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ESKAY CREEK Schroeter Mar.'90

MINERALIZATION AND ALTERATION

At least five general types of mineralization are noted at Eskay Creek:

1. Stratabound Au+Ag (+Sb,As,Hg)

   eg. #21 Zone

2. Disseminated and fissure-vein type Au+Ag (+Zn+Pb + minor Sb, As)

   eg. #22 Zone, #5 Zone, #23 Zone, part of #21 Zone

3. Disseminated to massive sulphide type with low grade Au+Ag plus significant amounts of base metals (sphalerite, galena and iron sulphides) associated with modest chlorite, muscovite, and silica alteration within the footwall dacite tuff unit

   eg. North sub-zone of #21 Zone OR 21B Subzone

4. Disseminated Au+Ag associated with iron sulphides in silicified footwall dacite tuff unit

   eg. 'Rusty' bluffs (#3 and #5 Bluffs)

5. Low grade Au+Ag plus minor base metals (sphalerite, galena and iron sulphides) associated with chlorite and quartz within shears at the contact of an intrusive feldspar porphyry and epiclastic rocks.

   eg. Porphyry showing

At least ten zones of mineralization have been noted on the Eskay Creek property (see Fig.): #'s 5,6,10,21,22,23,28, Mackay, Porphyry and #3 and #5 Bluffs. The 21 Zone is the most studied to date and is currently the target for economic evaluation. Other zones have received relatively minor exploration but will continue to offer attractive exploration targets.

#21 ZONE

To date, the #21 Zone has been traced by diamond drilling for 1400m (approx 4600 ft.) along strike, 5m to 45m in width, and for approximately 250m downdip. The Zone is open to the northeast and downdip. Mineralization is strata-controlled and appears to have a pronounced keel at depth. Both a **lateral** mineralization zoning (along strike), characterized by Sb,As, and Hg mineral assemblages to the south, and Zn, Pb, and Cu to the north, and a **vertical mineralization** zoning, expressed as a systematic increase in Au, Ag, and base metal content upwards, exists.

The #21 Zone has been further subdivided, based primarily on distinctive mineral associations and grade continuity, into two sub-zones:

21A (formerly 'South') and 21B (formerly 'Central' and 'North')

a) 21A Subzone

At the time of writing, most information available was from the 21A sub-zone, however, many of the general characteristics of the stratigraphic setting can also be applied to the 21B sub-zone. Some interesting and significant differences are nonetheless noted. One of the two 'Discovery' holes, DDH-88-6, returned values of 25.78 grams gold per tonne (0.752 opt) and 38.74 grams silver per tonne (1.13opt) over 29.4m (96.5 ft.). These holes actually penetrated the immediately overlying high grade sulphide body located at the rhyolite-andesite contact; whereas, previous holes had penetrated mineralization within the footwall rhyolite deposit.

Stratabound high-grade gold and minor silver with minor Sb, As, and Hg mineralization associated with intense hydrothermal alteration

(Mg-chlorite, muscovite, gypsum, and chalcedonic silica) occurs at the contact between rhyolite breccia and overlying pillowed andesitic flows. The ore has a relatively high As and Sb content. The 21A subzone which occurs in a west-facing homocline, strikes 058^{o} and dips from 25^{o}to 45^{o} to the northwest. Further along strike, into the 21B sub-zone, the zone appears to bend slightly towards the north and dips become flatter and may actually roll over. The 21A sub-zone has been traced over 280m in length, 100m in width, and an average thickness of 10m with locally much greater thicknesses indicated (i.e. CA89-23 returned a core length of 34.51m grading 14.93 grams gold/tonne and 103.1 grams silver/tonne). The southwestern end of the 21A subzone is cut by a younger north-northwesterly trending cross fault. These crossfaults also interrupt stratigraphy locally. The basic stratigraphic section, as determined by diamond drilling into a low predominantly tree-covered ridge with minor outcrops of a hangingwall andesitic unit, is shown in Fig. . The hangingwall andesite unit is barren of significant mineralization (except for minor pyrrhotite , barite and calcite) and is not altered. The main mineralization occurs within variably sheared and fractured graphitic mudstone and felsic debris breccia (Contact unit and/or Transition zones) at the contact of overlying pillowed andesitic flow rocks and intercalated sediments and an underlying rhyolite breccia. This Contact unit, up to 60m thick, is variable altered, containing pervasive silica (chert), chlorite (Mg-rich), muscovite, barite, and hydrocarbon residues, plus a variety of sulphide, arsenide and native mineral species. Graphitic argillite, containing primary cavities, glass shards, and possibly calcareous fossils and gypsum grains and rosettes has locally been variably replaced by this alteration/mineral assemblage and deformed. Muscovite-altered rocks have appreciable Fe content expressed by minute pyrite spheres with characteristic growth textures (Barnett, 1989). The black carbonaceous material (original organic matter) appears to be an overprint on earlier alteration. Gold and silver mineralization occurs in association with massive to disseminated stibnite, realgar, and orpiment hosted with the Contact unit (mudstone and adjacent mineralized tuffs) and passes along strike and downdip into less massive to disseminated domains. Stibnite and arsenopyrite needles occur in both the matrix and within rock fragments within debris breccia containing rhyolite and mudstone blocks and chips 'floating' in a black carbonaceous matrix. The breccia is matrix-supported, 'swirled' in appearance, and variably pyritic. Textures such as these Chips set in a granular or 'clastic' sulphide-rich rock may be suggestive of an exhalite facies. The Transition zone contains a myriad of clast sizes and compositions, including chert, rhyolite, clay 'balls', mineralized fragments, broken pyrite, arsenopyrite, and stibnite crystals. Rocks are moderately to highly foliated, with pressure shadows, rotated grains and schistose to dense interlocking mats of Mg-chlorite and muscovite together with a high proportion of hydrocarbon and graphite (Barnett, 1989). Sulphides exhibit slump features, debris flow textures and bedding that suggest deposition on the sea floor. Gold values report to native gold, amalgam, and Hg-bearing wurtzite; silver values report to amalgam, tetrahedrite minerals, gold, and other sulpharsenide minerals (Barnett, 1989).

Metallic mineral assemblages identified by Barnett 1989) include:

Stibnite Sb_2S_3	Pyrite FeS_2
Gold Au	Orpiment As_2S_3
Aktashite $Cu_6Hg_3As_5S_{12}$	Galena PbS
Arsenic As	Arsenopyrite FeAsS
Hg-Wurtzite (Zn,Hg)S	Sphalerite ZnS
Cinnabar HgS	Tetrahedrite - $(Cu,Ag,Fe)_{12}(Sb,As)_4S_{13}$
Ullmannite NiSbS	
Realgar AsS	Tennantite - $(Cu,Ag,Fe)_{12}(Sb,As)_4S_{13}$
Amalgam Hg-Ag-(Au)	
Freibergite - $(Cu,Fe,Zn,Ag)_{12}(Sb,As)_4S_{13}$	Boulangerite $Pb_5Sb_4S_{11}$
	Bournonite $PbCuSbS_3$

There appears to be an older 'colloform' (sometimes concentrically zoned with rims of antimony and/or arsenic bearing minerals) pyrite and a younger coarse-grained, cubic pyrite. Sphalerite exhibits amber, brown, and reddish brown colours, a function of the percentages of Hg, Mn, or Fe present. They are either zoned or unzoned. Tetrahedrite also exhibits a textural and chemical zoning.

Gangue mineral assemblages (alteration/hydrothermal products) include:

Mg-chlorite	Sericite/muscovite($\pm$Ba-rich)
Gypsum	Quartz
Celestite	Barite
Dolomite	Calcite
Carbon	

Footwall rhyolite breccia, approximately 80 meters thick, is intensely altered to a muscovite-quartz-pyrite assemblage and sometimes displays a penetrative cleavage (sub-greenschist facies). Mineralization in the footwall is characterized by the association with disseminated and fracture-filled (stockwork) breccia with sphalerite, galena, pyrite and tetrahedrite (and related species) with modest gold and silver tenor. In schistose rhyolite, Au-Ag mineralization occurs as films on cleavage surfaces or as knots and veinlets parallel to schistosity. At depth, as schistosity intensity decreases, mineralization becomes more veinlets and fracture fillings in microbreccia zones which appear to be localized within a series of subparallel structures which obliquely crosscut the trend of Contact-hosted mineralization.

The lower portion of a suspected 'keel' of mineralization in the rhyolite breccia contains an alteration assemblage of Mg-chlorite (with high fluorine), gypsum, minor barite, and celestite. This passes vertically into barian muscovite (approaching ocellarite in composition) and a quartz dominated assemblage (Private Calpine Res. report, July 17,1989). Metallic minerals and alteration minerals are similar to the upper portion except realgar and orpiment are rare to non-existent, and carbon and graphite are absent. Metallic minerals are mainly the tetrahedrite species, sphalerite, galena, wurtzite, and aktashite. The presence of locally high fluorine content in chlorite may be suggestive of an igneous source associated with a hydrothermal system.

Deep in the footwall, in the 'Datum Unit', a second zone of mineralization exists beneath graphitic sedimentary rocks underlying rhyolite. The zone consists of semi-massive to disseminated pyrite, sphalerite, galena, chalcopyrite and tetrahedrite (with gold and silver values) in highly feldspar and quartz altered vesiculated dacite and lithic tuff. This zone was the target of a volcanogenic massive sulphide exploration program by Texasgulf Sulfur in the mid-1970's (see History), based on a 'kuroko-type' model. 'Datum dacite' overlies a variably sulphidic lapilli tuff and is an important and readily recognizable marker.

b) 21B Subzone

The 21B Subzone now comprises the former 'Central' and 'North' sub-zones, now continuously linked by drilling. The former 'Central' subzone is separated by a 140m (460 ft.) area of 'lower' grade mineralization in mudstone and rhyolite northwards along strike from the former 'South' subzone. It contains the most consistent (i.e. continuous) zone of massive sulphide mineralization and is marked by a decrease in arsenopyrite, realgar and stibnite. The 'upper' massive sulphide mineralization (in the form of a 'sheet') has been traced along strike for 900m (2953 ft.), has a range in width between 60m (197 ft.) and 200m (656 ft.), and locally in excess of 40m thick The deposit is displaced on the east by the major northeast-trending Pumphouse Creek fault zone. The subzone is open at depth to the west, along strike to the northeast, and immediately east on the fault-offset portion of the deposit. Associated north-trending splay faults appear to similarly cut and displace mineralization. High grade gold and silver mineralization (including electrum), locally with grades in excess of 35 grams gold per tonne, is associated with tetrahedrite (up to 40%) sphalerite (up to 40%) (predominantly amber in colour), pyrite

(<5%), galena (av.2%), boulangerite (av. 10%), and bournonite (av.10%), hosted in banded massive sulphide intervals, parallel to bedding, ranging from 1.83m (6 ft.) to 10.7m (35 ft.) in thickness. Banding is dominated by the presence of sphalerite. Of note is the abundance of slump structures, graded beds and tuffaceous debris incorporated into sulphide beds within the mudstones which are part of the persistent stratigraphy within the Transition zone of the 21 Zone. The former'Central' subzone contains up to 15% by volume of calcite plus trace celestite. An example of this high grade nature is DDH89-169 which assayed 203.04 grams gold/tonne (5.92 opt), 6565 grams silver/tonne (191.5 opt), 14.08% lead, 6.16% zinc, and 1.8% copper over 11m (36 ft.). Barite, up to 8 to 10 modal %, occurs associated with the upper massive sulphide lenses and host mudstones and has aided with stratigraphic 'positioning'. The gold and silver reporting to electrum occurs primarily as 5 to 80 micron-sized particles, frequently in grain contact with galena. Preferred loci are within fractured sphalerite grains.

In the footwall of the former 'North' subzone, veinlet hosted sulphosalts (tetrahedrite-tennantite), pyrite and minor boulangerite exist over a length of 335m (1100 ft.) and for at least 183m (600 ft.) downdip. This gold-rich zone, hosted by rhyolite breccia, lies approximately 56m (184 ft.) below the upper zone of massive sulphide mineralization. Diamond drill hole No. CA89-109 yielded the following very significant results (George Cross Newsletter, August 22, 1989).

Interval	Length	Gold g/t(opt)	Silver g/t(opt)	Lead %	Zinc %
a) Hanging wall massive sulphide bearing mudstone	3m (9.84 ft)	22.94 (0.67)	1159.0 (33.8)	5.99	16.13
b) Another band of massive sulphide bearing mudstone					
c) 'Contact' mudstone and upper rhyolite unit	61.0m (200 ft)	9.827 (0.29)	29.0 (0.85)	1.8	3.44
d) Rhyolite breccia					
104.0-123.0m (341.1-403.4 ft)	19.0m (62.3 ft)	266.22 (7.765)	46.3 (1.35)	1.63	3.26

Cumulatively, CA89-109 intersected a core length of 208m grading 29.96 grams gold/tonne, 33.2 grams silver/tonne, 2.26% zinc, and 2.12% lead.

The former 'North' subzone is linked along strike to the former 'Central' subzone with dimensions outlined to date of 457m (1500 ft.) in length and up to 9.1m (30 ft.) in thickness. As with the former 'Central' subzone, the former 'North' subzone is marked (from the 21A subzone) by a distinct decrease in arsenopyrite, realgar, and stibnite within the common, persistent host "21 Zone" stratigraphy. The subzone takes a deviation in strike towards the north and appears to plunge gently towards the north. Significantly, massive base metal sulphide intervals, characterized by well-banded and/or deformed sphalerite and minor chalcopyrite-rich bands, containing high gold and silver values, have been intersected in the hangingwall inter-flow mudstone units, as well as in the Contact unit mudstone and underlying rhyolite (cf. Transition zone for former 'Central' and 21B subzones). Gold mineralization occurs as films, wires, and blebs associated with sphalerite with approximately 85% of the gold occurring along grain boundaries. Associated with this type of mineralization is an intense calcite alteration which apparently extends up into the hanging wall andesites. As an example, diamond drill hole 89-143 yielded the following two intervals of massive sulphide mineralization (The Northern Miner, November 13, 1989).

Interval	Length	Gold g/t(opt)	Silver g/t(opt)	Lead %	Zinc %	Copper %
120.0-129.0m	9.0m	10.0	587.3	1.17	1.58	0.17
(393.6-423.1ft)	(29.5ft)	(0.293)	(17.13)			
144.0-148.0m	4.0m	0.55	53.8	0.77	1.26	0.10
(472.3-485.5ft)	(13.1ft)	(0.016)	(1.57)			

Some intervals carry higher grades of copper (eg.DDH89-137:4m (13.1ft) grading 3.7 grams gold/tonne (0.108 opt), 260 grams silver/tonne (7.57 opt), 3.37% lead, 9.73% zinc, and 1.29% copper. In intensely deformed areas, the massive sulphide units exhibit an 'ultra-mylonite' texture with banding defined by chalcopyrite and quartz ± ankerite knots. The Transition breccia mineralization is characterized by fragments of chloritized rhyolite in a sphalerite groundmass. Below these gold-silver bearing massive sulphide lenses in the footwall rhyolite breccia, a zone of intense silica flooding and veining (plus sericite and pyrite) with visible gold exists, associated with disseminated black (Fe-rich) sphalerite, and minor galena, chalcopyrite, and tetrahedrite group minerals (eg. high grade gold section in DDH-89-109). Lower in the stratigraphic section, in the footwall dacite unit, mineralization consisting of native gold and dark coloured sphalerite cuts across rhyolite banding.

MINERAL INVENTORY

A preliminary estimate of 'reserves' for the 21 Zone, prepared by Roscoe, Pottle and Associates on behalf of Prime Res., is shown below. In general, gold assays were uncut, a cut-off grade of 8.57 grams gold/tonne(0.25 opt) was used, a specific gravity of 2.76 was used, and a minimum thickness of 2.0m was selected.

TABLE :

and focussed, both spatially and temporally, into a zone of hydrothermal alteration. The abundance of arsenides and sulphosalts suggests that the system was sulphur poor. Coincident with a shift in magma composition from felsic (footwall) to intermediate (hangingwall) rocks, anoxic marine sediments were deposited into the floundering rifted rhyolite pile. The 'best' mineralization appears to be located within the Contact and/or Transition zones, especially where a vertical, crosscutting hydrothermal system (fault controlled or vent area) encountered reduced conditions at the top of the rhyolite pile. Textures suggest periods of open space growth followed by shearing and/or brecciation. Locally a high degree of shear fabric development (including realgar-rich sections) suggests that the mineralizing event in part accompanied a phase of local deformation. The apparent lack of deformation in the hangingwall andesite unit suggests that either mineralization and deformation preceded its deposition of that this unit is an allochthonous slab that has slid or been thrust into its current location. Evidence from the 21B subzone suggests against the latter possibility.

Early stage fluids were apparently rich in Mg, Si, and arsenopyrite as large volumes of argillite-chert (Transition zone) and the underlying footwall rhyolite unit were apparently replaced by Mg-chlorite producing large volumes of massive Mg- chlorite (with sporadic but significant fluorine content) plus Sb$\pm$Zn$\pm$Pb assemblages.

Intermediate to late stage evolved fluids, characterized by their increase in K, Ba, CO_2 and SO_4, components are suggested by the presence of coarse grained intergrowths of calcite, Mn-dolomite and barite by increasing amounts of silver and mercury-rich components (especially exhibited in compositional zoning on grains of sphalerite and tetrahedrite), and by strong replacement of earlier formed Mg-chlorite by muscovite. Arsenopyrite appears to have been stable in the intermediate stage. Masses of stibnite without a fabric indicates that the fluid system was still active after deformation.

It is tempting to suggest that mineralization observed in the 21B subzone is related to a vent area (especially the former 'North' subzone) and underlying stockwork zone in the rhyolite pile, with the 21A subzone (former 'South' subzone) representing a more distal portion of the mineral deposit setting (eg. kuroko-type model). However, there are still many questions to be answered before the exact nature of this very significant deposit can be determined. Blackwell (1989) has referred to this deposit as the "Eskay Epithermal Exhalative" (EEE) Model.

AGE OF MINERALIZATION

Much has been said earlier about the physical geological constraints on the timing of mineralization. The presence of Pleinsbacian fossils in footwall argillites suggests that the mineralization is upper early to mid-Jurassic in age. Recent in-house (Calpine Resources Inc.) Pb-isotope data also supports an earlier Jurassic age (see lead isotope section).

OTHER ZONES

<u>#22 ZONE (or **Emma Adit Area**) - Incl. #22,#6,and #28 Zones</u>

The #22 Zone occurs approximately 1220m (4000 ft) southwest of the 21 Zone (see Fig.) in a similar geological setting. Erratic mineralization consisting of massive pyrite, sphalerite, galena, and tetrahedrite exists as stratabound lenses, fissure veins and disseminations in sericitic and quartz-veined rhyolite breccia. Mineralization has been traced over a length of 488m (1600 ft) and a width ranging from 4.6m (15 ft) to 6m (20 ft) within which there are two sub-lenses with gold and silver values. One lens has been described as being 15.3m (50 ft) in length and 4.3m (14 ft) in width and grading 5.14 grams gold/tonne (0.15opt) and 388.5 grams silver/tonne (11.33 opt) (Private company report, July 17, 1989).

The overlying contact with the hanging wall pillowed andesite unit has not yet been tested and offers good exploration potential.

Earlier underground exploration programs fell short of reaching the target mineralized zone and subsequent, more recent, exploration programs have been directed at testing local pockets of high grade ore with short angle drill holes. In 1971 a bulk sample shipment of 1.86 tonnes yielded 10.3 grams of gold/tonne and 8194 grams of silver/tonne. In 1979 a shipment of 10.75 tonnes of high grade ore yielded 1392.7 grams of gold/tonne and 28 098 grams of silver/tonne (Private company report, July 17, 1989).

MacKAY ADIT

The MacKAY Adit zone is the southernmost significant zone of mineralization on the Eskay Creek property (See Fig.). It was previously explored and evaluated by trenching, diamond drilling and a 110m (360 ft) adit which failed to reach its objective. The zone is 168m (550 ft) in length and has a width up to 36.6m (120 ft). Host rocks consisting of brittle silicified tuff (rhyolitic), bounded by major shears in argillite, strike 050° and dip to the west. Shear and vein orientations strike at 100° (i.e. crosscut bedding). Moderate to high grade shear (quartz-filled tension gashes) and vein hosted gold-silver mineralization is associated with fine-grained disseminated pyrite and quartz veinlets parallel to foliation and containing galena, sphalerite, and sulphosalts.

Three principal mineral lenses were identified by work performed by Premier Mines:

'X' - 127 ft. (38.7m) long X 11 ft. (3.35m) wide
@ 9.26 g Au/tonne + 42.86g Ag/tonne

'Y' - 75 ft. (22.9m) long X 16 ft. (4.9m) wide
@ 6.17g Au/tonne + 48.34g Ag/tonne

'Z' - 111 ft. (33.8m) long X 26 ft. (7.9m) wide
@ 7.54g Au/tonne + 17.14g Ag/tonne

Apparently, eight additional lenses have also been recognized.

#10 ZONE incl. #4,#7,and #10 Zones

The #10 Zone occurs about 400m north of the MacKAY Adit zone (see Fig.). Low grade gold-silver bearing showings associated with sulphosalts, galena, sphalerite, and pyrite occur in quartz veinlets within the lower footwall rhyolite tuff and breccia unit.

A few hundred metres to the north in a prominent rusty bluff quartz veinlets with sulphides strike 125^{o} and are near vertical. These cut across the trend of the rhyolite-argillite contact at 035^{o} and are interpreted to represent tension gashes. Flatter lying quartz veinlets without sulphides cut across the earlier sulphide-bearing quartz veinlets at right angles.

#5 ZONE

The #5 Zone received the most attention by earlier prospectors (1930's) and subsequent exploration programs (mid-1970's). As we know

now, this zone sits in the footwall rhyolite breccia unit, immediately below the recently discovered and potentially significant economic Transition and/or Contact zones of the 21 Zone. As early as 1936 the occurrence of realgar float in blue clay was noted by Premier Mines. Mineralization consists of disseminated and fissure-vein type tetrahedrite, galena, and sphalerite with low to moderate gold and silver values hosted by footwall rhyolite breccia.

#23 ZONE

Disseminated and fissure-vein type gold-silver mineralization, associated with galena, sphalerite and minor antimony and arsenic bearing minerals is hosted by footwall rhyolite breccia. Alteration assemblages are predominated by muscovite and silica.

PORPHYRY ZONE

The porphyry zone lies east of the #5 and #23 zones (see Fig.). Evidence of previous work in the area includes numerous small hand dug trenches, and at least one short old adit. Low grade gold-silver values are associated with disseminated chalcopyrite, galena, sphalerite, tetrahedrite, and pyrite (up to 15% by volume) hosted in a crowded porphyry of possible dioritic to monzonitic composition near the contact with argillite. Locally the porphyry has been silicified and also contains large coarse (up to 3cm in length) laths of feldspar. The significance of this zone both locally and regionally is yet to be determined, but may offer an important clue as to the geologic setting and evolving hydrothermal/volcanic 'package'.

SURFACE SAMPLING

Numerous grab samples from many of the surface showings were collected by Schroeter in September, 1989, and the resulting assays are presented in Table . The location of the zones are shown in Fig. .

TS:JB