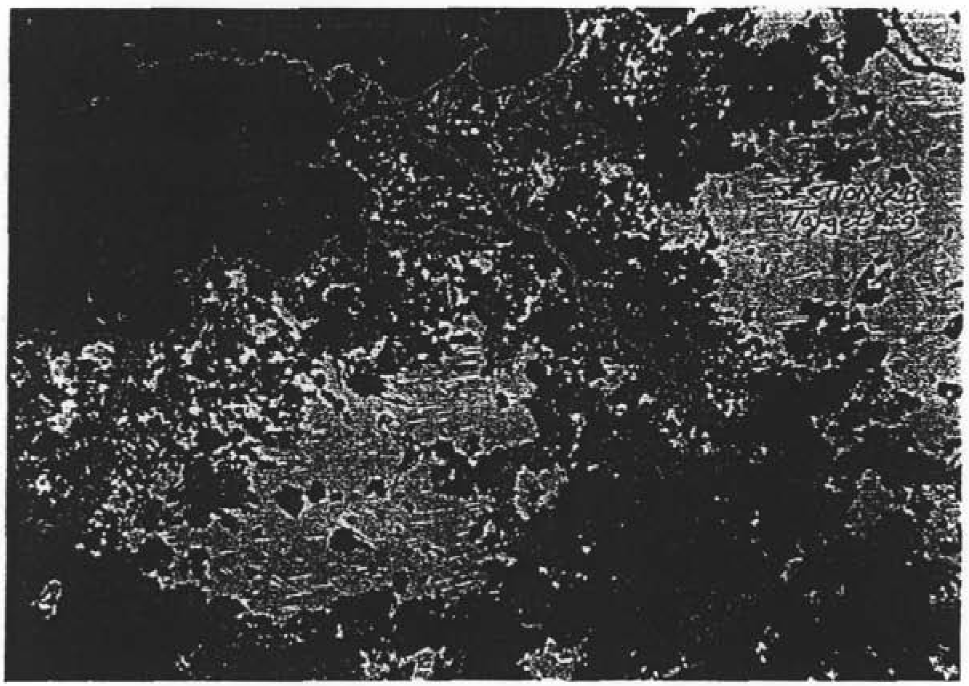
Target #1 Spinel SEM = Fe Cr Al (oxide).

4 grains euhedral (.05 to 0.3 mm)



Section 2B Target area 8 0.1 mm

SEM scan across intergrowths of covellite, digenite, hematite. SEM = Cu S (covellite), Cu S and Fe (covellite and hematite) and Cu > Fe S (bornite). No Ag!



Section 2B Target area 9 0.1 mm

SEM scan across intergrowths in dark material.

SEM = Fe, Fe Cu S, Si No Ag!

APPENDIX B

Herd Dome Geochemical Analysis Results on
103 Rock Samples from Placer Dome Laboratories

PLACER DOME RESEA..CH CENTRE
Geochemical Analysis

Project/Venture: V299 | Geol.: G DELANE | Date Received: SEPT 20, 1991 | Page 1 of 2
Area: HERD DOME 93L4E | Lab Project No.: D1574 | Date Completed: OCT 18, 1991 | Attn: G DELANE, E KIMURA, R HODGSON

Remarks:
Au – 10.0 g sample digested with Aqua Regia and determined by A.A. (D.L 5 PPB)
ICP – 0.5 g sample digested with 4 ml Aqua Regia at 100 Deg. C for 2 hours.
N.B. The major oxide elements and Ba, Be, Cr, La and W are rarely dissolved with this acid dissolution method.

SAMPLE No.	Au ppb	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm
6826	<5	1.0	2.15	11	13	<1	5	0.02	<0.1	6
6827	<5	0.1	0.34	<5	58	<1	<2	<0.01	<0.1	<1
6828	<5	0.9	0.48	12	70	<1	<2	0.32	<0.1	5
6829	<5	2.1	0.60	9	73	<1	<2	0.46	0.2	6
6830	<5	1.8	0.64	<5	107	<1	<2	0.32	0.1	6
6831	<5	0.7	0.56	<5	70	<1	<2	0.16	<0.1	5
6832	25	0.2	1.17	7	133	<1	<2	0.35	<0.1	9
6833	25	2.1	0.37	<5	45	<1	<2	0.23	<0.1	3
6834	<5	3.4	0.30	<5	47	<1	<2	0.10	0.1	2
6834*	<5	3.5	0.30	<5	47	<1	<2	0.10	0.1	3
6835	<5	3.0	0.88	26	93	<1	2	0.12	0.3	8
6836	<5	2.5	0.80	31	51	<1	2	0.07	<0.1	10
6837	<5	1.9	1.04	46	68	<1	4	0.02	<0.1	7
6838	25	0.9	0.86	35	43	<1	<2	0.03	<0.1	6
6839	<5	0.7	1.00	23	46	<1	<2	0.04	<0.1	8
6840	15	2.4	2.18	22	343	<1	5	0.32	0.3	32
6841	<5	<0.1	1.90	19	105	<1	3	0.49	0.1	26
6842	5	1.0	1.70	18	2.16	<1	3	0.35	0.2	26
6843	15	1.1	2.14	29	59	<1	5	0.45	0.2	31
STD-AU8-P1	325	0.2	1.06	21	198	<1	<2	0.90	0.5	6
6844	<5	2.7	1.92	34	124	<1	6	0.53	0.3	31
6845	<5	2.0	2.25	33	122	<1	6	1.25	0.1	31
6846	<5	2.9	2.07	26	310	<1	8	1.02	0.2	31
6847	<5	1.4	2.12	23	98	<1	9	0.03	<0.1	7
6848	<5	1.2	2.09	22	31	<1	8	0.04	<0.1	8
6849	<5	0.7	2.18	26	18	<1	11	0.04	<0.1	10
6850	<5	0.8	1.49	16	38	<1	6	0.03	<0.1	7
14109	<5	0.4	1.45	6	93	<1	4	0.04	<0.1	11
14110	<5	0.6	1.77	13	55	<1	4	0.04	<0.1	15
14110*	<5	0.8	1.78	17	54	<1	5	0.04	<0.1	15
14111	<5	0.7	2.42	18	60	<1	5	0.05	0.3	23
A826	<5	0.3	0.95	11	127	<1	<2	0.61	0.1	7
A827	<5	0.8	1.06	<5	228	<1	<2	0.56	0.1	7
A828	<5	1.3	0.93	<5	100	<1	<2	0.67	0.1	8
A829	<5	1.3	0.96	<5	93	<1	<2	0.58	0.2	9
A830	<5	1.5	0.93	<5	93	<1	<2	0.48	0.1	8
A831	<5	5.3	0.88	7	143	<1	<2	0.11	0.1	8
A851	<5	0.8	2.85	25	548	<1	4	0.56	0.3	47
A852	<5	1.7	2.16	35	107	<1	<2	1.66	0.6	41
A852*	<5	1.6	2.14	36	107	<1	3	1.66	0.7	41
A853	<5	1.2	1.38	24	614	<1	3	0.28	0.3	16
A854	<5	36.0	1.96	23	272	<1	6	0.42	0.8	33
A855	<5	1.0	1.37	5	156	<1	3	0.29	0.2	22
A856	<5	0.6	0.33	<5	386	<1	<2	0.01	<0.1	<1
A857	30	0.8	1.15	<5	133	<1	<2	0.50	0.3	21
A858	<5	3.0	1.14	7	304	<1	<2	0.09	0.2	23
A859	<5	63.0	0.99	<5	249	<1	3	0.04	0.2	20
A860	<5	78.0	1.34	7	277	<1	2	0.11	0.3	19
A861	<5	6.1	2.11	18	118	<1	6	0.32	0.3	24
A861*	<5	6.3	2.15	21	120	<1	4	0.32	0.3	24

SAMPLE No.	Cr ppm	Cu ppm	Fe %	K %	La ppm	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm
6826	92	18	5.06	0.04	9	1.52	955	3	0.06	27
6827	137	10	1.04	0.22	2	0.02	18	5	<0.01	6
6828	105	2089	1.79	0.07	9	0.23	383	3	0.06	6
6829	114	3818	2.55	0.10	12	0.31	513	4	0.05	7
6830	116	4278	2.67	0.13	10	0.32	491	4	0.05	7
6831	129	2613	2.44	0.11	10	0.28	449	3	0.05	7
6832	86	778	2.60	0.12	6	0.74	1319	3	0.03	6
6833	125	3734	1.65	0.07	11	0.14	383	3	0.07	7
6834	129	0.64%	1.50	0.08	9	0.09	284	1	0.06	6
6834*	130	0.64%	1.49	0.07	9	0.09	283	2	0.06	6
6835	110	0.54%	2.54	0.15	16	0.50	822	2	0.04	8
6836	147	835	4.55	0.13	3	0.65	640	2	0.04	25
6837	136	439	4.50	0.10	2	0.87	827	2	0.04	22
6838	138	265	3.06	0.09	4	0.63	701	3	0.06	15
6839	128	341	3.35	0.07	3	0.81	859	2	0.06	18
6840	73	2400	4.24	0.09	9	1.92	2341	<1	0.02	29
6841	80	50	3.83	0.10	12	1.56	2048	<1	0.02	25
6842	71	3201	3.56	0.09	11	1.47	1876	2	0.02	23
6843	71	1798	4.40	0.07	8	1.96	2444	<1	0.05	31
STD-AU8-P1	127	29	2.22	0.34	9	0.83	597	46	0.06	32
6844	87	3498	4.28	0.07	10	1.71	2152	2	0.05	41
6845	68	1901	4.31	0.04	9	2.26	2781	1	0.04	36
6846	85	2503	4.28	0.06	9	2.05	2638	3	0.04	35
6847	57	116	8.08	0.14	6	0.76	711	<1	0.02	30
6848	70	58	6.79	0.02	4	1.67	1448	3	0.05	28
6849	74	35	7.15	0.01	3	1.70	1462	2	0.04	40
6850	93	26	5.42	0.03	4	1.08	922	2	0.06	29
14109	85	19	5.17	0.04	4	1.06	1017	2	0.05	37
14110	77	21	5.41	0.04	3	1.31	1294	3	0.03	49
14110*	79	20	5.42	0.04	3	1.32	1300	4	0.03	50
14111	83	25	5.99	0.03	6	1.95	1993	1	0.04	66
A826	52	515	2.21	0.13	11	0.50	1189	4	0.02	5
A827	65	1223	2.45	0.13	10	0.59	1300	2	0.03	6
A828	103	1986	2.23	0.08	10	0.55	1153	3	0.03	6
A829	75	2497	2.20	0.10	13	0.58	1175	3	0.03	6
A830	86	2653	2.08	0.12	14	0.54	1034	2	0.04	6
A831	62	0.46%	2.60	0.12	9	0.49	747	2	0.03	6
A851	85	3332	4.37	0.07	5	3.18	2670	3	0.02	36
A852	57	0.58%	3.41	0.10	11	2.40	2750	3	0.02	30
A852*	57	0.58%	3.38	0.10	12	2.37	2747	3	0.02	29
A853	57	919	2.91	0.19	8	1.01	1389	2	<0.01	16
A854	82	1.27%	3.58	0.07	7	2.05	2732	2	0.03	44
A855	110	362	2.23	0.17	17	1.27	1788	1	0.02	32
A856	75	131	1.44	0.34	11	0.04	55	3	0.04	4
A857	104	231	1.40	0.09	4	1.39	885	3	0.03	23
A858	83	2006	2.36	0.14	2	1.29	821	3	0.01	37
A859	93	2582	2.46	0.10	4	1.24	709	3	0.01	23
A860	101	3874	2.47	0.11	4	1.76	1063	2	0.01	22
A861	83	0.77%	3.28	0.09	5	2.71	1981	2	0.02	28
A861*	82	7671	3.35	0.09	5	2.75	2030	2	0.02	28

SAMPLE No.	P %	Pb ppm	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
6826	0.04	6	<5	2	<0.01	295	<10	170
6827	<0.01	<2	<5	1	<0.01	3	<10	5
6828	0.03	2	<5	4	0.11	167	<10	32
6829	0.05	4	<5	5	0.13	220	<10	44
6830	0.06	2	<5	5	0.12	254	<10	44
6831	0.05	<2	<5	4	0.08	183	<10	39
6832	0.04	<2	<5	5	0.04	67	<10	122
6833	0.04	<2	<5	2	<0.01	60	<10	22
6834	0.04	<2	<5	2	0.01	78	<10	13
6834*	0.04	<2	<5	2	0.02	77	<10	13
6835	0.05	<2	<5	4	0.03	109	10	79
6836	0.05	11	<5	3	0.02	61	<10	84
6837	0.05	7	<5	2	0.01	74	<10	103
6838	0.03	<2	<5	2	<0.01	51	<10	79
6839	0.04	2	<5	2	<0.01	59	<10	104
6840	0.05	5	<5	5	<0.01	99	<10	334
6841	0.05	3	<5	4	<0.01	93	<10	274
6842	0.05	<2	<5	3	<0.01	98	<10	254
6843	0.06	5	<5	3	<0.01	122	<10	317
STD-AU8-P1	0.08	48	<5	85	0.11	35	<10	147
6844	0.07	2	<5	5	<0.01	229	<10	272
6845	0.06	5	<5	7	<0.01	148	<10	370
6846	0.06	6	5	11	<0.01	149	<10	338
6847	0.04	10	<5	2	<0.01	61	<10	113
6848	0.06	9	<5	3	0.02	84	<10	179
6849	0.06	11	7	2	<0.01	83	<10	203
6850	0.05	8	<5	4	<0.01	66	<10	125
14109	0.04	5	<5	5	<0.01	60	<10	132
14110	0.04	5	6	3	<0.01	69	<10	165
14110*	0.04	4	<5	3	<0.01	69	<10	165
14111	0.04	6	<5	4	<0.01	87	<10	245
A826	0.03	<2	<5	4	<0.01	19	<10	88
A827	0.03	<2	<5	6	<0.01	29	<10	99
A828	0.04	<2	<5	5	0.02	64	<10	89
A829	0.04	<2	<5	4	0.01	67	<10	94
A830	0.04	<2	<5	4	0.01	80	<10	87
A831	0.05	<2	<5	4	0.04	126	<10	73
A851	0.07	7	<5	10	<0.01	179	<10	486
A852	0.06	4	6	12	<0.01	115	<10	419
A852*	0.06	4	<5	12	<0.01	114	<10	416
A853	0.05	6	<5	15	<0.01	57	<10	220
A854	0.07	9	8	6	<0.01	155	<10	419
A855	0.04	<2	<5	4	<0.01	95	<10	302
A856	0.02	<2	<5	16	<0.01	5	<10	12
A857	0.04	<2	<5	4	0.06	237	<10	111
A858	0.04	<2	<5	5	0.17	541	<10	117
A859	0.04	21	<5	6	0.13	591	<10	112
A860	0.05	13	<5	4	0.15	453	<10	150
A861	0.06	<2	5	4	0.18	406	<10	229
A861*	0.06	2	7	4	0.19	414	<10	231

PLACER DOME RES_ARCH CENTRE
Geochemical Analysis

Project/Venture: V299
Area: HERD DOME 93L4E
Remarks:
Au – 10.0 g sample digested with Aqua Regia and determined by A.A. (D.L 5 PPB)
ICP – 0.5 g sample digested with 4 ml Aqua Regia at 100 Deg. C for 2 hours.
N.B. The major oxide elements and Ba, Be, Cr, La and W are rarely dissolved with this acid dissolution method.

Geol.: G DELANE
Lab Project No.: D1574

Date Received: SEPT 20, 1991
Date Completed: OCT 18, 1991

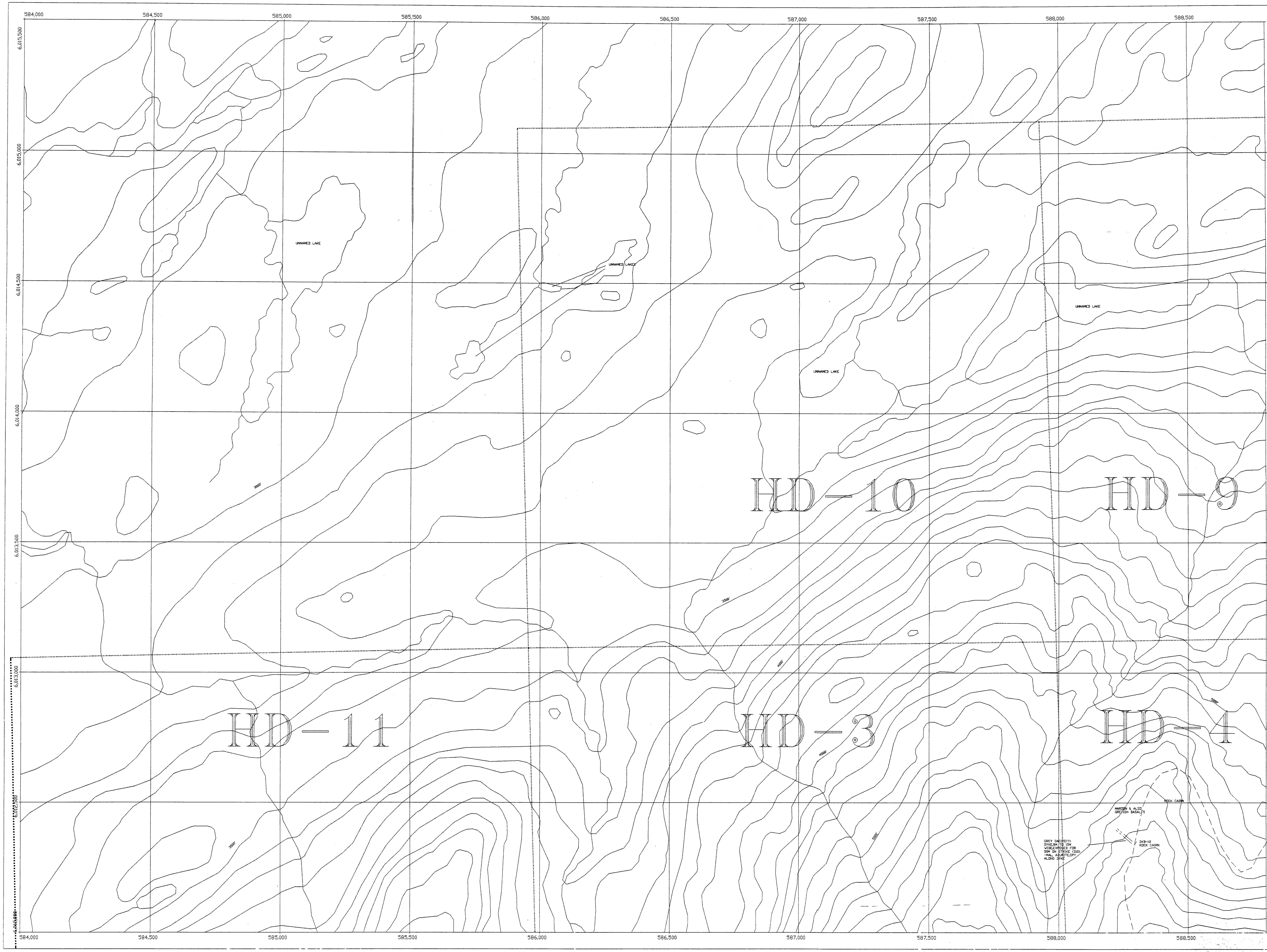
Attn: G DELANE
E KIMURA
R HODGSON

SAMPLE No.	Au ppb	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	K %	La ppm	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P %	Pb ppm	Sb ppm	Sr ppm	Ti %	V ppm	W ppm	Zn ppm
A862	<5	1.7	1.47	9	56	<1	5	0.20	0.2	15	105	98	4.01	0.09	10	1.23	1385	4	0.04	29	0.05	4	<5	3	0.02	209	<10	125
A863	<5	0.9	2.04	18	322	<1	8	0.45	0.2	20	87	3040	4.41	0.08	10	1.83	1919	2	0.04	30	0.06	9	5	6	<0.01	210	<10	181
A864	<5	1.1	2.14	21	206	<1	7	0.58	0.1	22	77	1699	4.52	0.07	9	2.06	2259	<1	0.04	34	0.06	4	<5	5	<0.01	221	<10	208
A865	<5	3.0	2.13	26	154	<1	7	0.98	0.2	23	78	3171	4.63	0.09	11	2.14	2384	2	0.03	36	0.06	5	<5	7	0.02	304	<10	186
A866	<5	2.5	1.99	38	189	<1	7	1.13	0.3	20	74	2644	4.31	0.09	11	1.92	2093	1	0.04	30	0.06	6	<5	9	<0.01	230	<10	183
A867	<5	3.9	1.70	19	211	<1	7	0.93	0.2	19	73	4914	3.68	0.10	9	1.59	1784	2	0.03	31	0.05	2	<5	7	<0.01	272	<10	153
A868	<5	1.3	1.89	13	298	<1	4	0.59	0.2	20	67	3188	3.71	0.06	10	1.83	1933	2	0.04	33	0.06	7	<5	6	<0.01	250	<10	161
A869	<5	1.9	2.01	12	229	<1	6	0.69	0.2	21	75	1521	3.80	0.07	12	1.97	1919	3	0.04	33	0.06	6	<5	6	<0.01	284	<10	176
A870	10	3.1	1.70	37	252	<1	7	1.61	0.4	20	72	4402	3.65	0.07	9	1.64	1821	1	0.03	33	0.06	6	<5	9	0.02	328	<10	155
A870*	<5	3.3	1.77	41	263	<1	5	1.68	0.4	21	74	4560	3.77	0.08	9	1.69	1873	2	0.04	35	0.06	7	<5	10	0.02	339	<10	154
A871	90	1.9	1.30	34	127	<1	3	0.81	4.1	10	93	754	3.90	0.07	9	1.00	2956	2	0.01	17	0.04	19	<5	12	0.07	71	<10	1432
A872	50	1.0	1.26	90	130	<1	3	2.13	0.2	16	106	900	4.08	0.19	9	0.75	2629	2	0.02	20	0.06	7	<5	12	<0.01	60	<10	123
A873	45	2.0	1.07	55	139	<1	<2	1.07	0.1	13	130	956	3.85	0.14	7	0.63	1983	1	0.02	18	0.05	4	<5	7	<0.01	62	<10	108
A874	<5	1.4	0.83	<5	156	<1	<2	0.10	<0.1	5	86	1136	2.84	0.11	11	0.45	1295	<1	0.02	8	0.04	<2	<5	3	<0.01	32	<10	84
A875	<5	<0.1	1.38	13	186	<1	2	0.55	0.2	8	75	787	3.36	0.17	6	0.80	1589	2	0.03	8	0.05	5	<5	7	<0.01	29	<10	169
A876	20	6.6	1.13	38	55	<1	<2	0.16	1.3	9	95	3559	4.23	0.07	7	0.75	1821	<1	0.05	8	0.08	47	<5	3	<0.01	63	<10	337
A877	10	0.7	2.09	53	74	<1	5	2.02	0.9	27	46	132	7.40	0.06	8	1.71	2546	<1	0.06	10	0.09	98	7	37	0.28	208	<10	351
A878	200	5.4	0.70	45	106	<1	<2	0.56	12.4	9	172	0.55%	3.20	0.08	5	0.39	1456	19	0.03	8	0.04	36	<5	6	<0.01	55	<10	0.34%
A879	65	2.7	0.96	26	107	<1	4	0.71	19.1	10	131	2185	3.95	0.13	5	0.50	1537	23	0.02	8	0.05	17	<5	10	<0.01	44	<10	0.50%
STD-AU8-P1	325	0.3	1.11	15	205	<1	<2	0.95	0.5	6	128	33	2.29	0.35	9	0.86	609	51	0.07	33	0.08	49	8	89	0.11	37	<10	167
A880	140	1.1	0.64	9	226	<1	<2	1.17	0.7	10	137	1213	3.08	0.16	7	0.26	1803	3	0.02	8	0.03	11	<5	12	<0.01	27	12	200
A881	30	32.0	0.65	92	131	<1	2	0.24	0.4	11	88	1.52%	3.88	0.07	9	0.05	886	1	0.09	9	0.12	<2	<5	7	<0.01	44	<10	121
C3307	<5	0.1	1.15	11	101	<1	<2	0.55	0.1	7	93	379	2.38	0.20	8	0.54	1277	2	0.05	6	0.03	<2	<5	5	0.10	19	<10	100
C3308	<5	0.5	1.05	6	90	<1	<2	0.84	0.1	6	85	586	2.28	0.16	8	0.53	1268	2	0.05	6	0.03	<2	<5	6	0.03	23	<10	98
C3309	<5	0.1	1.07	<5	56	<1	<2	0.45	<0.1	6	85	361	2.32	0.08	9	0.62	1255	<1	0.05	5	0.04	<2	<5	4	0.02	45	<10	103
C3310	<5	0.4	0.80	<5	70	<1	<2	0.59	<0.1	4	103	384	1.78	0.09	7	0.39	910	<1	0.09	5	0.03	<2	<5	5	0.03	30	<10	67
C3311	25	<0.1	1.03	6	95	<1	<2	0.51	<0.1	6	75	362	2.17	0.17	7	0.51	1127	<1	0.06	5	0.03	<2	<5	6	0.03	27	<10	87
C3312	10	0.8	2.33	43	85	<1	8	2.40	0.5	31	37	107	6.77	0.11	10	2.47	1531	<1	0.05	19	0.08	8	6	54	0.07	220	<10	136
C3313	<5	0.6	2.31	46	64	<1	12	3.25	0.4	32	38	247	6.63	0.07	9	2.35	1645	<1	0.04	19	0.08	10	12	67	0.14	251	<10	125
C3313*	<5	0.5	2.31	45	66	<1	12	3.27	0.5	32	39	263	6.55	0.07	9	2.36	1640	<1	0.04	19	0.08	9	16	67	0.14	250	<10	126
C3314	<5	4.4	2.13	35	268	<1	10	0.51	0.5	37	90	1.22%	4.80	0.11	8	2.08	2451	4	0.04	48	0.08	4	<5	7	<0.01	173	<10	377
C3315	<5	4.6	2.22	27	321	<1	8	0.40	0.5	40	88	0.76%	4.60	0.09	7	2.41	2529	4	0.05	50	0.07	4	<5	8	<0.01	175	<10	380
C3316	<5	3.5	1.81	22	240	<1	7	0.49	0.5	35	77	0.90%	3.54	0.05	7	2.00	2227	2	0.07	39	0.07	<2	<5	6	0.10	176	<10	315
C3317	<5	2.9	2.06	19	241	<1	8	0.27	0.4	36	77	0.66%	4.02	0.08	10	2.33	2502	3	0.03	34	0.06	4	<5	7	0.02	140	<10	354
C3318	<5	0.1	1.02	6	253	<1	4	0.20	<0.1	13	85	166	3.81	0.19	9	1.04	1010	2	0.03	28	0.05	6	<5	6	0.08	90	<10	82
C3319	<5	2.5	1.64	10	188	<1	6	0.64	0.2	31	153	851	1.55	0.10	9	2.31	1533	5	0.05	27	0.04	<2	<5	7	0.10	197	<10	192
C3320	<5	0.1	1.01	20	39	<1	6	1.62	<0.1	12	66	199	4.10	0.17	13	0.72	1263	3	0.05	9	0.06	5	<5	10	<0.01	30	<10	93
C3321	<5	<0.1	0.96	8	46	<1	3	0.96	0.1	8	81	106	3.29	0.11	9	0.63	1266	3	0.07	7	0.05	3	<5	7	<0.01	30	<10	95
C3322	<5	5.0	3.16	49	104	<1	12	4.61	0.3	27	119	1743	4.17	0.21	8	2.95	4658	2	0.02	35	0.06	10	7	16	0.13	118	<10	312
C3322*	<5	5.0	3.10	45	102	<1	10	4.58	0.4	26	121	1757	4.08	0.20	8	2.93	4582	4	0.02	35	0.06	11	8	16	0.13	116	<10	309
C3323	<5	6.6	2.88	30	116	<1	8	2.03	0.4	28	129	2326	4.29	0.21	8	3.12	4779	<1	0.02	37	0.05	8	7	9	0.14	115	11	334
C3324	20	0.5	0.35	<5	186	<1	<2	0.06	<0.1	1	122	69	2.12	0.31	9	0.05	102	4	0.04	6	0.03	11	<5	7	<0.01	5	<10	56
C3325	40	<0.1	0.42	10	101	<1	3	1.30	<0.1	6	67	15	3.19	0.11	12	0.14	953	1	0.04	8	0.05	4	<5	10	<0.01	22	<10	52
C3642	25	<0.1	4.67	41	98	<1	11	3.23	0.3	23	75	83	4.00	0.24	7	2.22	830	<1	0.32	35	0.06	13	7	130	0.16	122	<10	70
C3643	40	<0.1	2.20	29	57	<1	8	0.34	0.2	32	101	4	6.19	0.07	9	2.34	1607	<1	0.02	61	0.06	8	9	6	0.01	94	<10	119
C3644	30	0.1	0.45	<5	11	<1	<2	0.05	<0.1	<1	177	5	2.28	0.19	1	0.05	61	3	<0.01	8	<0.01	<2	<5	2	<0.01	28	<10	6
C3645	25	0.1	0.47	<5	11	<1	<2	0.04	<0.1	<1	62	<1	0.18	0.19	<1	0.02	36	<1	<0.01	2	0.02	<2	<5	3	<0.01	4	<10	3
C3646	<5	0.4	0.74	<5	42	<1	<2	<0.01	<0.1	1	65	5	1.92	0.03	<1	<0.01	8	24	<0.01	4	<0.01	<2	<5	11	<0.01	12	<10	3
C3646*	5	0.4	0.72	<5	43	<1	<2	<0.01	<0.1	1	65	5	1.91	0.03	<1	<0.01	8	25	<0.01	4	<0.01	<2	<5	11	<0.01	11	<10	4

PDI GEOCHEM SYSTEM: Data From: V299 HERD DOME

GRID	SAMPLE		PROJECT	Ag PPM	Au1 PPB	Cu PPM
93L4E5E		14134	1492	46	<5	0.33%
93L4E5E		14135	1492	10	<5	0.29%
93L4E5E		14136	1492	33	<5	0.78%
93L4E5E		14137	1492	23	<5	0.66%
93L4E5E		14138	1492	3	<5	0.64%
93L4E5E		14139	1492	2	<5	0.62%
93L4E5E		14140	1492	1	<5	0.32%
93L4E5E		14141	1492	1	<5	0.60%
93L4E5E		14142	1492	77	<5	1.63%
93L4E5E		14142*	1492	77	15	1.62%
93L4E5E		14143	1492	15	<5	1.65%
93L4E5E		14144	1492	2	15	0.09%
93L4E5E		14145	1492	<1	<5	0.01%
test	STD CU		1492			1.25%
test	STD AG		1492	50		
test	STD AU8		1492		335	

END OF LISTING - 16 RECORDS PRINTED Run on: 91:08:29 at 11:44:24



LEGEND

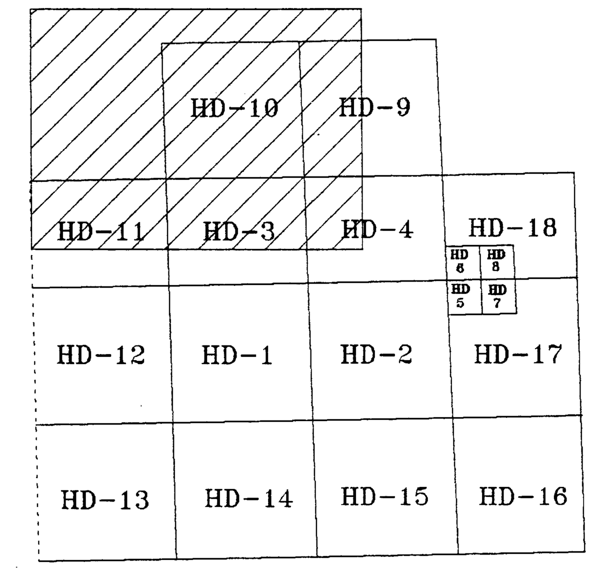
1. Ash tuff or lapilli tuff flows
2. red-maroon basalt flows- massive/fragmental(RV)
3. Dark grey-black andesite flows or andesite basalts- locally tuffaceous/fragmental
4. light grey dacite flows-locally tuffaceous/fragmental
4a. Altered dacitic lapilli tuff
5. Quartz-serecite altered felsic lapilli tuff

mal,az	malachite,azurite
cpy	chalcopyrite
bo	bornite
co	covellite
ch	chalcocite
py	pyrite
ob	overburden
otc	outcrop
qtz	quartz

⊠ Claim Post

— — — Prospector's Traverse

Elevations are in feet
6500 feet equals 1981.2 metres
6000 feet equals 1828.8 metres
5500 feet equals 1676.4 metres
5000 feet equals 1524.0 metres
4500 feet equals 1371.6 metres
4000 feet equals 1219.5 metres



GEOLOGICAL BRANCH
ASSESSMENT REPORT

22,542

DATA PLOTTED ON THIS MAP:
DIRECTORY: $EXPL/HERD
RUN FILE: GEOLOGY.NW.RUN

	FIELD	FILE
———	ID	SNOW.ASC2
———	ID	STREAMLAKE2
———	ID	INDXCON.ASC2
———	ID	INTMCON.ASC2

N

PROFESSIONAL ENGINEER
PROVINCE OF BRITISH COLUMBIA
G. D. DELANE

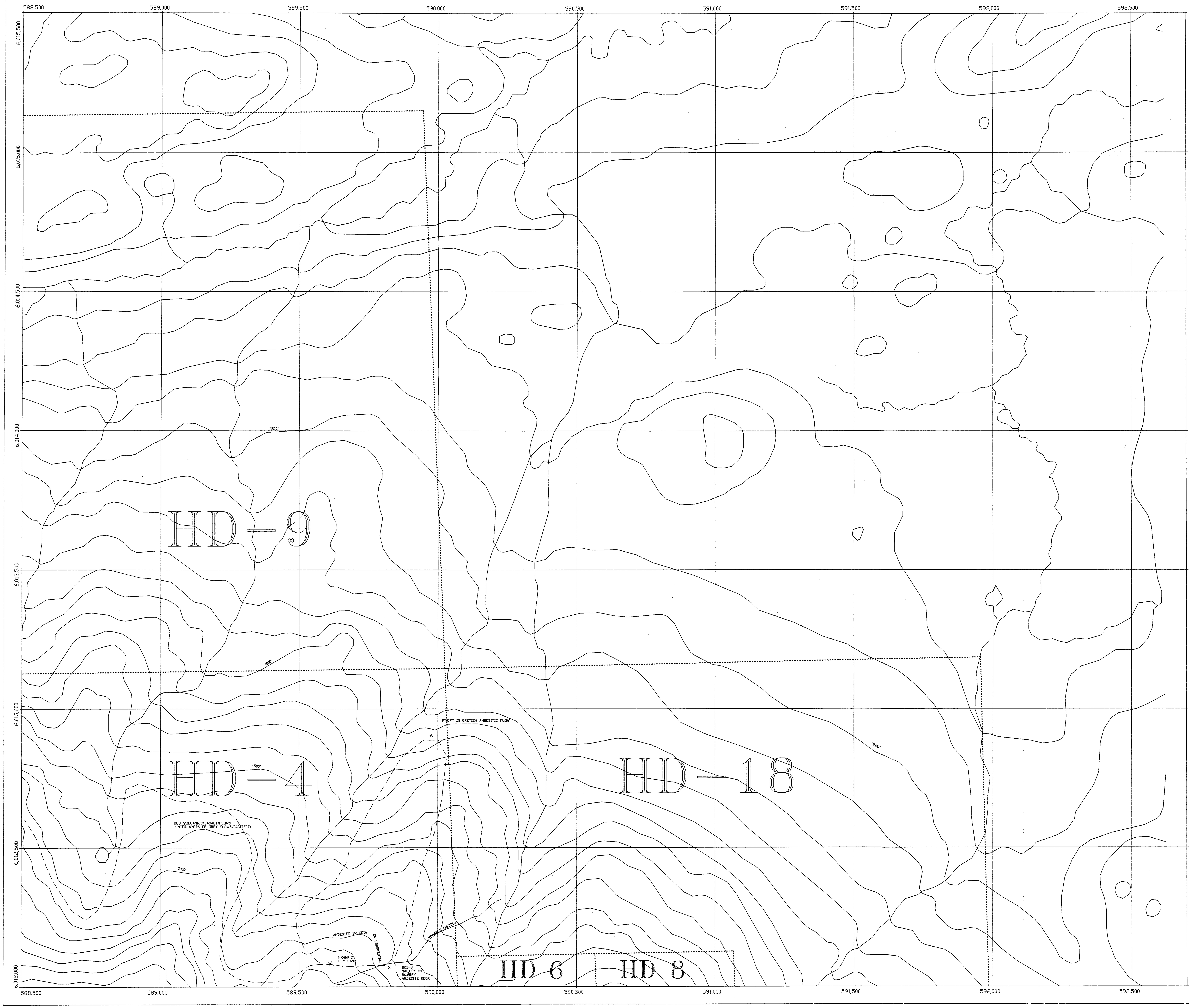
G.D. Delane

UTM NORTH IS 1 DEG 4.4 MIN EAST OF TRUE NORTH

0 200 400 600
METRES

PLACER DOME INC.

DRAWN LAM	HERD DOME PROJECT
DATE 92:09:22	Property Geology and Prospectors Traverses
SCALE 1:5000	
	NO. FIG 5,A N.W.



LEGEND

1. Ash tuff or lapilli tuff flows
2. red-maroon basalt flows- massive/fragmental(RV)
3. Dark grey-black andesite flows or andesite basalts- locally tuffaceous/fragmental
4. light grey dacite flows-locally tuffaceous/fragmental
4a. Altered dacitic lapilli tuff
5. Quartz-serecite altered felsic lapilli tuff

mal,az	malachite,azurite
cpy	chalcopyrite
bo	bornite
co	covellite
ch	chalcocite
py	pyrite
ob	overburden
otc	outcrop
qtz	quartz

⊠ Claim Post

Prospector's Traverse

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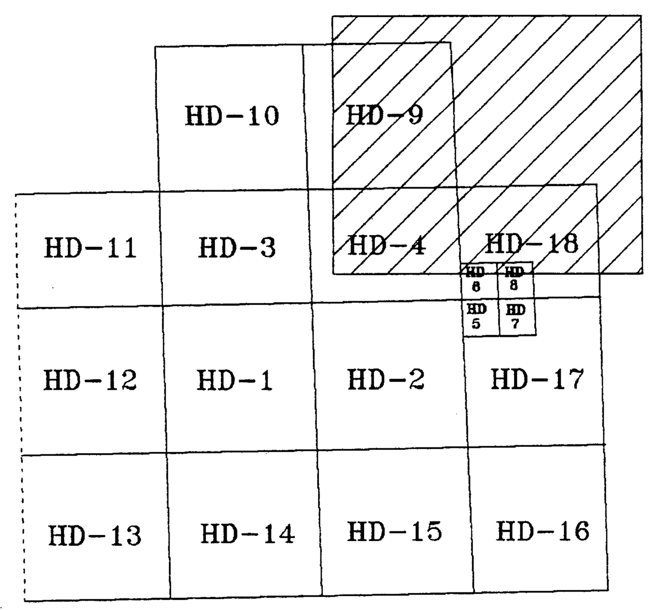


GEOLOGICAL BRANCH
ASSESSMENT REPORT

22,542

DATA PLOTTED ON THIS MAP:
DIRECTORY: $EXPL/HERD
RUN FILE: GEOLOGY.NE.RUN

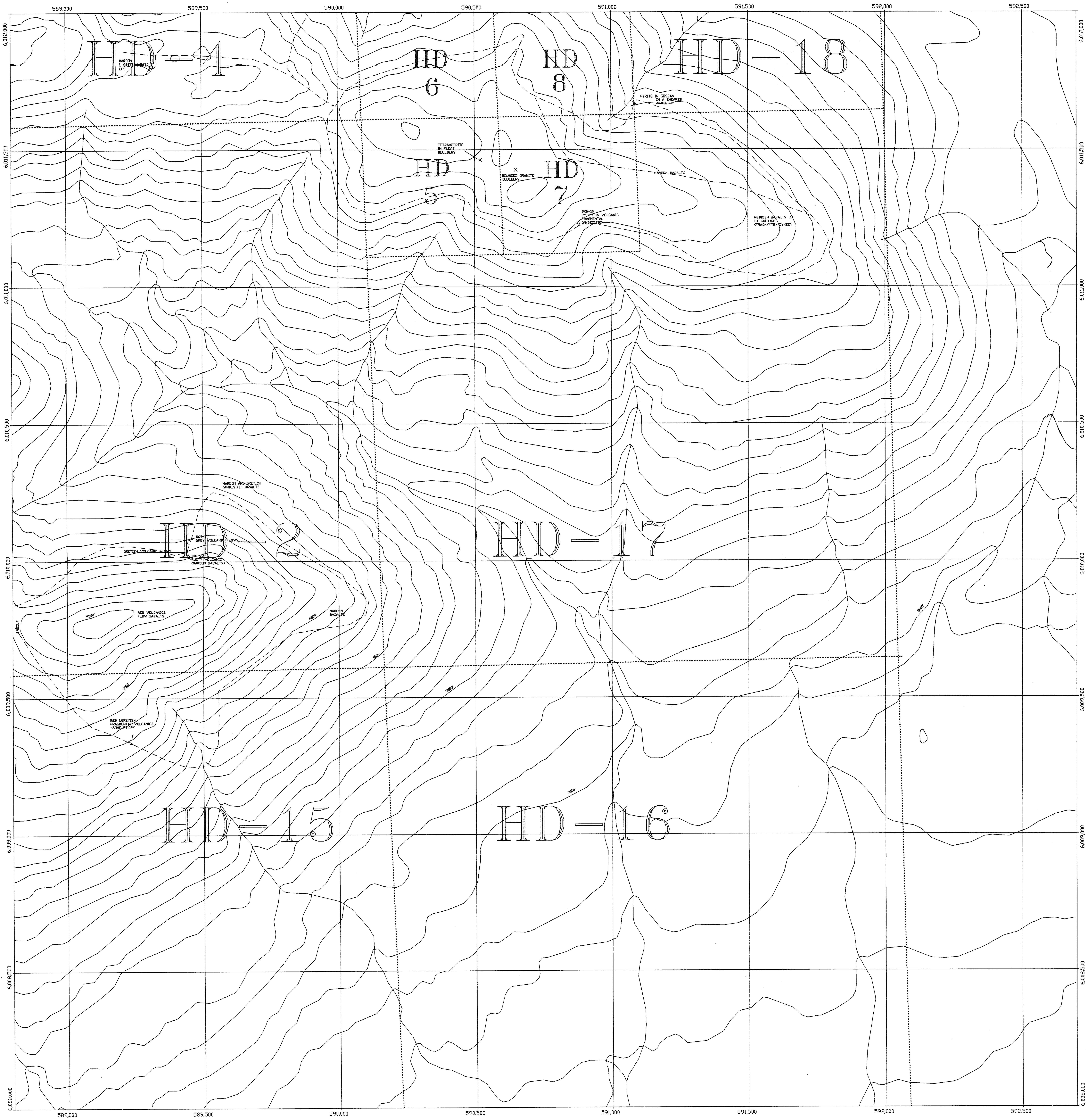
	FIELD	FILE
———	ID	SNOW.ASC2
———	ID	STREAMLAKE2
———	ID	INDXCON.ASC2
———	ID	INTMCON.ASC2

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — G. D. DELANE

UTM NORTH IS 1 DEG 7.7 MIN EAST OF TRUE NORTH

0 200 400 600
METRES

PLACER DOME INC.	
DRAWN LAM	HERD DOME PROJECT
DATE 92:09:22	Property Geology and Prospectors Traverses
SCALE 1:5000	
	NO. FIG 5.B N.E.



LEGEND

1. Ash tuff or lapilli tuff flows
2. red-maroon basalt flows- massive/fragmental(RV)
3. Dark grey-black andesite flows or andesite basalts- locally tuffaceous/fragmental
4. light grey dacite flows-locally tuffaceous/fragmental
4a. Altered dacitic lapilli tuff
5. Quartz-serecite altered felsic lapilli tuff

mal,az	malachite,azurite
cpy	chalcopyrite
bo	bornite
co	covellite
ch	chalcocite
py	pyrite
ob	overburden
otc	outcrop
qtz	quartz

⊠ Claim Post

Prospector's Traverse

Elevations are in feet
6500 feet equals 1981.2 metres
6000 feet equals 1828.8 metres
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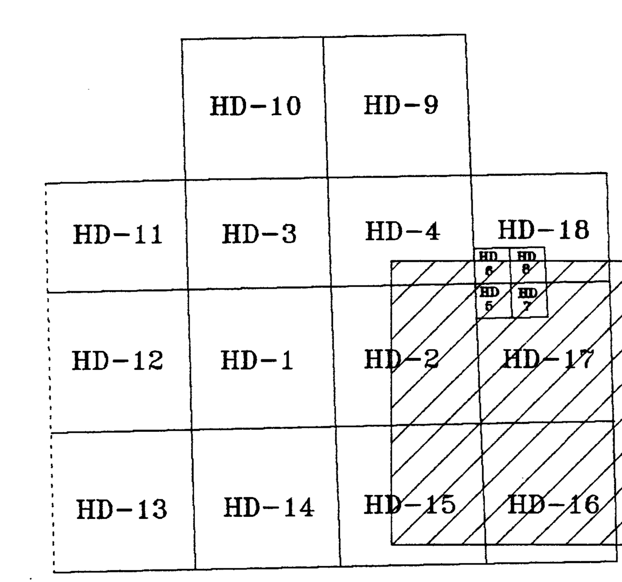
5000 feet equals 1524.0 metres
4500 feet equals 1371.6 metres
4000 feet equals 1219.5 metres

GEOLOGICAL BRANCH ASSESSMENT REPORT

22,542



DATA PLOTTED ON THIS MAP:
DIRECTORY: $EXPL/HERD
RUN FILE: GEOLOGY.SE.RUN

	FIELD	FILE
————	ID	SNOW.ASC2
————	ID	STREAMLAKE2
————	ID	INDXCON.ASC2
————	ID	INTMCON.ASC2

N

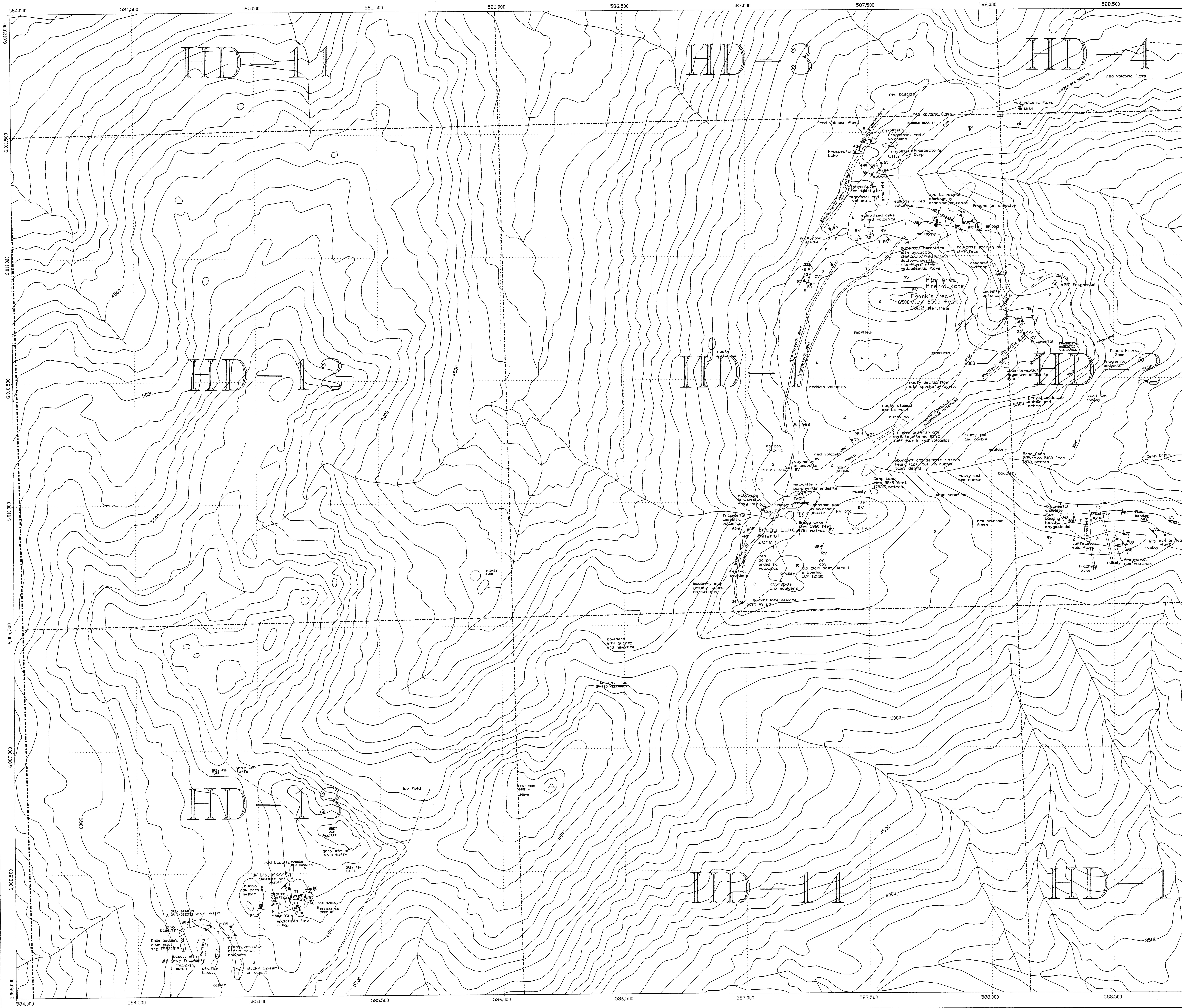
UTM NORTH IS 1 DEG 7.8 MIN EAST OF TRUE NORTH

PROFESSIONAL ENGINEER — PROVINCE OF BRITISH COLUMBIA — G. D. DELANE

G. D. Delane

0 200 400 600
METRES

PLACER DOME INC.	
DRAWN LAM	HERD DOME PROJECT
DATE 09/26/92	Property Geology and Prospectors Traverses
SCALE 1:5000	
	NO. FIG 5,C S.E.



LEGEND

1. Ash tuff or lapilli tuff flows
2. red-maroon basalt flows- massive/fragmental(RV)
3. Dark grey-black andesite flows or andesite basalts- locally tuffaceous/fragmental
4. light grey dacite flows-locally tuffaceous/fragmental
4a. Altered dacitic lapilli tuff
5. Quartz-serecite altered felsic lapilli tuff

mal,az	malachite,azurite
cpy	chalcopyrite
bo	bornite
co	covellite
ch	chalcocite
py	pyrite
ob	overburden
otc	outcrop
qtz	quartz

28 Joints- with dip

Joint- vertical

22 Igneous Flow banding or layering, with dip

T Talus Boulders

Dykes, Trachyte or Diorite

Outcrop

Snowfield

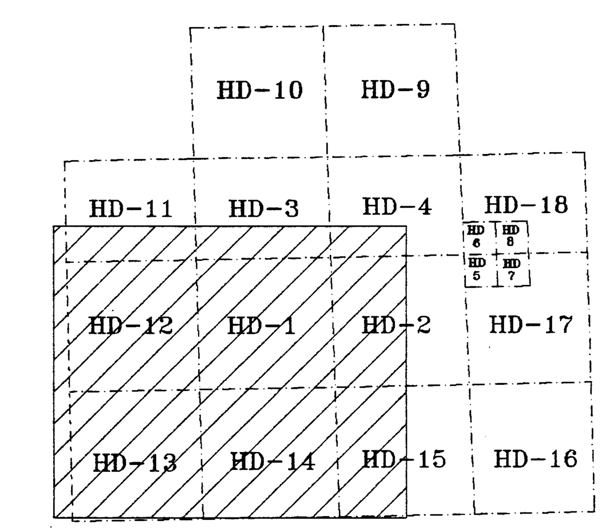
Claim Post

Prospector's Traverse

Elevations are in feet
6500 feet equals 1981.2 metres
6000 feet equals 1828.8 metres
5500 feet equals 1676.4 metres
5000 feet equals 1524.0 metres
4500 feet equals 1371.6 metres
4000 feet equals 1219.5 metres

GEOLOGICAL BRANCH
ASSESSMENT REPORT

22,542



GEOLOGY by K.Edwards & G.Delane, PEng.

Magnetic Declination = 24° 30'E

DATA PLOTTED ON THIS MAP:
DIRECTORY: $EXPL/HERD
RUN FILE: GEOLOGY.SW.RUN

FIELD	FILE
ID	SNOW.ASC2
ID	STREAMLAKE2
ID	INDXCON.ASC2
ID	INTMCON.ASC2

N

UTM NORTH IS 1 DEG 4.3 MIN EAST OF TRUE NORTH

PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. D. DELANE

0 200 400 600
METRES

PLACER DOME INC.	
DRAWN lam	HERD DOME PROJECT
DATE 09/26/92	Property Geology and Prospectors Traverses
SCALE 1:5000	
	NO. FIG. 5.D S.W.


HD-12
HD-1
HD-2
HD-13
HD-14
HD-15
HERD DOME PEAK (6401 Feet) (1951 metres)
LEGEND
Sample Number
Copper in ppm
3644 30 5.0 .05
3645 25 0.5 .10
Gold in ppb
Silver in ppm
All samples are one metre chip samples except samples 14142 and 3313 which are grab samples
Claim Line
Claim Name
HD-13
HD-14
Elevation Marker with elevation in feet
Elevations are in feet
6500 feet equals 1981.2 metres
6000 feet equals 1828.8 metres
5500 feet equals 1676.4 metres
5000 feet equals 1524.0 metres
4500 feet equals 1371.6 metres
4000 feet equals 1219.5 metres
Helipad
Icefield
HD-10 HD-9
HD-11 HD-3 HD-4 HD-18
HD-12 HD-1 HD-2 HD-17
HD-13 HD-14 HD-15 HD-16
GEOLOGICAL BRANCH ASSESSMENT REPORT
22,542
DATA PLOTTED ON THIS MAP:
DIRECTORY: $EXPL/HERD
RUN FILE: HERDROCK.SW.RUN (HERD.RUN)
FIELD FILE
× POINTS: SAMP HERDPOINT1
× POINTS: EL TCON.ASC
ID SNOW.ASC2
ID STREAMLAKE2
ID INDXCON.ASC2
ID INTMCON.ASC2
UTM NORTH IS 1 DEG 4.5 MIN EAST OF TRUE NORTH
PROFESSIONAL ENGINEER PROVINCE OF BRITISH COLUMBIA G. D. DELANE
0 200 400 600
METRES
PLACER DOME INC.
DRAWN LAM
DATE 09/26/92
SCALE 1:5000
HERD DOME PROJECT
Rock Sample Location Map and Results
NO. Fig 6 S.W.
/data3/expl/herd/swrock.dwg