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Mining District File Summary Sheet

DISTRICT	Rosebud
DIST_NO	4010
COUNTY If different from written on document	Pershing
TITLE If not obvious	Rosebud - File of documents about geology, stratigraphy, and geochemistry
AUTHOR	Turner, S.J.; Moore S; Brady M; Clayton R; Muerhoff, C;
DATE OF DOC(S)	1995 - 1997
MULTI_DIST Y / (N?) Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Dreamland prospect; Rosebud Project; South Zone; North Zone; East Zone Lac Minerals; Santa Fe; Hecla Mining Co
COMMODITY If not obvious	gold; silver
NOTES	Geology; geochemistry; stratigraphy; map handwritten notes; stratigraphic columns, assay; resources; list of minerals; geologic map; cross section 34 p.

Keep docs at about 250 pages if no oversized maps attached
(for every 1 oversized page (>11x17) with text reduce
the amount of pages by ~25)

Revised: 1/22/08

	Initials	Date
SS:	DD	9/9/08
DB:		
SCANNED:		

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* needs re-formatting

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PROPOSED STRATIGRAPHIC NOMENCLATURE FOR THE ROSEBUD DISTRICT

Introduction

Stratigraphic nomenclature at Rosebud has evolved through several different companies and mapping programs. Government geological maps have not subdivided the Kamma Mountain Volcanic Group, so the formations and units are used in an informal sense. The usual protocol for stratigraphic naming is to continue using early subdivisions, unless these are not clearly defined or the names are not reasonable for the rock types included. At Rosebud, earlier subdivisions were not always well defined, and some names are incorrect i.e., Lower Bud Tuff for the Mine Host sequence of ?trachytic flows and breccias. Rock compositions are also not clearly or consistently defined from the available petrographic work. Hence, different nomenclature has been used for the same stratigraphic units (Fig. 1).

Following are comments on each of the main units recognized from the Rosebud Canyon - South Ridge section, with recommendations for changes. These are proposed to provide a reasonable stratigraphic framework for both exploration and mine geology.

Auld Lang Syne Group (JT a)

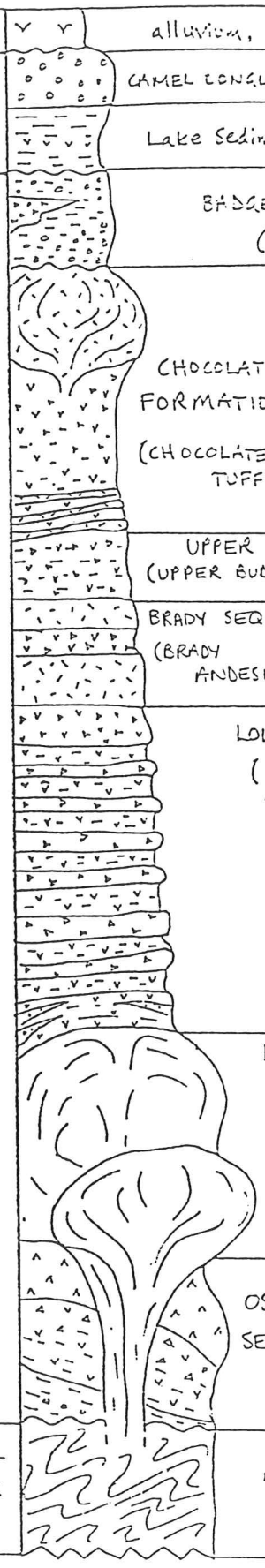
This basal sequence of deformed metasedimentary rocks underlies the Kamma Mountain Volcanic Group. The contact is commonly faulted. Fragments of these rocks are distinctive, and are recognized as clasts in the Lower Bud Tuff.

Oscar Sequence (Tos)

A sequence of andesitic to basaltic andesitic flows and breccias, locally underlain by tuffaceous sedimentary rocks intercalated with pebble conglomerate. These sedimentary rocks have been termed Tcs (Basal Tertiary Sediments) where encountered in drill holes. Walck et al. (1993) originally described these sediments as the lower part of the Oscar Sequence, and it is recommended that this be continued.

Petrographically, the rocks are vesicular, probable hornblende andesitic flows (phenocrysts ; ~8% plagioclase, 4-5% mafic minerals / hornblende). Alteration is

FIGURE 1 : ROSEBUD CANYON STRATIGRAPHIC SECTION

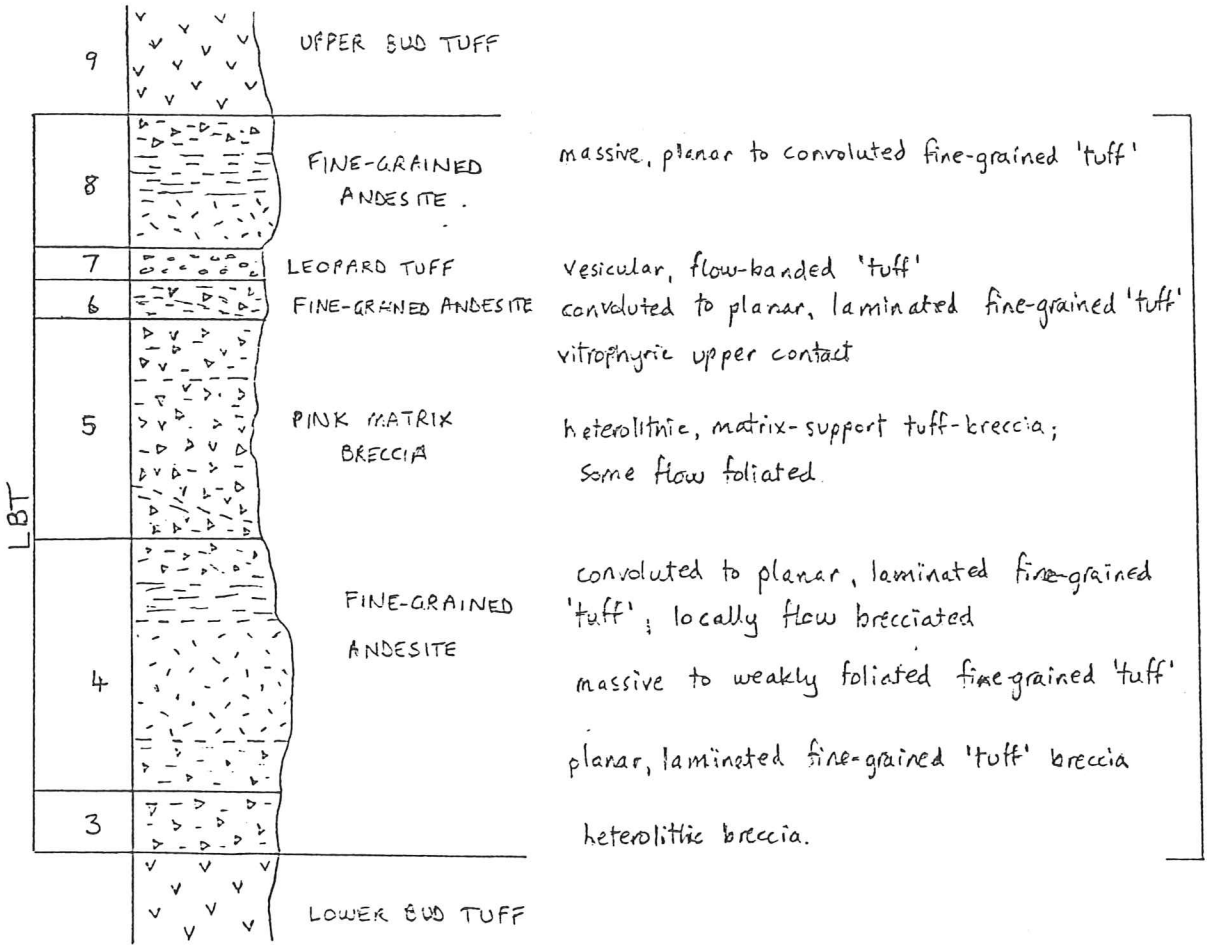


			SYMBOLS	SCALE 1" = 500'
QUATERNARY	alluvium, colluvium		Qal	alluvial gravels with placer Au
TERTIARY (MIOCENE) — KAMMA MOUNTAIN VOLCANIC GROUP	CAMEL CONGLOMERATE	SULFUR GROUP	Tsc	conglomerate and scree breccia 40 to +250'
	Lake Sediments	SULFUR GROUP	Ts	volcanic ash and lacustrine sediments : to 2000'
	BADGER FORMATION (GATOR)		Tb	hematitic volcaniclastic and conglomeratic breccias - red silty matrix 900-1000'
	CHOCOLATE FORMATION (CHOCOLATE TUFF)	Chocolate Flow	Tc	flow banded, sparsely porphyritic latitic flow - local eruptive center +300'
		Chocolate Tuff	Tc	non-welded lithic tuffs +300'
		Marker Porphyries	Tc	glomeroporphyritic flows or sills +125'
	UPPER BUD SEQUENCE (UPPER BUD TUFF, UPPER SURGE)		Tbs_1	well-bedded lithic tuff-breccias graded bedding +150'
	BRADY SEQUENCE (BRADY ANDESITE)	see MINE HOST SEQUENCE	Ta	fine-grained flow, planar flow 90' laminations - intervening lithic 26' tuff-breccia 185'
	LOWER BUD SEQUENCE (LOWER BUD TUFF; LOWER SURGE; OSCAR SEDIMENTS; WILD ROSE)		Tbs_2	heterolithic, well-bedded lithic tuff-breccias and volcaniclastic units with reverse and normal grading - includes fragments of the Auld Lang Syne Group and clasts of Dozer towards the base. +1000'
	DOZER RHYOLITE DOZER FORMATION (EQUIVALENT TO 'BROWN FLOW' OR WILD ROSE FLOW DOMES)		Td	flow banded, locally vesicular probable exogenous rhyolite flow dome(s) with significant relief on its upper surface. - upper flow laminated zone. 250-1800'
	OSCAR SEQUENCE	OSCAR ANDESITE	Tos	andesitic flows, generally fine-grained with flow breccias and tuffs (?)
		Basal Tertiary Sediments	Tcs	carbonaceous sandstone, siltstone and pebble conglomerate 0-100'
JURASSIC-TRIASSIC	AULD LANG SYNE GROUP		JTa	deformed, dark grey metasediments - graphitic slate, phyllite, quartzite, hornfels.

NOTES : 1. selected compilation of previous descriptions with alternate unit names shown in brackets. Recommended new terminology is highlighted.

2. Thicknesses for the upper Dozer to the Chocolate Fm. are from a measured section on South Ridge; other thicknesses are schematic only.

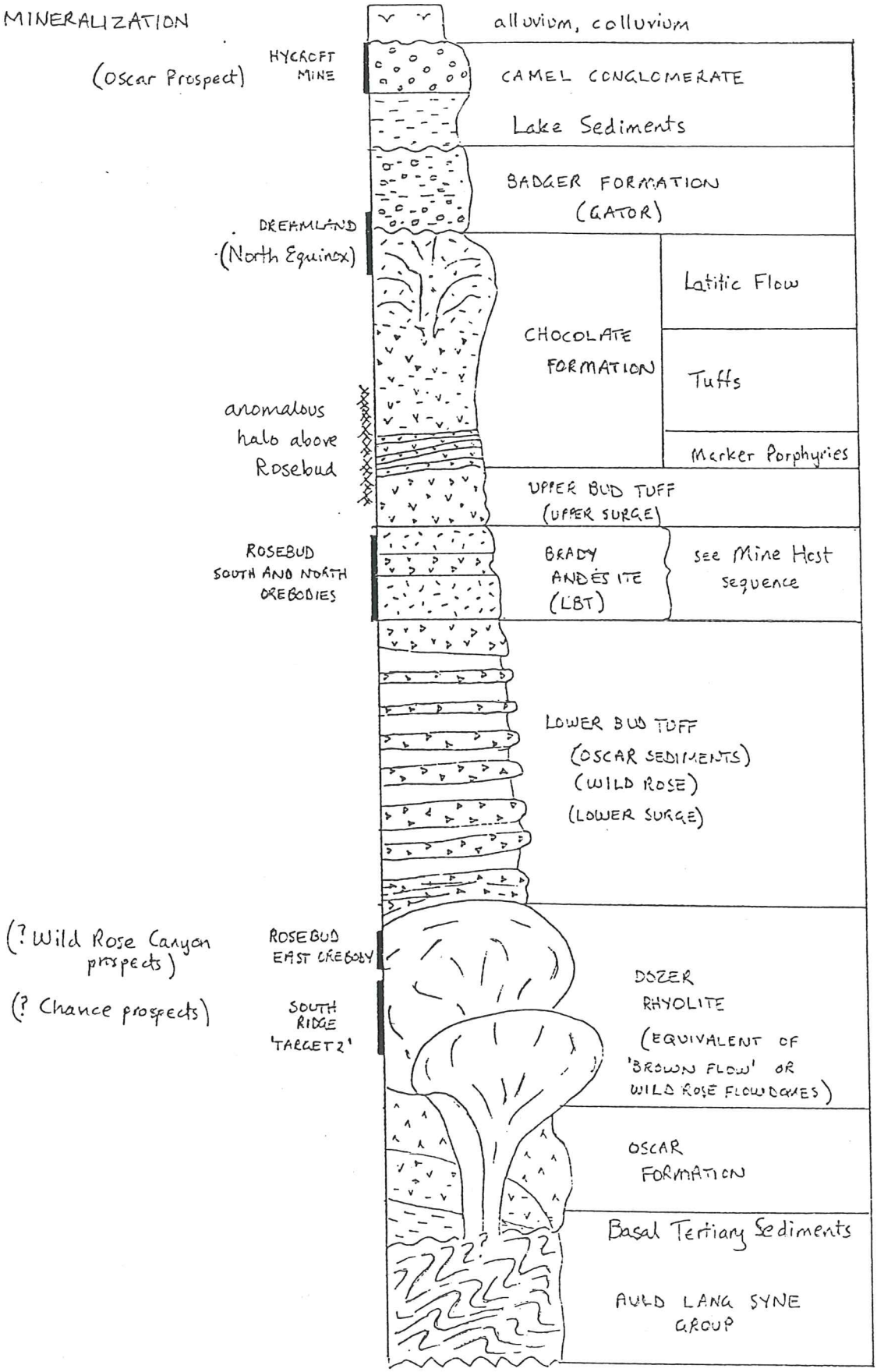
FIGURE 2 : MINE HOST SEQUENCE



NOTES :

1. The symbol LBT (Lower Bud Tuff) for the Mine Host sequence is an old term, which is now confusing and should be discontinued.
2. Similarly the descriptions and symbols within the Mine Host sequence refer to fine-grained tuff, whereas the general consensus is that these units are flows, or possibly sills. The symbols and references to tuff (apart from the pink-matrix breccia) should be changed.
3. The exploration group would equate the Mine Host sequence with the Brady Andesite (Ta), whereas there is conjecture from the mine geologists that the Mine Host may correlate with the upper Dozer. My observations are that the exploration correlation is a more comfortable fit and would recommend that this be adopted unless new evidence comes to light.

FIGURE 3 : MINERALIZED INTERVALS IN THE ROSEBUD STRATIGRAPHY



typically propylitic with an assemblage of chlorite - epidote - carbonate - hematite - chert.

Dozer Rhyolitic Dome (Td)

The lower, and several upper contacts of the Dozer unit were carefully examined in the field on South Ridge. At the lower contact with the Oscar Sequence a narrow, 3 - 5' rhyolitic dike with chilled margins clearly cuts a dark, fine-grained flow and extends as a feeder to the Dozer Rhyolite. A second, possible major feeder dike has a weakly sheared and brecciated southern margin. In contrast, the upper contact is not intrusive. This contact is sharp but irregular and locally shows considerable paleo-relief, as noted by Walck et al. (1993). Well-bedded volcaniclastic units infill this irregular contact, with considerable variations in thickness, and stratigraphic pinch outs against the original dome margins. The unusual outcrop pattern of Dozer and Lower Bud Tuff mapped on the southern side of South Ridge is therefore attributed to paleo-topography. Fragments of Dozer are present in the lowermost volcaniclastic beds overlying the dome.

The Dozer Rhyolite Dome may be subdivided into a lower, more massive fine- to slightly coarser-grained unit, and an upper strongly flow laminated unit succeeded by a zone of coarse, rounded lithophysae up to 5" in diameter. These lithophysae have been infilled with chalcedonic to crystalline quartz, manganiferous carbonate and clays. The upper part of the dome is strongly auto-brecciated (all Dozer clasts), and in places is altered to chalcedonic and jasperoidal silica, carbonate and green clays. This alteration is thought to be early, and may be related emplacement of the dome into a shallow subaqueous environment. The lithophysae are consistent with this interpretation. Rockchip samples are not anomalous for Au in this area.

Phenocrysts are very sparse in the Dozer, and compositionally it has been described as rhyolitic, andesitic or latitic. Trace sanidine, 1% plagioclase and up to 3% mafic minerals have been recognized.

Whereas the Dozer at this location does not exhibit intrusive relationships, equivalent units (the Wild Rose flow domes) are not necessarily extrusive, and their contact relationships would need to be examined separately.

Lower Bud Tuff (Tbs_1)

This is a well-bedded sequence of volcaniclastic deposits and breccias which are typically heterolithic, planar bedded, locally with both reverse and normal grading. The matrix is commonly either a bright green clay which was described by Walck et al. (1993) as a mixture of celadonite and glauconite, or hematitic. These have been interpreted as base surge deposits, however, the heterolithic clast content, the graded bedding and lack of cross bedding and scour or channel structures is not typical of a base surge origin. A base surge should also mantle the original topography of the Dozer dome, rather than exhibit the stratigraphic pinch outs described. They are more likely to be subaqueous volcaniclastic debris flow units, similar to those described by McPhie et al. (1993; p.150). The presence of glauconite supports a subaqueous origin. Both glauconite and celadonite are probably products of deuteric alteration, and not a later hydrothermal overprint.

The term 'base surge' is not recommended, and while Lower Bud Tuff may be an acceptable exploration term, Lower Bud Sequence may be better (the symbol Tbs would remain the same).

Brady Andesite or Mine Host Sequence (Ta)

Field evidence supports this sequence as that which hosts the Au mineralization in the South and North orebodies at Rosebud, although the mine geologists do not agree (Fig. 2). It comprises at least two fine-grained, probable flows separated by volcanic breccia. Petrographically it is described as having a trachytic texture but the composition is uncertain. It is darker in outcrop than the Dozer Rhyolite and has therefore been interpreted to be andesitic, although other characteristics are very similar to the Dozer i.e., strong platy flow laminations, local vesicularity and diffuse spherulites derived from devitrification of a glassy rock. Some of these characteristics were also observed in the mine exposures. In the mine the intervening volcanic breccia is termed the 'pink-matrix breccia'.

Petrographically, this unit has a more distinct phenocryst population than the Dozer, with 1-3% sanidine, up to 3% plagioclase, 2-3% biotite, and 1-5% mafic minerals / needle-like hornblende. It has been variably defined as a latite, trachyte, andesite or even a basalt. In some samples k-feldspar was estimated to be greater than plagioclase, and in others vice versa.

LBT should be discontinued as a term for this sequence. It is recommended that Mine Host Sequence or Brady Sequence be used instead, avoiding 'andesite' until the composition can be better determined.

Upper Bud Tuff (Tbs_2)

This sequence is similar to the Lower Bud Tuff, but the heterolithic breccias lack fragments of Auld Lang Syne, which were present in the lower sequence. A similar origin as subaqueous debris flows is also suggested.

It is recommended that this unit be renamed the Upper Bud Sequence.

Chocolate Formation (Tc)

This is a sequence of flows and volcanic lithic tuff-breccias, with a distinctive brown, hematitic appearance where alteration is minimal. The upper contact with the Upper Bud Tuff has been placed either at uppermost 'green tuff' or 'surge' horizon, or the lowest glomeroporphyitic flow or sill unit (termed the Marker Porphyries). The Marker Porphyries should probably be used to denote the basal Chocolate Formation, and a broad subdivision into Marker Porphyries, Chocolate Tuffs and upper Chocolate Flow is reasonable based on field exposures. The Chocolate Tuffs are poorly exposed but appear to be lithic tuff-breccias, and auto-brecciated flows. On Big Chocolate Hill there is a flow banded, vesiculated latitic flow which apears to define a local eruptive center.

Petrographically, the flow unit is most consistently defined as latitic, or quartz latitic, with 10 - 15% plagioclase, trace sanidine, 3% biotite, 4% mafic minerals and rare resorbed quartz. The groundmass is coarser textured than other units.

Badger Formation (Tb)

Above the Chococlate Flow is a fragmental unit composed almost entirely of fragments of the Chocolate flow. This could equally well be designated as uppermost Chocolate Formation or lowermost Badger Formation. The Badger is a widespread volcaniclastic to conglomeratic breccia with a distinctive oxidized reddish brown matrix. It has been interpreted as a fanglomerate deposit, and this seems reasonable.

Both the Chocolate and Badger have been termed formations, and there is

probably sufficient exposure to define a reference section, so this usage is reasonable, even though a formal reference section has not been defined. Gator is a poorly defined unit which is presumably at the same stratigraphic level as the Badger Formation. It is recommended that it be considered part of the Badger Formation.

Post-Badger Sequences

The Lake Sediments and Tertiary Fanglomerate mapped by Mike Brady at, and to the west of the Oscar Prospect are probably part of the Sulfur Group (Wallace and Friberg, -), which are the host rocks to the Hycroft mine. The Tertiary Fanglomerate is probably equivalent to the Camel Conglomerate member.

It is recommended that the Sulfur Group stratigraphic equivalents be adopted, if they can be reasonably correlated.

General Comments

1. the volcanic stratigraphy exhibits variations in facies and thickness of units along strike, so the section described will differ at Wildrose and other locations. Thicknesses of individual units have been used to decide where a stratigraphic contact should be in a drill hole. This may 'force' contacts where the variation is simply due to changes in volcanic facies. Mike Brady noted that the dip of bedding is commonly steeper on the ridges than on the sides of the valleys. This may be explained in that the centers of volcanic activity have been preferentially preserved on the ridges, with steeper original dips than the more distal volcanic units.

2. there does not appear to be a stratigraphic horizon that is more consistently mineralized than another (Fig. 3). There are more favorable stratigraphic units, but these only become important where they are intersected by mineralizing structures.

References

McPhie, J., Doyle, M., and Allen, R., 1993. *Volcanic Textures : A guide to the interpretation of textures in volcanic rocks.* Center for Ore Deposit and Exploration Studies, University of Tasmania.

Walck, C.M., Bennett, R.E., Kuhl, T.O., and Kenner, K.L., 1993. Discovery and geology of gold mineralization at the Rosebud Project, Pershing County, Nevada. SME Annual Meeting, Reno, NV, Feb. 15 - 18, 1993, Preprint No. 93-175.

Wallace, A., and Friberg, R.S., -. Sulphur Mining District : Geology and mineral deposits of the Sulphur Mining District, Humboldt County and Pershing County, Nevada.

PRELIMINARY

Some figures to be added.
- needs re-formatting

ROSEBUD PROPERTY, PERSHING COUNTY, NEVADA : TECHNICAL ASSESSMENT

JUNE, 1997

S.J. Turner

From Steve Turner
@
Newmont

Summary and Recommendations

Rosebud is a 0.5 Moz high-grade, free-milling structurally-controlled stockwork, low-sulfidation Au-Ag deposit. There is good potential to incrementally add to the current reserve, and increase the district resource to over 1 Moz Au. And there is the possibility of discovering a larger bonanza-type Au system at depth.

The impetus of exploration has been lost from the time that Santa Fe Pacific Gold acquired their interest from Lac Minerals in August, 1996, mainly as a result of the uncertainty of the Homestake and Newmont bids. That exploration has continued is largely due to the efforts of Hecla, but it has resulted in a disjointed, and probably ineffectual program. A hiatus in exploration is probably warranted after the completion of the current program, to allow Randy Vance to become fully conversant with the database and to set up a systematic exploration program.

The type of exploration needed to explore for such targets is different to larger tonnage deposits, and requires highly focussed and multi-disciplinary exploration, with a reasonable drill budget. The experience gained at Rosebud will potentially be important for assisting with exploration on other structurally-controlled, volcanic-hosted high-grade systems, such as Seven Troughs. While Rosebud in itself is not a Newmont-size deposit, exploration for highly profitable bonanza deposits such as Hishikari should be targets.

The following recommendations are made for exploration in the Rosebud district :

i. more communication and discussion is needed with the Hecla mine geologists, including some consensus on stratigraphic nomenclature.

ii. prospects within range for drifting from the Rosebud mine (+- 6,000'), are a higher exploration priority than other targets.

iii. an improved structural model is needed for the North Dozer block, including the Rosebud mine, and the district.

iv. apart from Au, Se is probably the best pathfinder element to locate high-grade zones. Barium, As, Sb and Hg are also anomalous, but more erratic; Cu and Zn are anomalous at deeper levels in the Rosebud deposit.

v. it will be important to integrate geophysical data into the geological framework for the district, to assist with target definition.

vi. further drill testing is needed on altered, geochemically anomalous structures, rather than drilling more conceptual targets.

vii. there is evidence that some previous RC drilling may have severely diluted narrow, high-grade intercepts, e.g. an RC hole adjacent to the pilot hole for the vent shaft returned only 0.02 opt assays. The extent of this problem needs to be ascertained.

viii. it is recommended that selected alteration samples, representing varying distances from ore zones be submitted to NMS for XRD identification, and then these be compared to results from the PIMA.

ix. I found the petrographic work by T. Pasteur to be somewhat confusing and inconsistent, particularly in the application of rock compositions. This is partly due to the fine-grained, vitrophyric nature of most of the units, and sparcity of phenocrysts. Whole rock analyses on fresher rock samples would probably be the best means of determining actual rock compositions.

Introduction

A 3 week technical assessment was completed on the Rosebud property, which recently came into the Newmont portfolio as a result of the Santa Fe deal. Rosebud is a small, high-grade Au-Ag mine operated by Hecla Mining Co., and in a 50:50 joint

venture, now with Newmont. Newmont will be responsible for district exploration outside of the immediate mine environs.

The purpose of this assessment has been to examine the previous exploration work on the property, review the volcanic stratigraphy and geological mapping, and rank the exploration potential of prospects within the 23 m^2 of the JV property. This review was coordinated to coincide with a familiarization trip by Randy Vance. The review was greatly assisted by the input of Mike Brady (contract geologist responsible for geological mapping and data collation on the Rosebud property), Bob Kastelic (geologist looking after the current exploration program), Holly MacLachlan (contract geologist on logging), Ron Clayton (Mine Manager), Charlie Muerhoff (Chief Geologist for the Rosebud mine), Kurt Allen (Senior Mine Geologist, conducted an underground tour for us).

The Rosebud mine comprises a cluster of small orebodies, the South, North and East zones, with a combined reserve of 1.3Mt @ 0.39 opt Au and 2.7 opt Ag (507,000 oz Au), which is being mined at an average rate of ~750 tpd. The South and North orebodies appear to plunge NE along the line of intersection between a major footwall fault and a favourable stratigraphic sequence of flows and breccias. The East orebody occurs in the Dozer Rhyolite, in the footwall to the fault. There is an immediate need to add reserves to counter depletion, and to extend the mine life. The potential for further discoveries is highlighted by the intersections made in the pilot hole for a ventilation shaft, i.e. 10' @ 0.948 opt (715-725') and 15' @ 0.202 opt Au (775-790').

In this brief review, several possible interpretations of the structural setting and stratigraphic controls were evident. The mine mapping is very detailed and has provided a very good basis for understanding the local controls on mineralization, but some of the interpretations are difficult to reconcile with surface mapping.

Volcanic Stratigraphy and Setting

As a result of several generations of geological mapping and successive companies, the stratigraphic nomenclature is confusing, and in some cases, incorrect. This has been addressed in a separate memo, attached to this report.

Although the Mine Host Sequence has clearly been an important control in the location of the Rosebud orebodies, it is not the only stratigraphic level at which significant mineralization is found. Mineralization occurs throughout the stratigraphy,

with high-grade Au in fractures in the lower part of the Dozer Rhyolite, a recent sample with 1 opt Au in a narrow shear in the Badger Formation above the Dreamland prospect, and bulk mineable low-grade Au in the Sulfur Group sediments. Gold mineralization is not intimately associated with the various flow domes recognized within the volcanic rocks (i.e. not synchronous). Structure is the pre-eminent control, and should be the primary focus of exploration, with a secondary emphasis on favourable units anywhere within the stratigraphy. Favourable units include recognition of possible aquitards, as well as porous breccias and fractured fine-grained flows.

Structural Regime

Structure plays an important role at Rosebud. Initial discovery drill holes were drilled to intersect the South Ridge fault, a silicified and geochemically anomalous oblique left-lateral, and listric dip slip fault. It has generally been assumed that the low-angle structure in the footwall to the South and North orebodies is the same fault plane. However, there are several other interpretations (Fig. -). Mike Brady plotted structural contours for both the South Ridge, and the footwall faults, and these have very different strikes and contour intervals that are difficult to reconcile with being the same structure.

Further work needs to be done on this problem. My preliminary observations would be that the South Ridge Fault is a splay of the Rosebud Shear, forming a negative flower structure (i.e. a consistent dip slip, normal component of movement towards the main shear). The footwall fault may be an earlier structure that has been dilated during subsequent oblique strike slip movement on the Rosebud Shear.

Figure - diagrammatically illustrates a semi-circular zone of fault splays around the Rosebud Shear, with a negative flower structure. This may explain the apparent change in strike of the Badger Formation along the Rosebud Shear. Dip slip striae on faults at Dreamland and White Alps also appear to consistently indicate downthrow towards the main Rosebud Shear.

The ENE-trending Rosebud Shear is evidently a long-lived and important structure. It has probably controlled fluid flow for the mineralization, but has also had some post-mineral movement. Two scenarios are possible :

1. mineralization is late-stage and post-dates displacement of the Range Front fault to the west of Rosebud. This is estimated at ~6,000' for displacement of the

Range Front fault, and 1,600' east of Dozer Hill (M.Brady, 1995), implying a scissor type of movement. There is some evidence that alteration and geochemical anomalies may extend from the Rosebud mine area across the Rosebud Shear without apparent offset. IP anomalies can also be traced across the shear zone. Such a young age would be consistent with the the age of the Hycroft mineralization (~1.9 Ma).

2. if the age of adularia from the Rosebud mine (~16 Ma) is accepted as the age of mineralization, then it must be accepted that any potential extensions of Rosebud orebodies across the shear have been substantially offset left-laterally, and downthrown to the north.

Steve Moore (for Lac Minerals), and Mike Brady (for Santa Fe) have tried to determine age relationships on the major structures. Field mapping shows evidence for ~N-S trending, W-dipping listric normal faults that locally repeat sections of the stratigraphy. The Kamma Fault in the east is such a fault, and juxtaposes the youngest volcanic unit, the Badger Formation, against basement rocks of the Auld Lang Syne Group. Intersections of the Auld Lang Syne rocks beneath the volcanic sequence are surprisingly shallow, and consistently at about 1,500 to 2,000' depth. This suggests the presence of a detachment fault (Fig. -).

Mineralized ~E - W structures (e.g. South Ridge Fault, Dreamland structure and the Chance - North Equinox zone of alteration) may be Riedel shears from earlier movement on the Rosebud Shear, and another ENE- structure in the vicinity of Wild Rose Canyon (evident from discontinuities in geophysical data).

It has also been noted that the Rosebud, Dreamland and Hycroft orebodies are aligned in N10-20W direction. Mapping in rocks of the Auld Lang Syne Group at Scossa, SE of Rosebud suggest the presence of an anticlinal structure in the basement that may coincide with this alignment. There is some evidence for gentle arching of the volcanic stratigraphy along this trend.

In the satellite imagery there is a suggestion of a series of ring structures in the volcanic rocks, and mineralization at Rosebud and Dreamland appears to coincide with this structure. This feature cannot be related to the primary volcanic setting, i.e., it cannot be a caldera or similar structure, because these rocks have been tilted and

substantially faulted since their eruption. It could possibly be related to an intrusion at depth although the areomagnetic signature does not support this. I would suggest that the semi-circular structures on the north side of the Rosebud Shear are related to the fault, as previously described.

Alteration and Mineralization

Rosebud is a structurally-controlled, stockwork lode-type, low-sulfidation Au-Ag deposit with free-milling sulfide ore. Several stages of alteration and mineralization have been recognized. The alteration and mineralization zoning are schematically shown in Figure -.

There are early alteration assemblages, which may coincide with inital eruption of volcanic units in a sub-aqueous environment, e.g., the green clay component of the Tbs units is probably due to deuteric alteration of volcanic glass. Similarly some of the chalcedonic silica, Fe-Mn carbonate, and zeolitic alteration are likewise early.

The ore zone is characterized by a fine stockwork of chalcedonic silica - sulfide - clay - (barite) in a clay-rich matrix (illite - smectite - kaolinite), which grades out to bleached wallrock with chloritic fractures. This is typical of the pink-matrix breccia, although locally the wallrocks are more competent and siliceous with a pinkish coloration either due to finely disseminated hematite, or k-feldspar flooding. This is more common where the wallrocks are Dozer Rhyolite. Mineralization in footwall has been described as more silicified, but this is probably due to a more silicic wall rock, the Dozer Rhyolite.

A PIMA IR unit has been used by exploration to identify clay types, but the data to date appears to be confusing. Phoebe Hauff of Spectral International, Inc. is an expert on the interpretation of the spectral patterns, and has been used by Newmont (Dave Coulter) and Santa Fe. Her interpretations of the Rosebud clays appeared uncertain, which may reflect unusual mixtures of clays, or possibly some unexpected clay species. It is recommended that this be looked at, possibly in conjunction with some XRD determinations by NMS. There has been a convention in logging that all green rocks are propylitic alteration, whereas much of the greenish coloration is due to

smectitic clays. Chlorite is generally restricted to fracture selvages, and true propylitic alteration is uncommon.

The mine geologists equate density of stockwork veins (veins typically <0.5" wide), with grade in the ore zones. These stockwork veinlets appear to locally trangress alteration types, i.e. they may extend out into the chloritic halo. It is evident from summary logging of several drill holes (96-373 and 97-379), that some zones of stockwork veins can be barren of Au, although they may appear similar to those in the ore zones. Bladed marcasite is commonly present in these veins, but it was noted that in the ore zones the marcasite has been replaced by fine pyrite, but retains the bladed form. Other grey sulfides ?Ag sulfosalts, also appear to locally replace the marcasite. This replacement texture may distinguish barren from Au-bearing stockworks.

Carbonate veining is ubiquitous in the ore zones, and may be pre-, syn- or post-mineral. According to the mine geologists Fe-Mn carbonates are more commonly associated with the ore zones whereas calcitic veins are post-mineral. Barite, kaolinite and stibnite are also late-stage, and not necessarily part of the ore zone.

The Au occurs as fine electrum associated with a range of other sulfides, many Ag-bearing; pyrargyrite, miargyrite, stylotypite, proustite, polybasite, naumannite, aguilarite, acanthite, native Ag, arsenopyrite, chalcopyrite, sphalerite, galena, pyrrhotite, tetrahedrite - tennantite, freibergite, marcasite and pyrite. These are mostly very fine and difficult to recognize in hand specimen, and the overall sulfide content is low (<3%).

Geochemically, the ore is characterized by high Ag values, anomalous but erratic Sb, Ba and Hg, Cu (Zn) in the deeper ore zones, and Se. Arsenic is anomalous but is surprisingly low-order. For exploration the most consistent pathfinder element is probably Se, although this has not been consistently included in analyses. Selenium is an element commonly associated with many bonanza-type Au-Ag deposits e.g., Hishikari in Japan, Lebong Donok in Indonesia, Republic district in Washington, and Sleeper and Midas in Nevada.

Exploration Targets, Potential and Priorities

The best exploration potential in the district is undoubtably for similar mineralization to the Rosebud mine, i.e., small to moderate size high-grade ore shoots.

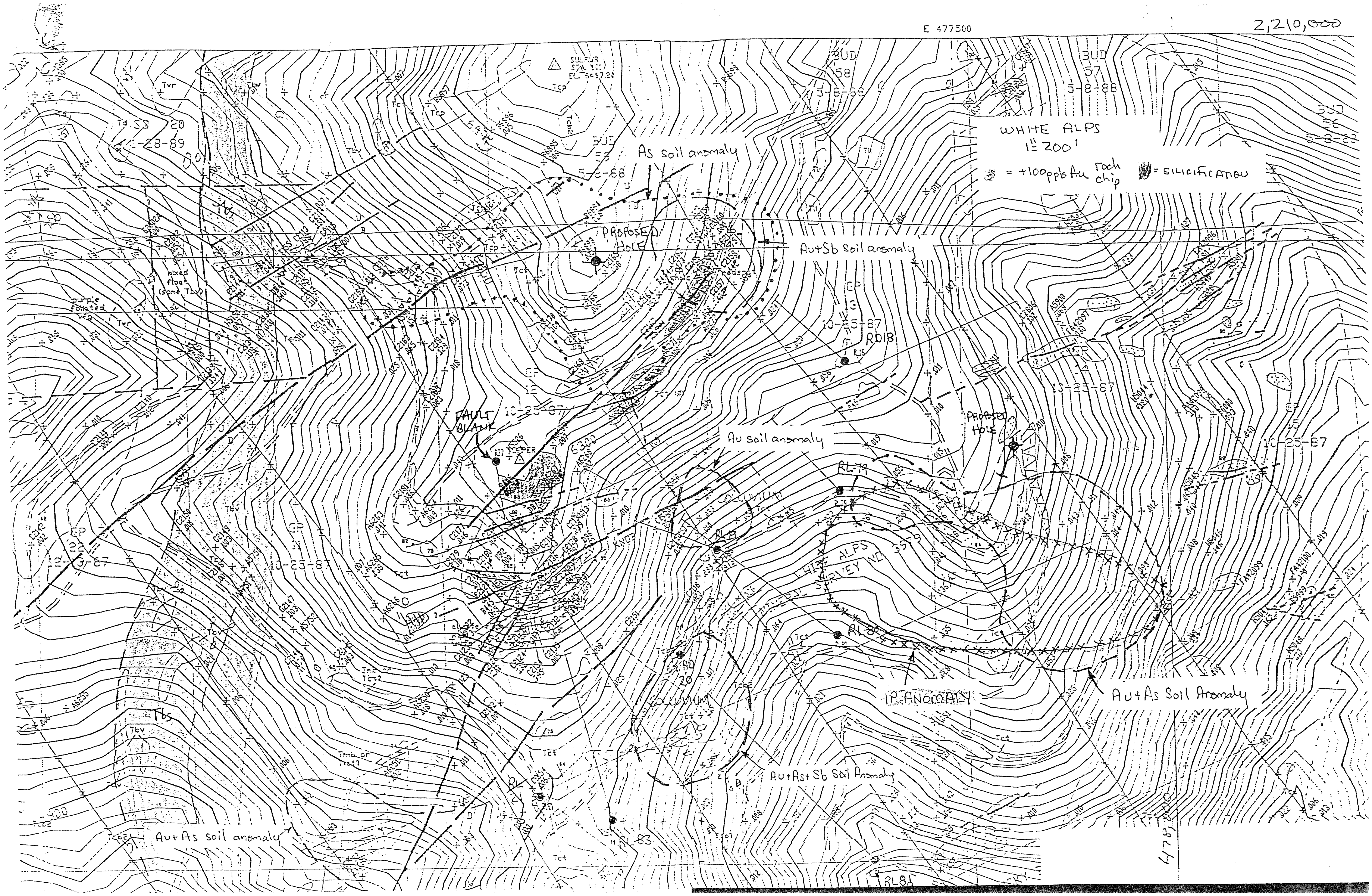
Potential for near-surface, open pittable Au mineralization has been well tested by previous exploration, and only the Oscar prospect (see below), had any real hope.

Exploration for high-grade, structurally-controlled deposits is very different to much of the CarlinTrend type of exploration, although it is akin to the Deep Star and High Desert targets. Exploration is expensive and highly focussed, but in the Rosebud district has the potential for high-grade, free-milling ore.

Because many of the targets are probably deep, relatively small and irregular in shape, ore-grade intercepts are uncommon, and definition drilling expensive. Within the immediate mine environs, such intercepts are best followed up by underground drifting and drilling. Unfortunately this means that it is difficult to add substantially to reserves ahead of mining, and a balance must be found between sufficient drilling to have confidence in outlining a new ore shoot, and proceeding with drifting (as has been noted by J.M. Rendu).

Ron Clayton (Mine Manager) and Charlie Muerhoff (Chief Geologist) at Rosebud have indicated that they would be willing to drift out to a maximum of about 6,000' from the existing mine workings on the basis of 3 or 4 drill intercepts that showed the potential for a new ore shoot to host at least 200,000 to 300,000 ozs, i.e. some evidence of geological continuity would need to be demonstrated. Other factors such as the depth of new mineralization and ground conditions would need to be taken into account. However, this 6,000' radius (shown on accompanying map) provides a basis for assigning priorities for exploration. Prospects within this radius would take precedence over outside prospects in locating more ore for the current mine operations.

At first inspection it appeared that many of the dozen or so outside prospects in the Rosebud district had been well tested with previous drilling by Asarco, Homestake, Freeport (1985-86), St Joe (1981-82), USMX (1988-89), Lac Minerals (1988-94) and Hecla Mining (1994-present). However, all this drilling was shallow RC and generally targetted at shallow open pittable mineralization. In many cases the mineralized structures have not been tested at all. For example, at White Alps a silicified breccia zone about 100' wide and 1,200' long, with anomalous rockchip values, has not been tested by a single drill hole (Figure -). The only hole that had a chance (RB7) hit a fault blank. Most of the previous drilling was on the footwall side of the structure which is



E 477500
2,210,000
WHITE ALPS
1" = 200'
= +100 ppb Au rock chip
= silicification
SULFUR STA. 1C1 EL. 6457.26
As soil anomaly
Au+Sb Soil anomaly
PROPOSED HOLE
BUD 58 5-8-88
BUD 57 5-8-88
BUD 53 5-8-88
GP 3 10-25-87
RD18
GP 12 10-25-87
GP 11 10-25-87
GP 23 12-3-87
10-25-87
FAULT BLANK
Au soil anomaly
PROPOSED HOLE
AL-19
AL-8
AL-18
RD 20
WHITE ALPS SURVEY NO. 3559
mixed float (some Tbv)
purple foliated
COLLUVIUM
IP ANOMALY
Au+As Soil Anomaly
Au+As+Sb Soil Anomaly
Au+As soil anomaly
AL-83
RL81
Tbs
Tbv
Tct
Tcp
Tvr
6300

either vertical or dips steeply NW. A similar situation is evident for the Dreamland, North Equinox, Degerstrom, Short Shot and possibly Chance prospects.

Targetting of the small high-grade pods must be based on smart vectoring using our knowledge of altered structures, favourable stratigraphy, geochemical trends and geophysical techniques. I would recommend at least one shallower drill hole in a fence of drilling into an altered structure to assist with vectoring.

I understand that some of the current drilling (e.g. Dreamland) has been based on targetting a certain depth below 'shallow' level features such as chalcedonic silica, to intersect the bonanza zone, i.e. it must be deep. From my experience there is no 'normal' depth at which bonanza grades might be expected and high Au grades can certainly occur associated with chalcedonic silica, as they do at Rosebud. I can see no reason why a high-grade zone should not exist at shallower, but not exposed levels in some of these structures. In some of these systems the surface expression of deeper high-grade mineralization may be quite weak, e.g. Hishikari.

In Table 1 I have listed the currently identified prospects with a ranking based on my review and understanding of their potential. This ranking is biassed towards prospects that are closer to the existing operations. This review has taken into account Mike Bradys' more complete review of the data for each of the prospects (Brady, 1996). Rosebud Canyon was added as a new prospect despite the limited surface expression because it is occurs in the favourable mine sequence, and has anomalous rock chip geochemistry.

Table 1 : Ranking of Prospects in the Rosebud District

1. immediate mine environs - North Dozer Hill, i.e. within the fault block defined by the South Ridge Fault, Footwall fault, Rosebud Shear and eastern fault margin.

2. Dreamland - East Dreamland : main structure has had only limited drill testing.

3. Valley zone - deeper exploration along the covered Rosebud Shear.

4. Target 2 - small zone that requires limited drill testing

5. White Alps : altered structure needs drill testing

6. Chance area : main E-W ateration zone is inadequately tested

7. Rosebud Canyon : small zone that needs limited drill testing

8. Wildrose Canyon : more mapping and target definition needed

9. Degerstrom : more drill holes in altered structure

10. North Equinox : more drill holes in altered structure

11. Short Shot / North Rosebud Peak : a couple of angled drill holes to test the E-W and NNE-trending structures.

12. Oscar : re-assess the current data

1. North Dozer Block : this block certainly has the most immediate potential to add ounces to the mine reserve. This exploration should be conducted in coordination with the mine geologists. There is an abundance of drill data within this block, with some lower grade intercepts outside the kown ore zones that may be proximal to additional high-grade mineralization.

2. Dreamland - East Dreamland : a prospect with limited past production, extensive alteration, anomalous rock chip values and 10 previous drill holes. Only one of these drill holes tested the main Au-Se soil anomaly (or is it due to contamination?), and the main E-W structural zone. A current 4 hole drill program is due to test a deep conceptual target to the north of the E-W structure. This still leaves the main altered structure with very limited drill testing. East Dreamland is a contiguous structural zone with some higher grade rock chip assays (7.2 ppm Au, 158 ppm Ag and 6.8 ppm Se). There have been 15 previous drill holes in and around this zone so shallow potential has been tested. — deep potential / favorable host rocks have not been tested.

3. Valley Zone : alluvium covered Rosebud Shear zone with at least one deep drill intercept (96-356 : 10' @ 0.357 opt) and some lower grade zones in 13 previous drill holes. This zone may include several fault splays, with potential mineralization

displaced deeper to the north. The higher-grade intercept is currently being followed up with 2 vertical offset holes.

No - Ag, not Au according to historic records.

4. Target 2 : a limited surface zone of alteration, and shallow old workings which apparently had patches of native Au in series of limonite - barite fractures which cut the lower part of the Dozer Rhyolite. Several adjacent drill holes failed to test the main altered structure.

5. White Alps : a NE-trending structural zone with silicified breccias, widespread alteration and weak rock chip anomalies. As shown in Figure -, the main altered structural zone has not been tested despite 9 drill holes in the area.

6. Chance : a large E-W trending alteration zone with silicified breccias. Despite 14 previous drill holes the zone is not well tested. The first of those drill holes (RL-113) intersected 305' @ 0.029 opt Au (395 - 700') and an offset on the same section intersected 100' @ 0.036 opt Au (410 - 510'). RL-113 probably drilled almost down the structure which most likely dips south. All other drill holes were apparently based on a north dip, and failed to intersect the silicified zone. A southerly dip does not even appear to have been considered!

Five recent RC holes were drilled around the Chance area, but only one of these tested the main E-W zone. This hole (97-394) intersected several zones of stronger alteration with minor quartz veins and sulfides. Assays are pending. It is the only drill hole in the eastern section of this altered zone.

7. Rosebud Canyon : several restricted zones of alteration south of the Rosebud mine with spotty rock chip values up to 3.65 g/t Au in an old working, and 8.7 ppm Se. Although the surface expression is not impressive it is entirely hosted within the Ta unit which is thought to be equivalent to the Mine Host sequence. This prospect is also on the N10-20E trend linking the Rosebud - Dreamland and Hycroft mines. Narrow, 3 -5' chalcedonic stockworks are present, and a distinctive vesicular horizon in the Ta may correlate with the Leopard Skin unit at the mine.

SFPG interpretation

8. Wildrose Canyon : a broad, ill-defined zone of alteration, patchy silicification and rock chip anomalies up to 3.34 g/t Au generally associated with an E-W structural zone, and the Wildrose flow domes. There are 5 previous drill holes, 3 of which tested a low-angle W-dipping, silicified fault plane on the west side of Wildrose. Four recent drill

holes tested various targets with only low -order 100 - 200 ppb Au results. This area requires good folio-type mapping and target definition prior to another round of drilling.

I agree.

9. Degerstrom : a low-angle SW-dippping fault / siicified zone with an aureole of alteration and weak rock chip anomalies. Four previous drill holes intersected the silicified zone at shallow levels in only one section. Although only weakly anomalous at the surface, Degerstrom is within the 6,000' radius of the Rosebud mine.

10. North Equinox : a structurally-controlled, silicified breccia zone, vertical to north-dipping with weak rock chip anomalies. There are 4 earlier drill holes which did not test the central part of the silicified zone, and a more recent hole which tested an IP anomaly without any significant assays.

11. Short Shot / North Rosebud Peak : weaker altered structural zones with minor rock chip anomalies. Four previous vertical holes at Short Shot and 3 holes at North Rosebud Peak have not adequately tested the structural zones.

12. Oscar prospect : This is the only prospect that had real potential for shallow open pittable mineralization. Low order (0.01 - 0.02 opt) Au occurs in strongly silicified conglomeratic breccias which are probably equivalent to the Camel Conglomerate at the Hycroft mine to the north. Oscar is similarly located adjacent to the Range Front fault and is probably hot spring-related. Fourteen previous drill holes have defined a small, low-grade oxide resource, but without any apparent higher grade zones, or any indications of additional mineralization. A remaining target may be higher grade sulfidic mineralization at depth.

Other Prospects : other targets in the Rosebud district that may warrant review are Wildrose East, Gator, South Ridge and South Kamma. These are all small and / or geochemically weak. Further, more complete information on most of the targets is found in Bradys' report (1996).

Finally, perhaps the most important question : do these represent valid Newmont targets ? With rapidly increasing production rates can Newmont afford to explore for difficult high-grade targets? In my opinion these offer the opportunity to find high value ounces, and the potential to discover multi-million ounce bonanzas, such as Hishikari or

Midas. It will also give Newmont the opportunity to become efficient and experienced explorers for such deposits, which are destined to become more important in the future.

SLIDE

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COPY

Summary of Alteration and Mineralization at Hecla Mining Company's Rosebud Deposit

Charles V. Muerhoff
Rosebud District Geologist
May 18, 1995

Introduction

The Rosebud Deposit is hosted in the Miocene-age Kamma Mountain volcanics. Epithermal-style gold and silver mineralization occurs associated with discreet structures as well as with broad areas of variable silicification, and argillic, potassic, and chloritic alteration. The Kamma Mountain volcanic sequence is composed of a thick section (4,000 ft. ±) of alkali rhyolite to quartz latite composition pyroclastics, lahars, fine- to coarse-grained flow banded tuffs, and epiclastic/volcaniclastic rocks.

The Rosebud Deposit has been divided into three (3) distinct, spatially separate zones of precious metal mineralization: the South, East, and North Zones. The South Zone and the majority of the North Zone are hosted within the LBT unit of the Kamma Mountain volcanics in fine-grained waterlain and airfall tuff, and lithic ash flow tuff and tuff breccia. The East Zone and a small portion of the North Zone are hosted within the Dozer Tuff unit, which is an aphanitic, siliceous, weakly flow-banded ash flow tuff. The unit designations of LBT and Dozer Tuff are local, informal subdivisions of the Kamma Mountain volcanics.

Hydrothermal alteration and mineralization assemblages at the Rosebud Deposit have been identified using optical (reflected and transmitted light) microscopy, electron microscopy, and X-ray diffraction, as well as hand-specimen examination. Age relations among different paragenetic assemblages were derived from cross-cutting relations and corrosion/replacement textures observed. This report summarizes work performed or contracted by Lac Minerals and Hecla Mining Company.

Alteration and Mineralization - LBT Unit

Alteration associated with precious metal deposition within the LBT unit of the Kamma Mountain volcanics displays vertical and lateral zonation. In general, there is a 'core' of moderate to intense argillic and potassic alteration within the ore zone itself. Extending upward (proximal to structures) and outward (along favorable stratigraphic horizons) is an intermediate zone of propylitic alteration (carbonate-chlorite dominant), followed by a more distal 'halo' of a quartz/chalcedony-clay alteration assemblage. A hematite-carbonate assemblage comprises an extreme distal alteration package to the mineral deposit. The

List of Ore Minerals & Formulas

Acanthite	$Ag2_S$
Aguilarite	Ag_2S / $Ag_2(S, Se)$
Anatase	TiO_2
Argentite	Ag_2S
Arsenopyrite	FeAsS
Chalcopyrite	$CuFeS_2$
Electrum	Ag, Au
Freibergite	$(Cu, Fe, Ag)_{12}(Sb, As)_4S_{13}$
Galena	PbS
Marcasite	FeS_2
Miargyrite	$Ag_2S.Sb_2S_3$
Native Silver	Ag
Naumannite	Ag_2Se
Polybasite	$9Ag_2S.Sb_2S_3$
Proustite	Ag_3AsS_3
Pyrargyrite	Ag_3SbS_3
Pyrite	FeS_2
Pyrrhotite	$Fe_{1-x}S$
Sphalerite	(Zn, Fe)S
Stibnite	Sb_2S_3
Stylotypite	$(Ag, Cu, Fe)_3SbS_3$
Tetrahedrite-Tennantite	$(Cu, Fe)_{12}(Sb, As)_4S_{13}$

boundaries of these alteration assemblages are not sharp, as the different alteration zones clearly overlap, suggestive of alteration overprinting due to a fluctuating hydrothermal cell.

Alteration began with the diagenetic devitrification of glassy volcanic fragments to quartz, K-feldspar and albite. Early sericitic alteration of both feldspars appears to accompany the introduction of disseminated pyrite, marcasite, sphalerite, and galena. The sericite often contains minor amounts of iron and therefore can be classified as illite. Fractures filled with quartz, pyrite, marcasite, arsenopyrite, chalcopyrite,and sphalerite, with lesser pyrrhotite, galena, anatase, and tetrahedrite-tennantite may be the same age of, and feeders for, the disseminated sulfides and sericitization.

A later set of fractures contain the mineralizing assemblage consisting chiefly of manganese- or iron-rich calcite, silver sulfosalts (pyrargyrite, miargyrite, stylotypite, proustite, and polybasite), silver selenides (naumannite, aguilarite), silver sulfide (acanthite), native silver, and silver-rich electrum. Calcite in these veins appears to corrode earlier pyrite and marcasite. While alteration of marcasite to pyrite proceeded from the margins of the marcasite blades inward toward the center, calcite or kaolinite commonly replaces the core of the marcasite blades. The calcite-silver veining phase appears to often incorporate fragments of earlier quartz-sulfide mineralization.

The next stage of mineralization is dominated by minor veining and open-space filling of stibnite and barite. The latest stage consists of veinlets of kaolinite which cut across calcite veins, and replace both the calcite and earlier marcasite; it is uncertain whether the kaolinite is hydrothermal or supergene. It is possible that a portion of the chlorite formed instead of kaolinite where iron was locally available.

Alteration and Mineralization - Dozer Tuff

Alteration within the Dozer Tuff unit of the Kamma Mountain volcanics is dramatically different from the assemblages observed in the LBT unit. In the deposit area, the top of the Dozer Tuff is fault-bounded by the listric-normal South Ridge Fault, which acts as a boundary to alteration and mineralization in the East Zone. Mineralization in the Dozer Tuff is associated with pervasive silicification; consisting of chalcedony and locally vein quartz. Protolith rock textures are commonly totally replaced by sulfide-bearing silica. Silicification persists downward from the South Ridge Fault from 30 to 120 feet, but does not extend upward into the hanging wall of the fault. There is a gradational boundary between the zone of silicification and a strongly propylitic to moderately argillic alteration package which occurs below the zone of silicification.

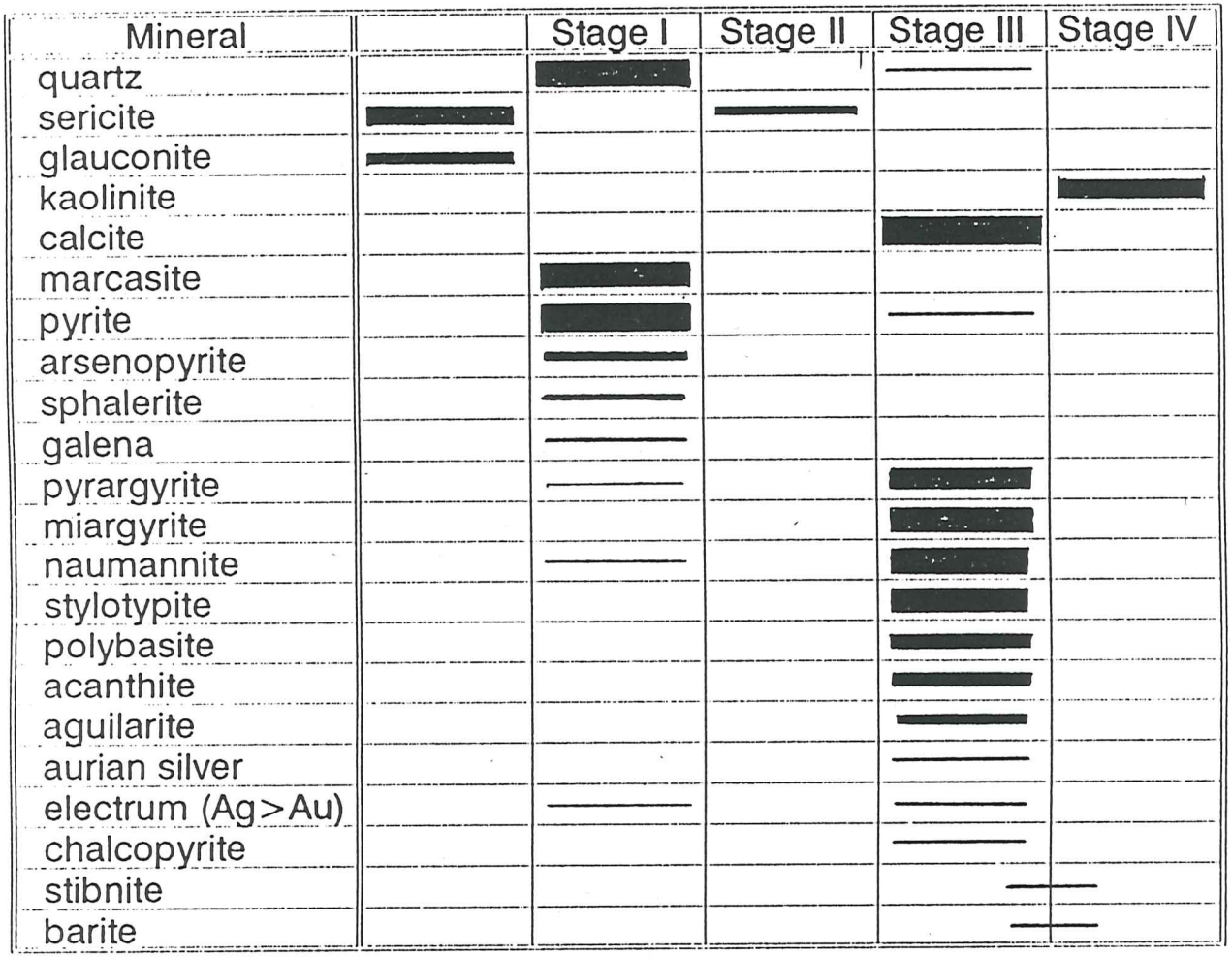
Like the alteration and mineralization within the LBT unit, alteration within the Dozer Tuff unit began with the diagenetic devitrification of glassy volcanic fragments to quartz, K-feldspar, and albite. The feldspars have been sericitized and the igneous quartz corroded, but not to the extent observed in the LBT unit. Wall rocks contain disseminated pyrite, marcasite, and sphalerite.

The main mineralizing event appears to be quartz veining and silica replacement followed by a sericite-illite-glauconite veining phase. Unlike the alteration and mineralization within the LBT unit, calcite veining associated with precious metals and sulfides is rare within the Dozer Tuff. Also, quartz stockwork veins and silica-replaced host rock contain very little native silver and only minor amounts of the silver-sulfosalts which are so abundant in the mineralized portion of the LBT unit. Gold dominantly occurs as gold-rich electrum, either 'liberated' within silica or encapsulated within pyrite or marcasite. Silver occurs as pyrargyrite and freibergite (the silver-rich analogue of tetrahedrite), and as a minority electrum component. Associated sulfides include pyrite, with lesser amounts of marcasite, arsenopyrite, chalcopyrite, sphalerite, pyrrhotite, and galena.

Late mineralizing events are similar to those of the LBT unit, in that precious metal mineralization is followed by deposition (commonly open-space) of barite and stibnite, which is in turn followed by kaolinite veinlets.

HECLA MINING COMPANY – ROSEBUD PROJECT

South Zone Mineralization Paragenesis



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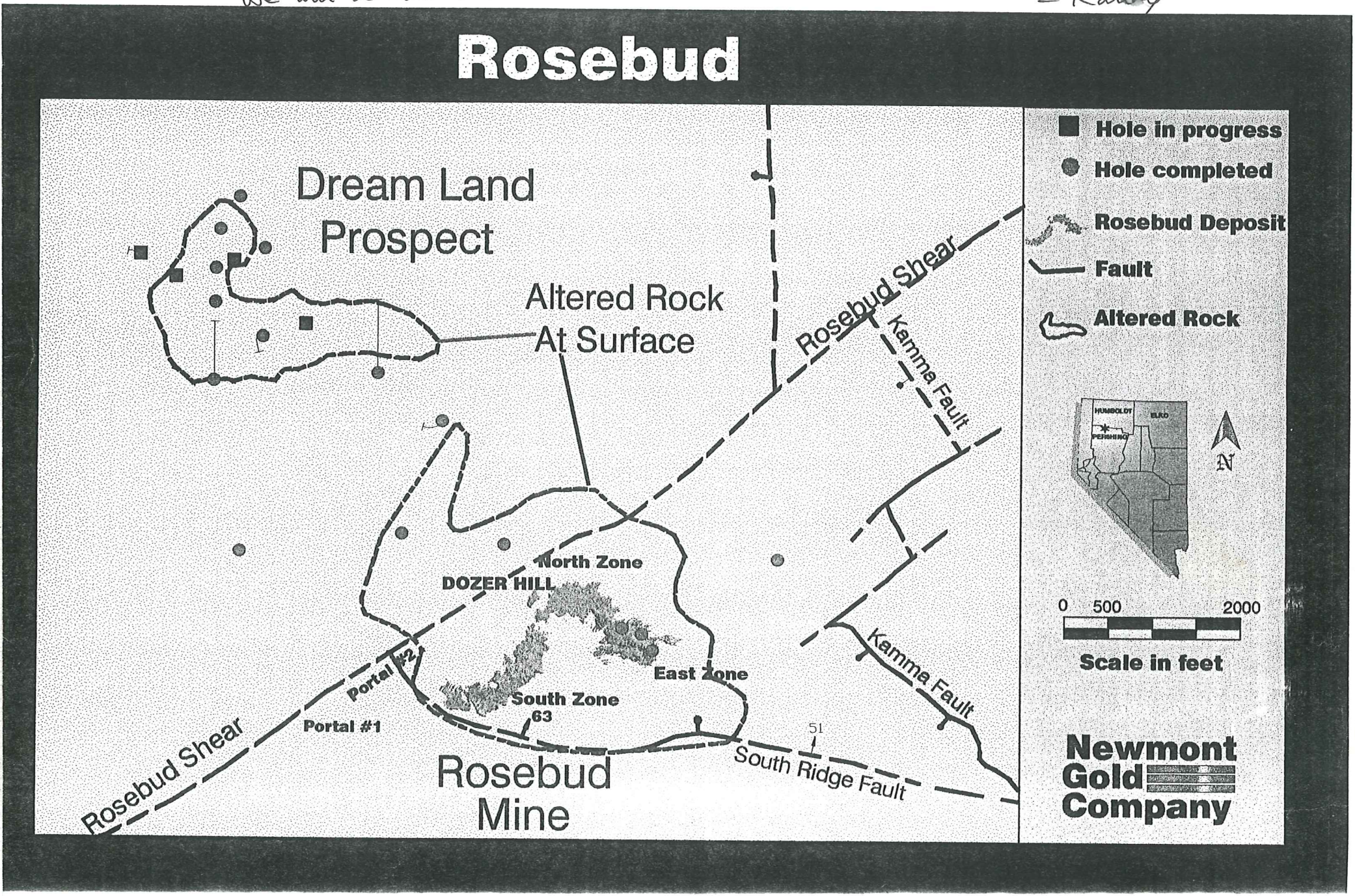
Kurt-
Here are black + white copies of colored figures already prepared for slides.
IF we can discuss on Monday, I'll get the draftsman to process for your talk.
We will be able to make modifications if needed. I'll bring colored originals.
— Randy



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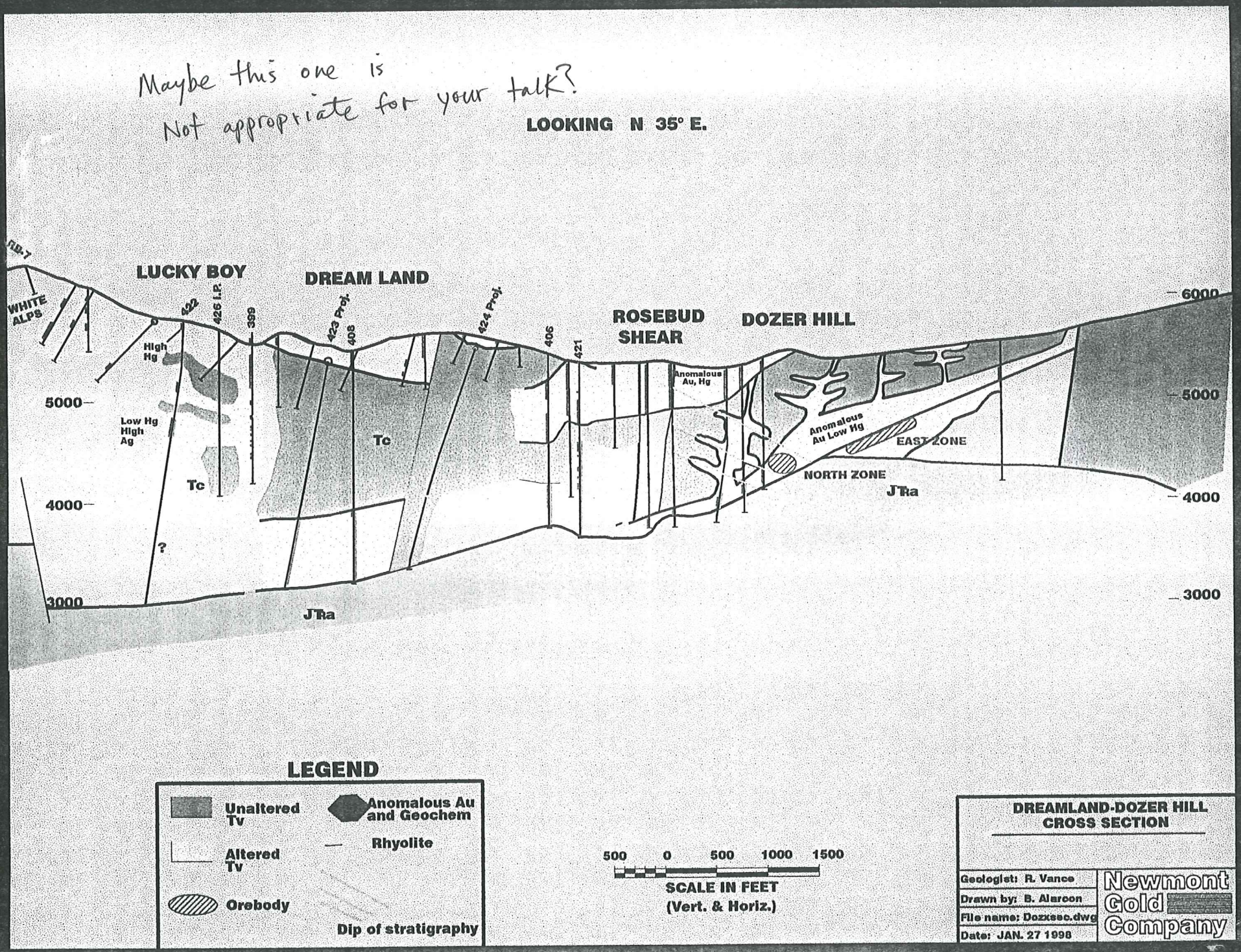
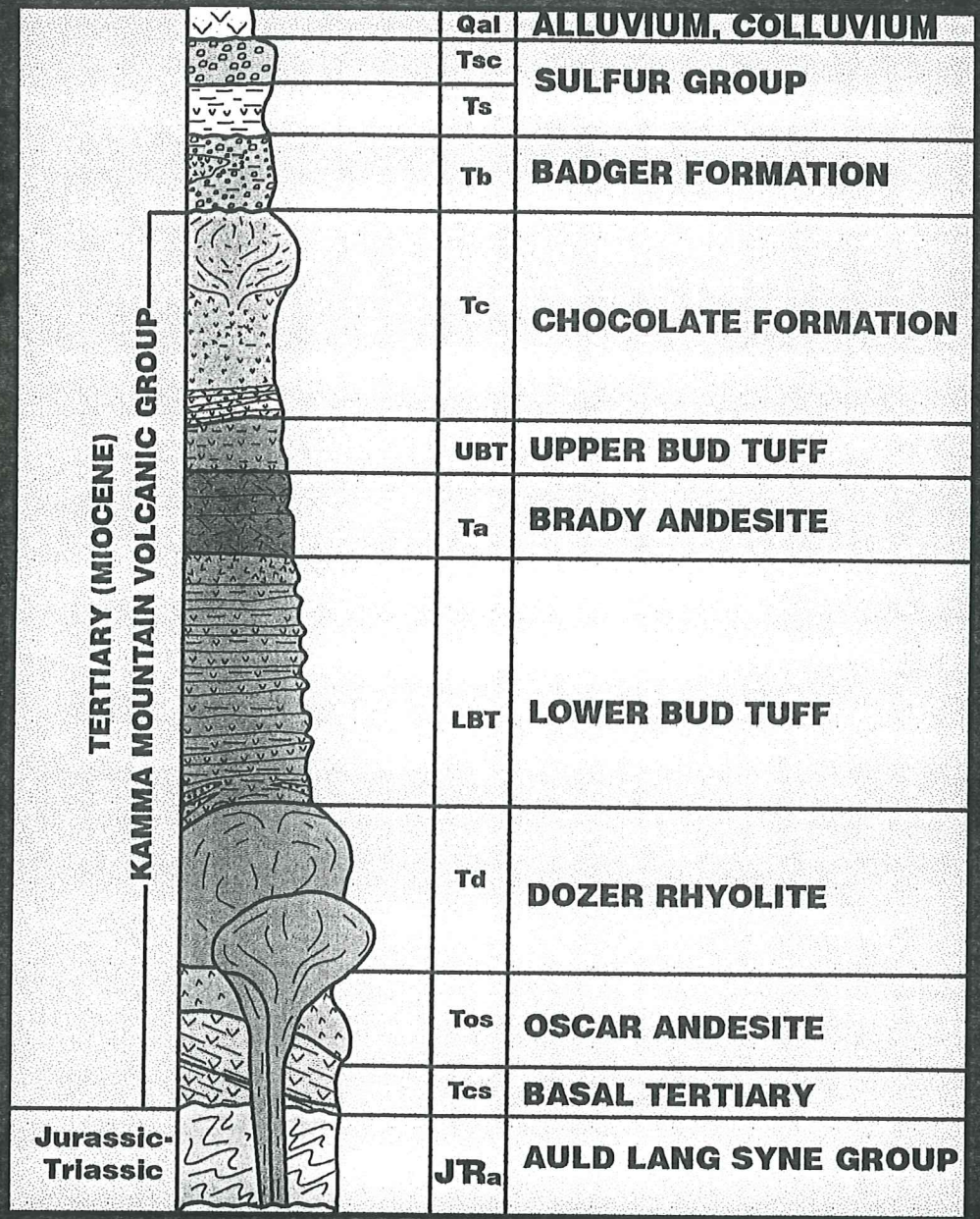


ROSEBUD GEOLOGY

ROSEBUD



NEWMONT GOLD COMPANY
ROSEBUD CANYON
STRATIGRAPHIC
SECTION

Newmont Gold Company