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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	Newmont Exploration, Reconnaissance Geology of the Rosebud Property, Pershing and Humboldt County, Nevada, for Hecla Mining Co, December 1, 1995
AUTHOR	Brady M; Paster T; Wallace, A; Freiberg R
DATE OF DOC(S)	1995
MULTI_DIST Y / [✓ N?] Additional Dist_Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine; Rosebud property; Hecla Mining Co. Lac Minerals (USA), Inc; Rosebud Project; Valley; North Kamma; Wildrose; Gator; Chance; North Equinox; North Rosebud Peak; Short Slot; White Alps; Dreamland; East Dreamland; Degerstrom; School Bus Canyon; Chalcedony; Oscar; South Kamma; South Ridge; Dozer Hill; Equinox
COMMODITY If not obvious	gold; silver
NOTES	Property report; geology; geologic map; cross sections; assays; geochemistry; petrographic report; property maps; resources; handwritten notes NOTE: Scan dividers 85p. 2 over sized plates

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)

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Revised: 1/22/08

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Newmont Exploration

RECONNAISSANCE GEOLOGY OF THE ROSEBUD PROPERTY

Pershing and Humboldt County, Nevada

by MICHAEL W. BRADY, Consulting Geologist

for HECLA MINING CO.

December 1, 1995

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CONCLUSIONS/RECOMMENDATIONS

Epithermal precious metal mineralization is widespread throughout the mapped area of the Kamma Mountains. Hycroft/Granges is exploiting through open-pit mining stockwork/disseminated gold deposits within a lacustrine tuff host on the north end of the range that aggregates +60,000,000 tons @ 0.019 opt Au. The Rosebud deposit in the south-central portion of the range is hosted in Tertiary volcanics and it is being developed as an underground mine by Hecla Mining Co. with announced reserves of 1,756,000 tons @ 0.326 opt Au. Both deposits share a similar origin although they are postulated in this study to be of different ages and to have formed at different depths below the paleo-surface.

Mapping and sampling on Hecla's property has identified 10 specific target areas that are described in this report. More detailed work is now required to establish each area's exploration potential prior to a drill test. The following activity is therefore recommended to continue with the evaluation process:

1) compile all previous mapping, sampling and drilling data that was completed on the Rosebud Property by predecessor companies (Lac and Equinox) and other companies that are known to have worked in the district (St. Joe Minerals, Independence, USMX, Asarco, etc.) Use this information to:

- refine the geologic picture as presented in this study
- further evaluate the identified target areas
- possibly identify new target areas
- established the missing data so that attempts can be made to obtain a copy

2) compile all geophysical work completed in the area by others. Published records indicate that airborne and ground magnetics, IP/resistivity and VLF surveys were completed by Lac and Equinox. The airborne magnetics would be of particular interest to identify district scale geologic features that might be of importance to understand the genesis for the mineralization.

3) consider additional 1" = 500' scale geologic mapping down Rosebud Canyon west of the completed mapping. Hecla's property persists an additional 3-4 square miles in this direction so the information would be useful in determining what claims need to be kept, dropped and/or added prior to the $100/claim rental charges being due next August 31. Also, the information

would provide additional insight into the Rabbit Hole gold placers and how they might possibly relate to the mineralization at Sulphur and Rosebud.

4) detailed core logging and underground mapping by Hecla and others has allowed the ore host to be subdivided into the upper Bud, Bud marker and Lower Bud Tuff stratigraphic intervals at the Rosebud Mine. This study did not include access to the information or the mine workings. Additional work needs to be completed to resolve the mine terminology into a more regional, district-wide context.

INTRODUCTION

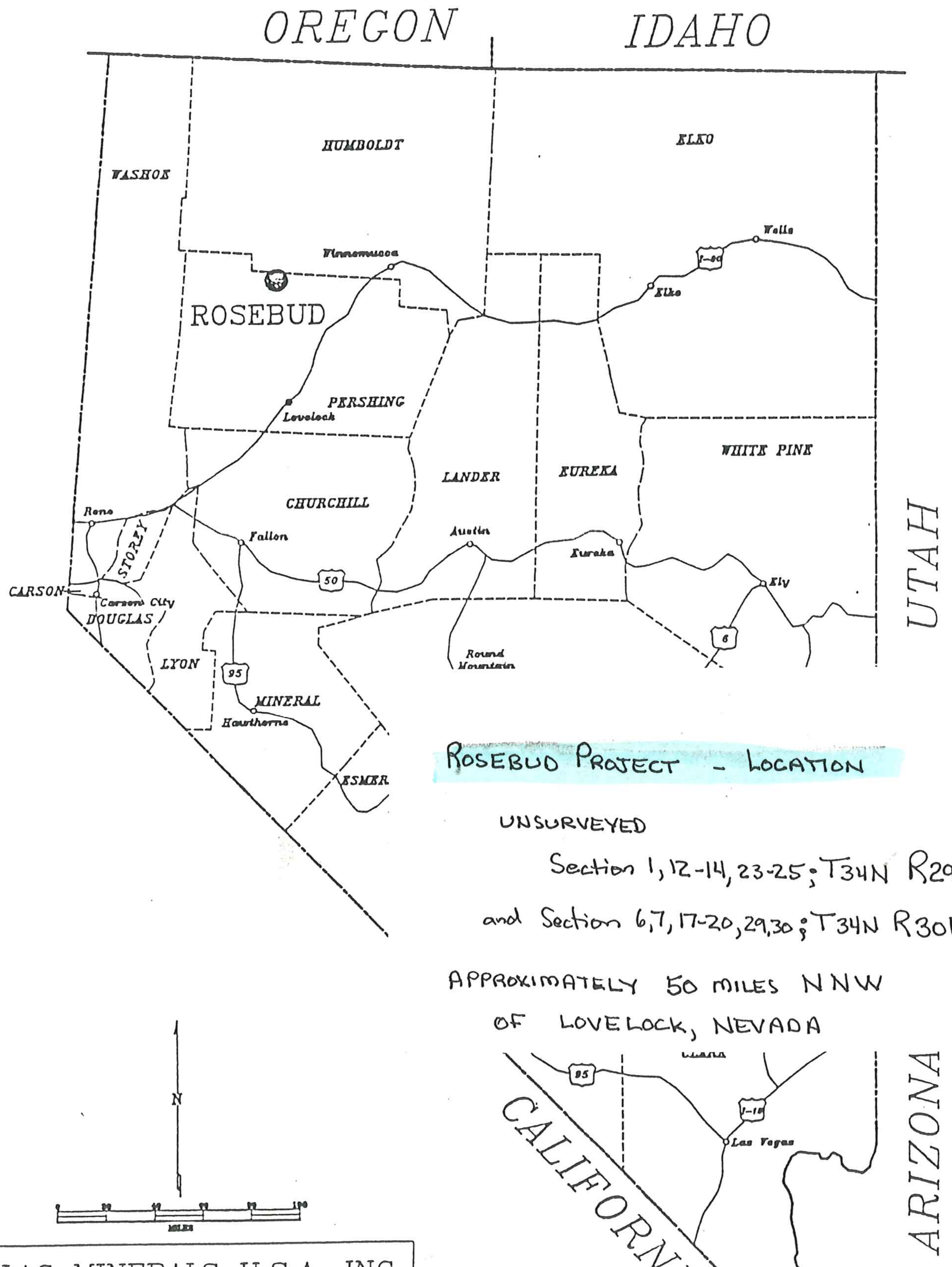
As a result of discussions with Charles Muerhoff, Senior Mine Geologist at the Rosebud Project on August 14, 1995, it was agreed that I would map and sample the Rosebut Project Area. This work was to be completed independently but under the supervision of C. Muerhoff with a tentative completion date set at no later than December 31, 1995. This report is a summary of the work results but specifically the project entailed the following:

1) the mine provided a topographic map base at 1" = 500' scale with a 50 foot contour interval in two separate sheets - a north half and a south half. Actual field mapping was conducted on an enlarged 1"=2000' published topo base (Sulphur 7.5 min quad) with a 10 meter contour interval. Field data was then transferred back to the mine topographic base manually to construct the enclosed final map.

2) a total of 23 square miles of geologic mapping was eventually completed in 2.5 months. The mapping was completed in a rapid, reconnaissance fashion to maximize coverage while keeping costs to a minimum. The enclosed map is therefore an attempt to depict the district geologic relationships and not the details of any one specific area that might be of potential interest. More detailed follow-up mapping is therefore required in several specific areas of the property.

3) a total of 104 surface rock chip samples were obtained for assay (RS-1 to RS-104), and 33 surface samples were obtained for thin section descriptions (RB-1 to RB-33). Assays and individual sample descriptions are attached in the appendix of this report.

Whenever possible, the geologic map names employed in this study were formation names used at Hecla's Rosebud Mine and/or Hycroft's Sulphur Mine to the north. This was not always possible since several of the map units identified were not previously identified in the literature for the area. Also, the host for mineralization at the Rosebud Mine is termed the Lower Bud Tuff by mine personal but no corresponding unit appears on the enclosed geologic map. This apparent contradiction is a result of my lack of access to the underground workings to observe the specific character of the Lower Bud Tuff as well as the inherent difficulty of depicting fine geologic details at a mapping scale of 1"=500'. It does seem clear that the Lower Bud Tuff is a sub-unit of the Tbs2 base surge deposit as shown on the geologic map but additional study remains to be completed.



ROSEBUD PROJECT - LOCATION

UNSURVEYED

Section 1, 12-14, 23-25; T34N R29E

and Section 6, 7, 17-20, 29, 30; T34N R30E

APPROXIMATELY 50 MILES NNW
OF LOVELOCK, NEVADA

LAC MINERALS U.S.A. INC.
1395 GREG ST. – SPARKS, NEVADA 89431

ROSEBUD PROJECT
NEVADA LOCATION MAP

NEVADA	PERSHING		
R.THOMAS	J.A. MUELLER	4/93	

FIGURE 1F

GEOLOGY

General

The Kamma Mountains are composed of a +6,000 foot thickness of Tertiary volcanic flows, clastic sediments and ash flow tuff units that disconformably overlie sediments of Jurassic to Triassic age. The volcanics are of andesite, rhyolite and quartz latite composition having been erupted from various small isolated vents both within and south of the map area.

After the eruption of the volcanic flows, a series of north trending faults developed in response to east-west directed regional extension. Displacement was generally rotational west side down resulting in a 30-45 degree east dip for the volcanic sequence. Regional studies by others place the extensional event in this portion of present day Nevada at roughly 10-15 MY. Younger north-south trending basin and range faulting followed as a distinctly separate event. It was this block faulting that uplifted the tilted volcanic section as a horst to form the present Kamma Mountains.

Precious metal mineralization is represented as epithermal deposits of gold with minor silver in shallow hot spring and deeper veins associated with anomalous As, Sb, Hg, and Se trace element geochemistry. A very young age of mineralization related to basin and range faults is recognized at the Sulphur District (1.9 MY) while an older stage of mineralization related to subtle east-west lineated faults and shear zones is implied at Rosebud (15-17 MY).

Rock Types

Qal = Quaternary Alluvium

Alluvium is not widespread in the map area due to the Kamma Mountain's young age. Only in Rosebud Canyon, Wildrose Canyon and along the northeast trending valley that parallels the Rosebud Shear are significant alluvial gravels recognized and they attain a maximum thickness of only 50-150 feet.

Tf = Tertiary Fanglomerate

A local unit exposed only in the southwestern portion of the map area south of Rosebud Canyon but it probably correlates to the base of the Camel

Conglomerate in the Sulphur District 6 miles to the north. It is composed of angular to sub-rounded fragments of volcanics and pre-Tertiary basement sediments that thicken eastward up to a maximum of 40-60 feet. Throughout its outcrop extent it is flooded with opaline silica cement that intensifies along the range bounding fault at its east outcrop extent. The fanglomerate was derived from rapid erosion of the Kamma Mountains in response to basin and range faulting.

Ts = Tertiary Lake Sediments

Primarily volcanic ash deposited in local lacustrine basins along the margins of the Kamma Mountains. It underlies the Tf unit in the southwestern portion of the map area and therefore may correlate to the Sulphur Group of sediments in the Sulphur District. In the east-central portion of the map area the sediments directly overlie the pre-Tertiary basement in a local restricted sag basin. Throughout its outcrop extent exposure is very poor but incompletely lithified airborne tuff and fine volcanic ash debris that was deposited in thin horizontal layers within a lacustrine environment is implied.

Tb = Tertiary Badger Formation

A probable alluvial fan deposit emplaced along the central and eastern portions of the Kamma Mountains in response to gentle uplift, eastward rotation and extension of the mountains prior to basin and range faulting. The unit is composed of angular to semi-rounded volcanic fragments up to 3-5 inches in diameter derived mainly from the underlying Chocolate Tuff. A distinctive red silt matrix locally cements the volcanic fragments indicating deposition in an arid environment. Local interbedded tuffaceous lake sediments are also recognized but they are not mapped separately due to their poor outcrop exposure. Near the top is a distinctive but thin rhyolite flow breccia (Tbrx) that was mapped separately along the east margin of the Kamma Mountains. The Badger appears to overlie the Chocolate Tuff in a slight angular unconformity of possibly 2-3 degrees. The Badger may aggregate up to 900-1,000 feet in total thickness but this is highly variable now since it is being removed by present day erosion. As discussed later, the Badger appears to be largely post-mineral to the Rosebud age of mineralization.

Tc = Tertiary Chocolate Tuff

A variable unit consisting of volcanic lahars (Tcbx), welded and flow banded ash flows (Tw), vapor phase altered flows (Tcv), vitropheres as well as extensive areas of non-welded ash flow tuffs (Tc) all of probable quartz latite composition. Overall the unit may aggregate 1,500 - +2,000 feet in total thickness with a thinning towards the north away from its postulated source. One probable vent was mapped south of Rosebut Canyon in the southeast portion of the map area while a north-trending fissure vent (Tc vent) was mapped north of Rosebud Canyon but south of the Rosebud Mine.

Petrographic composition = 4-10% feldspar as plagioclase grains 0.1-3.5 mm in size
1-3% biotite in grains 0.2 - 1.0 mm in size
85-95% groundmass composed of feldspar, clay, quartz and hematite

Tbf = Tertiary Brown Rhyolite Flow

Massive, fine grained rhyolite flows that appear to interfinger with the base of the Chocolate Tuff (Tc) in the west-central portion of the map area. The rhyolite flows appear to be locally derived from a vent just south of the west mouth of Wildrose Canyon where its greatest thickness was observed of +1,500 feet. The unit thins rapidly towards the south since is was not recognized in the Rosebud Mine vicinity but it persists to the northern map boundary. This is a new formation name not previously recognized in the published literature from the area.

Petrographic composition = 1% feldspar as plagioclase grains 0.02-2.5 mm in size
1-2% biotite in grains 0.1-1.0 mm in size
90-95% groundmass composed of feldspar, limonite, quartz and biotite

Tbs 1,2,3,4 = Tertiary Base Surge Deposits

Where exposed, these deposits consist of horizontal layers of well sorted epiclastic particles. Individual layers may aggregate 1-3 feet thick showing graded bedding but no channel scours, crossbedding or organic debris that might imply water deposition. Individual layers tend to encompass volcanic debris of similar composition emplaced as a blanket deposit over the pre-existing topographic surface. I believe that a base surge origin for these clastic deposits is a reasonable interpretation based on field evidence.

In general the base surge deposits are poorly lithified and difficult to observe in outcrop except along ridge tops and within gullies that have been eroded across their outcrop projection. Mapping has shown at least 4 separate groupings of base surge deposits within individual stratigraphic horizons that locally total 50-80 feet in thickness. By convention I have denoted the lower most base surge group lying at the unconformity on the Dozer Tuff (Td) as Tbs1, and each successively higher base surge group as Tbs2, then Tbs3, etc. The Rosebud Mine host appears to be within the Tbs2 unit but each of the base surge horizons are non-distinctive in appearance so lateral correlations across large distances may not be reliable.

In a stratigraphic sense, all of the base surge groups occupy the interval from the top of the Dozer Tuff (Td) up into the base of the Chocolate Tuff (Tc) and interfinger with various andesite flows (Ta) but their specific stratigraphic position varies throughout the map area depending on the distance from the source vents and the pre-eruption topographic surface. As a general statement, they all appear to thin towards the north and therefore essentially absent on the north geologic map sheet.

Ta = Tertiary Andesite Flows

Multiple, thin flows of andesite composition derived from vents south of the map area. Most of the flows are very fine grained hence the confusion in the thin section descriptions as a trachyte but an andesite composition appears to be correct. It is interesting to note that both thin section descriptions and field observations imply a similar composition and therefore possibly a similar vent source for the Ta and underlying Oscar (Tos) Formation. The total thickness for the Ta unit in the northern map area is 30-50 feet, in the central map area near the Rosebud Mine approximately 50-100 feet while south of Rosebud Canyon it exceeds 500 feet. Specific vents were not located for the unit but the thickening towards the south implies that they are located in this direction.

Petrographic composition = 1-3% biotite as 0.05-0.5 mm grains
1-3% feldspar as plagioclase particles 0.02-0.2 mm in size
95% groundmass as feldspar, hematite and calcite

Td = Tertiary Dozer Formation

Probably a flow-dome complex of rhyolite composition. Most of the unit outcrops as a distinctive flow-banded platy rhyolite that forms broad skree slopes. Actual boundaries between Dozer rhyolite flows (Td) and Dozer rhyolite domes (Tdi) are difficult to identify locally due to talus cover especially in the area north of Wildrose Canyon but two specific flow-domes were identified that will be described separately under intrusives in a following report section. One is located at the northeast mouth to Rosebud Canyon while the other is located north of Wildrose Canyon. The total thickness of the Td flows appears to exceed 1,500 feet in Rosebud Canyon but mapping implies only a 250-400 foot thickness in the west-central portion of the map area. It was impossible to establish reliable thickness information elsewhere on the property.

Petrographic composition = 1% or less sanidine in grains 0.1-0.2 mm in size
+95% groundmass composed of quartz, feldspar, magnetite and glass

The top of the Dozer Formation appears to represent an erosional unconformity of unknown duration. It was upon this erosional surface that the andesite flows, the base surge deposits and the Chocolate tuff were emplaced.

Tos = Tertiary Oscar Formation

Multiple andesite flows of similar appearance and composition to the Ta unit. Most are fine grained but one laterally persistent flow is coarser grained and is shown on the geologic map as a marker (Tosm). The base of the Oscar is not exposed but it may lie directly on pre-Tertiary basement. Very little additional information is known regarding the Oscar since its outcrops are sparse.

Petrographic composition = 5-8% feldspar as plagioclase grains 0.2-2.0 mm in size (for marker unit)
4-5% ferromags (possibly originally biotite but now completely altered) in grains 0.05-1.0 mm in size
90% groundmass composed of feldspar and hematite

Jtra = Jurassic-Triassic Auld Lange Syne Formation

Basement sediments composed of highly contorted carbonaceous shale, siltstone and limestone. Locally extensive white, bull quartz veins and lensoid bodies are present that were formed as a result of low to medium grade regional metamorphism.

Intrusives

Intrusive activity is extensive although all are recognized as intrusive volcanics since no granitics were found. Crosscutting relationships are rare therefore age relationships are interpretative.

Tdi = Rosebud Canyon Rhyolite Dome

Located at the southeastern mouth to Rosebud Canyon it outcrops over a 2,000 feet x 3,000 feet surface area. Field observations and petrographic descriptions imply a rhyolite dome and a probable vent for the Dozer Tuff (Td). It outcrops primarily as an intrusive breccia with weak flow banding except on the margins where it is near vertical. Weak disseminated hematite (after pyrite) is noted but otherwise the rhyolite dome is unaltered.

Petrographic composition = 5% quartz in grains up to o.2 mm in size
93% feldspar in grains 0.01-0.05 mm in size
2% disseminated hematite (after pyrite?)

Tcbx = Chocolate Vent Breccia

Located in the extreme southeast corner of the map area a 600 feet x 1,000 feet surface area exhibits vertical flow banding within a Chocolate flow breccia unit (Tcbx). A vent is implied that is essentially unaltered. Outside of this restricted area the Tcbx designation is used for flow breccias and lahars of the Chocolate volcanic sequence with no vent connotations.

Tri = small scale dikes scattered throughout the southern portion of the map area

Located along poorly defined ENE trends primarily south of the Dreamland Intrusive described below. They appear as narrow dikes and sills but outcrops are poor and their presence is usually marked only by float that can be easily mistaken for bleached volcanic talus near subcropping shear zones. Therefore, some areas shown on the geologic map as a dike may in fact be only bleached volcanics. Small prospects for Au+Ag commonly are present at the intrusive margins but no major zones of mineralization are recognized.

Petrographic composition = 12% feldspar in grains 0.2-2.5 mm in size
4 % sanidine in grains 0.3-2.0 mm in size
1% quartz in grains 0.3-1.0 mm in size
1% biotite ? altered to chlorite
80% groundmass composed of feldspar, quartz and glass?

Tri = Dreamland Intrusive

Located in the central map area outcropping over an east-west lineated area 500 feet x 2,500 feet, it is primarily a crystal rich rhyolite similar to the Tri dikes. The entire intrusive mass is argillically altered while the western on-third is also silicified. Disseminated pyrite is present throughout (now oxidized to hematite). Extensive east-west lineated shearing hosts supergene(?) Ag+Au mineralization trapped in the clay gouge of the shear zones.

Petrographic composition = 30-35% feldspar as sanidine and orthoclase grains 0.02-2.5 mm in size
20% quartz as grains 0.5-1.5 mm in size
1% muscovite in grains 0.1-0.2 mm in size
40-45% groundmass composed of clay, feldspar and quartz

Tc vent = Fissure Vent for the Chocolate Tuff

Located in the southeastern portion of the map area it was traced over a north lineated strike distance of 3,500 feet. It is composed of angular fragments of Ta and Tc and interpretations are that it is a fissure vent for the Tc unit. Petrographic descriptions for sample RB-13 confirm the field interpretation.

Tbf vent = Intrusive dome for the Tbf unit

Located in the west-central portion of the map area just south of the western mouth of Wildrose Canyon. It is an east-west lineated vent with surface dimensions of 400 feet x 1,600 feet where intrusive breccias and vertical flow banding are evident. No alteration is related to the vent.

Td/Tdi = Wildrose Canyon intrusive

Located just north of the western mouth of Wildrose Canyon a rhyolite flow dome complex is implied based on field observations. The composition is similar to the Rosebud Intrusive and therefore they probably are of a similar age. Several rhyolite domes are implied that have intruded rhyolite flows of Td composition. In the time allowed for mapping it was not possible to differentiate all of the intrusive/flow relationships so the entire mass was shown on the geologic map as one unit.

Petrographic composition = 1-2% feldspar as grains 0.2-1.5 mm in size
80-85% lithic fragments composed of Tdi lapilli
10-15% groundmass composed of quartz and clay

Structure

The oldest faulting in the map area is expressed as discontinuous zones of east-west trending shears primarily north of Rosebud Canyon. Most of the shears are poorly exposed and where mapped and they appear to represent zones of crushing and focused argillic alteration with relatively minor actual offset. The major exception appears to be along the South Ridge Fault where possibly 1,600 feet of normal displacement is implied assuming no lateral component. Other shears are exposed in the Dreamland Mine area and in Targets VII, VIII and X.

Younger faults trends through the map area along a north-south orientation. Surface exposure is again poor except where crushing has generated clays expressed at the surface as areas of low relief with a red-brown coloration. The faults usually can be traced laterally over long distances as offset boundaries between separate mapped lithologies. As a general rule the following characteristics apply:

1) they always offset older east-west trending shear zones.

2) displacement is generally normal down on the west in variable amounts of 200-1,500 feet.

3) the west hangingwall units are generally rotated to slightly steeper angles implying a shallow flattening of the faults with depth.

4) essentially none of the faults were found to be altered or mineralized.

In general this set of faults appears to be related to a gentle rotation of the Kamma Mountains 35-45 degrees to the east in response to extensional tectonics. This was a prolonged event since early rotational fault offset initiated erosion responsible for the formation of the Badger Formation. Additional displacement resulted in the Badger outcrops also being rotated.

The next younger fault set appears to be along north-south trending range bounding faults related to basin and range development. Mapping failed to extend sufficiently into the valley east to identify one specific range bounding fault but the west periphery is clearly marked by a range bounding fault set that essentially parallels Hecla's property line. In contrast to the above faults, these appear to:

1) have only normal dip slip displacement of +1,500 feet with no rotational component.

2) bound young lacustrine sediments as valley fill (grabens) with bedrock volcanic flows and pre-Tertiary units in the Kamma Mountains (horsts).

3) be a focus for shallow hot springs activity and associated epithermal mineralization at the Sulphur District and Target I on Hecla's property.

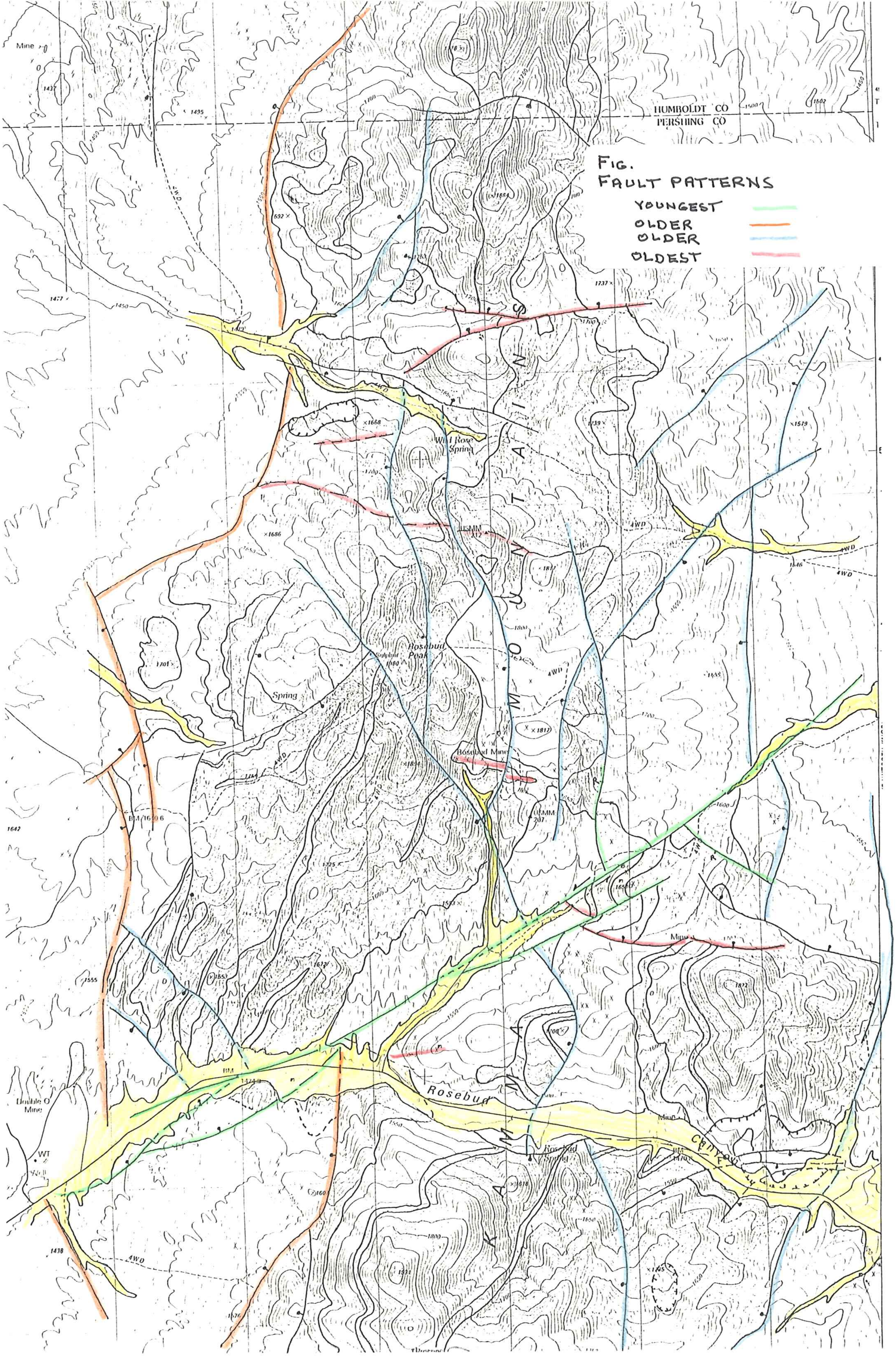


Fig.
FAULT PATTERNS

Finally, the youngest displacement is present along the ENE trending Rosebud Shear. Based on the available information it is impossible to determine if older movement also occurred along the Rosebud Shear but clearly there is a young component of displacement that cuts all rock units and all previously described faults.

The sense of offset along the Rosebud shear appears to be as a combination left lateral and hinge normal (north side down relative to the south). The following observations in combination imply the above:

1) where intersected in drilling the Rosebud shear is reported to have a 75 degree north dip.

2) the Badger Formation is present on both hanging and footwall but more extensive on the hangingwall implying preservation from erosion due to normal, north side down relative movement.

3) mapped field relationships immediately north and east of Dozer Hill can best be explained by some reverse fault movement along pre-existing north trending extensional faults. Strike orientations where reverse movement occurred implies some left lateral displacement along the Rosebud Shear.

4) direct measured offset of the Badger/Auld Lange Syne extensional fault contact east of Dozer Hill is approximately 1,600 feet left lateral whereas the offset along the north trending basin and range structure west of Target II is +6,000 feet left lateral. A hinge component of movement must be employed to explain this difference.

Therefore I presently interpret offset along the Rosebud Shear zone to be very young and to be composed of at least 1,600 feet of left lateral displacement and hinge normal displacement of possibly 200-600 feet east of Dozer Hill and 500-1,000 feet in western Rosebud Canyon.

Two gentle north trending anticlinal folds were identified in the northern and central map area. Others may exist but reliable strike and dip information was difficult to obtain in the field. Present interpretations are for the gentle folds to be generated as local features on the hangingwall of the north trending extensional faults.

Alteration/Mineralization

Alteration and mineralization is widespread throughout the map area primarily focused on pre-existing shear zones and faults. The majority of the host rocks are brittle and non-reactive and therefore alteration envelopes are narrowly focused and mineralized zones more vein-like in character. The major exceptions are the Rosebud orebody where mineralization is hosted in more porous base surge deposits and at the Sulphur District where lacustrine sediments provide the host.

Published articles pertaining the Sulphur District mineralization describe hot springs sinter development on the northern periphery underlain by acid leached rock with fracture controlled mercury and sulfur deposits. Deeper still is characterized by quartz flooding, extensive argillic alteration and pyritization associated with Au+As+Sb+Hg mineralization. Interpretations are for a low temperature hydrothermal system focused on the north trending basin and range faults that breached the paleo-surface and deposited hot springs terrace sinters. The underlying acid leached zone was formed by boiling solutions above the water table depositing mercury and sulfur in a vapor dominated environment. Below the water table, silicification and pyritization was pervasively developed within porous lake sediments in association with the Au+As+Sb+Hg mineralization locally accompanied with barite, fluorite and anomalous selenium.

Target I in the southwestern portion of Hecla's property is similar albeit on a smaller scale. Terrace hot springs sinter and most of the acid leach zone is absent but pervasive silicification with anomalous Au+Ag+Hg is present. Interpretations imply a high water table possibly at the paleo-surface when the mineralization was deposited.

Alteration and mineralization at the Rosebud Mine is poorly documented in the published literature and this study did not include entering the mine workings or examining any Hecla in-house studies. The following district-wide generalizations may apply though:

1) alteration/mineralization is primarily focused on the older, east-west trending faults.

2) peripheral alteration consists of clay development accompanied with 1-3% disseminated pyrite (now oxidized). Fault reconstructions indicate argillic alteration and pyritization flare upward and outward into the hangingwall with decreasing depth.

3) core zones of alteration consists of massive opaline quartz as passive silicification that envelops pre-existing fault breccia. Crustiform banding and hydrothermal breccia textures are lacking implying one phase of mineralization below the boiling horizon.

4) anomalous As+Sb+Hg+Se is ubiquitous although all appear to increase in intensity and become more continuous with depth.

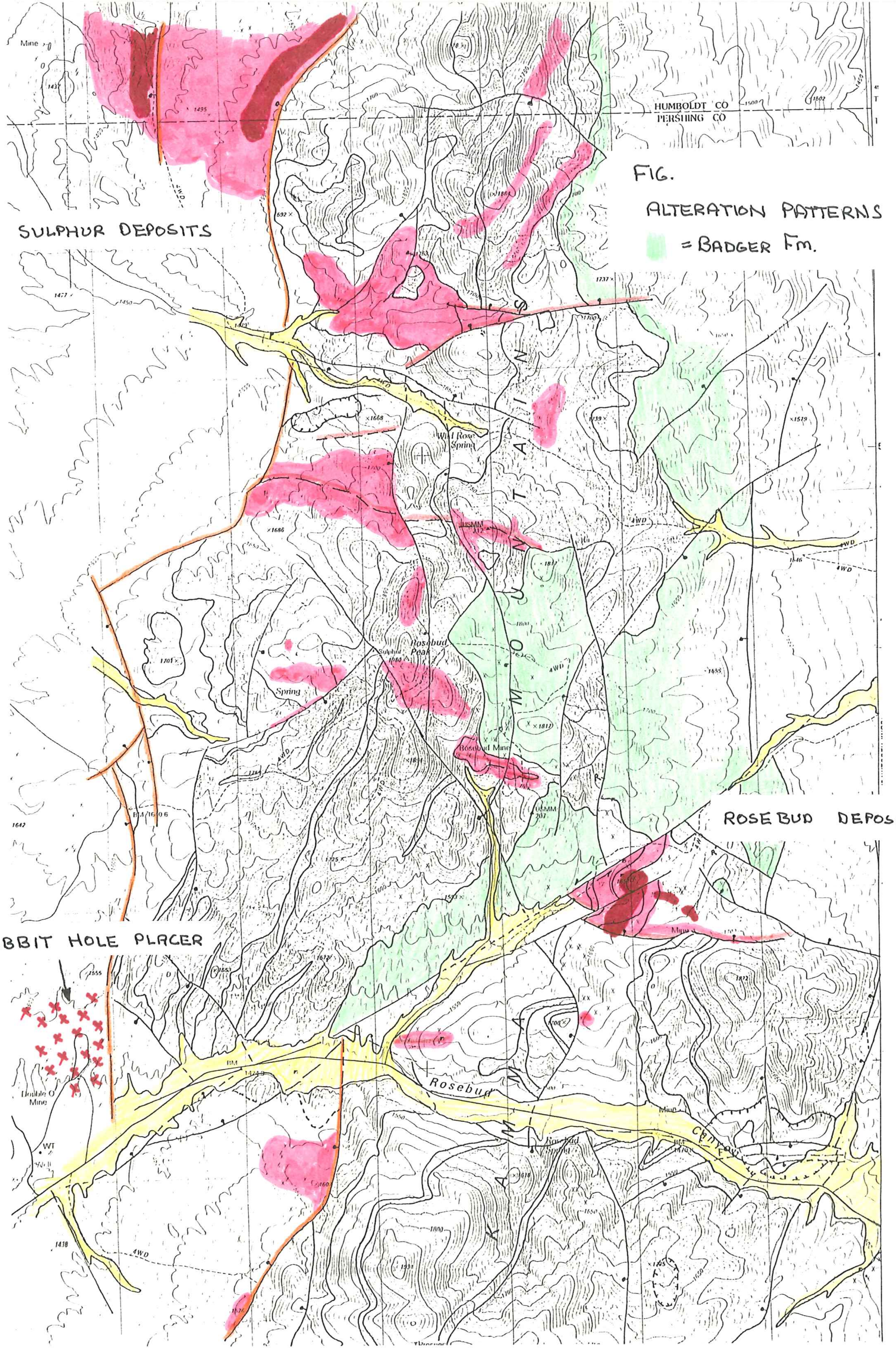


FIG.

ALTERATION PATTERNS

🟩 = BADGER Fm.

SULPHUR DEPOSITS

ROSEBUD DEPOSIT

RABBIT HOLE PLACER

5) Ag/Au ratios and weak associated Cu, Pb and Zn values all appear to have a random scatter throughout the property and were not helpful in establishing reliable zonation patterns.

Mineralization at the Rosebud Mine as well as most of the identified targets on the Rosebud Property are thought to be older than Sulphur District mineralization, possibly as old as 15-17 MY. The following observations imply this older age:

1) nearly all of the alteration/mineralization is focused on the older faults that trend east-west while the extensional faults and those related to the Rosebud Shear are barren.

2) in two specific areas (Target VI at the Dreamland Mine and Target VII north of Dreamland) the alteration/mineralization was found to persist within the Chocolate Tuff up to the contact with the Badger Formation where it then becomes covered by the Badger. Although the Badger outcrops poorly, just to the north of the Dreamland Mine the base of the Badger is exposed in road cuts where rounded pebbles of silicified volcanics and possible hot springs sinter are present. Interpretations are for the Badger to be post-mineral in age and yet older than 1.9MY since it is tilted nearly parallel to the other volcanic flows in the Kamma Mountains.

3) at dating at Hog Ranch (15.2 MY), Seven Troughs (14.1 MY) and Ten Mile (16.7 MY) in the general vicinity document an older period of mineralization for the area.

In summary, mineralization at the Rosebud Mine probably was channeled up along the South Ridge Fault. Deposition occurred in a fluid dominated environment below the zone of boiling within the South Ridge Fault zone as well as within the porous Tbs2 unit in the hangingwall as passive replacements. Without this favorable host rock control, the Rosebud Deposit might only have formed as a high grade epithermal vein similar to those known elsewhere in northwetern Nevada.

The exploration targets described in the following report section are therefore attractive primarily for higher grade mineralization deposited within relatively narrow shear zones. The major exceptions are where more porous, reactive hosts are suspected such as the base surge deposits in Targets III, IV and V or the intrusive rhyolites in Targets VI and X.

Throughout the map area the following general relationships are recognized but that I am unable to explain:

1) the Rabbit Hole gold placers are located along the southwest periphery of the Rosebud Property just north of Rosebud Canyon. Mapping was not attempted but based on published descriptions, coarse gold is present in association with Auld Lange Syne (JTra) fanglomerates overlying barren bedrock. There is no obvious source for the placers upstream in the general vicinity of Rosebud Peak.

2) weak to minor carbonate alteration is commonly associated with all rock types south of the Rosebud shear. Curiously, high barite is also is present in rock chip samples from the same area while north of the Rosebud shear, barite and carbonate alteration is essentially lacking.

3) district scale alteration patterns and known mineralization at Sulphur and Rosebud all appear to cluster along a N25-30W trend that extends from north to south across the map area. This may be indicative of deep structural control for the source of the mineral fluids.

TARGET DESCRIPTIONS

Target 1

Located in the SW portion of the map area, it was previously drilled by St. Joe Minerals, USMX and Lac Minerals although none of the drill results, sampling, etc. was examined as part of this study. Surface observations record strongly silicified Tf fanglomerate along a north-trending normal fault that separates Tos andesite on the east from Tf and underlying Ts sediments on the west. The Ts sediments appear to be argillically altered and leached while the Tf unit is silicified due by hot springs activity. A fluid boiling point may therefore be envisioned near the Tf/Ts sedimentary contact.

Surface rock chip samples in the Tf unit (RS-24,25) record 219 ppb Au, 15.6 ppm Ag, 5 ppm Hg and relatively low 35 ppm As and 15 ppm Sb. Sampling in the Ts below the most altered Tf unit is inconclusive since no samples were obtained due to the lack of outcrop. Sample RS-22 was obtained 1,000 feet west and it returned 39 ppb Au, 58 ppm As, 27 ppm Sb and 2.1 ppm Hg. The surface geochemistry in the Tf units is consistent with the upper levels of a boiling system and better gold values might be expected at depth.

The drill results should be reviewed to ascertain the exploration potential of the following areas:

- the Ts as a host for stockwork/disseminated mineralization similar to that known in the Sulphur District to the north.

- the Ts/volcanic contact (probably the Chocolate Tuff) for abrupt permeability changes that could have caused premature fluid boiling and gold deposition.

- the Tbs2 unit below the Chocolate Tuff for high grade stockwork/disseminated Au+Ag mineralization deposited within a favorable host.

- the north trending feeder fault for vein hosted Au+Ag mineralization.

Target II

Located in the west-central portion of the map area where the mine road intersects the Rosebud Canyon road. In samples RS-5 to 7, strong gold (565 ppb) and arsenic (103 ppm) is present in NE trending fractures that cut the

Dozer Tuff (Td). Silver, mercury and antimony are uniformly low. Multiple prospect pits explore the shallow surface shows and a crosscut drift (not entered) intersects the mineralized area from the level of the valley. The mine dumps reveal quartz flooding in a vuggy (desilicified?) rhyolite volcanic breccia associated with barite (averages 1248 ppm in samples) and white hydrothermal clay.

There are numerous drill holes in the general vicinity but presumably all are for shallow water exploration and not drilled to test the mineralization at depth. No favorable base surge horizons can be projected to underlie the target area but possible exploration targets might include:

- a fracture zone within the Td unit that may be sufficiently mineralized and of sufficient continuity to contemplate underground mining.

- high grade Au+Ag mineralization along the Td/Tos faulted contact.

- mineralization along the Tos/JTra contact directly underlying the surface fracture hosted mineralization.

Target III

Located on the west flank of the present Rosebud orebody. Surface mapping over the orebody in the general vicinity of Dozer Hill appears to define a normal sequence with Chocolate Tuff (Tc) at the peak and Tbs2 down the west facing slope. The area is highly altered and considerable surface disturbance with reclaimed roads obscures important details.

The mine crossections in the area show Chocolate Tuff underlain by Bud (possibly base of Tc or Ta underlain by LBT (possibly Tbs2) and then bottoming at Oscar (Tos) with the South Ridge Fault and Td below. My interpretation implies that Tos is really Ta and that Tbs1 lies below wedged between the Rosebud Shear and the South Ridge Fault.

The drill results should be reviewed to test the above interpretation. If the above proves to be correct, the target could be very attractive since the Tbs1 unit would be the first favorable host to be encountered by the vertically(?) rising hydrothermal fluids. Also, if the target area proves to be mineralized, presumably the age relations between the Rosebud Shear, the South Ridge Fault and the mineralization itself might be more completely understood.

Target IV

Located in the central portion of the south map sheet. On the ridge top a small shaft of probable less than 50 foot depth explores a clay rich shear 0.5-1.0 foot wide trending N65W and dipping 78 degrees south within the Td unit. The west Td contact is defined by a north-trending fault with possibly 1,500 feet of normal displacement (west side down). Gold (2416 ppb) and arsenic (91 ppm) are present although barite, mercury and antimony are uniformly low in the one sample taken (RS-8).

Several drill holes were completed on the west side of the fault (RL-42-45) up the north slope of the ridge. Their results should be reviewed to determine if they intersected the Tbs1 and/or Tbs2 units as well as any anomalous mineralization. A secondary target might be the underlying Td formation for fracture hosted mineralization but this would be of lower priority.

Target V

A broad area of surface bleaching and weak local silicification of the Tc unit that envelops focused silica flooding of a north-trending shear zone known as the White Alps. The altered area attains maximum dimensions of 2,000 feet east-west by 1,000 feet north-south. Mapping reveals that the Tbs3 unit outcrops along the western margin of the alteration dipping under the alteration towards the east at 35-45 degrees. A major northwest trending normal fault projects into the area from the south, but it appears to horsetail into several separate segments before passing out to the north again as one segment.

Surface rock chip samples (RS-37 to 40; 60 to 63) were unsuccessful in delineating any continuously mineralized areas although locally gold is anomalous at 100-300 ppb. Extensive drilling was completed by Lac(?) on the steep, eastern slope that leads up to the White Alps with presumably negative results. The drill logs and assays should be reviewed to ascertain that they were indeed a disappointment.

The target as presently envisioned is blind where the Tbs3 unit dips east under Tc cover to intersect the White Alps silicified zone. I could find no old drill hole collars in the field that would have tested this conceptual target.

Target VI

The Dreamland intrusive appears to be a vertical plug that intrudes the Tc unit over an east-west lineated outcrop extent of 2,400 feet. It exhibits strong argillic alteration, weak to minor iron oxide staining and local veinlet silicification whereas I assume that in the unoxidized zone, quartz-sericite-pyrite stockwork veinlets would be present. Cutting the intrusive in an east-west orientation are several clay-rich shear zones each up to 1-3 feet wide with strongly anomalous Au+Ag+As+Sb mineralization (samples RS-33,47 and tailings samples RS-64,65).

The base of the Badger just north of the intrusive outcrop is composed of rounded to semi-rounded fragments of silicified Tc and hot springs sinter(?) material. I could not determine if this material was eroded from the local area of the Dreamland Mine or from a more distal source. Based on alteration textures and field relationships, my present guess is that the eroded material was derived from the upper levels of the White Alps system to the west and then shed eastward during the extensional tilting event.

My present interpretation is that the Dreamland Mine exploited the narrow high grade shears recovering approximately 8,500 tons @ 0.40 opt Au/13.0 opt Ag from supergene accumulations that were trapped in the kaolinized shear zones. Outcrop samples within the intrusive but away from the shears (RS-45,46,48) record anomalous gold (78 ppb) but weak arsenic (30 ppm) and essentially no silver (2.7 ppm) which I postulate is due primarily to surface oxidation and leaching. Higher grades of supergene enriched silver with 0.01-0.05 opt Au might occur at the oxide/sulfide interface in a broad stockwork zone.

Several old drill sites were noticed in the field that record some previous sampling of the Dreamland intrusive. They appear to be targeted at the high grade shear hosted mineralization but the logs and assays should be reviewed to determine:

- the depth of oxidation

- the mineral distributions outside of the shear zones

- a better definition for the shape of the Dreamland intrusive

Target VII

This target area is located in the south-central portion of the north map area across a prominent hill just south of Wildrose Canyon. Mapping revealed a silica breccia zone trending east-west across the hill crest over a strike distance of 2,200 feet that attains maximum surface widths of 150-200 feet. It strikes to the east under post-mineral Tb cover while the western margin appear to be at a north trending fault that is itself silicified and re-brecciated.

Surface rock chip samples (RS-53 to 59) reveal continuously anomalous gold (63 ppb), arsenic (55 ppm), antimony (38 ppm) and mercury (4 ppm) but low silver (1.2 ppm) along the entire strike length. Also, since the zone outcrops across the peak of the hill over a topographic relief of roughly 300 feet, it was interesting to note the following:

- the zone appears to narrow in width with decreasing topography

- the surface rock chip geochemistry increases dramatically with decreasing elevation as shown below

Sample No.	Elevation	Au(ppb)	As(ppm)	Sb(ppm)	Hg(ppm)
RS-57	6100	19	29	22	4
56	6050	49	55	46	3
55	6000	61	37	30	5
54/58	5900	122	65	34	5

The exploration target as presently envisioned consists of primary, high grade Au+Ag mineralization as a laterally continuous but narrow zone at +500 foot depths. Additional detailed mapping and sampling is required, but preliminary observations imply that the footwall is most intensely altered and mineralized (apparent dip to the south). Also, three old drill collars were found in the field (Asarco in the 1980's?) and this data needs to be assembled for examination if possible. At this early stage I believe that a very attractive target for high grade mineralization is implied.

need 1500' holes
- ppr

Target VIII

This target area is located 3,000 feet WNW of Target VII presumably on the western continuation of the same silica breccia zone. In contrast to Target VII where the deeper roots of the shear is prospective for higher grade mineralization, Target VIII is at a shallow erosional level due to offset along several post-mineral faults. It therefore may have some low grade, open pit potential. Alteration is broadly distributed over a surface area of 1,000 feet x 3,400 feet within which gold appears to be erratically distributed but anomalous (samples RS-71, 73 to 76 averaged 101 ppb Au).

The reconnaissance mapping and sampling completed to date is of insufficient detail to identify drill targets. It is therefore proposed that the entire Target area be evaluated through a more comprehensive work program but first Hecla's property boundary must be established since is now appears to bisect the area of interest. If clear title is established for the entire Target area, then the following might be considered:

- geologic mapping at 1"=200' scale

- additional surface rock chip sampling

- possible soil sampling

- at least 8 old drill hole collars were found in the field and an attempt should be made to obtain the logs and assays (Norgold - late 1980's?). Negative results would not necessarily eliminate the Target since most of the holes cluster on the western target periphery while the higher gold values were obtained from the central portion of the target area (RS-73,74).

Target IX a.k.a. "Gator"

This target area is located 3,000 feet NNE of Target VII on the north side of Wildrose Canyon. Previous work by Lac, Equinox and Hecla has apparently shown the presence of some gold mineralization so no sampling was attempted. I have not examined any of the exploration results to date but the following geologic comments are offered:

- surface alteration extends over a lineated area 500 feet x 2,000 feet parallel to a NNE trending fracture zone. The southern boundary of the alteration was not determined since it appears to extend under talus cover south of Wildrose Canyon.

- the host for the alteration appears to be the Tc unit roughly parallel to a gentle anticlinal axis. The Tbf unit is projected to underlie the area at shallow depth, possibly only 200-250 feet below the surface outcrops.

- there are no favorable porous base surge deposits that can be reliably projected into the target from peripheral areas. The most likely exploration target is for higher grade mineralization focused on the NNE trending shear, possibly near the intersection with several WNW faults that parallel Wildrose Canyon.

Target X

This target covers a poorly defined area along an east-west strike approximately 1,500 feet north of Wildrose Canyon. The eastern edge of the target is marked by shear hosted silica breccia outcrops 3-5 feet wide and individually 50-100 feet long where surface sampling (RS-86 to 88) revealed anomalous gold (59 ppb), arsenic (99 ppm), antimony (65 ppm) and mercury (13 ppm). The host for the mineralization is both the Tbf and Tc units. Projected west, the shear zone appears to horsetail and intersect into the Wildrose rhyolite intrusive as well as form possibly the intrusive/Tbf contact. Two samples in this area (RS-80,81) contained anomalous gold (72 ppb), arsenic (92 ppm), antimony (24 ppm) and mercury (7 ppm). Again due to the reconnaissance nature of this study no specific drill targets are envisioned but additional work including 1"=200' mapping and detailed surface sampling is justified.

Other Areas

The genetic relationship between the Rosebud Deposit and the South Ridge Fault is clear but the relationship of the orebody/South Ridge Fault and the Rosebud Shear remains ambiguous. This study implies that the Rosebud Shear is post-mineral with possibly some earlier movement but that its relationship to the formation of the Rosebud Deposit is only spatial and not genetic. I therefore believe that some effort should be directed at locating the north, offset portion of the Rosebud Deposit by the Rosebud Shear. If present it probably underlies the Badger Formation along the hangingwall of the shear north of Rosebud Canyon. All past drill results, geophysics, etc. should be reviewed for clues that might lead to specific drill targets.

The Dreamland Mine area was previously described for its exploration potential as Au+Ag mineralization hosted in the intrusive (Target VI). One additional target might be for disseminated/stockwork mineralization to be hosted in one of the base surge horizons at the intrusive margins. Mapping revealed the Tbs3 and Tbs4 units within the Tc persisting in outcrop from the south up to a major north trending fault just west of the Dreamland Mine area. Essentially no extension of the base surge horizons could be reliably located east of the fault but they probably are present and only covered by surface talus and soil. At least one deeper hole should be attempted to prospect for these favorable horizons.

Just north of the western mouth of Wildrose Canyon is an area of massive opaline silica that appears to rest on the south-southwest facing hill slope. Interpretations are for silicification along the dip slope of the north trending basin and range fault locally extending up to the northeast along the extensional fault trace. The silica bodies are erosional reminants of the fault with Tdi units on the footwall. All of the samples obtained from the area (RS-83 to 85, 93, 95, 102, 103) were found to be anomalous. (average 70 ppb Au, 30 ppm As, 3.2 ppm Hg and 34 ppm Sb) Additional exploration interest appears to be justified although Hecla's land position is limited by the Hycroft/Hecla property boundary approximately 1,000 feet to the northwest.

ROCK CHIP ASSAYS

ASSAY LABORATORIES

LYSIS REPORT : SP035298

American
Assay
Laboratories

LIENT : HECLA MINING CO.
OJECT : ROSEBUD
EFERENCE : RS-1/16

REPORTED : 18 SEP 1995

SAMPLES	Au FA60 ppb	Au(R) FA60 ppb
RS-1	20	
RS-2	8	
RS-3	<5	<5
RS-4	<5	
RS-5	8	
RS-6	1448	
RS-7	238	
RS-8	2416	2492
S-9	<5	
RS-10	301	
RS-11	<5	
RS-12	6	
RS-13	200	
RS-14	<5	
RS-15	<5	
RS-16	<5	

CLIENT: HECLA MINING INC.
CLIENT REF: ROSEBUD
AAL REF: SP035298
METHOD: AAL 02-1

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
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ELEMENT	Ag	Al	As	Ba	Be	Bi	Ca	Cd	Co	Cr	Cu	Fe	Ge	Hg	K	La	Mg	Mn	Mo	Na	Nb	Ni	P	Pb	Sb	Sc	Se	Sn	Sr	Te	Th	Ti	Tl	U	V	W	Y	Zn	Zr
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppb	%	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	ppm
RS-1	0.5	6.52	6.3	421	2	0.4	1.16	0.4	2	17	17	1.45	0.1	45	2.21	27	0.06	471	5	3.39	16	11	0.013	27	1.3	3	0.2	6	98	0.2	12	0.02	5	10	2	4	16	45	105
RS-2	0.5	6.62	8.6	549	3	0.1	0.17	0.4	2	19	20	2.37	0.1	90	4.31	33	0.08	280	6	1.1	14	11	0.011	27	0.9	4	0.1	8	58	0.2	15	0.03	5	10	6	4	13	140	81
RS-3	0.5	6.86	3.6	1076	2	0.1	0.6	0.4	5	37	34	3.6	0.1	20	4.47	38	0.05	447	11	2.04	17	19	0.014	25	2.9	3	0.1	11	96	0.2	14	0.03	5	10	7	4	10	33	101
RS-4	0.5	7.02	2.2	1088	2	0.5	0.99	0.4	6	44	28	3.71	0.1	35	4.73	60	0.09	617	7	1.75	14	21	0.035	21	2	5	0.1	8	115	0.2	13	0.14	5	10	22	4	21	51	134
RS-5	0.5	7.96	15.8	1006	3	0.2	0.33	0.4	2	23	20	6.64	0.1	35	3.63	67	0.22	433	17	2.06	20	17	0.018	34	1.6	5	0.4	6	112	0.2	16	0.06	5	10	10	4	21	183	127
RS-6	23.3	5.32	198	2232	1	0.2	0.24	0.4	3	16	19	3.22	0.1	250	2.66	66	0.09	182	567	1.02	20	10	0.012	58	22.7	6	1.5	8	63	0.4	15	0.05	5	10	13	4	14	51	90
RS-7	0.9	6.45	95.9	508	1	0.1	0.37	0.4	3	24	23	6.25	0.1	60	3.66	57	0.05	268	8	1.74	17	13	0.019	17	7.5	4	2.1	8	67	0.2	14	0.05	5	10	5	4	15	83	59
RS-8	7.7	6.13	91	557	2	0.2	0.41	0.4	2	7	22	3.22	0.1	30	3.12	55	0.14	738	19	0.53	17	6	0.011	44	4.2	5	4.4	3	56	0.2	14	0.05	5	10	9	4	16	81	127
RS-9	0.5	7.35	79.9	496	2	1.9	0.27	1	2	11	13	4.18	0.1	25	4.34	39	0.08	468	7	2.38	18	8	0.017	26	1.9	5	0.3	12	54	0.2	14	0.06	5	10	4	4	21	153	132
RS-10	4.2	3.09	55.1	392	1	0.1	0.15	0.4	5	17	17	3.89	0.1	45	1.17	12	0.11	299	5	0.28	9	9	0.04	11	6.3	2	8.7	6	50	0.2	5	0.09	5	10	14	4	8	41	77
RS-11	0.5	8.01	11.5	569	2	0.3	0.2	0.4	2	8	8	2.46	0.1	20	4.83	70	0.09	567	4	2.98	21	5	0.014	26	1.4	6	0.1	5	41	0.2	17	0.06	5	10	2	4	23	90	123
RS-12	0.5	8.01	19	1315	3	0.1	0.42	0.4	4	12	14	3.43	0.1	30	4.35	27	0.21	436	3	1.96	14	7	0.063	18	4.4	4	0.3	3	173	0.2	10	0.23	5	10	14	7	17	78	223
RS-13	2.1	7.42	53.8	1085	2	0.1	0.52	0.4	3	16	16	2.86	0.1	70	3.9	27	0.24	165	14	1.3	13	8	0.066	17	2.7	4	0.4	5	128	0.2	10	0.2	5	10	15	4	17	50	189
RS-14	0.5	7.29	3.7	1027	2	0.2	0.71	0.4	3	15	18	2.46	0.1	15	4.53	80	0.03	1827	4	2.2	17	10	0.015	39	1.4	4	0.1	7	56	0.2	17	0.06	5	10	7	4	27	50	150
RS-15	0.5	7.45	2.9	469	3	0.1	0.88	0.4	2	19	21	3.4	0.1	20	4.47	64	0.06	508	7	2.92	20	12	0.028	28	2	5	0.1	8	56	0.2	16	0.06	5	10	6	4	32	77	205
RS-16	0.5	6.97	8.3	700	3	0.3	1.46	0.4	5	17	24	3.89	0.1	30	4.12	63	0.09	1658	6	2.63	18	18	0.03	24	2.7	5	0.1	7	55	0.3	15	0.06	5	10	16	4	29	79	166
STANDARD CT/C	6	7.03	44.7	897	1	20.6	1.21	16.5	29	98	54	4.41	0.1	1820	1.93	42	1.22	1195	17	1.63	9	68	0.115	37	17.4	15	0.8	16	245	0.2	43	0.33	5	19	108	23	11	129	53
DETECTION LIM	0.2	0.01	0.1	2	1	0.1	0.01	0.2	1	1	1	0.01	0.1	5	0.01	2	0.01	1	1	0.01	2	1	0.001	2	0.1	1	0.1	2	1	0.1	2	0.01	2	5	2	1	2	1	1

0.500 GRAMS OF PULP IS DIGESTED WITH HYDROCHLORIC, NITRIC ACID, HYDROFLUORIC AND PERCHLORIC ACIDS.
THIS IS A TOTAL ACID DIGEST THAT DUE TO VOLATISATION LOSSES CAN UNDERSTATE THE As AND Sb VALUES
THIS DIGEST WILL REPORT ACID SOLUBLE Sn, Th, U AND Zr
IS FROM AND AQUA REGIA DIGEST AND DETERMINED BY COLD VAPOR/AAS. As,Bi,Ge,Sb,Se, AND Te ARE AQUA REGIA/AAS HYDRIDE.

CAN ASSAY LABORATORIES

ALYSIS REPORT : SP035471

American
Assay
Laboratories

LIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-17/28

REPORTED : 20 SEP 1995

SAMPLES	Au FA30 ppb	Au(R) FA30 ppb	Ag D210 ppm	As D210 ppm
RS-17	7		<0.5	28
RS-18	9	7	<0.5	12
RS-19	7		<0.5	12
RS-20	15		0.6	84
RS-21	<5		<0.5	15
RS-22	39		2.4	59
RS-23	40		2.9	27
RS-24	374	410	20.8	30
RS-25	243		29.2	54
RS-26	220		3.6	24
RS-27	<5		0.6	40
RS-28	20		4.8	141

SAY LABORATORIES

ISTONAL REPORT : SP035591

NT : HECLA MINING CO.
JECT : ROSEBUD
REFERENCE : RS-29/35

REPORTED : 5 OCT 1995

SAMPLES	Au(OZ)	Au(RZ)	Ag(OZ)	As
RS-29	0.001		<0.02	27
RS-30	<0.001		0.04	46
RS-31	<0.001		0.02	26
RS-32	<0.001		0.09	41
RS-33	0.073		0.50	110
RS-34	0.088	0.087	8.63	94
RS-35	0.002		0.20	38

AMERICAN ASSAY LABORATORIES

ANALYSIS REPORT : SP035766

American Assay Laboratories

CLIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-36/44

REPORTED : 17 OCT 1995

SAMPLES	Au(OZ) FA30 OPT	Au(RZ) FA30 ppb	Ag(OZ) D410 OPT	As D410 ppm	Cu D410 ppm	Pb D410 ppm	Se D410 ppm	Zn D410 ppm
RS-36	0.001	35	<0.02	<2	10	10	<0.2	2
RS-37	0.004	143	5.04	31	16	10	1.1	<2
RS-38	<0.001	<	0.27	4	14	<5	1.5	<2
RS-39	<0.001	<	0.06	3	26	<5	<0.2	3
RS-40	0.003	122	<0.02	4	26	<5	1.6	<2
RS-41	<0.001	25	<0.02	13	16	<5	<0.2	2
RS-42	0.104	3500	2.05	12	10	6	6.8	2
RS-43	<0.001	27	0.16	2	11	8	0.3	3
RS-44	0.015	513	0.06	4	4	6	1.2	2

CLIENT: HECLA MINING COMPANY
CLIENT REF: ROSEBUD - MIKE BRADY
AAL REF: SP036112
METHOD: AAL 01-0

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ELEMENT	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Th	Ti	U	V	W	Zn
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
RS-17	0.3	1.34	23	5	59	2	0.49	0.2	3	18	18	2.71	2	0.16	19	0.12	156	5	0.01	9	0.024	10	13	48	5	0.01	5	10	18	36
RS-18	0.1	0.83	20	6	28	2	0.36	0.4	4	23	29	2.7	2	0.12	13	0.07	157	6	0.01	10	0.017	5	13	26	5	0.01	5	7	2	8
RS-19	0.1	0.78	13	3	84	2	0.33	0.2	5	28	28	3.61	2	0.12	5	0.09	227	7	0.01	13	0.027	7	10	41	3	0.01	5	14	1	48
RS-20	0.4	1.05	97	8	343	2	0.56	0.2	2	15	35	1.69	2	0.48	5	0.09	55	10	0.06	5	0.029	5	11	68	2	0.01	5	25	1	6
RS-21	0.1	0.99	11	6	363	2	0.35	0.3	3	13	13	1.5	2	0.67	12	0.1	92	3	0.05	8	0.016	6	4	187	5	0.01	5	9	1	17
RS-22	2.1	0.52	58	4	172	2	0.17	0.2	2	13	19	1.81	7	0.33	16	0.09	48	3	0.03	6	0.017	7	27	149	8	0.01	5	6	1	13
RS-23	2.2	0.43	22	5	205	2	0.54	0.2	3	15	19	2.01	2	0.31	12	0.1	130	4	0.02	8	0.026	11	4	133	2	0.01	5	9	1	5
RS-24	17.3	0.28	26	4	306	2	0.5	0.2	9	52	65	4	2	0.05	3	0.08	615	12	0.01	22	0.043	6	12	70	2	0.01	5	13	1	5
RS-25	27.3	0.52	56	4	727	2	0.3	0.2	5	24	28	2.55	10	0.09	4	0.05	173	6	0.01	13	0.007	5	28	55	2	0.01	5	13	1	5
RS-26	2.7	0.29	21	4	425	2	38.52	0.2	1	4	7	0.33	2	0.1	2	0.11	2705	1	0.01	2	0.014	4	7	178	5	0.01	16	6	1	18
RS-27	0.2	0.78	34	6	92	2	0.23	0.3	4	23	21	2.08	2	0.24	11	0.03	225	6	0.01	11	0.005	6	3	23	2	0.01	5	8	1	21
RS-28	3.6	0.4	150	2	69	2	0.56	0.2	4	30	44	2.88	2	0.28	11	0.03	255	17	0.01	13	0.008	47	12	26	4	0.01	5	5	1	10
RS-29	0.1	0.63	16	2	88	2	0.12	0.2	5	33	57	2.96	2	0.14	7	0.04	178	8	0.02	15	0.033	11	11	135	2	0.01	5	9	1	20
RS-30	1	0.87	44	3	83	2	0.32	0.2	7	28	84	3.66	2	0.06	10	0.09	260	6	0.01	14	0.05	11	22	33	3	0.01	5	12	1	28
RS-31	0.4	0.71	33	4	36	2	0.12	0.4	3	27	24	2	2	0.08	15	0.03	119	6	0.01	11	0.008	12	5	17	7	0.01	5	6	1	3
RS-32	2.5	1.05	32	4	70	2	0.13	0.2	4	22	27	2.77	6	0.14	19	0.05	125	6	0.02	11	0.008	19	16	24	11	0.01	5	8	1	10
RS-33	15.9	0.92	101	14	110	2	0.58	0.2	1	5	17	2.79	2	0.25	12	0.09	31	5	0.62	3	0.01	19	11	58	10	0.01	5	7	1	56
RS-34	197	0.5	70	2	10	2	0.08	0.4	4	26	29	2.42	2	0.13	10	0.03	129	6	0.01	12	0.003	9	202	26	4	0.01	5	5	1	6
RS-35	0.2	0.74	14	3	23	2	0.09	0.3	1	13	11	2.08	2	0.11	9	0.02	60	4	0.01	6	0.009	11	12	33	7	0.01	5	3	1	27
RS-36	0.1	0.93	10	2	157	2	0.21	0.2	3	9	12	1.86	2	0.38	21	0.05	89	2	0.03	7	0.009	14	4	23	13	0.01	5	4	1	11
RS-37	128.1	0.61	25	3	69	2	0.09	0.2	3	21	24	3.07	2	0.37	11	0.05	123	5	0.02	9	0.008	10	87	22	8	0.01	5	6	1	14
RS-38	0.1	1.32	7	2	39	2	0.07	0.2	4	20	18	2.47	2	0.65	3	0.02	136	6	0.01	12	0.03	3	8	44	2	0.01	5	5	1	2
RS-39	0.3	1.07	7	2	72	2	0.29	0.2	5	33	31	2.92	2	0.37	10	0.03	160	8	0.03	14	0.019	5	8	37	6	0.01	5	7	1	6
RS-40	0.1	1.07	9	2	128	2	0.07	0.2	7	36	30	3.63	2	0.44	2	0.03	223	10	0.01	18	0.005	4	24	43	2	0.01	7	10	1	1
RS-41	0.1	0.71	23	4	66	4	0.09	0.2	2	16	15	3.9	2	0.1	19	0.03	79	6	0.01	7	0.009	6	27	27	11	0.01	5	14	1	10
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

0.500 GRAMS OF PULP IS DIGESTED WITH HYDROCHLORIC AND NITRIC ACID AT 95 DEGREE CENTIGRADE FOR ONE HOUR.
DIGEST IS PARTIAL FOR B Ba Ca Cr Fe La Mg Mn Sr Ti AND W
DIGEST IS LIMITED FOR Al K AND Na

CLIENT: HECLA MINING COMPANY
CLIENT REF: ROSEBUD - MIKE BRADY
AAL REF: SP036112
METHOD: AAL 01-0

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
FACSIMILE (702) 356-1413

ELEMENT SAMPLES	Ag ppm	Al %	As ppm	B ppm	Ba ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Hg ppm	K %	La ppm	Mg %	Mn ppm	Mo ppm	Na %	Ni ppm	P %	Pb ppm	Sb ppm	Sr ppm	Th ppm	Ti %	U ppm	V ppm	W ppm	Zn ppm
RS-42	62.1	0.71	75	3	334	2	0.1	0.2	4	17	20	2.43	27	0.21	6	0.03	110	6	0.01	9	0.007	9	25	55	2	0.01	5	5	1	6
RS-43	1.1	0.39	31	2	559	2	0.21	0.2	4	19	24	2.11	2	0.21	11	0.08	112	5	0.02	11	0.013	8	4	55	5	0.01	5	8	1	27
RS-44	0.4	0.54	36	3	138	2	0.1	0.2	2	11	10	1.9	2	0.3	12	0.05	92	3	0.02	6	0.011	9	5	27	5	0.01	5	5	1	7
STANDARD C	6.3	1.92	39	31	188	21	0.51	20.0	33	61	59	4.05	2	0.15	40	0.94	1065	21	0.06	66	0.094	36	16	52	37	0.08	20	61	12	134
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

0.500 GRAMS OF PULP IS DIGESTED WITH HYDROCHLORIC AND NITRIC ACID AT 95 DEGREE CENTIGRADE FOR ONE HOUR.
DIGEST IS PARTIAL FOR B Ba Ca Cr Fe La Mg Mn Sr Ti AND W
DIGEST IS LIMITED FOR Al K AND Na

American
Assay
Laboratories

CAN ASSAY LABORATORIES
ALYSIS REPORT : SP036083

American
Assay
Laboratories

CLIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-44/66

REPORTED : 2 NOV 1995

SAMPLES	Au FA30 ppb	Au(R) FA30 ppb
RS-45	43	
RS-46	65	
RS-47	4118	
RS-48	125	
RS-49	28	
RS-50	<5	
RS-51	<5	
RS-52	69	
RS-53	23	
RS-54	182	
RS-55	61	
RS-56	49	
RS-57	19	
RS-58	63	
RS-59	48	
RS-60	385	
RS-61	21	
RS-62	<5	
RS-63	<5	
RS-64	534	
RS-65	1299	
RS-66	129	

CLIENT: HECLA MINING COMPANY
CLIENT REF: ROSEBUD - MIKE BRADY
AAL REF: SP036083
METHOD: AAL 01-0

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
FACSIMILE (702) 356-1413

ELEMENT	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Th	Ti	U	V	W	Zn
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
RS-45	1.9	0.42	28	4	171	2	0.12	0.2	3	21	22	2.68	2	0.29	12	0.06	108	5	0.01	9	0.008	12	7	36	9	0.01	5	6	1	7
RS-46	3.3	0.31	18	4	33	2	0.12	0.2	3	15	15	2.93	2	0.2	7	0.03	115	5	0.02	9	0.017	12	11	21	7	0.01	5	5	1	9
RS-47	130	0.24	121	2	21	2	0.05	0.2	3	20	21	6.54	4	1.06	4	0.03	83	15	0.06	9	0.011	41	83	82	3	0.01	5	7	1	7
RS-48	3.1	0.29	44	3	72	2	0.12	0.2	3	16	16	3.03	2	0.17	8	0.03	118	5	0.01	10	0.004	12	14	16	7	0.01	5	5	1	4
RS-49	0.9	0.68	13	5	66	2	0.15	0.3	1	8	9	1.53	2	0.34	10	0.03	31	2	0.03	4	0.003	14	6	25	8	0.01	5	3	1	9
RS-50	0.3	0.97	9	5	97	2	0.28	0.2	2	10	12	1.75	2	0.49	24	0.07	87	2	0.14	5	0.006	21	2	223	10	0.01	5	4	1	42
RS-51	1	0.63	73	3	62	4	0.09	0.3	3	16	12	2.31	2	0.09	14	0.03	93	4	0.01	9	0.021	13	8	158	10	0.01	5	5	1	9
RS-52	0.9	0.71	67	37	73	2	1.48	0.2	1	6	7	3.56	2	0.42	16	0.19	69	6	0.81	2	0.033	15	18	160	4	0.01	5	7	1	29
RS-53	5.1	0.29	115	3	142	2	0.17	0.3	5	24	24	4	4	0.06	5	0.03	336	18	0.01	14	0.011	8	92	44	2	0.01	5	10	1	21
RS-54	1.9	0.49	70	4	92	2	0.12	0.2	4	29	28	3.41	8	0.05	8	0.04	134	18	0.01	13	0.011	36	48	31	5	0.01	5	6	1	13
RS-55	0.1	0.38	37	6	77	3	0.13	0.4	4	20	19	3.68	5	0.13	17	0.06	175	14	0.01	12	0.019	48	30	52	11	0.01	5	6	1	24
RS-56	0.8	0.39	55	9	48	2	0.19	0.3	5	33	34	5.01	3	0.11	9	0.04	1882	10	0.01	15	0.048	16	46	43	4	0.01	5	12	1	63
RS-57	0.1	0.34	29	4	44	2	0.17	0.6	3	15	15	2.85	4	0.07	15	0.04	110	5	0.01	9	0.011	8	22	33	8	0.01	5	5	1	2
RS-58	0.8	0.3	61	2	49	2	0.05	0.3	3	27	23	2.85	2	0.09	9	0.02	107	7	0.01	10	0.009	11	20	16	5	0.01	5	6	1	8
RS-59	0.1	0.44	18	2	173	2	0.04	0.4	5	30	33	3.59	2	0.11	8	0.02	150	7	0.01	13	0.007	7	8	38	4	0.01	5	7	1	7
RS-60	3.3	0.33	21	4	155	2	0.23	0.2	3	20	20	2.27	3	0.14	13	0.07	119	5	0.01	9	0.008	7	16	31	7	0.01	5	5	1	4
RS-61	0.3	0.36	13	3	43	2	0.22	0.2	3	18	18	2.02	2	0.09	11	0.06	111	5	0.01	9	0.009	6	10	20	8	0.01	5	4	1	4
RS-62	0.1	0.42	5	5	55	2	0.21	0.2	1	4	4	0.67	2	0.25	27	0.04	107	1	0.07	1	0.004	10	2	26	13	0.01	5	3	1	33
RS-63	0.4	1.22	8	2	666	2	0.87	0.2	2	7	7	1.59	2	0.37	28	0.09	339	2	0.21	4	0.034	18	2	828	11	0.02	5	5	1	34
RS-64	10.2	0.63	263	3	34	2	0.3	0.2	1	11	26	5.03	2	1.26	14	0.03	48	18	0.03	4	0.005	34	39	29	9	0.01	5	4	1	189
RS-65	6.8	0.59	158	2	51	2	0.3	0.3	1	8	22	3.64	2	0.97	21	0.02	38	11	0.06	4	0.004	31	10	21	13	0.01	5	2	1	381
RS-66	0.1	0.75	32	4	175	2	0.15	0.2	4	14	16	3.48	2	0.13	16	0.04	179	7	0.01	7	0.057	17	21	360	8	0.01	5	4	1	54
STANDARD C	7.1	1.97	43	28	180	22	0.52	18.8	31	63	61	4.18	4	0.16	41	0.96	1091	21	0.06	67	0.096	36	18	54	44	0.09	17	57	13	136
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

0.500 GRAMS OF PULP IS DIGESTED WITH HYDROCHLORIC AND NITRIC ACID AT 95 DEGREE CENTIGRADE FOR ONE HOUR.
DIGEST IS PARTIAL FOR B Ba Ca Cr Fe La Mg Mn Sr Ti AND W
DIGEST IS LIMITED FOR Al K AND Na

ICAN ASSAY LABORATORIES
NALYSIS REPORT SP036271

American Assay Laboratories

CLIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-67/95

REPORTED : 13 NOV 1995

SAMPLES	Au FA30 ppb	Au(R) FA30 ppb	Ag D210 ppm	As D210 ppm
RS-67	185		<0.5	28
RS-68	15		<0.5	129
RS-69	26		<0.5	29
RS-70	20		<0.5	33
RS-71	16		<0.5	13
RS-72	72		<0.5	27
RS-73	114		2.9	32
RS-74	300		1.0	27
RS-75	5		<0.5	5
RS-76	72		<0.5	40
RS-77	190		<0.5	39
RS-78	15	17	<0.5	41
RS-79	11		<0.5	25
RS-80	52		<0.5	254
RS-81	92		5.7	18
RS-82	30		1.2	29
RS-83	92		0.6	45
RS-84	35		<0.5	10
RS-85	101		<0.5	7
RS-86	63		<0.5	137
RS-87	64		<0.5	16
RS-88	50		<0.5	104
RS-89	30		<0.5	37
RS-90	107		2.1	97
RS-91	29		0.6	70

.ICAN ASSAY LABORATORIES

NALYSIS REPORT SP036271

American
Assay
Laboratories

CLIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-67/95

REPORTED : 13 NOV 1995

SAMPLES	Au FA30 ppb	Au(R) FA30 ppb	Ag D210 ppm	As D210 ppm
RS-92	10		0.5	26
RS-93	93		0.7	32
RS-94	255		1.3	70
RS-95	82		0.6	57

CLIENT: HELCA MINING CO./MIKE BRADY
CLIENT REF: ROSEBUD
AAL REF: SP036271
METHOD: AAL 01-0

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
FACSIMILE (702) 356-1413

ELEMENT	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Th	Ti	U	V	W	Zn
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
RS-67	0.2	1.04	23	6	115	4	0.16	0.2	2	14	15	3.79	3	0.11	15	0.04	150	9	0.01	5	0.038	11	31	26	9	0.01	23	5	1	54
RS-68	0.1	1.09	121	7	128	2	0.16	0.6	1	7	9	1.75	2	0.36	19	0.07	41	3	0.02	4	0.011	13	15	36	11	0.01	5	2	1	10
RS-69	0.1	0.7	23	2	212	2	0.24	0.2	1	9	8	2.02	2	0.22	23	0.04	69	3	0.02	3	0.03	27	20	63	6	0.01	5	6	1	8
RS-70	0.3	1.36	26	5	375	2	0.5	0.4	2	17	17	2.73	5	0.07	12	0.1	200	6	0.01	8	0.033	19	19	89	6	0.01	5	9	1	12
RS-71	0.1	0.83	4	6	100	2	0.39	0.3	4	31	28	2.93	5	0.06	11	0.05	256	8	0.09	12	0.017	10	13	50	3	0.01	5	6	1	20
RS-72	0.1	0.66	8	5	59	7	0.2	0.4	1	6	15	9.47	2	1.12	52	0.04	61	6	0.06	3	0.118	9	26	498	10	0.01	5	11	1	53
RS-73	2.7	1.08	23	5	95	4	0.15	0.4	1	9	13	3.1	2	0.12	22	0.05	73	3	0.01	4	0.036	23	33	99	9	0.01	5	6	1	10
RS-74	0.6	1.15	19	3	86	2	0.11	0.5	1	9	12	2.7	2	0.09	17	0.04	67	3	0.01	5	0.027	17	77	75	9	0.01	5	3	1	9
RS-75	0.1	0.79	2	4	261	2	0.27	0.3	1	6	8	2.12	2	0.37	23	0.09	36	3	0.02	2	0.043	11	2	129	10	0.01	5	3	1	9
RS-76	0.1	1.28	34	4	179	2	0.22	0.5	1	6	8	2.61	3	0.08	12	0.07	32	6	0.01	2	0.022	14	21	61	10	0.01	5	5	1	7
RS-77	0.1	1.11	21	6	123	4	0.25	0.2	1	10	15	5.69	2	0.3	24	0.03	61	5	0.08	4	0.132	10	29	78	6	0.01	5	22	1	32
RS-78	0.1	0.92	51	2	101	2	0.2	0.2	3	7	13	3.23	5	0.11	23	0.02	95	5	0.01	3	0.061	23	32	52	8	0.01	5	7	1	36
RS-79	0.1	1.34	15	4	82	2	0.2	0.2	2	16	15	2.64	4	0.08	18	0.03	83	5	0.01	5	0.048	6	15	44	6	0.01	5	5	1	14
RS-80	0.1	1.74	138	4	117	2	0.08	0.5	1	10	13	3.11	11	0.29	8	0.01	51	3	0.02	4	0.034	16	30	37	4	0.01	5	5	1	8
RS-81	3.6	1.02	46	4	133	2	0.12	0.3	2	15	14	2.55	3	0.65	16	0.03	79	8	0.03	6	0.03	10	19	77	6	0.01	5	5	1	7
RS-82	0.8	1.26	19	3	123	2	0.13	0.5	1	7	7	1.82	2	0.25	26	0.04	47	2	0.04	3	0.027	12	7	112	10	0.01	5	4	1	7
RS-83	0.6	0.53	35	4	96	2	0.42	0.2	3	24	21	2.87	2	0.18	41	0.05	415	9	0.02	9	0.016	8	19	26	11	0.01	5	7	1	49
RS-84	0.1	0.15	2	2	648	2	0.27	0.2	5	38	38	3.03	6	0.04	2	0.04	251	9	0.01	16	0.02	6	5	34	2	0.01	5	9	1	5
RS-85	0.1	0.06	2	6	238	3	1.36	0.2	2	13	16	1.07	2	0.02	2	0.17	59	3	0.1	6	0.005	3	2	73	2	0.01	5	4	1	4
RS-86	0.1	1.14	149	3	256	2	0.25	0.2	3	22	22	2.82	29	0.11	10	0.04	194	9	0.02	10	0.05	13	112	90	4	0.01	5	11	1	16
RS-87	0.1	0.85	46	2	95	4	0.23	0.2	2	17	17	2.37	6	0.13	15	0.03	95	6	0.02	7	0.022	32	40	57	5	0.01	5	6	1	8
RS-88	0.1	1.17	102	4	245	2	0.29	0.5	1	11	15	3.96	5	0.16	20	0.08	143	5	0.01	4	0.07	24	43	102	6	0.01	5	8	1	11
RS-89	0.2	0.97	18	2	175	2	0.12	0.2	1	11	12	2.26	2	0.29	20	0.07	68	4	0.03	6	0.018	12	13	34	10	0.01	5	7	1	10
RS-90	1.9	0.94	82	2	164	2	0.14	0.4	2	16	16	2.43	2	0.25	23	0.04	111	5	0.01	7	0.027	17	19	95	7	0.01	5	6	1	8
RS-91	0.6	0.84	51	6	72	2	0.08	0.4	2	16	14	2.3	3	0.22	21	0.02	91	6	0.02	5	0.009	13	19	20	10	0.01	5	4	1	11
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

0.500 GRAMS OF PULP IS DIGESTED WITH HYDROCHLORIC AND NITRIC ACID AT 95 DEGREE CENTIGRADE FOR ONE HOUR.
DIGEST IS PARTIAL FOR B Ba Ca Cr Fe La Mg Mn Sr Ti AND W
DIGEST IS LIMITED FOR Al K AND Na

IENT: HELCA MINING CO./MIKE BRADY
CLIENT REF: ROSEBUD
AAL REF: SP036271
METHOD: AAL 01-0

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
FACSIMILE (702) 356-1413

ELEMENT	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Th	Ti	U	V	W	Zn
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
RS-92	0.3	0.79	9	3	115	2	0.16	0.3	2	20	19	2.19	3	0.24	20	0.03	128	6	0.03	6	0.01	6	17	24	10	0.01	5	7	1	7
RS-93	0.3	0.74	26	3	134	2	0.17	0.2	3	29	28	3.07	2	0.19	35	0.02	193	9	0.02	11	0.05	6	16	27	9	0.01	5	10	1	26
RS-94	1.1	0.76	68	3	70	3	0.18	0.4	1	15	15	2.97	2	0.28	14	0.03	66	4	0.01	6	0.007	12	23	23	5	0.01	5	3	1	4
RS-95	0.2	0.49	37	2	41	2	0.17	0.3	4	32	30	3.08	6	0.04	6	0.04	161	8	0.01	13	0.012	7	10	24	2	0.01	8	8	1	5
STANDARD C	6.6	1.89	41	26	191	21	0.5	18.4	31	60	61	4.13	2	0.16	41	0.95	1113	22	0.07	70	0.098	38	18	52	38	0.08	21	59	12	137
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

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DIGEST IS LIMITED FOR Al K AND Na

AMERICAN ASSAY LABORATORIES

PROVISIONAL REPORT SP036437

CLIENT : HECLA MINING CO.
PROJECT : ROSEBUD
REFERENCE : RS-96/104

REPORTED : 14 NOV 1995

SAMPLES	Au AA(R)
RS-96	<5
RS-97	51
RS-98	<5
RS-99	10
RS-100	<5
RS-101	69
RS-102	58
RS-103	25
RS-104	99

CLIENT: HECLA MINING COMPANY
CLIENT REF: ROSEBUD - MIKE BRADY
AAL REF: SP036437
METHOD: AAL 01-0

1500 GLENDALE AVENUE
SPARKS, NEVADA 89431
TELEPHONE (702) 356-0606
FACSIMILE (702) 356-1413

ELEMENT	Ag	Al	As	B	Ba	Bi	Ca	Cd	Co	Cr	Cu	Fe	Hg	K	La	Mg	Mn	Mo	Na	Ni	P	Pb	Sb	Sr	Th	Ti	U	V	W	Zn
SAMPLES	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm
RS-96	0.1	0.59	78	5	130	2	0.33	0.2	2	14	17	2.9	3	0.15	18	0.1	115	4	0.03	6	0.022	8	19	45	11	0.01	5	7	1	16
RS-97	0.1	0.72	79	3	122	2	0.05	0.2	3	24	27	3.61	36	0.31	16	0.02	143	5	0.04	10	0.016	13	28	22	7	0.01	5	5	1	9
RS-98	0.2	0.88	29	4	109	3	0.38	0.4	2	8	12	3.62	2	0.16	27	0.08	784	3	0.02	4	0.033	15	22	37	12	0.01	5	3	1	105
RS-99	0.1	1.05	79	5	82	2	0.24	0.2	3	22	26	3.6	2	0.29	5	0.04	122	7	0.03	10	0.011	7	12	53	3	0.01	5	6	1	4
RS-100	0.1	1.06	26	2	40	2	0.11	0.2	4	33	36	2.94	3	0.22	7	0.02	186	8	0.03	13	0.018	7	8	48	3	0.01	5	7	1	4
RS-101	1.5	0.96	37	3	55	2	0.26	0.2	5	38	41	4.05	2	0.1	23	0.04	218	10	0.01	17	0.025	24	13	25	8	0.01	5	8	1	6
RS-102	0.7	1	66	2	43	2	0.13	0.2	7	43	49	3.84	3	0.13	11	0.08	267	11	0.01	18	0.026	13	25	18	5	0.01	5	17	1	22
RS-103	0.2	0.55	42	2	58	2	0.33	0.2	6	46	47	4.01	2	0.02	6	0.03	289	11	0.01	18	0.014	3	52	34	3	0.01	5	12	1	8
RS-104	1.9	0.81	80	4	196	3	0.33	0.2	6	31	50	4.48	2	0.08	19	0.09	579	9	0.01	16	0.053	20	17	83	6	0.01	5	24	1	37
DETECTION LIMIT	0.1	0.01	2	2	2	2	0.01	0.2	1	1	1	0.01	1	0.01	2	0.01	1	1	0.01	1	0.001	2	2	1	2	0.01	5	2	1	1

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DIGEST IS PARTIAL FOR B Ba Ca Cr Fe La Mg Mn Sr Ti AND W
DIGEST IS LIMITED FOR Al K AND Na

PETROGRAPHY

THEODORE P. PASTER, Ph.D.
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(303) 771-8219

September 27, 1995

Mike Brady
Consulting Geologist
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FAX: (702) 345-1317

RE: Petrography of Tertiary Volcanics; RB-1 through RB-7.

SUMMARY

Rock Types

Because of the extremely fine-grained nature of the rocks and the absence of, or poorly preserved nature of, phenos it is very difficult to identify specific feldspars and hence the rock types.

There is no doubt that all of the rocks are closely-spaced in time and in genesis because: 1) They were all vitric initially. 2) They show similar devitrification features.

A quick and dirty procedure for identifying the amount of K-spar in the rocks would be staining for K. This could be done and looked at for $8.00/sample. Let me know if you want this dome ASAP.

Alteration

The major alteration is devitrification.

RB-1 is propylitically altered with some additional carbonate alteration.

RB-7 is either slightly propylitically altered or slightly clay altered.

RB-2, RB-4, RB-6 are slightly carbonate altered.

RB-3 contains some minor zeolite in fractures.

The reddish-colored rocks are oxidized.

Respectfully submitted:

PETROGRAPHIC DESCRIPTIONS

RB-1; Propylitically-Altered Vesicular Basalt or Andesite. (TOS)

Tos

Phenos (7%):

5% [Ferromag]	0.16-4mm	Relict euhedra 100% replaced with carbonate (Carb) > chert + chlorite (Chl) with limonite or earthy hematite (Ht) in relict cleavages.
2% [Olivine?] (Ol)	0.12-1.0mm	Deformed structures 100% replaced with green fibrous chlorophaeite.

Groundmass (86%):

59% Feldspar (F)	0.05-0.3mm long	Tabular crystals aligned on local scale (trachytic texture). Murky with fine-grained incipient alteration. Can't tell whether it is K-spar or plagioclase (Pl).
20% Chlorite (Chl)	<0.01-0.07mm	Fibrous green mineral in an- to subhedral patches and euhedral relict crystals.
10% Epidote (Ep)	-	Extremely fine-grained material appears to partly replace F.
7% Carbonate +Hematite + Chert	12-50u	Mottled relict subhedral mineral may be amphibole.
4% Magnetite (Mt)	<0.01-0.05mm	Small octahedra with Ht rinds.

Vesicles (7%):

	0.6-4mm long	Parallel, elongate structures which generally have scalloped edges. 96% filled with coarse Carb with occasional Chl along Carb grain boundaries and between Carb growth layers.

RB-2; Devitrified Acidic or Alkaline Volcanic. (Td) ?trachyte? Rhyolitic glass?

Structures (20%):

	1-4mm	Equant to elongate patches with indistinct boundaries. Generally occur along partly Fe-stained micro-fractures. Consists of Carb patches and small Q subhedra in groundmass of clay.

Td

Phenos (tr%):

tr Sanidine	0.3-0.7mm	Euhedra in a cluster in small part of thin section (ts). 60-95% replaced by Carb.

Groundmass (80%):

95% Feldspar/ Quartz, spherulitic.	0.05-0.3mm	Annealed spherulites with abundant inclusions.
5% Quartz	0.02-0.1mm	An-subhedra both monocrystalline and in

[ ] = Totally replaced or destroyed phase.

polycrystalline aggregates. More or less disseminated in groundmass.

Based on past observations this texture is most common in devitrified rhyolitic glass.

RB-3; Devitrified, Possibly Altered Trachytes ~~Andesitic~~ Glass. (Td)

Devitrified Glass (98%):

Phenos (tr%);

tr Plagioclase(?) (Pl)	0.1-2.4mm	Sparse, aligned crystals. Cloudy with incipient alteration.

Groundmass (98%);

98% Cryptocrystalline Fibrous Mineral	<0.05mm	Has undulatory extinction. More or less aligned to give a foliation to rock. Apparently a spherulitic F which has been replaced with a zeolite or clay.
2% Magnetite	3-30u	Small disseminated grains.

Td

Vuggy Fractures (2%):

2% Chabazite(?) zeolite	0.04-0.3mm	Subhedra nucleate in fractures and are commonly radiate.
tr Clay	-	Appears to be an occasional alteration product of zeolite.
tr Limonite(Lm)	-	Stain in portions of fractures.

Vesicle (tr%):

	0.2mm dia.	Contains radiate Q and walls replaced with clay.

RB-4; Brecciated or Tuffaceous(?) Vitric Andesite. (Td)

Andesite (84%): Subangular fragments 0.01-1.3 cm in size.

Phenos (2%);

2% [Ferromag]	0.03-0.07mm	Replaced with limonite (Stained).
tr Feldspar	0.1-0.3mm	Cloudy subhedra with carlsbad or albite twinning.

Td

Groundmass (98%);

98% Feldspar	up to 0.07mm	Poorly crystallized tabular crystals non-oriented to common direction.
2% Magnetite	<0.01-0.05mm	Ragged octahedra with thin Ht rinds.

Voids (1%):

	0.04-2.5mm	Irregular-shaped voids. Sometimes within andesite fragments but mainly interstitial to fragments.

Inter-fragmental Cement (15%):

This material, due to its vitric nature, shows little visual difference from the andesite fragments.

75% Comminuted Vitric Andesite	-	Practically indistinguishable from fragments.
30-5% Carbonate (Carb)	up to 1.2mm in section	Late interstitial cement that is optically continuous for over 4mm.
5% Quartz (Q)	<0.1mm	As anhedra in cherty polycrystalline aggregates interstitial to fragments.
tr Limonite	-	Generally as red stain on surface of fragments but occasionally through portions of cement.

This rock, except for the brecciation, is very similar to RB-3. One fragment deformed over another and slight differences in texture and mineralogy of the fragments suggest that this rock is a tuff.

RB-5; Devitrified ~~Andesitic~~ trachyte Glass Tuff. (Td)

This is the same rock as RB-3 except it is a tuff with the finer-grained matrix being Fe-stained. The Fe-staining is the same as in RB-4 but stronger.

Devitrified Glass Fragments (80%):

See RB-3 for description.

Inter-fragmental Cement (20%):

Td

10% Comminuted Glass	-	Indistinguishable from larger fragments except intermixed with Q and Ht.
5% Quartz	0.01-0.4mm	Sub-anhedra in polycrystalline aggregates interstitial to lithic fragments.
5% Hematite(Ht) or Limonite	-	As opaque stain on glass fragments.

RB-6; Trachyte(?). (Ta)

This rock is similar to RB-1 in that it has trachytic texture. It is different in that it has no Chl, Ol, nor propylitic alteration. It is oxidized.

Phenos (2%):

And marker

2% Biotite (Bt)	0.05-0.3mm	Brown anhedra stained and partly replaced with bright red Ht.
tr [Feldspar]	0.08-0.4mm	Euhedra replaced with Carb.

Groundmass (98%):

87% Feldspar	up to 0.05mm	More or less aligned to common direction. Can't tell whether it is K-spar or Pl.

10% Hematite and/or Ilmenite(Ilm).	1-50u	As grains and plates interstitial to F.
3% Carbonate	0.05-0.7mm	As anhedral patches. Disseminated and often strung out along discontinuous microfractures.

RB-7; Devitrified Trachytic or Rhyolitic Glass. (Tdi)

93% Feldspar	0.05mm long	As indistinct laths with traces of spherulitic or trachytic texture which has been annealed into indistinct super-grains. See RB-2.
5% Quartz	up to 0.12mm	An-subhedra in small polycrystalline aggregates erratically scattered in rock.
2% Hematite	2-24u	As disseminated spherulites and euhedra. Variability in distribution gives mottling to rock.
tr Clay or Chlorite	24u	Blebs up to 0.08mm after ferromag often contain Ht spherulites.

Tdi

September 27, 1995

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October 19, 1995

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FAX: (702) 345-1317

RE: Petrography of Tertiary Volcanics; RB-8 through RB-14.

SUMMARY

Rock Types

Samples RB-8 through 14 were stained for K-spar free of charge to help identify rock types. There is quite a bit of K-spar in all of the rocks; some more than others.

Comparing RB-12 of this suite to the first seven samples described suggests that RB-3 and RB-5 are probably trachytes instead of andesites.

Most rocks are trachytic. Those that contain less K-spar and more Pl are fragments in RB-10 (A breccia.), RB-11, RB-13.

Some fragments in RB-10 contain perlitic fractures which suggests a rhyolitic composition.

A welded tuff is present in the breccia or volcanic conglomerate of RB-13. This is the only welded tuff seen in the samples through RB-14.

Alteration

RB-9, RB-11 and RB-12 are lightly argillic-altered.

RB-10 contains variable fine-grained Chl after groundmass Pl.

Carb replaces patches of groundmass in RB-10 and fills or lines voids in RB-10 and RB-13.

RB-14 is moderately silicified.

Respectfully submitted:

PETROGRAPHIC DESCRIPTIONS

RB-8; Trachyte. (Ta)

This rock is nearly identical to RB-6 in texture, grain size, Cal patches.

Microphenocrysts (1%):

1% Sanidine > Plagioclase(Pl)	0.02-0.15mm	More or less aligned laths which are often partly replaced by Carb.

Groundmass (99%):

45% Cryptocrystalline Fibrous Mineral	-	Bundles of fibers have undulatory extinction and are aligned to rock foliation. F is more radiate than spherulitic.
25% K-Spar > Plagioclase(?)	up to 0.08mm	Turbid, indistinct laths and equant grains aligned in bundles.
15% Glass	-	Isotropic phase interstitial to other phases.
7% Calcite (Cal)	0.1-1.0mm	As irregular poikilitic patches of alteration, larger of which, contain mottle specks and stains of Ht.
3% Magnetite (Mt)	2-24u	Euhedra altered on edges to Ht.
3% Biotite (Bt)	0.02-0.1mm	Ragged reddish-brown flakes in randomly scattered clumps.
2% Anatase(?)	2-18u	Scattered subhedra.

Note that part of this section has been stained for K-spar and most F indicates K-spar.

RB-9; Argillic(?)-Altered Vitric Trachyte. (Tri)

Trachytic texture not distinct as in RB-6 and 7 due to clay alteration. No visible opaques have crystallized.

Phenos (2%): Occasionally in 2mm clusters.

tr [Feldspar] (F)	0.2mm	Relict deformed subhedra either as voids or filled with fine-grained WM/clay or with Q near veinlets.
2% [Ferromag]	0.05-0.35mm	Relict, occasionally deformed euhedra 100% replaced with Chl.

Porphyroblasts (1%):

1% [Pyrite]	0.02-0.08mm	Cubic molds inhomogeneously distributed.

Groundmass (93%):

93% [Feldspar] + Glass	up to 0.1mm	F is aligned, very murky and altered to WM/clay. It stains yellow indicating that

the WM/clay is K-bearing. Murkyness caused by glass and Lx.

Late Veinlets (1%):

	3-30u thick	3 parallel veinlets spaced about 4mm apart composed of chalcedony recrystallized into equant Q grains. About 45° to foliation.

Early Veinlets/Vugs (3%):

	0.01-0.4mm thick	Discontinuous, disrupted, often lensoid, structures perpendicular to late veinlets. Lined with Q and lenses filled with fine-grained WM or illite.

RB-10; Lithic Vitric Trachytic, Andesitic and Rhyolitic(?) Breccia. (Tbs)

Phenos (3%):

3% Plagioclase	0.2-2.0mm	Fractured, broken, fresh subhedra.

Lithic Fragments (40%):

	0.4-5.0mm	Subangular fragments of vitric volcanics with rare Pl and Bt phenos. They show varying degrees of devitrification and foliation. Some contain fine-grained Chl. Some have perlitic fracturing (Indicating rhyolite).

Groundmass (57%): The groundmass also appears to be brecciated and cemented with 3% glass.

89% Feldspar	<0.03mm	Estimated percentages and variable. 50/50 : K-spar/(Pl + Q).
5% Carbonate	<0.01-3mm	Bimodal size. Small euhedra in clumps up to 0.2mm in altered zones in groundmass and larger size as anhedra appear to be cement in vugs in breccia.
3% Glass	-	Interstitial to groundmass fragments.
3% Epidote (Ep)	<3u	As polycrystalline aggregates replace F in patches. May also include Lx in groundmass.

RB-11; Oxidized/Weathered(?) Latite(?). (Tc)

Phenos (13%):

10% Plagioclase (An_{25})	0.06-4.5mm	Nearly fresh sub-anhedra. Largest are commonly in polycrystalline clumps. Occasionally replaced by clay along fractures.
3% Biotite	0.2-0.7mm long	Indistinct subhedra. Occasionally replaced with clay in patches associated with fractures. May be secondary Bt because phenos have Ht granules on rims. Most small, 0.04-0.3mm, books are aligned and solidly

		replaced with Ht.
Vesicles?(4%):	0.2-0.8mm	Spherical structures composed (filled?) of earthy deep red Ht.
Groundmass (86%):		Coarser than most groundmasses seen in the suites thus far.
78% Feldspar	0.01-0.15mm	Inter-grown anhedra nearly micro-spherulitic structure and aligned indistinct tabular crystals.
12% Clay	-	Montmorillonite or illite in ragged diffuse patches which are often Fe-stained near vesicles and in other areas related to microfractures(?).
5% Quartz	0.02-0.17mm	Dispersed anhedra. More often than not in aligned elongate aggregates which may be filled trapped gas voids in volcanics.
5% Hematite/ Limonite(Lm)	2u-0.15mm	Ragged discontinuous dark grains and as stain in clay.
Vugs?(1%):	1.6-5mm long	Lensoid cavities aligned to foliation filled with 8% euhedral Q on walls and filled with unusually plumose-formed adularia. Q content is variable. Some small discontinuous veinlets are over 90% Q.

RB-12; Brecciated Trachyte. (Tdi?)

Very similar to RB-3 and -5 except this rock is a breccia. Because the F staining of this rock is so strong and uniform this rock (and probably RB-3 and -5) is judged to be a trachyte.

Lithic Fragments (80%):	0.2-7mm	Fractured and displaced trachyte. Poor lineation due to flowage is conformable from fragment to fragment. One fragment is a F/Q agglomerate in trachyte.
Cement (17%):		Apparently more glassy trachyte with more abundant finely disseminated Ht and Lx than adjacent fragments.
Tension Gashes and Vesicles(?) (3%):	0.01-0.4mm thick	Discontinuous, generally aligned structures occur in cement. Filled with sub-anhedral seriate (<0.01-0.2mm) Q and clay.

RB-13; Latite and Latitic Welded Tuff Fault(?) Breccia. (Tc vent)

Lithic Fragments (92%):

	0.04-12mm	Angular fragments of welded tuff, latite(?) and vitric andesite(?). Many of the fragments are broken and offset.

Welded Tuff and Latite (4%);
Phenos (4%),

4% Plagioclase	0.2-2.5mm	Equant subhedra. Largest are crushed.

Voids (2%),

	0.4-1.0mm	Angular spaces in fractured fragments which are lined with Carb.

Groundmass (94%),

86% Feldspar + Glass	-	Composed of 50% crudely to non-aligned F crystallites intermixed with 50% glass.
10% Hematite	-	Stain in laminae between less-stained glass in tuff.
1-5% K-Spar $\geq$ Plagioclase(An_{25}).	0.05-0.25mm	Tabular crystals aligned to form a foliation (with Bt).
tr-2% [Biotite]	0.04-0.3mm	Books are stained and/or replaced earthy Ht.

Cement (8%):

Appears to be glass or rock powder which is opaque due to strong earthy Ht stain.

The welded tuff has not been seen in the previous samples. The 6% vitric andesite is not described here.

It is not certain that this is a fault breccia. The variety of lithic fragments would suggest this, an intrusive breccia or a lithic tuff. The fragments are not rounded enough for an intrusive breccia. The variety of rock types is not common in tuffs. Another possibility besides a fault breccia is a sedimentary rock from a caldera environment.

RB-14; Silicified Trachytic Tuff. (Tc silic?)

Lithic fragments are the same as RB-9, except instead of clay, the alteration is silica.

Lithic Fragments (60%):

	0.2-10mm	Rounded fragments. K-spar stain and microphenos (K-spar) indicate this is a trachyte. All one rock type. Fragments in some areas of section are silica enriched.

[ ] = A phase that has been totally altered or destroyed.

Cement (40%):

Consists of Q (0.1mm) down to 0.01mm in size. Q is generally anhedral, is inter-grown and has wavy extinction. Evidently replaces fine ash because Mt/Ht is present in cement.

Both fragments and cement contain 3%, 1-40u, Mt anhedra which are partly altered to Ht.

October 19, 1995.

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October 30, 1995

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RE: Petrography of Tertiary Volcanics; RB-15 through RB-24.

SUMMARY

Rock Types

The most important rock in this suite, petrographically, is the andesite RB-23. It contains small Pl tabs aligned in a groundmass of relatively coarse K-spar. The groundmass in this case is not devitrified glass so that it can be seen that the Pl gets its trachytic texture from the relatively fluid groundmass. This explains why many rocks of the area have trachytic texture yet have Pl phenos or even aligned groundmass Pl tabs with trachytic texture. As a result, this rock is in many ways similar to RB-2, -3, -5, -11, -12, -13 and -21, all of which have trachytic texture but Pl as the predominant identifiable F. These have been variously called trachyte or latite with many question marks. Being an andesite it also demonstrates a genetic relationship between the trachytes, latites, and andesites.

In the vernacular of petrologists the rocks, at least from trachytes to andesites, appear to be consanguineous.

Alteration

Silicification is common to rocks RB-15, -16 and -20.

Argillic alteration is found in RB-18, -19, -22 and -24.

Carbonate alteration and/or veinlets is in RB-17 (with chlorite), -20, -21 and -23.

Respectfully submitted:

PETROGRAPHIC DESCRIPTIONS

RB-15; Silicified Trachytic Lithic Tuff. (Tc silic?)

Lithic Fragments (80%):

	0.04-8.0mm	Subangular particles. Textures and mineralogy percentages very slightly from particle to particle.

Phenos (tr%);

tr Sanidine	0.05-0.15mm	Fresh, blocky, fractured subhedra.

Groundmass (99+%);

87% Feldspar (F)	<0.1mm	Aligned indistinct crystallites with trachytic texture.
10% Quartz (Q)	0.02-0.1mm	Anhedra in polycrystalline aggregates as patches or indistinct discontinuous veinlets.
3% Magnetite(Mt) > Hematite(Ht)	<2-4u	Disseminated sub-anhedra.

Cement (20%):

75% Chert	<10u	Rather featureless. Tends to be slightly coarser at contacts of lithic fragments and occasionally at centers of inter-fragment areas.
13% Voids	0.08-3.0mm	Some areas interstitial to lithic fragments.
10% Carbonate (Carb)	up to 0.1mm	Anhedra in polycrystalline aggregates up to 0.4mm in size in fractures in chert and in fractures in lithic fragments.
2% Hematite	<1-15u	Dust-like particles disseminated in some chert. Concentration is variable.
tr Monazite(?)	0.04x0.18mm	Rare prism in chert.

RB-16; Silicified Trachytic and Basaltic Lithic Tuff. (Tri?)

Lithic Fragments (65%):

	0.08-12+mm	Subangular fragments. More variety in textures and grain size than RB-15, Also contains some chert-filled vesicular fragments. A large vesicular basalt fragment contains plagioclase (Pl) in spherulitic growths.

Cement (35%):

91% Chert	<0.02mm	Same description as in RB-15 except less Mt/Ht but also up to 10% of 0.06-0.3mm coarse anhedral Q in polycrystalline aggregates scattered in chert.
5% Voids	0.06-3.0mm	Occasionally unfilled segments or centers of interstitial areas.

3% K-Feldspar (K-Spar)	0.05-0.12mm	Fresh subhedra. Probably unaltered crystal tuff.
tr-1% Magnetite/ Hematite	5-30u	Ragged grains inhomogeneously distributed in chert.
tr Biotite (Bt)	0.02-0.08mm long	Rare dark-brown books and ragged flakes.

RB-17; Trachytic Lithic Tuff.

(Ta)

Trachyte Fragments (69%):

	0.02-10+mm	Sub-rounded fragments of same rock type.

Phenos (4%);

3% K-Spar	0.05-0.2mm	Blocky subhedra commonly replaced by patches of coarse Carb.
1% [Biotite]	0.05-0.4mm	Relict books 100% replaced with chlorite(Chl) and chloritoid.

Groundmass (96%);

Texture is similar to RB-1.

96% Feldspar	0.02-0.15mm long	F is tabular and aligned in trachytic texture. Well crystallized relative to suite up to this point.
4% Magnetite > Hematite	2-10u	Disseminated irregular grains.

Cement (31%):

Consists of comminuted trachyte plus 3-10% disseminated Ht>Mt. Some areas are stained solid with earthy Ht.

RB-18; Quenched, Slightly Argillic-Altered Andesite.

(Tosm)

Phenos (12%):

8% Plagioclase (Pl)	0.2-2.0mm	Euhedra 50+% replaced with patches of illite > Carb.
4% [Ferromag]	0.3-2.5mm	Bt(?). Rounded equant relict 6-sided crystals. Rarely altered to Chl or chert. Commonly replaced by illite with goethite (Gt) - staining along fractures. Contain small columnar prisms of apatite (Ap).

Vesicles (4%):

	0.2-1.2mm	Irregular-shaped equant to elongate structures lined with stubby prismatic Q and filled with clay.

[ ] = Phase is totally altered or destroyed.

Groundmass (84%):

Has micro-radiate texture composed of inter-grown laths of 55% Pl and 20% interstitial K-spar/Q(?). 25% inter-radiate areas composed of Gt-stained clay-altered ferromags.

RB-19; Argillically-Altered Rhyolite or Welded Tuff. (Tri)

Phenos (17%):

12% [Plagioclase]	0.2-2.5mm	Relict sub-rounded fractured euhedra. Replaced along fractures by montmorillonite (Mont) or illite and between fractures by kaolinite.
4% Sanidine	0.3-4.0mm	Fresh fractured, occasionally broken, subhedra.
1% [Ferromag]	0.3-1.6mm	Relict rounded fractured subhedra. Replaced along fractures by Chl and between fractures by Mont or illite. Contain small crystal molds filled with leucoxene (Lx). Possibly Bt books.
tr Quartz	0.3-1.0mm	Sparse embayed corroded crystals.

Porphyroblasts (2%):

	0.02-0.05mm	Empty molds of relict cubes. Probably Py.

Groundmass (79%):

86% [Glass]	-	Light tan. Now replaced by clay.
10% Feldspar, spherulitic	0.03-0.1mm	Equant spherulitic growths surrounded by halos of brown Fe-stain. Form folia which define foliation in rock.
2% [Feldspar + Biotite(?)]	0.02-0.25mm long	Relict tabular crystals aligned to foliation in rock. Now replaced by clay (F) and Chl + clay (Bt).
2% Quartz	<0.01-0.03mm	Anhedra in sutured polycrystalline aggregates as spots and elongate lenses parallel to foliation. devit.?
tr [Opaques]	<0.01-0.07mm	Relict anhedra now replaced by Lx.

Lithic Fragments (2%):

	1.6-3.5mm	Rounded fragments of micro-crystalline glassy rock. chert?

RB-20; Argillic/Silica/Carbonate - Altered Mixed Rock Tuff. (Ts)

Lithic Fragments (65%):

	0.1-23+ mm	Fragments of rhyolitic vitric tuff, andesite(?) and trachyte which are variably altered. Some are silicified, others are kaolinized.

Occasionally, at and near rims, some are partially Carb-altered patches or totally carbonate-replaced relict phenos (molds?).

Groundmass (35%):

94% Chert >> Kaolinite	-	The two minerals are practically identical in thin section(ts). Fine-grained and textureless. Apparently rock is glassy tuff first replaced by fine-grained chert then whatever wasn't replaced by silica later by clay.
3% Carbonate	up to 20u	Anhedra in polycrystalline aggregates in rare fractures in groundmass and occasionally as fragment/groundmass boundaries.
3% Quartz	up to 08	Small prisms as cement to smaller fragments between large fragments in scattered patches in tuff.

Total Carb alteration is about 3% and appears to be later than chert + clay alteration.

RB-21; Fractured Moderately Carbonate-Altered Trachytic Tuff with Quartz/Carbonate Cement. (Ta)

Lithic Fragments (92%):

	0.06-24+ mm	Angular fragments with a couple phenos of Pl, 35% more or less aligned, 0.02-0.2mm, tabular K-Spar, 25% interstitial Carb alteration (After glass?), 5% opaques replaced with Ht and 35% cryptocrystalline interstitial matrix. Ht also stains Carb and matrix.

Cement and Fracture Fillings (8%):

70% Quartz	<0.04mm	An-subhedra line fractures and fill or partly fill inter-fragmental areas.
20% Voids	0.1-1.6mm	Unfilled portions of veins and fragmented areas.
10% Carbonate	<10u	Fills Q-lined fractures and lines voids or partly fills Q-lined voids.

This sample is one of few that has a well crystallized groundmass. In this respect it is similar to RB-17.

RB-22; Moderate Argillically-Altered Devitrified Rhyolite(?). (Tcv)

Phenos (5%):

4% [Feldspar]	0.4-3.0mm	Relict tabular euhedra. 100% replaced by illite ± Q ± relict sulfide. Q sometimes grows on walls of F molds. F is probably Pl. The relict sulfide has been replaced with earthy Ht/Lx(?).

tr Quartz	0.8mm	One rounded embayed anhedron.
tr [Ferromag]	0.2-1.4mm	Relict tabular rounded euhedra. 100% replaced with apple-green Chl. Probably Bt.
tr Sanidine	0.2-2.0mm	Sub-euhedra. Occasionally replaced on rims by kaolinite.

Groundmass (95%):

91% Spherulites	0.05-0.3mm	Fibrous, cryptocrystalline, radiate mixture of F and Q. F is mostly argillized to illite.
8% [Feldspar]	0.03-0.15mm	Relict euhedra 100% replaced by illite.
1% Inclusions	<7u	Disseminated in spherulites. Mostly gaseous.

<u>**RB-23; Brecciated Andesite(?)**</u>. (Ta)
Trachytic groundmass is well crystallized as in -17 and -21.

Lithic Fragments (73%):

	<0.01-3+mm	Sub-rounded fragments all of same rock and all more or less in parallel alignment which gives foliation to rock.

Phenos (4%);

3% Plagioclase (An_{54})	0.2-2.5mm	Fresh euhedra. Often in clots but when as single crystals aligned to foliation.
1% [Ferromag]	0.06-0.8mm	Relict rounded subhedral molds. Fe-stained on walls.

Groundmass (96%);

60% Plagioclase	0.02-0.15mm long	Fresh tabs more or less aligned in a trachytic texture.
36% K-Spar(?)	0.06-0.18mm	Fresh equant anhedra interstitial to Pl. Full of Ht/Lx inclusions.
4% Hematite + Leucoxene	<1u-0.15mm	Disseminated anhedral grains. Probably relict Mt.

Breccia Cement (25%):

Predominately earthy Fe-oxide which stains or fills inter-fragmental areas.

Carbonate Veinlets and Alteration (2%):

	0.2+mm	Both as optically continuous patches in some fragments and as portions of breccia cement. Very localized in section.

The groundmass of this rock is coarse enough to show the F percentages and how the rock has a trachytic texture but is an andesite or even a basalt.

RB-24; Argillic-Altered Vitric Andesite or Latite. (Ts)

Lithic Fragments (65%):

	0.04-30+mm	Angular fragments.

✓ **Phenos (22%);**

15% [Plagioclase]	0.08-3.0mm	Relict euhedra 100% replaced with kaolinite.
5% Sanidine	0.1-2.5mm	Fresh fractured euhedra.
2% [Ferromag]	0.2-1.2mm	Broken relict subhedra 100% replaced with Lx and Ht(?).

✓ **Porphyroblasts? (5%);**

tr- 20% [?]	0.05-0.15mm	Relict rounded subhedra 100% destroyed to voids or occasionally filled with jarosite. Appears in zones in fragments. May be related to cooling. Unstable mineral and may be Py.

Vesicles (1%);

	0.02-0.16mm	Only in some fragments. Filled with polycrystalline Q.

✓ **Groundmass (72%);**

93% Glass	-	Light-tan now mostly replaced by clay.
5% Spherulites	<0.01-0.06mm	Brown structures in clouds in some fragments.
2% [Ferromag]	0.01-0.16mm	Elongate aligned. May be Lx/Ht-replaced Bt.

Cement (35%):

82% Quartz	<0.01-0.06mm	Anhedra in polycrystalline aggregates fill or line most fractures and inter-fragmental areas.
10% Clay	-	Patches tend to fill centers of some of largest cement patches. Kaolinite?
8% Voids	2-5mm	Non-cemented inter-fragmental areas.

October 30, 1995

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December 8, 1995

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RE: Petrographic descriptions of 9 standard thin sections; RB-25 through -33.

SUMMARY

This is the last of the samples from the project and consists of 5 samples sent 10/19 and 4 sent 11/1.

Rock Types are not new and they are either fresh or contain light to heavy **argillic alteration** (RB-26, 29, 30, 31 and 32).

Quartz content of some of the fresh rocks (RB-29, 32 and 33) is probably deposited through normal cooling and de-gassing in volcanic and is not due to hydrothermal alteration.

Respectfully submitted:

PETROGRAPHIC DESCRIPTIONS

RB-25; Oxidized Pyrite-Bearing Trachyte or Basalt(?).

Tbf

Phenos (1%):

1% [Ferromag]	0.1-1.8mm long	Relict prisms 100% replaced by Ht and Carb and more or less aligned to produce a foliation in rock.
tr Plagioclase (Pl)	0.3-1.2mm long	Relict crystals with rare, unaltered edge. Replaced by montmorillonite(?), Q and Carb.

Groundmass (99%):

79% Feldspar (F)	up to 0.6mm long	Laths in 0.5-2.0mm structures. Some are crudely radiate, others are in sub-parallel clumps. Predominately K-spar but some larger Pl contain iddingsite-like altered cores.
15% Limonite(Lm)/ Clay(?)/Glass(?)	<5u	Yellowish-brown to orange stain interstitial to and on F in 0.4 to 8mm irregular-shaped patches scattered through rock in an almost lace-like pattern. In hand specimen this pattern is purplish. Pl phenos are concentrated in these patches like it is a different rock. Also contains Q patches. Reddish stain in weathered rim of specimen.
3% Biotite (Bt)	0.08-0.4mm	Pinkish-brown ragged subhedra contain disseminated relict Py.
3% [Pyrite] (Py)	<1-20u	Disseminated relict cubes 100% replaced by Ht.
tr Quartz (Q)	0.02-0.1mm	Anhedra in aggregates in centers of Lm/clay/glass patches.

General F texture is most like RB-6 or -8.

RB-26; Argillically-Altered Pegmatite-Cemented Devitrified Breccia or Tuff.

Fragments (50%):

PIMA = Illite

Tri DREAMLAND

	0.5-10mm	Angular "ghosts" of fragments. Boundaries with cement are diffuse. One Fragment clearly contains devitrification spherules like those described in RB-27.
50% Illite(?)	-	As groundmass to Q and K-spar. Percentage is variable from fragment to fragment.
35% K-Spar	0.02-0.25mm	Tabular euhedra 40% altered to clay. Appears to be sanidine or orthoclase. Percentage is variable form fragment to fragment. Probably recrystallized spherulites.

[ ] = Totally destroyed or replaced phase.

15% Quartz	0.01-0.04mm	Equant anhedra in groundmass of clay.

Pegmatite? (50%):

88% Quartz	0.1-0.8mm	Subhedral prisms with clay inclusions.
12% K-Spar	0.1-0.8mm	Euhedra variably replaced with clay. Tend to be concentrated in centers of pegmatite areas. Smaller crystals encapsulated in Q.
tr Muscovite (Ms)	0.05-0.12mm	Sparse ragged books usually in Q.

The original rock type is unrecognizable because of replacement and alteration but the relict spherulites in one fragment suggests it may be like RB-27.

<u>RB-27; Silica-Cemented, Brecciated, Devitrified Trachyte</u>.

Lithic Fragments (70%):

	0.04-20+mm	Angular fragments. Larger are commonly fractured and slightly displaced along the Q-filled fractures. Flow structure is common. Consists of K-spar, fine-grained aplitic matrix and phenos as described below. Fractures and texture are similar to rinds of submarine pillows.

Phenos (1%);

1% Feldspar	0.02-2.6mm	Relict euhedral crystals 100% replaced by fine-grained chert/clay mixture ± coarse Q anhedra.
tr Quartz	0.5-1.6mm	Rounded phenos. Some are polycrystalline.

Spherulites (42%);

42% K-spar	0.04-0.4mm	Devitrification structures arranged in clumps which commonly show flow structure in rock. Composed of rectangular bundles of optically continuous fibers nucleated on small crystals in glass.

Tri Dreamland

Groundmass (55%); PIMA = Illite

45% Clay	<3u	In patches which are difficult to distinguish from F.
30% Feldspar > Quartz(?)	<20u	Mostly if not all anhedral F. Usually in clumps of anhedral grains. Has aplitic texture.
25% Quartz	<0.01-0.15mm	In patches of seriate anhedra in discontinuous veinlets in groundmass ("tension gashes"?).
tr	3-30u	Red grains dispersed in groundmass.

Veinlets (2%);		
	0.01-0.15mm thick	In all directions and through particles. Predominately Q with thickest containing centers of clay.
Cement (30%):		
95-80% Quartz	<0.01-0.15mm	Coarsest crystals on edges of smaller lithic particles. As over-growths for many lithic particles appear to be replaced with Q.
5-20% Hematite (Ht)	<0.1mm	Interstitial to Q. Concentrated along fracture zone in sample.

RB-28; Basalt with Trachytic Texture.

82% Plagioclase (Pl, An_{59})	0.03-1.2mm long	Tabs aligned in trachytic texture. Larger may be partly replaced by Carb.
5% [Ferromag]	0.1-1.2mm long	Relict prisms 100% replaced with phlogopite(?) and green Chl on edges. Occasionally replaced by Carb.
5% Hematite	-	As stain in basalt along tension-gash-like structure across foliation in rock. Gashes are 1-3mm thick in centers and up to 3 cm long.
5% Clay	-	Interstitial to Pl and in centers of some of larger Pl crystals.
3% Magnetite (Mt)	3-50u	Disseminated anhedra extensively altered to Ht.

Ta

The alteration of this rock is oxidation and a very mild propylitic and argillic.

Fine to Course

RB-29; Argillically-Altered Vitric Tuff or Breccia. (Tc altered near Target VII

Lithic Fragments (90%):		
	0.1-24+mm	Angular fragments. Some contain spherulites due to quenching of glass. Texture is similar to RB-26 and -27. Has a faint flow structure.
Phenos (4%);		
4% [Feldspar]	0.1-2.0mm	Relict euhedra 100% replaced by clay ± Ht.
Groundmass (96%);		
95% Clay	-	Includes altered glass and spherulites.
5% Hematite	up to 0.1mm	In scattered patches which may have been Mt or Py. Also stains clay in area of fractures.

Cement (10%):

45% [Lithic Dust]	-	Dust of lithic fragments now primarily clay >> Ht.
30% Quartz	0.02-0.2mm long	Elongate crystals disseminated in dust and lines some cavities.
25% Clay	-	Pure secondary clay fills some late(?) interlithic areas.

This rock could be the same as RB-27.

RB-30; Argillically-Altered Andesite or Latite. (Tc altered in Target VIII

Phenos (19%):

15% [Feldspar]	0.5-4.0mm	Relict euhedra 100% replaced with clay.
4% [Ferromag]	0.2-2.0mm	Relict euhedra 100% replaced with Ht, voids, clay ± reticulated leucoxene-replaced rutile.

Groundmass (81%):

Texture is most similar to andesite or latite.

76% Plagioclase > K-Spar	0.01-0.15mm	Tabular crystals with no common orientation. About 40% replaced by clay. ← PIMA = Kaolonite
15% Quartz	0.03-0.1mm	Anhedra interstitial to F.
5% [Pyrite?]	0.02-0.15mm	Cubic-looking empty molds.
4% [Magnetite]	5-40u	Relict subhedra altered to Gt and Lx.

RB-31; Light Argillic-Altered Andesite or Basalt.

Phenos (1%):

1% Plagioclase	0.3-1.0mm	Sparse tabs in rare clumps. Contain some relict ferromags and clay alteration along fractures.
tr Pyroxene	0.02-0.4mm	Sub-anhedra mixed in with clump of Pl.

Groundmass (99%):

90% Plagioclase > K-Spar	0.05-0.4mm	Laths and anhedra 18% replaced by clay along fractures and in patches in crystals. Not aligned to any one direction.
8% [Ferromag]	0.01-0.5mm	Relict elongate subhedra to anhedra 100% replaced with phlogopite(?) and later clay.
2% Hematite	3-25u	Disseminated subhedra.
tr Apatite	0.01-0.1mm long	Scattered slender prisms embedded in F.

Veinlet (tr%):		
	0.06mm thick	Linear and across section. Filled with Q.
Fractures (tr%):		
	0.01-0.04mm thick	More or less continuous, in two directions and cuts veinlet. Both filled with and irregularly stained on both sides by Ht.

RB-32: Argillically-Altered Vitric Lapilli Tuff with Silica/Clay Cement. (Wildrose Intrusive)

Lithic Fragments (90%):		
	0.08-20+mm	Rounded fragments with wide variety of relict structures which include flow, spherulitic and structureless. 100% replaced with clay. Few particles contain up to 3% of sub-anhedral Lx after Mt(?).
Cement (10%):		
70% Quartz	0.01-0.25mm	Anhedra in polycrystalline aggregates and inter-mixed with clay.
Howman's Fell		
30% Clay PIMA = Illite/smectite	-	Probably mostly a result of argillized lithic dust.

This amount of silica between fragments is about normal for rock consolidation in this volcanic environment and does not necessarily mean the rock has been hydrothermally silicified.

RB-33: Silica-Cemented Vitric Lapill Tuff. (Wildrose Intrusive)

Probably the same rock as RB-32 except this rock is not altered. See comments in that sample for meaning of secondary Q in pores and inter-fragmental areas of this volcanic rock.

Fragments (90%):		
	1.5-13mm	Mostly rounded lapilli appear to have been soft when compacted. Generally fresh glass with particles of Ht. Fragments contain all manner of structures like RB-32. Very porous.
Cement and Pores (15%):		
11% Quartz	0.01-0.4mm	Anhedra in aggregates which partly fill pores and inter-fragmental spaces.
Howman Fell.		
4% Voids	0.02-1.0mm	Random voids between glass tuff particles and between spherulites within particles. Also between particles.
Pheno (tr%):		
tr K-Spar(?)	1.4mm	Anhedron in spherulitic glass.

4/13/'95

PETROGRAPHIC ABBREVIATIONS

Ab = albite
Act = actinolite
Ad = adularia
Amph = amphibole
An = anorthite
Ap = apatite
Aspy = arsenopyrite
Ba = barite
Bn = bornite
Bt = biotite
Cal = calcite
Carb = carbonate
Ch = chrysocolla
Chl = chlorite
Di = diopside
Dm = dumortierite
Dol = dolomite
Ep = epidote
F = feldspar
FM = ferromagnesian
Ga = galena
Gn = gneiss
Gp = graphite
Gr = garnet
Gt = goethite
Hb = hornblende
Ht = hematite
Il = illite
Ilm = ilmenite
K-spar = potassium feldspar
Lm = limonite
Lx = leucoxene Alt of illmanite
Mo = molybdenite
Mont = montmorillonite
Ms = muscovite
Mt = magnetite
Pl = plagioclase
Po = pyrrhotite
Px = pyroxene
Py = pyrite
Q = quartz
Rt = rutile
Sp = sphalerite
Sph = sphene
Tm = tourmaline
u = micron
WM = white mica
Zr = zircon

PUBLISHED INFO

ROSEBUD PROJECT - EXECUTIVE SUMMARY

LOCATION AND LAND STATUS

The property is located in Pershing and Humboldt Counties, Nevada, 50 miles northwest of Lovelock, within portions of sections 1, 11, 12, 13, 14, 23, 24, 25, and 26, T34N, R29E and sections 6, 7, 17, 18, 19, 20, 30, and 31, T34N, R30E. Access is by good gravel road from Lovelock. Hycroft's Crofoot Mine borders the property on the northwest. The present land position comprises 3 patented and 605 unpatented claims (11,700 acres) through direct ownership and various agreements. Equinox owns a 100% interest effective July 30, 1993.

HISTORY

In 1985 Equinox staked 46 claims near Rosebud Peak covering gold-mineralized volcanic rocks. LAC began exploring the district in 1987 and in 1988 entered into a joint venture with Equinox. The Dozer Hill deposit was found in 1989. A total of US$6.2 million has been spent by LAC ($5.4 million) and Equinox ($0.8 million) on Rosebud to date.

Extensive geochemical, geological and geophysical surveys have been undertaken, including airborne and ground magnetics, IP/resistivity, and VLF surveys. A total of 305 drill holes totaling 209,278 feet of drilling have been completed on numerous targets, with the majority being concentrated in the Dozer Hill area.

Baseline environmental and cultural/historical studies have been completed on the property and an EA and other necessary applications have been approved for an underground development program.

GEOLOGY AND MINERALIZATION

The Rosebud property is located in the Kamma Mountains, and is underlain by Miocene age volcanic rocks of felsic to intermediate composition. The volcanic stratigraphy consists of siliceous flows and tuffs with intercalated fine to coarse fragmental units. Jurassic-Triassic black carbonaceous metasedimentary rocks underlie the volcanic rocks. Tertiary age conglomerates occur along the flanks of the range.

The Kamma Mountains have undergone tectonic deformation creating a complexity of high angle and low angle faults throughout the range. The most prominent structural feature is the Rosebud shear, which strikes northeasterly through the southern portion of the project area. A second prominent feature in the Dozer Hill area is the South Ridge fault, which displays up to 1,700 feet of left lateral oblique displacement and dips northerly at 20-55 degrees. Gold mineralization in the Dozer Hill area is spatially associated with the South Ridge fault.

F

Dozer Hill mineralization consists of a crude stockwork and micro-veining of quartz, calcite, clay, pyrite, and marcasite within bleached, clay altered, sericitized, and locally silicified volcanic rocks. Gold and silver are present as electrum, aurian silver, and silver-bearing selenides and sulfosalts within narrow discontinuous veinlets. The precious metals are metallurgically free-milling, responding well to conventional cyanidation.

MINERAL RESOURCES

Detailed mineral resource estimation studies have been made by LAC on the Dozer Hill deposit. Probable resources may be summarized as follows (current to January 1, 1992):

Cut-off Grade	Tons	Au Grade	Oz Au
0.05	3,124,000	0.213	664,000
0.10	1,894,100	0.312	591,000

The above resource is conservative and excludes intercepts of less than 10 feet. An independent mineable reserve has been calculated at 1,330,000 tons grading 0.368 oz/t (uncut). The independent prefeasibility study on a smaller reserve at a 2 oz/ton cut grade generated pre-tax cash flow after capital pay-back of $27 million and a 22% IRR on invested capital of $38 million from today. Significant potential exists to expand the resource within the deposit and beyond it during in-fill underground drilling.

A re-evaluation by LAC in early 1993 of a high grade mining and custom milling option on a 2 oz/ton cut reserve of 681,200 tons grading 0.370 oz/ton generated pre-tax cash flow of $28 million after capital pay-back ($350 gold) and 83% IRR on invested capital of only $11 million from today. This salvage option represents an attractive worst-case scenario for the underground development program which will access the highest grade zones in the Dozer Hill deposit.

CURRENT TARGETS

In addition to Dozer Hill area, at least 14 other epithermal gold prospects have been identified on the Rosebud property. These targets have been variably explored ranging from reconnaissance mapping to drill tests. Re-evaluation of many of the previously drilled epithermal gold prospects during 1992 indicated that potential exists at depth for significant gold mineralization.

1. The Dreamland target covers the area which produced the limited recorded production of the Rosebud Mining district. Au-Ag were produced from narrow high grade east striking vertical veins and south dipping low angle structures. Shallow drill tests have yielded significant alteration. Untested potential exists at depth in the Dreamland area.

2. The east Dreamland target is between Dozer Hill and dreamland targets along the Dozer Hill-Dreamland structural/alteration zone. Numerous steep structures with ore grade values are coincident with large soil and geophysical anomalies. Drilling to date has tested shallow potential but deeper targets remain untested.

3. The North Kamma target was identified in 1991, but has only been evaluated in a reconnaissance level. The target is a structurally complex area north of the Wildrose target and southeast of the Lewis-Crofoot mine. Sparse rock chip sampling has yielded weakly anomalous gold values.

4. The Schoolbus Canyon target contains the favorable Wildrose-LBT stratigraphy. Significant bleaching is present and rock chip samples contain up to 159 ppb Au. A blind Dozer Hill style target is possible here where the Rosebud shear and White Alps structure intersect the Oscar-Lantern northwest alteration/structural trend. Shallow drilling has encountered encouraging alteration and favourable rocks. Untested potential exists at depth.

5. The Short Shot target is a large bleached area cut by northeast and east striking silicified structures. Anomalous soil and rock geochemistry is present.

6. The White Alps target consists of a chalcedonic quartz-alunite alteration along the White Alps structure. Weak soil geochemistry is present. Favorable host rocks are present at depth and should be tested with a deep drilling program.

7. The Wildrose Target represents a relatively untested target within strongly silicified breccias with pyrite and alunite associated with moderate northwest dipping structure. The target displays pervasive bleaching, a large soil anomaly and a strong IP anomaly. Early drilling did not adequately test this target due to the challenging topographic relief.

8. Lower priority targets include Chalcedony, Degerstrom, North Equinox, North Rosebud Peak, Gator, South Kamma, South Ridge, and Valley.

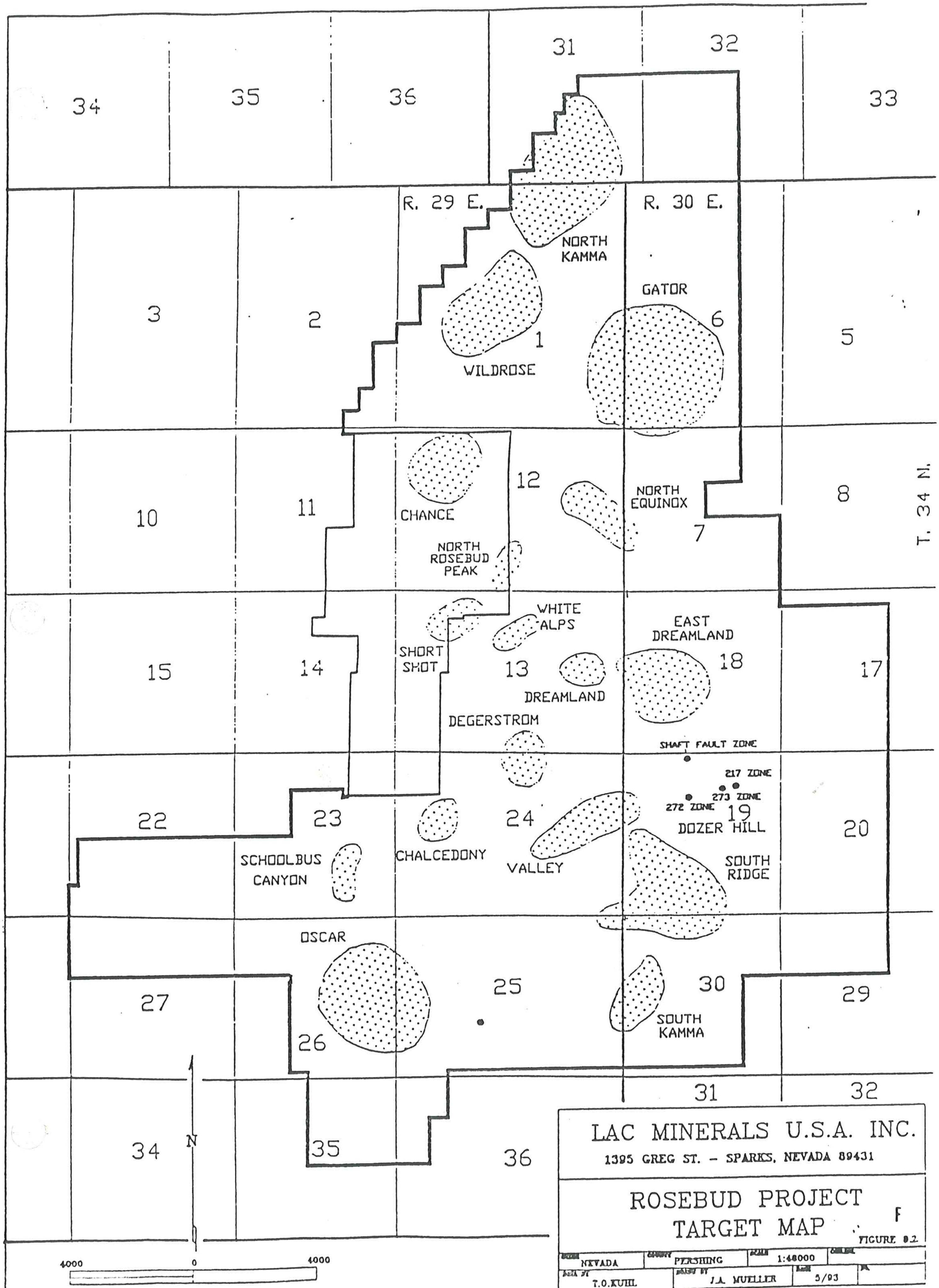
PERMITTING

Permitting for the underground development program is essentially complete. An EA was accepted by the BLM in January 1993. The Plan of Operations was accepted at that time to enable 3,300 feet of decline, 2,500 feet of adit, 10,000 tons of bulk sampling, mine water discharge and associated impacts. A draft Closure and Reclamation Plan was accepted in October 1992. The NDEP has stated the Water Pollution Control Permit will be issued in June. Water appropriations were received from the State of Nevada in late April. A Land Clearing Permit has been issued. County representatives are very supportive of the project.

SUMMARY

The Rosebud property contains a large high grade mineral resource, economic at today's gold prices. It requires a final underground program to establish a bankable feasibility study and enable a 1994 production decision and 1995 production start-up.

LAC believes the deposit does not meet its 1 million mineable ounce corporate threshold. Equinox believes the deposit holds much potential for reserve expansion internally, beyond its present limits and on other property targets. An excellent worst-case rate of return is obtainable from salvage mining and custom milling high grade Rosebud ore, making the next and final underground program a low risk expenditure. If reserve expansion occurs in this program a longer-life mine and on-site mill would be established.



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ROSEBUD PROJECT
TARGET MAP

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FIGURE 9.2

NEVADA

PERSHING

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T.O.KUHL

J.A. MUELLER

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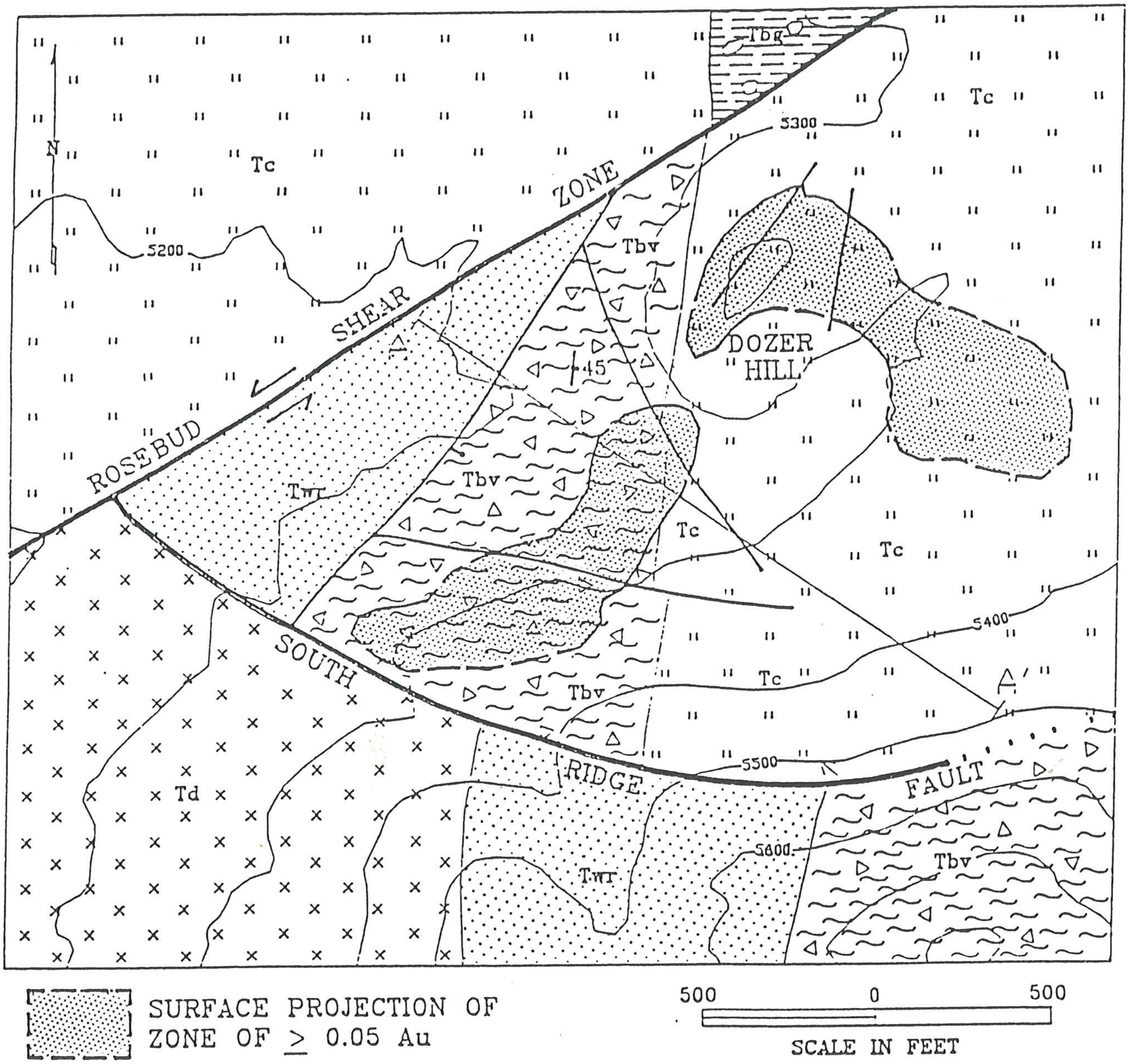
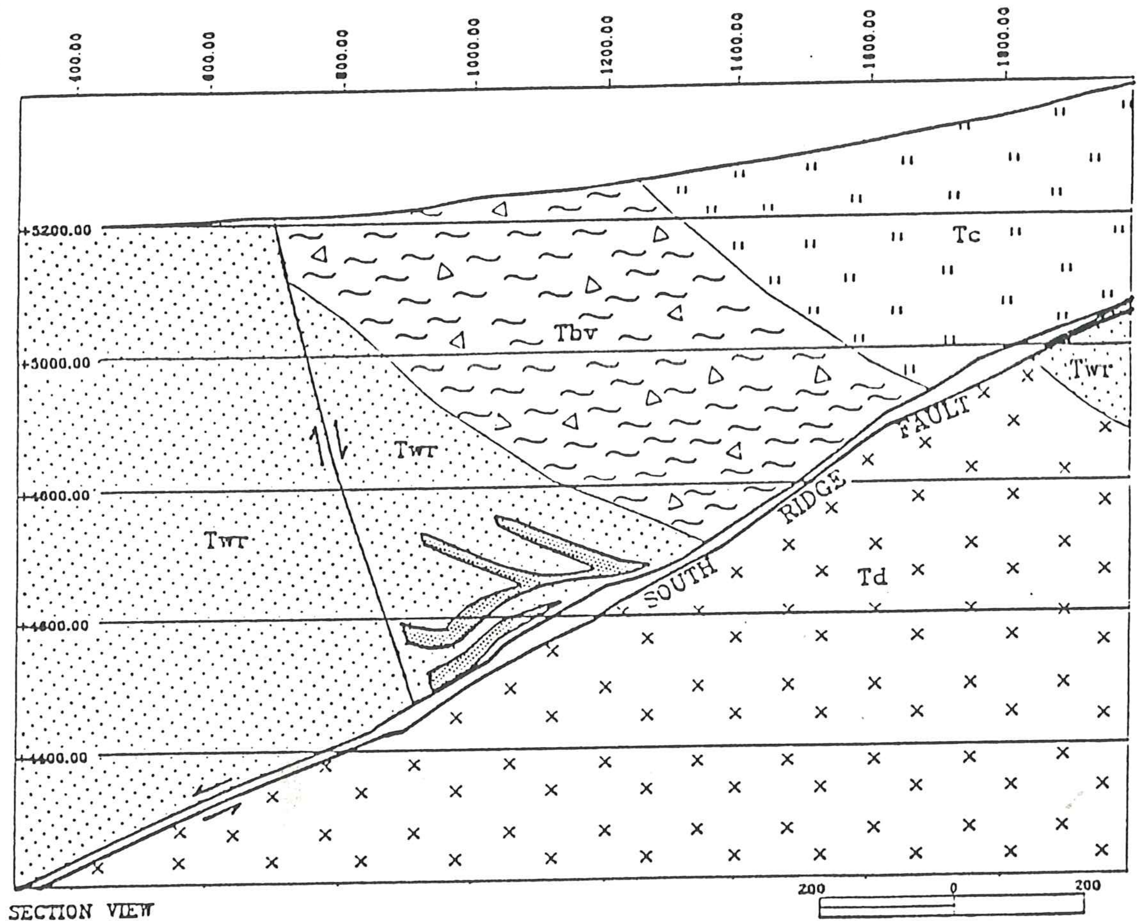


NOTE: For explanation of rock types
see Figure 2.

DOZER HILL GEOLOGIC MAP

FIGURE 3.



▨ Au Mineralization > 0.1 opt

Note: For explanation of rock types see Figure 2.

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ROSEBUD PROJECT
GENERALIZED GEOLOGIC CROSS SECTION, LOOKING N35E THROUGH MAIN ZONE
FIGURE 4.

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DISCOVERY AND GEOLOGY OF GOLD MINERALIZATION AT THE ROSEBUD PROJECT PERSHING COUNTY, NEVADA

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For presentation at the SME Annual Meeting
Reno, Nevada — February 15-18, 1993

G

Discovery and Geology of Gold Mineralization at the Rosebud Project, Pershing County, Nevada.

Cynthia M. Walck, Robert E. Bennett, Timothy O. Kuhl, and Kristen L. Kenner.

Abstract

The Rosebud district is located in the Kamma Mountains, southeast of the townsite of Sulphur, Nevada. Since discovery in 1989, LAC Minerals, in joint venture with Equinox Resources, has delineated a resource containing approximately 570,000 ounces of gold and 5,500,000 ounces of silver. The deposit is of the volcanic-hosted epithermal quartz-sericite type. Mineralization occurs in tabular zones in and along the hanging wall of the South Ridge fault, and in cross-cutting high-angle structures. Multiple stages of discontinuous stockwork gold- and silver-bearing quartz-calcite-clay veins cut variably clay-altered, silicified, and sericitized rhyolitic Miocene volcanic rocks.

Introduction

The Rosebud project is located in northern Pershing County, approximately 50 miles NNW of Lovelock, Nevada (Figure 1). The Rosebud district was discovered in 1906, and has a recorded production of 3,700 ounces Au and 116,000 ounces Ag between 1908 and 1947 (Johnson, 1984). Most of the production was from the Dreamland mine, located approximately 3000 feet northwest of the current resource at Dozer Hill. Modern gold exploration in the district began in the late 1970's, and several major mining companies conducted exploration programs prior to LAC's involvement in the district.

LAC's interest in the region was generated out of a regional reconnaissance program in 1987. In 1988 LAC Minerals began acquiring a land position in the district through claim staking and various property agreements, including the joint venture with Equinox Resources. Currently LAC controls approximately 10,000 acres, covering most of the northern Kamma Mountains. Evaluation of the property began in 1988 with geologic mapping, soil and rock chip geochemical sampling, and geophysical surveys, including airborne magnetics and IP. Initial drilling in 1989 was targeted on the basis of a multi-element soil anomaly in a previously untested area southwest of Dozer Hill. Ore-grade mineralization was encountered in the hanging wall of the South Ridge fault in the third hole (55 feet at 0.120 opt Au). Drilling has continued to the present, with a total of 235 holes in the Dozer Hill area, which have outlined a geologic resource of 570,000 ounces of gold at a 0.1 opt cut-off.

Regional Geologic Setting

The Kamma Mountains are located on the southeast side of the Black Rock Desert, in a region of Tertiary basin and range extension. The Tertiary-age Kamma volcanics were deposited in a north-trending caldera-like subsiding trough developed in a Jurassic-Triassic basement sequence of pelitic metasediments. The Kamma Mountains are bounded on the east by the Kamma fault, which juxtaposes the youngest volcanics next to the basement rocks. On the west side of the range, the Kamma Mountains are bounded by NNE trending rangefront faults.

The oldest rocks in the district are folded and faulted Jurassic-Triassic carbonaceous metasedamentary rocks of the Auld Lang Syne Formation (Johnson, 1977). Unconformably overlying the metasediments, the Kamma volcanic sequence is composed of a thick section (>7000') of flows, pyroclastic, and

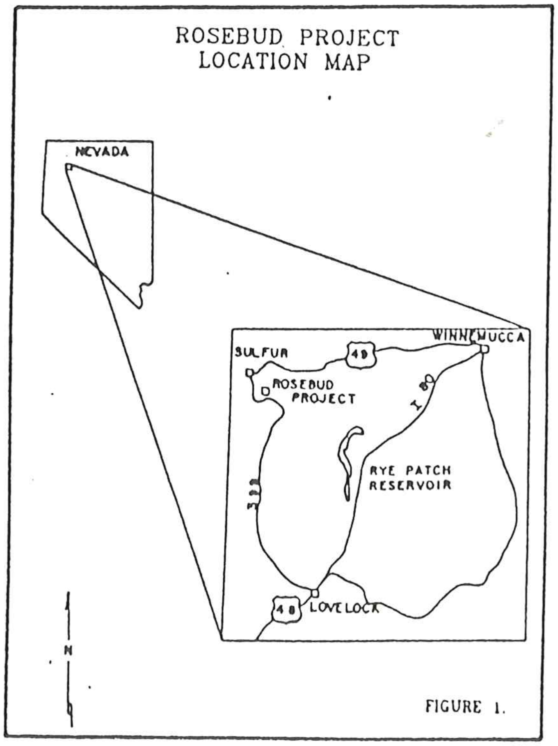
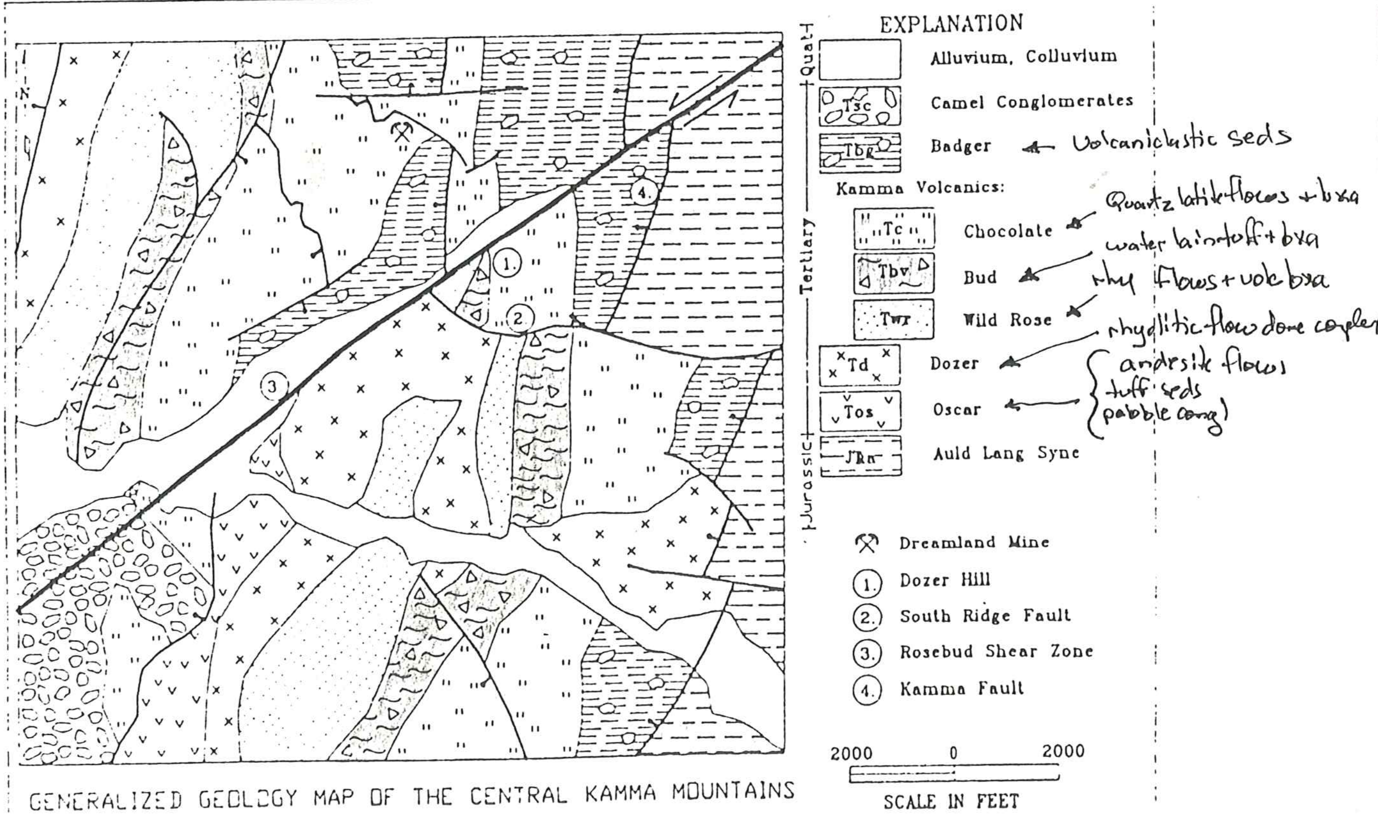


FIGURE 1.

epiclastic rocks, generally of quartz-latite to rhyolite composition (Figure 2). LAC geologists have broken the undifferentiated Kamma volcanics into mappable stratigraphic units, these unit names will be described and used throughout this paper. At the bottom of the volcanic pile is the Oscar Sequence, which grades upwards from Triassic pebble conglomerates interbedded with tuffaceous sediments, into a series of andesitic flows. The Oscar Sequence thins to the north, and is onlapped by the Dozer Formation. The Dozer Formation consists of a rhyolitic fine-grained flow dome complex, and varies in thickness from approximately 800 to 1800 feet. Flow dome breccias, probably equivalent to the Dozer Formation, occur locally. Considerable topographic relief was developed on top of the Dozer Formation before the volcanics of the Kamma Formation were deposited.

The Kamma Formation can be subdivided into three units; from base to top these are: the Wildrose, the Bud, and the Chocolate Members. These volcanic units are all similar in composition, consisting of quartz-latite to rhyolite flows and volcanic breccias with interbedded water-lain pyroclastics, often green in color. The Wildrose unit consists of an approximately 1300 foot thick sequence of dense dark fine-grained flows and volcanic breccias, locally with interbedded green clastic units. In the Dozer Hill area, the upper part of the Wildrose unit is the main host for mineralization. The Wildrose is transitional into the overlying Bud unit. The Bud is a key marker unit in the Kamma volcanics, generally displaying a distinctive green color. Bud volcanics consist of water-lain bedded pyroclastic breccias and epiclastics (with a celadonite/ glauconite clayey matrix), interbedded with fine-grained flows. Individual beds within the Bud are often discontinuous, having been deposited in local depressions. The contact between the Bud and the overlying Chocolate Member is gradational. The Chocolate Member consists of at least 1500 feet of porphyritic quartz-latite flows and volcanic breccias, and is the uppermost unit in the Kamma Formation. Unconformably overlying the Kamma Formation is the Badger Formation, a thick pile of volcaniclastic sediments with a distinctive red silt matrix.

Late Tertiary extensional tectonics have tilted the range to the east, and created a complex pattern of NE, NW, and E-W low- to high-angle faults. The most prominent regional structure is the Rosebud Shear zone, which trends N60E, appears to dip moderately to the



GENERALIZED GEOLOGY MAP OF THE CENTRAL KAMMA MOUNTAINS

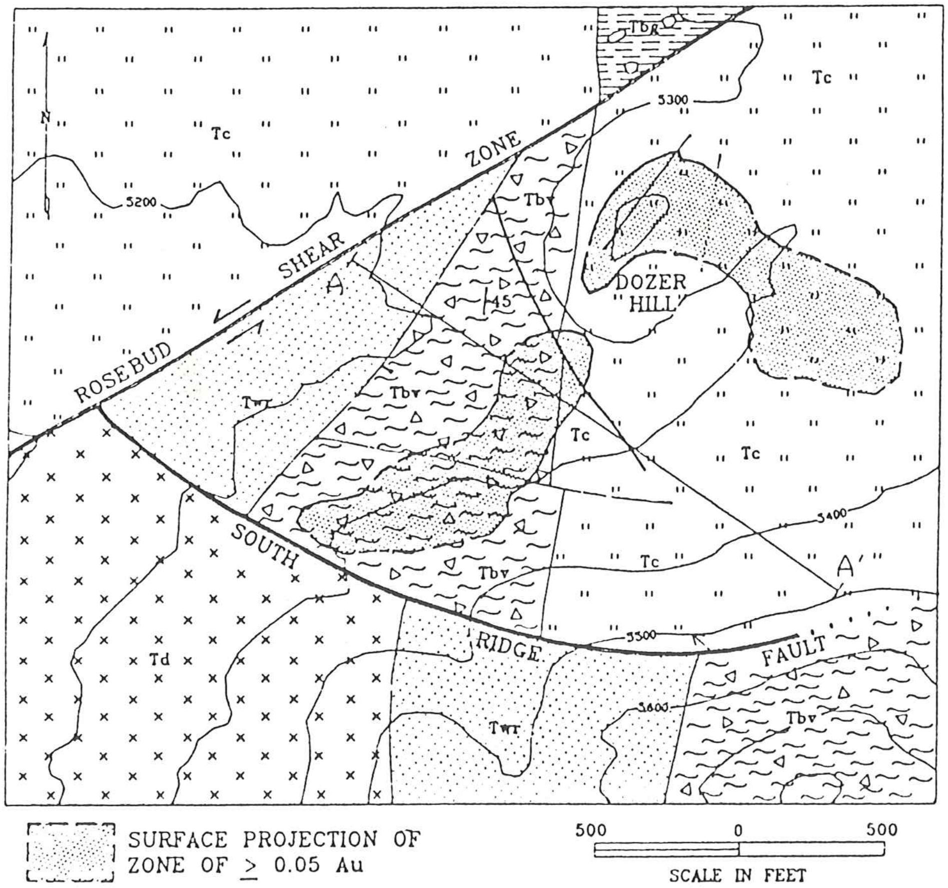
FIGURE 2.

northwest, and has about 5000′ of apparent left lateral displacement. Part of the left lateral movement on the eastern side of the range is taken up by the South Ridge fault, which strikes east-west and dips 25° to 45° to the north.

Geology and Mineralization of the Dozer Hill Area

The Dozer Hill area is bounded on the north by the Rosebud Shear zone and on the south by the South Ridge fault (Figure 3). Mineralization is hosted by the Wildrose Member of the Kamma Formation, and is localized in structural zones associated with the South Ridge fault. The South Ridge fault is expressed at the surface by a series of intensely silicified ribs; at depth the fault varies from calcite-rich to clay-rich to strongly silicified breccias. Mineralization occurs near the intersection of the South Ridge fault with high angle NE and NW structures, in favorable stratigraphy.

Dozer Hill mineralization can be divided into two areas: the Main zone and the East zone. Mineralization in the Main zone occurs in the hanging wall of the South Ridge fault, and is confined to the upper Wildrose unit, 10 to 200 feet below the contact with the overlying Bud unit (Figure 4). The Main zone is 1800 to 2000 feet long, and averages 250 to 300 feet wide and 25 to 45 feet thick. The orebody plunges 20° to 25° N35E (the orebody is 200 feet below the surface at the SW end, and 900 feet deep at the NE end). The NNE trend of the Main zone is defined by the intersection of the favorable hanging-wall wedge of the Wildrose unit (N15E, 42°E) with the north-dipping low-angle South Ridge fault. The Wildrose is a hard, dense unit, and fractures brittlely, creating open spaces for ore deposition. Mineralization is localized within tabular, shallow to moderately dipping bodies, probably in tensional fractures antithetic to the South Ridge fault. The overlying Bud unit is relatively soft with a green clayey matrix, which deforms ductilely. Possibly the Bud has acted as



NOTE: For explanation of rock types see Figure 2.

DOZER HILL GEOLOGIC MAP

FIGURE 3.

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an aquiclude to confine and concentrate mineralizing fluids in the Wildrose. Dense, weakly altered fine-grained flows of the Dozer Formation occupy the footwall of the South Ridge fault in the main zone.

The East zone ore body is tabular, approximately 400 feet by 600 feet in plan, and 15 to 45 feet thick. The zone dips slightly to the north, and is elongate in a northwest direction. Mineralization is localized within, and in the footwall of the South Ridge fault. In the East zone, the footwall is the Wildrose unit, and it is often mineralized for up to 100 feet below the fault, generally along low-angle fractures sub-parallel to the South Ridge fault. Chocolate volcanics occupy the hanging wall in this area, and contain only narrow mineralized fractures.

Alteration in the Dozer Hill area is characterized by widespread bleaching and sericitization. Local areas are variably clay-altered, silicified, and brecciated. The ore is characterized by a crude stockwork and micro-veining of quartz, calcite, clay, pyrite, and marcasite. Gold and silver minerals include electrum, aurian silver, and silver-bearing selenides and sulfosalts, which are generally contained in narrow discontinuous veinlets (less than 1 cm. thick) or in strongly clay altered rocks. Silver to gold ratios are highly variable, but average 10:1 overall. Elevated levels of Hg, Se, As, and Sb have been correlated with mineralization.

Currently, a total of 155,613 feet has been drilled in 235 holes in the Dozer Hill area. Fifty percent of the drilling has been core (78 holes totalling 54,173 feet), the rest were reverse-circulation. Using a cut-off of 0.1 opt gold, the drill-indicated geologic resource as of January 1992 is 1,746,000 tons containing 570,000 ounces of gold with an average grade of .326 opt Au, and 5,500,000 ounces of silver, at 3.15 opt Ag. Exploration activities are continuing on the Rosebud project, and permitting is currently in progress.

Acknowledgements

The authors thank the management of LAC minerals Ltd. and Equinox Resources for permission to publish this information. We would also like to acknowledge the contributions of other geologists who have contributed to our understanding of the area, in particular, N. Brewer, B. Thomas, S. Maynard, G. Massingill, C. Nelson, R. Weicker, R. Stoeberl, K. Tullar, and S. Moore. A. Mueller drafted the figures.

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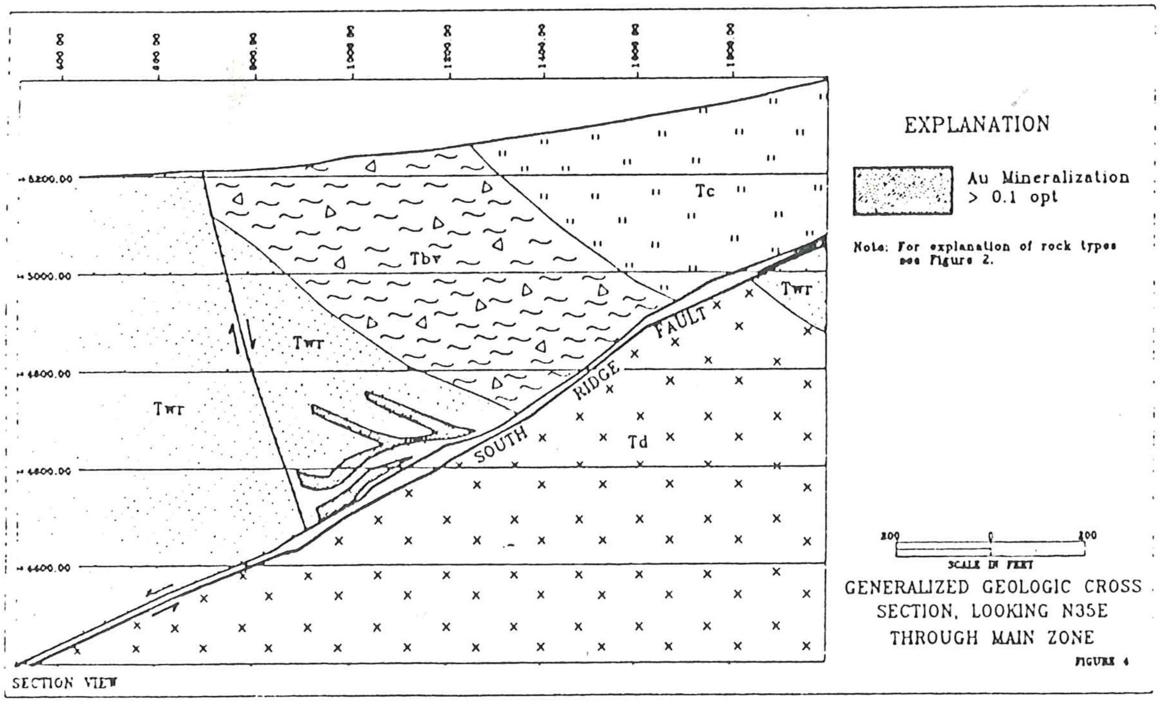

GENERALIZED GEOLOGIC CROSS SECTION, LOOKING N35E THROUGH MAIN ZONE

FIGURE 4

SULPHUR MINING DISTRICT

GEOLOGY AND MINERAL DEPOSITS OF THE SULPHUR MINING DISTRICT HUMBOLDT COUNTY AND PERSHING COUNTY, NEVADA

Andy Wallace
Cordex Exploration Company

Robert S. Friberg
Sierra Exploration Associates

INTRODUCTION

The Sulphur mining district, located about 95 miles northeast of Reno, is in the southwestern part of Humboldt County, and the northern part of Pershing County, Nevada (Figure 1). The district can be reached by travelling mainly gravel roads 60 miles north from Lovelock, Nevada, or alternately, 50 miles west from Winnemucca.

Hydrothermally altered rocks, dominantly volcanic, are exposed over an area of about 4.5 mi^2. Within this area sporadic past production has yielded sulfur, silver, alunite and mercury. Sulfur, the main commodity, has been mined intermittently since the late 1800's from both underground and open pit workings (Couch and Carpenter, 1943; Willden, 1964).

Alunite veins were discovered in 1917 (Clark, 1918) and approximately 500 tons were shipped to the west coast to be used as fertilizer (Vanderburg, 1938). Drilling projects in the 1960's and early 1970's by several companies have been directed toward developing sulfur reserves. The Silver Camel Mine area, located at the southwestern edge of the district produced about $150,000 in silver, mostly in the late 1800's (Lincoln, 1923; Couch and Carpenter, 1943). Exploration for gold and silver by several mining companies began in the mid 1970's. Currently, the Standard Slag Company is developing a gold deposit at the northern end of the district. The mine, scheduled to be on line in late 1984, will process several million tons of low grade ore by heap leach methods.

Figure 1. Index map showing Sulphur, Nevada.

STRATIGRAPHY

Rock units exposed in the Sulphur mining district are Tertiary in age (Willden, 1964). The lowermost unit, the Kamma Mountains Group, about 6000 feet thick, includes a thick section of rhyolite and latite lavas and plugs with interbedded volcaniclastic sediments. Overlying this dominantly volcanic group is a sequence of conglomerates, sandstone, lacustrine tuff and hot springs sinters. This sequence, the Sulphur Group, is considered to approach 2,000 feet in thickness. A few thin rhyolite dikes and flows occur in its upper part, all of which is highly altered over large portions of the district. Unlithified, postmineralization rocks include Tertiary terrace gravels, Quaternary-Tertiary alluvium accumulations along fault scarps, Quaternary Lake Lahontan beach gravels, and Quaternary stream gravels.

Kamma Mountains Group

Rocks of the Kamma Mountains Group crop out at high elevations in the central part of the Kamma Mountains east and southeast of the Sulphur district and a nearly complete section is exposed in the deep canyon east of the Rosebud placer deposit. The rocks are dominantly rhyolite lavas with interbeds of latite, volcaniclastic sediments, and lake bed sediments. Approximately 6,000 feet of Kamma Mountains Group is exposed in the canyon near Rosebud where the following units occur (from bottom to top):

1. Aphyric rhyolite and flow breccia, usually with well-developed highly contorted flow banding. This unit lies on volcaniclastic sediments with interbedded, sanadine-bearing rhyolite near the Sulphur deposits, but its base is not exposed in Rosebud Canyon. A vitrophyre and vitrophyre feeder dike occur at the base of the unit near the Sulphur district.
2. Epiclastic arkose, latite breccia, lacustrine tuff and minor rhyolite.
3. Flow-banded latite with prominent plagioclase phenocrysts, probably in part intrusive.
4. Biotite and hornblende rhyolite.
5. Tuffaceous siltstone and shale (lacustrine?), conglomerate with volcanic fragments, undifferentiated volcaniclastic and epiclastic sedimentary rocks.
6. Dark-colored banded, aphyric latite. Chaotic altitudes are characteristic and the unit is probably intrusive in part.
7. Undifferentiated rhyolite lava and plugs. Rich in feldspar phenocrysts near the Sulphur area where it is underlain by biotite-hornblende rhyolite.

In general, the sedimentary members of the Kamma Mountains Group thin considerably as one moves north from Rosebud Canyon into the Sulphur area. The entire group is complexly faulted in the vicinity of Sulphur. The base of the Kamma Mountains Group was not observed.

Sulphur Group

The Sulphur Group is composed dominantly of clastic units and may reach 2,000 feet or more in thickness. This is the primary rock unit exposed west of the major north-trending fault, which separates the Sulphur Group from the Kamma Mountains Group to the east.

The lowermost units of the Sulphur Group are known only from a 2,000-foot hole core-drilled by the Duval Corporation. Based on the character of the lowest unit penetrated, the hole must have almost reached the Kamma Mountains Group. This lowermost unit, which is unnamed, consists of reddish conglomerate with coarse volcanic clasts (many of which are from the flow-banded rhyolite of the Kamma Mountains Group). Overlying the conglomerate is more than 1,000 feet of lacustrine(?) tuff (also unnamed) with interbedded siltstone and sandstone. These units are pyritized and argillized.

The Camel Conglomerate is considered to directly overlie the lacustrine tuff. This contact is not exposed but has been inferred from the deep core hole by Duval. Total thickness of the conglomerate is not known but a 250 feet section is exposed at the Silver Camel Mine area. The unit is pyritized and silicified or argillized throughout the district. Two distinct lithologies make up the Camel Conglomerate. The lowermost part has abundant large fragments of Mesozoic(?) slate, siltstone, milky quartz and occasional limestone with only a few volcanic fragments. Upward in the unit, volcanic fragments increase in abundance, but older rock fragments (particularly dark silicified shale(?) and sandstone) are still present. The fragment size decreases towards the top and sandstone interbeds become much more common.

The Camel Conglomerate is overlain in the mineralized area by a solfatarically altered, heterogeneous unit variously consisting of opal breccia, highly leached sulfur-bearing breccia with opaline or chalcedonic fragments, conglomerate (usually leached or opalized) with mostly volcanic fragments, and highly siliceous chalcedonic breccia and conglomerate (produced by alteration of the above) (Figure 3). These units are often very light grey or white. The rocks seem somewhat argillized but the apparent softness is due to acid leaching on a microscopic scale and(or) the presence of abundant alunite.

This unit can be mapped separately from the underlying Camel Conglomerate, but the distinction is based principally on alteration differences. However, Wallace (1980) suggested the alteration boundary is lithologically controlled and the solfatarically altered rocks were originally finer grained, more tuffaceous sediments containing angular fragments from the underlying Camel Conglomerate.

Thick hot-spring sinter is preserved at about the same horizon along the northern portion of the district. Friberg (1980), on the basis of drill hole information, suggests that sinter is locally abundant in the solfatarically altered zone, and perhaps below in the Camel Conglomerate, in the main part of the district. The best exposures of sinter are along the range-front north of the main altered area, where the sinter is nearly 150 feet thick. The sinter pad is zoned from chalcedonic silica near its base to more opaline silica near the top where abundant silicified plant material is preserved.

Wallace (1980) mapped minor, aphyric rhyolite dikes cutting the Camel Conglomerate (Figure 2). A minor flow breccia is also interlayed with solfatarically altered rock in that area. Other workers argue that the fine, siliceous rock is an alteration effect, and not rhyolite (Friberg, 1980).

Several types of unaltered and unlithified materials of Tertiary and Quaternary age are shown on the accompanying geologic map. These overlie highly altered units and often contain altered rock fragments. Four units are mapped:

1. *Rosebud Gravel.* These gravels are as much as several hundred feet thick and can be traced several miles to the Rabbit Hole placer where they host placer gold (Vanderburg, 1936; Johnson, 1977). These gravels once covered the entire Sulphur area and contain mostly Mesozoic fragments and some Tertiary volcanic rock fragments.
2. *Scarp alluvium.* Locally thick accumulations along scarps of normal faults.
3. *Stream alluvium.* Coarse gravels along present day stream channels.
4. *Lake Lahontan sediments.* Undifferentiated material in the flats toward Sulphur siding occurring at elevations of 4,400 feet or less.

STRUCTURE

The dominant fault pattern within the Sulphur district is a N.20° to 35°E.-trending system which has divided the area physiographically into two plateaus. The western fault system bounds the Sulphur Group with the valley alluvium to the west. Displacement here is unknown but could amount to several hundred feet. The central fault system is well displayed along the 2½ mile-long silicified scarp. Displacement of this steeply dipping normal fault system is considered to be from 100 feet to 300 feet. The northern extension of this zone splays into a broad fracture pattern, loosing its continuity. The eastern fault zone marks the boundary between the Sulphur Group to the west and the Kamma Mountains Group to the east. The total displacement of this fault is considered to be in excess of 4,000 feet (Wallace, 1980). Strike along this fault is moderately sinuous. The dip along this system is to the west and averages 45° to 50°. Post-mineral movement is seen by striations on native sulfur in several mine workings. Near the Peterson Pit, the eastern fault has been offset several tens-of-feet by an east-west trending left-lateral fault.

A series of west-northwesterly-trending linears occurs in the southern and northern portions of the district. These are very obscure in the field and are best defined in aerial photographs.

Numerous north-trending fractures, some with silica or alunite fillings, are common throughout the district. All are very steeply dipping and show little to no evidence of displacement. Widths of these fractures range from a fraction of an inch to more than one foot.

Bedding throughout the Sulphur Group rocks is very consistent. The strike trend follows the primary north-south structural direction. An easterly dip is common throughout and is generally less than 10°.

MINERAL DEPOSITS

Several seemingly different types of mineralization occur in the Sulphur district which, although spatially distinct and very different in alteration and metal content, are probably genetically related. Each type will be discussed, beginning with those inferred to have formed uppermost in the system.

Sulfur and Mercury Deposits in the Solfataric Zone

The most obvious mineralization in the Sulphur district is the native sulfur that formed near the surface as small pods, matrix material, and along fractures and faults in the solfatarically altered or acid-leached rock. Rarely, sulfur occurs below the solfataric zone along faults in the upper part of the Camel Conglomerate. Crystals larger than 0.5 in. are also found within workings that cut the eastern fault zone. Sulfur is currently forming encrustations at the surface of a small natural vent which is emitting hydrogen sulfide. This gas is also being expelled from several of the holes drilled in 1974. Sulfur has been mined predominately from the acid-leached gravels that are now composed mostly of opaline silica.

Cinnabar occurs in minor amounts in several of the sulfur pits as horizontal streaks along bedding. Less often, it is found as blebs within sulfur pods or coating sulfur crystals. It is only associated with the acid-leached rocks, generally within solid opaline silica layers. Trace cinnabar occurrences are found in several resistant opal/chalcedony outcrops that have formed along the central fault zone. Thin black coatings of metacinnabar can be seen on exposed surfaces.

The solfatarically altered rock is almost everywhere intensely leached, particularly where it is sulfur bearing, and has undergone a complex alteration history. Below the zone of weathering the unit is often soft owing to intense leaching and the sporadic presence of fine alunite. X-ray patterns of the leached rock indicate it is composed mostly of opaline silica replacing fragments and coating cavities. Pods of massive opal as well occur locally. At least some of the massive opal was precipitated prior to the leaching.

For the most part, the acid-leached rocks retain their original textures. Although the alteration occurred very near the surface, these rocks are for the most part not true spring sinters or surficial deposits, but represent near-surface replacements of pre-existing clastic and

ed most of the surficial hot spring deposits, layers of opaline and chalcedonic material, which include opaline replacements of straw grass and reeds, are preserved in the northern part of the district. Friberg (1980) reports gold, silver, and antimony mineralization in this sinter, particularly along its more chalcedonic lower portion.

Several flat-lying zones of massive, white, chalcedonic breccia are present in the solfataric zone. These zones are interlayered in the more typical leached material. The origin is questionable, but the chalcedonic zones may have formed during periods of a high water-table fluctuation which encroached upward into the acid-leached zone, and deposited chalcedonic silica.

Pyrite-As-Sb-Hg-Au-Ag in Silicified Camel Conglomerate

Alteration of the Camel Conglomerate below the acid-leached material consists of dense silicification and pyritization which grades outward through zones of bedding-controlled, less dense silicification and weak silicification into argillization. Widespread antimony, arsenic and mercury are found in the intensely silicified and pyritized zones with locally anomalous gold and silver values. The alteration probably took place while the Camel was very porous, perhaps even unlithified, as all the rock fragments are coated with microscopic quartz crystals. There are still open vugs (only partially filled with quartz) present and many have a very late opal/chalcedony lining. Traces of fine, disseminated adularia, fluorite, and an unidentified low relief mineral (perhaps a zeolite) were also noted in the vugs.

Pyrite, the dominant sulfide mineral, occurs throughout most of the silicified portions of the Sulphur Group rocks. It always occurs with massive chalcedony and/or silica flooding; however, silica deposition is not always accompanied by pyrite. Several stages of pyritization have occurred in the Sulphur district. The first, a pervasive microcrystalline pyrite, is intimately associated with cryptocrystalline to microcrystalline silica that has flooded the clastics. Silica and pyrite deposition was contemporaneous throughout sections which range up to several hundreds of feet in thickness. Framboidal aggregates of both pyrite and marcasite occur within this sequence. A second pyritic episode formed visible, individual subhedral to anhedral pyrite grains not exceeding 0.05 inches in size. Later pyrite occurring in seams comprise the last stage of pyritization and is not as common as the first two types. Total pyrite content averages 3% and can exceed 5% over extensive areas. Surface exposures of this highly silicified and pyritized rock are characterized by a dark greenish color due to the oxidation of the finely disseminated pyrite.

Stibnite and stibiconite (antimony oxide) are found in trace to moderate amounts over widespread areas within the Sulphur Group and in the sinter. They range from very fine needles, sometimes intermixed with cryptocrystalline silica, to moderate-sized radiating crystals in hydrothermally brecciated zones. Thin stibnite encrustations that appear to have formed from surface emanations of antimony-rich waters are seen in the sinter zone in the northwest portion of the district. Many of the very fine grained antimony-bearing siliceous veins are dark brown in color and require close examination to identify the stibnite and stibiconite blades. At least three other antimony-bearing minerals have been identified in polished section and scanning electron microscopy: berthierite (iron-antimony sulfide), valentinite (antimony oxide) and rare iron-antimony oxide, has been identified as occurring with the alunite veins.

Other minerals identified that have been identified in polished section and SEM, occurring in trace amounts are: tiemannite (mercury selenide), barite, uranophane, native selenium and an unnamed lead-tin-antimony sulfide.

Gold and silver are found in trace to significant amounts in silicified conglomerates throughout much of the district. Better-grade gold mineralization is related to vertical, highly siliceous zones and also, at least in one area in the northwest, to a pyritized sinterous layer. Silver is found to occur both in the siliceous and alunite veins as well as secondary cerargyrite in fissures. Silver production came from the Silver Camel Mine where secondary silver values cease at moderately shallow depths (several tens-of-feet to approximately 300 feet). This probably correlates to the ancient Lake Lahontan water table. The silver to gold ratio is higher within the southern half of the district and lower in the northern half. With very few exceptions, no gold or silver values are found within the acid-leached horizon. Maximum gold and silver values are 0.2 ounces per ton and 60 ounces per ton, respectively.

Veins Cutting the Camel Conglomerate

Two types of veins occur along the north-trending normal faults cutting the Camel Conglomerate. Nearly pure alunite veins up to 6 feet in width were discovered in the early 1900's (Clark, 1918). The alunite is usually fine grained and contains pods of opal, and has occasional silver values. Crustiform quartz ± calcite also occurs as veins in the Camel, often in the same fractures as the alunite veins. Where the alunite and quartz veins occur together the quartz veins coat the walls of the fracture, having formed earlier than the alunite. Near the alunite, the calcite component of the quartz veins has been removed.

Although rhyolite dikes can occupy the same structures, the alunite appears to have been emplaced as an open-space filling in the silicified conglomerate, rather than by replacement (Wallace, 1980). The alunite veins are difficult to trace upwards into the acid-leached rocks. Often they pinch out both upward and laterally, passing into open cracks in the silicified Camel Conglomerate.

Calcite veins up to 5 feet thick form large, well developed scalenohedrons immediately southeast of the Devil's Corral. Large massive black-tinted calcite and gypsum veins have formed at several locations along the easterly fault. Dark grey opal veins up to 1 foot in width cut portions of the poorly lithified clastics in the northwest portion of the district.

Chalcedonic Quartz Veins in Kamma Mountains Group

Several silicified fault zones in the rhyolites of the Kamma Mountains Group carry silver and gold values with spotty high-grade silver. The veins are epithermal, with both open-space quartz fillings and white chalcedonic replacements of rhyolite. The better values occur in scarce patches of bluish "live" silicification colored by fine pyrite.

ORE GENESIS

In our opinion, the Sulphur district offers a unique chance to examine, at the surface, different levels of ore deposition now juxtaposed by block faulting. The following is an attempt to explain in a general way the geologic relationships observed in the Sulphur area, drawing heavily on the work of others in active geothermal areas (for example: Schoen, and others, 1974; White, 1968). Although the various Sulphur ores probably formed in the same hydrothermal system, they are grossly different because they were deposited in two contrasting environments separated by the water table. The lowest level of ore deposition is represented by the epithermal quartz veins in the volcanic rocks of the Kamma Mountain Group. Similar veins are probably present at depth in the volcanic rocks under the main part of the mineralized area. When the circulating hydrothermal fluids encountered the more porous, overlying Sulphur Group (particularly the Camel Conglomerate), the fluids deposited quartz and metals in much wider zones of silicification and pyritization below the water table.

Boiling at that water table produced H_2S (and mercury) bearing vapors, which upon condensation and oxidation in the overlying solfataric zone produced sulfuric acid, native sulfur, and cinnabar. This would place the boiling water-table at the time of ore deposition along the contact of the Camel Conglomerate and solfataric zone. The water table reached the surface in the northwest portion of the district, producing siliceous sinter from the hot springs activity.

The alunite veins cutting the Camel Conglomerate present a problem in interpretation. At first they were thought to represent feeders for acid fluids into the overlying solfataric zone (or perhaps return conduits for acid condensate moving downward to the water table). However, this is difficult to envision if the mineralization above and below the water table was synchronous, because the alunite veins cut previously silicified Camel Conglomerate. It is possible is that the alunite veins were emplaced by vapor-dominated fluids late in the mineralization period. As the system became sealed by the broad silicification of the Camel Conglomerate, fluid pressures might build below that horizon. Fracturing along the northerly faults would release that pressure, perhaps resulting in "flashing" and rapid upward flow of boiling fluid. Fluid inclusion data from alunite veins at Alunite Ridge near Marysvale, Utah, which are similar to the more coarse-grained parts of the Sulphur district alunite veins, indicate that they were emplaced by a vapor-dominated system (Cunningham and others, 1978).

SUMMARY AND CONCLUSIONS

Host units for ore deposits in the Sulphur district include a thick sequence of Tertiary volcanic rocks (Kamma Mountains Group) overlain by approximately 2,000 feet of coarse clastics and lacustrine tuff of the Sulphur Group. Unlithified Quaternary and Tertiary gravels blanket much of the area. North-trending Basin and Range normal faults are the only structures of importance.

The partially eroded mineral deposits are believed to represent a fossil hot spring or geothermal system. The deposits inferred to form lowermost in the system are siliceous veins cutting the rhyolites of the Kamma Mountains Group. The veins pass upward into broad zones of silicification and pyritization in the originally porous clastics of the Sulphur Group. The uppermost part of the Sulphur Group contains sulphur and mercury in rocks that were thoroughly leached, probably by acid condensate above a boiling water table. Economic amounts of gold and silver formed along and near the major north-trending structural zones during this phase. Nearly pure alunite veins probably formed late in the development of the system, and may have been emplaced by a vapor-dominated fluid.

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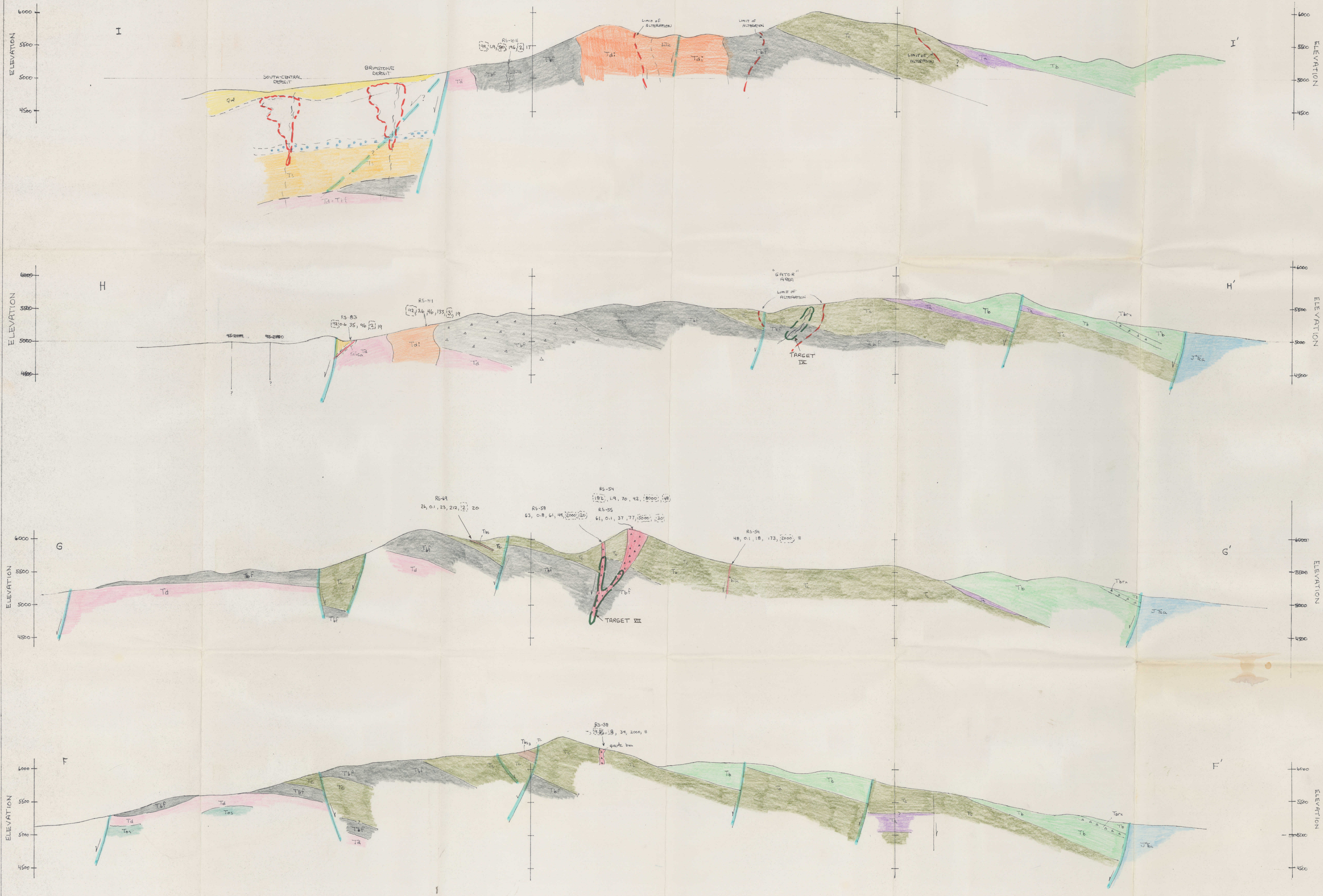
CROSSECTIONS EAST-WEST LOOKING NORTH

ROSEBUD PROJECT
1" = 500'
GEOLOGIC CROSSECTIONS
MLB

[ ] = ANOMALOUS VALUES

ROCK CHIP SAMPLES = RS-1
ASSAYS = (Au ppb), (Ag ppm), (As ppm), (Ba ppm), (Hg ppb), (Sb ppm)

CROSSECTIONS EAST-WEST LOOKING NORTH



ROSEBUD PROJECT
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