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COUNTY If different from written on document	Pershing
TITLE If not obvious	Proposed Stratigraphic nomenclature for the Rosebud Project
AUTHOR	Moore
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MULTI_DIST Y / N?	
Additional Dist. Nos:	
QUAD_NAME	Sulphur 7½'
P_M_C_NAME (mine, claim & company names)	Rosebud Mine
COMMODITY If not obvious	gold, silver
NOTES	Geology; stratigraphic column; handwritten notes  9 p.

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

SS: DP 9/10/08  
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Initials Date

Structure, Stratigraphy - Moore 1991

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## PROPOSED STRATIGRAPHIC NOMENCLATURE FOR THE ROSEBUD DISTRICT

### Introduction

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

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

### Auld Lang Syne Group (JT a)

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

### Oscar Sequence (Tos)

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

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



FIGURE 1 : ROSEBUD CANYON STRATIGRAPHIC SECTION

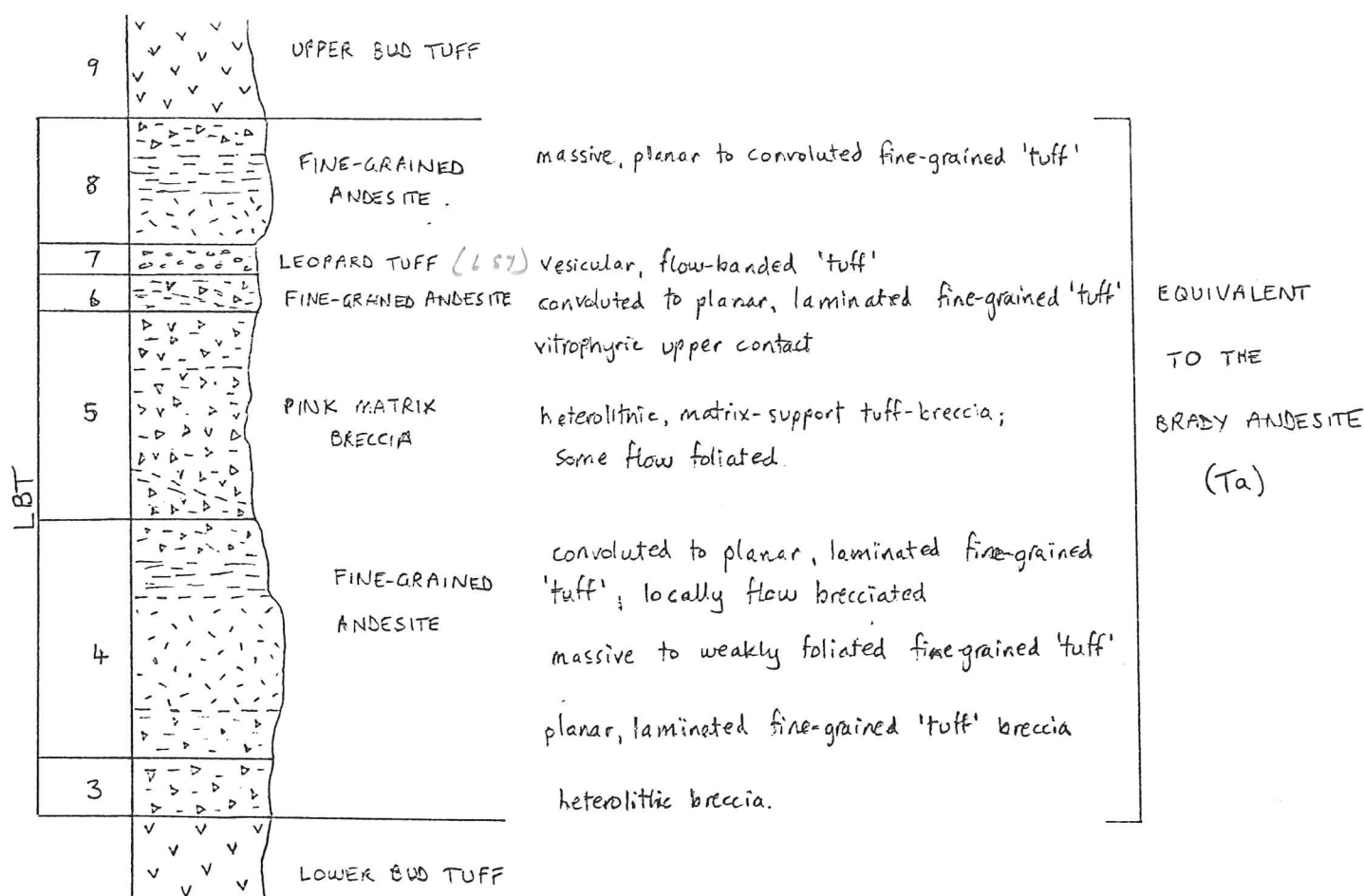
SYMBOLS

SCALE 1" = 500'

QUATERNARY	Y Y	alluvium, colluvium	Gal	alluvial gravels with placer Au
TERTIARY (MIOCENE)		CAMEL CONGLOMERATE	Tsc	conglomerate and scree breccia 40 to +250'
		Lake Sediments	Ts	volcanic ash and lacustrine sediments : to 2000'
		BADGER FORMATION (GATOR)	Tb	hematitic volcanoclastic and conglomeratic breccias - red silty matrix 900-1000'
		Chocolate Flow	Tc	flow banded, sparsely porphyritic latitic flow - local eruptive center +300'
		Chocolate Tuff		non-welded lithic tuffs +300'
		Marker Porphyries		glomeroporphyritic flows or sills +125'
		UPPER BUD SEQUENCE (UPPER BUD TUFF, UPPER SURGE)	Tbs <sub>1</sub>	well-bedded lithic tuff-breccias graded bedding +150'
		BRADY SEQUENCE (BRADY ANDESITE)	Ta	fine-grained flow, planar flow 90' lamination - intervening lithic 26' tuff-breccia 185'
		SEE MINE POST SEQUENCE		
		LOWER BUD SEQUENCE (LOWER BUD TUFF; LOWER SURGE; OSCAR SEDIMENTS; WILD ROSE)	Tbs <sub>2</sub>	heterolithic, well-bedded lithic tuff-breccias and volcanoclastic units with reverse and normal grading - includes fragments of the Auld Lang Syne Group and clasts of Dozer towards the base. +1000'
		DOZER RHYOLITE DOZER FORMATION (EQUIVALENT TO 'BROWN FLOW' OR WILD ROSE FLOW DOME)	Td	flow banded, locally vesicular probable exogenous rhyolitic flow dome(s) with significant relief on its upper surface. - upper flow laminated zone. 250-1800'
		OSCAR SEQUENCE	Tos	andesitic flows, generally fine- grained with flow breccias and tuffs (?)
		OSCAR ANDESITE		
JURASSIC- TRIASSIC		Basal Tertiary Sediments	Tcs	carbonaceous sandstone, siltstone and pebble conglomerate 0-100'
		AULD LANG SYNE GROUP	JRa	deformed, dark grey metasediments - graphitic slate, phyllite, quartzite, hornfels.

- NOTES : 1. selected compilation of previous descriptions with alternate unit names shown in brackets. Recommended new terminology is highlighted.
2. thicknesses for the upper Dozer to the Chocolate Fm. are from a measured section on South Ridge; other thicknesses are schematic only.

FIGURE 2 :

MINE HOST SEQUENCENOTES :

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

FIGURE 3: MINERALIZED INTERVALS IN THE ROSEBUD STRATIGRAPHY

MINERALIZATION

(Oscar Prospect)

HYCROFT  
MINE

DREAMLAND  
(North Equinox)

anomalous  
hole above  
Rosebud

ROSEBUD  
SOUTH AND NORTH  
DREBODIES

(? Wild Rose Canyon  
prospects)

(? Chance prospects)

ROSEBUD  
EAST DREBODY

SOUTH  
RIDGE  
'TARGET 2'

alluvium, colluvium

CAMEL CONGLOMERATE

Lake Sediments

BADGER FORMATION  
(GATOR)

Latitic Flow

CHOCOLATE  
FORMATION

Tuffs

Marker Porphyries

UPPER BUD TUFF  
(UPPER SURGE)

BRADY  
ANDESITE  
(LBT)

see Mine Host  
sequence

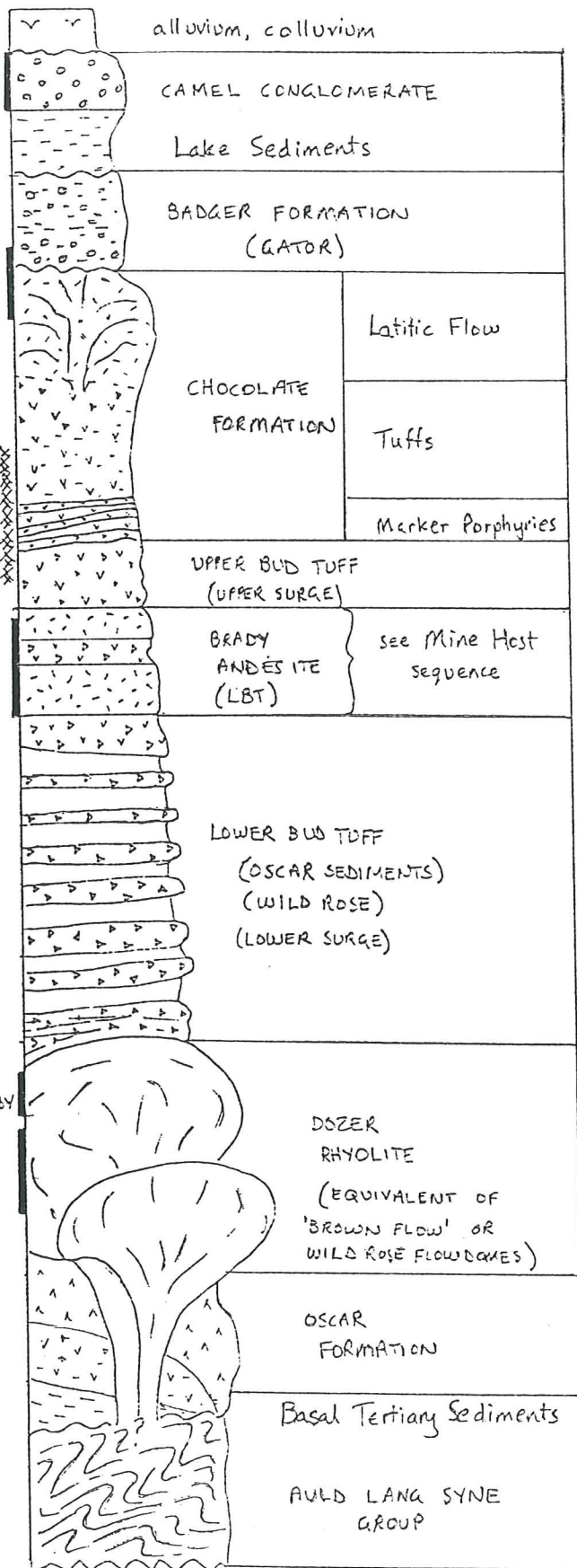
LOWER BUD TUFF  
(OSCAR SEDIMENTS)  
(WILD ROSE)  
(LOWER SURGE)

DOZER  
RHYOLITE  
(EQUIVALENT OF  
'BROWN FLOW' OR  
WILD ROSE FLOWDAMES)

OSCAR  
FORMATION

Basal Tertiary Sediments

PAUL LANG SYNE  
GROUP





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

### **Dozer Rhyolitic Dome (Td)**

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

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

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

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

### **Lower Bud Tuff (Tbs<sub>1</sub>)**

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

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

#### **Brady Andesite or Mine Host Sequence (Ta)**

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

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



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

### **Upper Bud Tuff (Tbs<sub>2</sub>)**

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

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

### **Chocolate Formation (Tc)**

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

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

### **Badger Formation (Tb)**

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

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

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

### **Post-Badger Sequences**

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

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

### **General Comments**

1. the volcanic stratigraphy exhibits variations in facies and thickness of units along strike, so the section described will differ at Wildrose and other locations. Thicknesses of individual units have been used to decide where a stratigraphic contact should be in a drill hole. This may 'force' contacts where the variation is simply due to changes in volcanic facies. Mike Brady noted that the dip of bedding is commonly steeper on the ridges than on the sides of the valleys. This may be explained in that the centers of volcanic activity have been preferentially preserved on the ridges, with steeper original dips than the more distal volcanic units.
2. there does not appear to be a stratigraphic horizon that is more consistently mineralized than another (Fig. 3). There are more favorable stratigraphic units, but these only become important where they are intersected by mineralizing structures.

### **References**

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

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

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