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Joint Planes in the Rhyolites of the Butte District, Montana

John B. Hopkins

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OF THE BUTTE DISTRICT, MONTANA

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JOHN B. HOPKINS

A Thesis
Submitted to the Department of Geology
in partial fulfillment of the
Requirements for the degree of
Bachelor of Science in Geological Engineering

MONTANA SCHOOL OF MINES
BUTTE, MONTANA
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INTRODUCTION

The following manuscript was submitted to the Department of Geology of the Montana School of Mines, as a partial fulfillment of the requirements for the degree of Bachelor of Science in Geological Engineering. The problem herein discussed deals with the pointing planes found in the area of rhyolite located in the northwestern portion of the Butte District. The question to be determined was whether or not the pointing planes in the rhyolites could be classified with the Butte Ore fissure systems.

A study of this problem was begun during the Fall semester of the 1931 school year and was completed May 30, 1932. All work was carried on in the field with the aid of a Brunton compass. A base map of the Butte district was also used, upon which all the data collected was plotted.

GENERAL GEOLOGY

Occurrence and character of the rocks.

Except for recent alluvium and a small patch of lake deposits located in the western portion of the area, the entire Butte district is made up of entirely igneous rocks. These rocks belong to two distinctly separate ages.

The oldest rocks are coarse textured granitic rocks having very uniform and homogenous characteristics, such that they can be very readily recognized in hand specimens. These rocks contain the Butte Ore deposits and compose the rocks of the Anaconda Hill.

The second class of rocks of the Butte area are characterized by their fine textures, and are typically volcanic in nature. They have been both intruded into the granite and extruded out upon its surface. These rocks are known as the Butte rhyolites and they cover an area of approximately two and one-quarter square miles of the northwest portion of this district.

Topography.

The topography of the Butte district is typically hilly. It is flanked on the east by the continental water shed, on the south by the Silver Bow Valley and on the north it extends up to the old Walkerville erosion plane. The main mining district lies on the crest and southern slopes of the well rounded Anaconda Hill which rises from the Silver Bow Valley flat up to an elevation of 6400 feet or approximately 900 feet above the valley below. Separating the Anaconda Hill from the Continental Divide is the northern portion of Silver Bow Valley which extends southward around the base of the Anaconda Hill where it broadens out into a large flat. Here the drainage turns to the west and flows through a narrow neck in the main valley towards the great open basin known as the Deer Lodge Valley. Where the drainage leaves the Butte district the valley is flanked on both sides by low hills composed of aplite and Butte monzonite.

To the northwest of the City of Butte, located on the southern flank of the Anaconda Hill, is a large volcanic cone composed of rhyolite, known as Big Butte. This butte is the most prominent, single, topographical feature of the district, and it rises almost abruptly from the rather gently rounded lava hills surrounding its base. The butte rises to an elevation of 6310 feet or about 400 feet above the surrounding foothills. Weathering has rounded off the sides of the butte to a relatively smooth conical hill. The large expanse of low hills composed of lava have also been worn down to relatively smooth topographical features. These hills extend away from the base of the butte with a gradual decrease in elevation towards the southeast, while they gradually rise to the northwest.

General relationship of rhyolite to other rocks.

The rhyolite cuts the coarse textured Butte monzonite in many places as dikes. Although the author has not been able to recognize any such structures, it has been reported to be a fact by Walter Harvey Weed in his professional paper No. 74 of the U. S. G. S. Evidence which shows that the rhyolite has been poured out upon the surface of the granite can be observed in the gulch on the south side of Big Butte, where a contact of the granite and rhyolite has been exposed by erosion. Here large boulders of both aplite and monzonite exist as an agglomerate cemented in a rather dark porphyrytic rhyolite. Also, a highly colored dark red sand can be seen at the base of the contact which at one time was decomposed granite sand that covered the slopes of the granite hills before the eruption of the lavas.

The lava flows probably extended as far to the south as Silver Bow Creek. This explains the many irregular patches of rhyolite on the southern extremity of the rhyolite area. Erosion has cut away the comparitively thin cover of lava leaving behind only a few disconnected patches scattered over the surface as shown in plate No. 1. (See Appendix).

What has been said about the rhyolite-monzonite relationship can be resaid about the aplite area located to the southwest of the rhyolite area. In no part of the district are there found any places where ore veins cut into the rhyolite, but it is a common case for veins exposed at the surface in either aplite or monzonite to extend up to the rhyolite contact and disappear under it.

GENERAL OBSERVATIONS OF THE RHYOLITE AREA

Weathering controlled by flow structure.

Weathering has played a very important part in exposing the jointing planes in the Butte rhyolite. Many small areas scattered throughout the rhyolite district are covered with the remnants of eroded rock. These places are usually located on the hilltops, small ridges, or holes, protruding above the general surface of the land. Figure No. 1 shows a hillside composed of rhyolite where erosion has been controlled by the joint systems within the rock.

Fig. 1 - Showing general erosion features of a hillside in the rhyolite area.

West of the butte the rhyolite has a typical lava structure showing a ribbed surface where weathered. The rock in this area shows small parallel buff colored streaks running throughout its whole mass. These streaks resemble slow structures within the original lava and are planes of weakness, along which jointing has taken place and along which weathering has been most effective. On the flanks of the hills where the lava has not been protected by a layer of surface soil, the flow structure within the lava can be traced for considerable distances. In these places erosion has cut away the rock along the flowage streaks such that the twisted and highly contorted lava flow structure can be seen very plainly. In Figures No. 2, 3 and 4 can be seen the flow structure as exposed by erosion.

Figs. 2 and 3 - Showing erosion along parting planes in the rhyolite.

Fig. 4 - Showing twisted and contorted structure in prospect.

<u>Origin of lava:</u>

The flowage planes have been abscured almost entirely by erosion in the vicinity of Big Butte and it has been very difficult to find enough of them exposed, to enable the author to study them very closely. However, from the highly contorted structure plainly shown on the west of the butte, it is infered that the same type of twisted and rolled lava structure has occurred alike on all sides of the central vent which is Big Butte and that the only reason this evidence is lacking on the eastern side of the district is because erosion has destroyed the greater part of the lava. These features have been covered with a layer of surface soil. However, the general outline of the hills on all sides of the butte show the general form of lava hills with their long axis roughly n ormal to the line of flow. On the south east of the butte the ground has a general slope away from the base of the vent which was no doubt covered with lava but erosion has cut and carried away all the rhyolite except for scattered and disconnected patches left here and there on the underlying granite surface. In plate two is shown the strikes of flow lines that were available in the near vicinity of Big Butte. These flowage plains are only roughly radial about the Butte as a center. Also a general coralation of these joints have been made which show the probable direction of flow of the lava from the butte as a center.

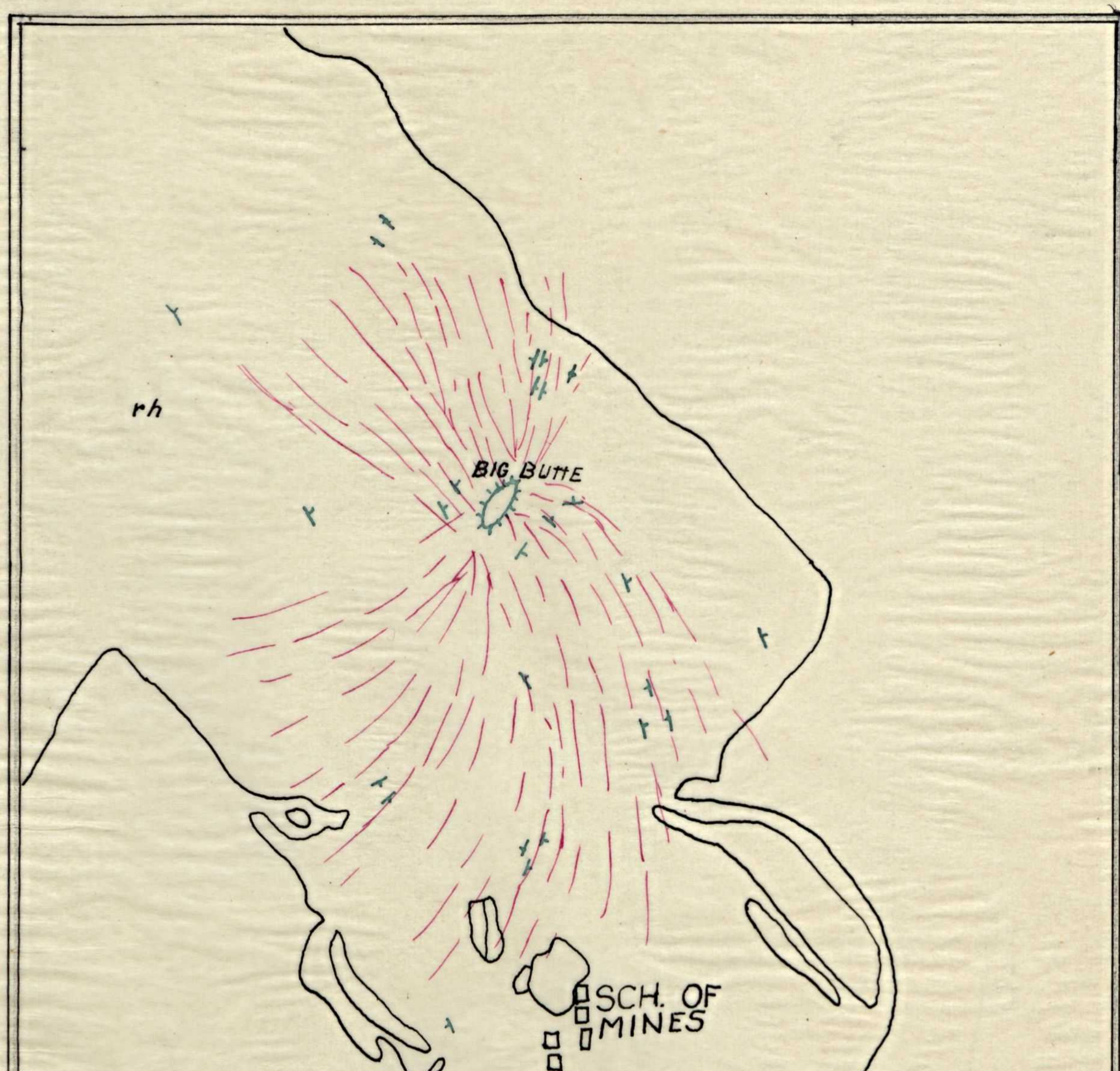


PLATE 2.

CORALATION OF FLOW JOINTS AND PROBABL DIRECTION of Lava flow

The reason for the lack of true radial joining and flow structure in the rhyolite is that due to the rolling, twisting and side-slipping in the molten lava when it was poured out upon the surface. There is no true agreement of flow lines only in a general waywhen considering a comparatively large area and since erosion has destroyed the greater part of the lava, only here and there is left any evidence of flow structure. These places are so haphazard and remote from one another that very little evidence of flow structure is left.

The northwest jointing system.

Two northwest joint systems striking 40°-45° West are found throughout the whole rhyolite area. The strikes of both these jointing systems are parallel or nearly so throught the whole area. The only difference is that one has a dip of 48°-87° to the north, while the other has a dip of 75°-90° to the south. In the vicinity of the School of Mines these northwest jointing planes are very numerous an can be clearly seen. These systems are very well exposed on the southern slopes of the butte near the top where weathering has followed these joints in wearing away the rock. In the area west of the butte the jointing systems follow the flow structure almost completely. In freshly exposed rock found in many prospect holes the northwest jointing has so completely scattered the rhyolite along flowage planes that the rock breaks in thin slabs, Weathering and perculating surface waters have loosened these slabs to such an extent that one can pull them loose from their place with little effort. In this part of the district the dips are extremely variable, following the dips of the contorted flowage plane. The presence of the northwest jointing system can be distinguished from the flowage planes in this area because the jointing cuts across the flow lines in maintaining their direction of strike. The dips of these planes also diverts from the rhyolite parting and form considerable planes of movement. Little or no displacement can be recognized in any part of the rhyolite along the northwest jointing system.

The east-west system of jointing.

This system of jointing or fracturing can only be found occasionally, it having a strike northeast 65°-89° and dipping southward. These fractures are the most outstanding and are next to the northwest system in strength. On the top of Big Butte and on the southern flank, this system of joints can be very clearly observed where large smooth face sheer planes cut the rock. Very little evidence of this jointing system is found west of the butte.

Miscellaneous jointing planes.

Throughout the whole rhyolite area are many hap-hazard jointing planes which have no general strike or dip, but are minor fractures, caused by general weathering conditions. These joint places may have beencaused from rock creep on the slopes of the underlying granite or they may be due to general unsatisfied stretches within the rock caused from cooling in the molten lava.

Classification of Butte Ore fissure systems.

The following classifications of the Butte Ore fissure systems has been taken from Walter Harvey Weed's professional paper No. 74 of the U. S. G. S.:
The following fissure systems are recognizable throughout the district, both in join t planes in the rocks and in veins underground:

(a) Parrot system, No. 80° E., and its complement (b) Anaconda system, No. 80° W., occupied by the principal east and west veins of the district.

(c) Silverbow system, No. 60° to 65° W.

(d) Blue Vein or Nipper system, No. 40° to 45° W.; includes the Covellite, the Skyrme, Jessie, Edith May, and Blue veins, the Mountain View, and many other prominent faults.

(e) The Steward system, No. 64° E.; includes the Middle or Blue Jay fault, which becomes No. 16 in the Rarus ground, the Steward fault, whose vein is worked in the Gagnon, Original, and Steward mines, the No. 6 fault of the Parrot workings, and a number of faults havig the same general course in the Bell and Diamond mines.

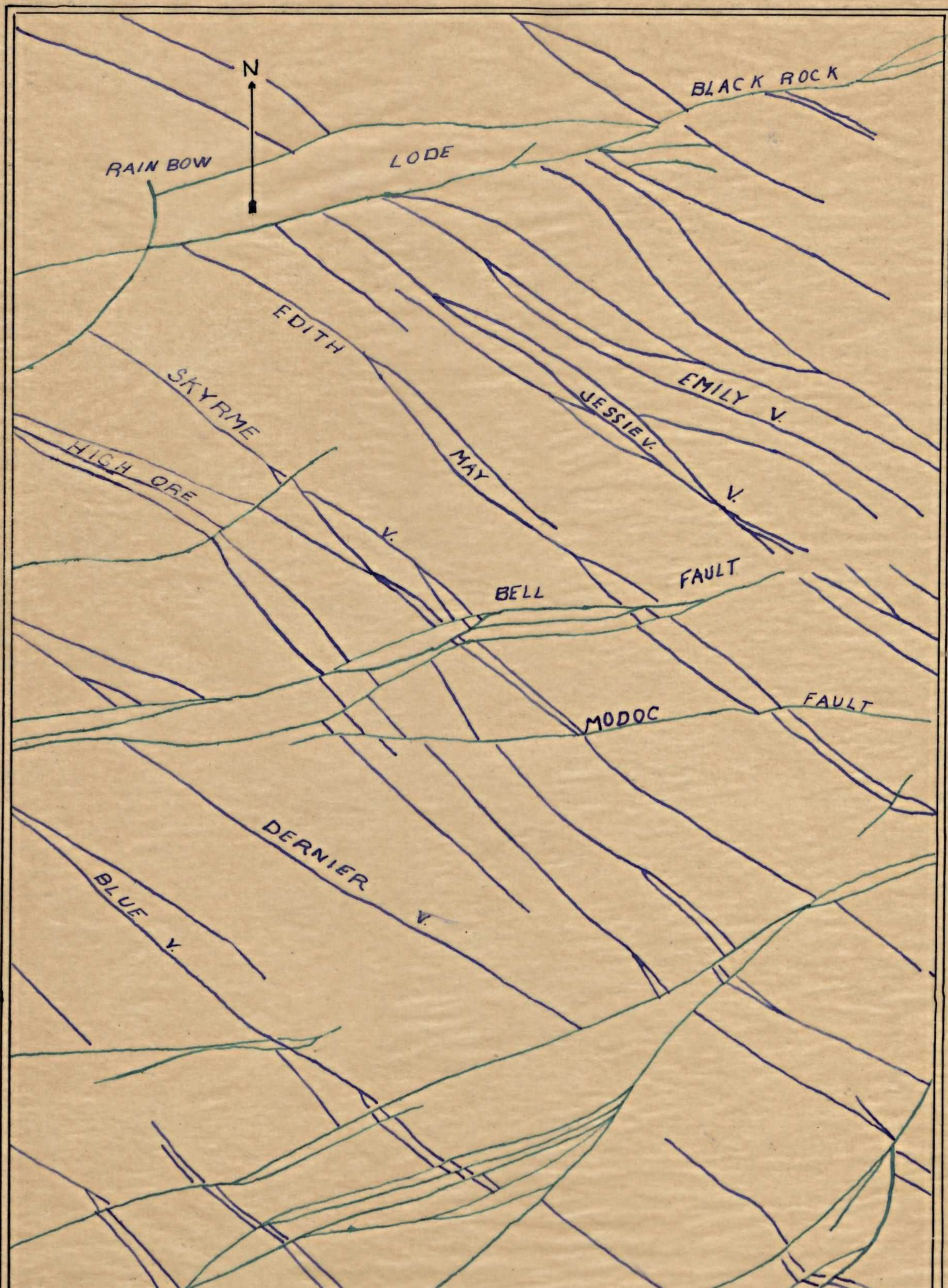
(f) Rarus system, No. 45° E.; faults which carry ore torn off from earlier veins.

CORALATION OF RHYOLITE JOINTING PLANES AND FISSURE SYSTEMS

Blue Vein and northwest jointing systems.

There is a general agreement of strike and dip between the Blue Vein ore bodies of the Anaconda Hill and the

NORTH-WEST JOINT SYSTEM IN RHYOLITE
PLATE 3.



BLUE VEIN-NIPPER SYSTEM + NORTH-EAST FAULT SYSTEM

PLATE 4.

northwest system of joints found in the rhyolite area. Mr. Weed classifies this set of veins as typical fault filling veins, and states that these faults cut and displace the older east-west system and in many places re-open and follow the older vein fissures. A general relationship of this fault system to the older east-west vein system can be observed in plate No. 1. All evidence seems to point to the fact that a great deal of fracturing occurred in the Anaconda Hill prior to the formation of the Blue Vein nipper system and the author believes that it is very probable that this stage of faulting or a later re-occurence of faulting along these same lines has caused the northwest jointing systems in the rhyolite. In Plates No. 3 and 4 a general comparison of these two fracture systems have been made showing the general agreement.of strikes between the northwest joints in the rhyolite and the Blue Vein nipper system in the Anaconda Hill.

CONCLUSIONS

1. The direction of flow structure found in the Butte rhyolites combined with the rudely radial joint pattern around the base of Big Butte show that it was once an active volcanoe.

2. A northwest system of joints found throughout the rhyolite area correspond in strike and dip with the Blue Vein-Nipper system of the Anaconda Hill.

3. A great many complex and minor jointing planes exist in the rhyolite that cannot be classified into any definite jointing system.

Bibilography

Walter Harvey Weed -- Professional paper No. 74 of the U.S.G.S.

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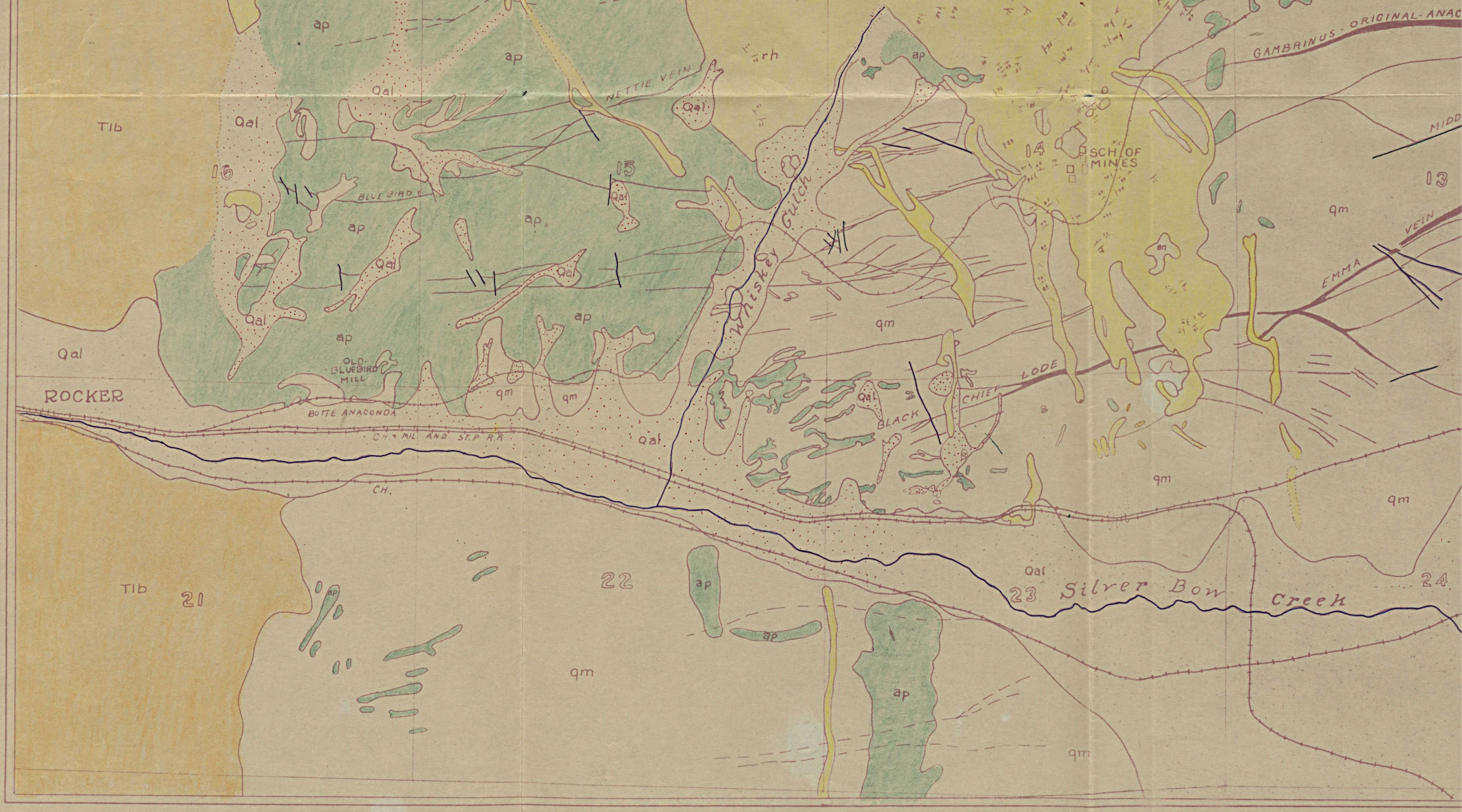
Tlb
qm
ap
Qal
Oro
Fino
Gulch
9
10
11
12
14
15
NETTIE VEIN
Big Butte
SYNDICATE MT CON
GAMBRINUS - ORIGINAL - ANA
SCH OF MINES


qm
ap
FAULT
BLACK ROCK
BLACKROCK
RAIN BOW
LODE
ELM ORLU
WALKER
VILLE
EDITH
EMILY VEIN
SKYRME
JESSIE
MAY
VEIN
HIGH ORE
7
12
CENTERVILLE
BELL
FAULT
8
Qal
9
CONTINENTAL FAULT
MODOC
FAULT
SKYRME VEIN
DICATE MT CON VEIN
HIGH ORE VEIN
DERNIER
VEIN
SHANNON
COLUSA V
BLUE VEIN
MEADERVILLE
ANACONDA
ORIGINAL-ANACONDA
TRAMWAY
Elk Park
Qal
MIDDLE FAULT
FAULT
RR
17
16


ap
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16
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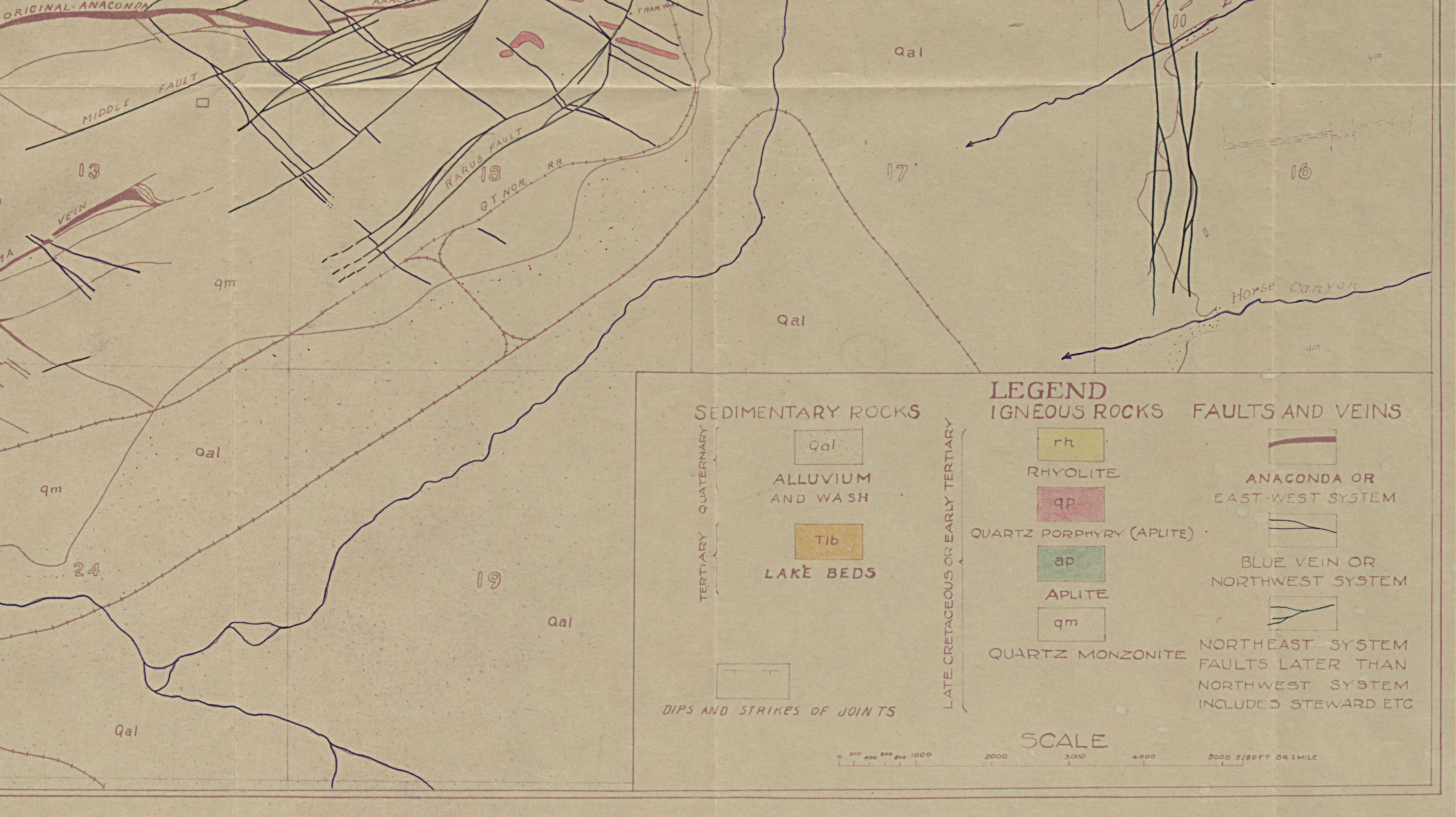
NETTIE VEIN
BLUE BIRD V.
Whiskey Gulch
SCH. OF MINES
GAMBRINUS - ORIGINAL -
EMMA VEIN
BLACK CHIEF LODE
ROCKER
OLD BLUEBIRD MILL
BUTTE ANACONDA
CH. & MIL. AND ST. P. R.R.
CH.
qm
21
22
23
24
Silver Bow Creek


ORIGINAL-ANACONDA
MIDDLE FAULT
RARUS FAULT
GT NOR. RR
VEIN
TRAM WAY
Horse Canyon
13
18
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16
24
19
Qal
qm
LEGEND
SEDIMENTARY ROCKS
TERTIARY QUATERNARY
Qal
ALLUVIUM AND WASH
Tlb
LAKE BEDS
DIPS AND STRIKES OF JOINTS
IGNEOUS ROCKS
LATE CRETACEOUS OR EARLY TERTIARY
rh
RHYOLITE
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QUARTZ PORPHYRY (APLITE)
ap
APLITE
qm
QUARTZ MONZONITE
FAULTS AND VEINS
ANACONDA OR EAST-WEST SYSTEM
BLUE VEIN OR NORTHWEST SYSTEM
NORTHEAST SYSTEM FAULTS LATER THAN NORTHWEST SYSTEM INCLUDES STEWARD ETC.
SCALE
0 200 400 600 800 1000 2000 3000 4000 5000 5280 FT OR 1 MILE