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# Geological Report of Summer Field Trip 1928

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Geological Report  
of  
Summer Field Trip  
1928

Clarence A. Corry  
Marcus McCanna



Geology Report

General Introduction:

The object of this trip and report was to familiarize the students of the Montana State School of Mines with methods of taking and mapping surface and underground geology.

All surface geology was mapped by means of plane table and alidade, and underground work by means of Brunton compass and taps.

The senior class of the Montana State School of Mines under the supervision of Dr. E.S. Perry performed the work, which covered an area in Madison County including South Boulder Creek, near Jefferson Island, the Silver Star Mining District, and the Alameda Mine, near Virginia City. The class was so divided that there were two squads of two men each, and one squad of three men. The party making this report was composed of Clarence A. Corry, and Marcus McCanna. The trip covered a period of three weeks, of which eight days were spent at South Boulder, five at Silver Star, and four at Virginia City, and four days on a trip through Yellowstone National Park.



## 1. South Boulder Area

### 1. Introduction

Location north end of Madison County, near Jefferson River, six miles south of Jefferson Island.

An area in extent of five miles long and three miles wide was mapped.

Data was taken on the various outcrops, mode of occurrence dips, and geologic significance.

### 2. Physiography

South Boulder Creek on its journey to join the waters of the Jefferson flows through a small valley, flanked on the left side at the area mapped by a one thousand foot range of Madison Limestone, and on the right by a broad level valley, through which the Jefferson River is supposed to have at one time flowed.

### 3. General Geology

The Archean gneisses are overlain by the Cambrian whose total thickness is about thirteen hundred feet. The Cambrian includes the Flathead formation, which is made up of a persistent quartzite or sandstone, now fossiliferous about one hundred twenty five feet thick and steeply inclined, with overlying beds of softer, shaly sandstone, being about three hundred feet in thickness. Total thickness is about eight hundred to one thousand feet. The ellis also includes the Gallatin form which consists essentially of mottled limestone beds usually separated by beds of shales, the limestone being one hundred twenty feet thick, massively bedded in center and laminated at top. This limestone is fossiliferous. Three hundred feet of calcareous and sandy beds overly this. The Ordovician and Silurian Strata are not present. The Devonian includes the Jefferson limestone consisting of seven hundred to one th



one thousand feet of massive block limestone with bands of laminated magnesium limestone. Devonian also includes the Three Forks formation which is made up of one hundred fifty to two hundred feet of orange shale and magnesium limestone. The overlying carboniferous includes the Madison limestone formation, consisting of twelve hundred to fifteen hundred feet of laminated limestone, massive limestone, and jaspery limestone; also, includes the Quadrant formation made up of three hundred to five hundred feet of cherty and red magnesium limestone. Next in the column appears the Juratrias Ellis formation, of three hundred to five hundred feet of Arenaceous and Argillaceous limestone and quartzite. Above this lies the Cretaceous sediments, including the Dakota form of eight hundred to one thousand feet of conglomerate quartzite, sandstone, and shale; also the Colorado formation of eighteen hundred to two thousand feet of sandstone and shale. Basalt, and then Andesite flows appears in considerable thickness above this.

#### 4. Structure

The beds slope to the north, dipping thirty five degrees at the basalt, increasing slightly to about forty degrees north on the Cambrian beds. There is evidently a north south fault to the west along the high Madison limestone ridge, being obviously responsible for the relief.

A small anticline exists to the south and west, giving evidence folding.

#### 5. Economic

No ores, or commercial minerals exist in the mapped area.



## II. Silver Star Mining District

### 1. Introduction.

Location the Silver Star district lies on the west side of the Jefferson River about fifty miles above Three Forks. It is situated on the SE slope of table mountain, just above the level of the Jefferson Valley.

It is one of the oldest of the quartz mining districts in the State. Even in the 60's the various mines of the district were well known reaching their climax of gold production in 1912.

There is no gold record of the mines, which were developed to depths ranging from two hundred fifty to four hundred feet vertically.

At present, it is an abandoned camp, except for the small activities carried on by leasers and the newly organized Victoria Gold Mining Co., which is engaged in the development of the Victoria group of claims.

### 2. Physiography

Rolling foothills of table mountain, and the Bozeman Lake beds constitute the physiography of the district.

### 3. General Geology

The Silver Star district is occupied by schists, slates, and quartzites and by a small area of limestone bordered by a granitic intrusion, which has been traced continuously from Silver Star northward to Butte, and is clearly a part of the Boulder Batholith commonly known as Butte quartz monzonite. Quartz monzonite varies in places along its borders to diorite and similar basic types.

### Stratigraphy

The schists, slates, and quartzites are apparently continuous in outcrop and identical in age with the schistose rocks of table



and Red mountains, which underly Paleozoic limestone and are believed to be Pre-Cambrian either in whole or in part. The limestone of the area is not seen in direct contact with the schists, but the surface relations indicate that the two are separated by a fault. On these premises the rocks of the district may be designated Butte quartz monzonite, Silurian limestone, and Pre-Cambrian schists, slates, and quartzites.

#### Petrology

The Limestone is usually bluish gray, and along its contact with the granite, is metamorphosed to garnet, epidote, and similar minerals. The schists include highly quartzose types, mica schists, hornblende schists, phyllites, and slates. On the border of the intrusion may be found iron silicates and calcium silicates, quartz felds, pears, biotite, epidote, garnet, calcite.

#### 4. Structural Geology

Highly folded Paleozoic sediments, cut by faulting indicate the structure. The schists dip about forty five degrees south. The main mass of Quartzite dip very gently east. The limestone forms a basin or trough, whose axis pitches south or southeast, the structure being apparent all along the northern edge of the limestone and in the mines. Thus at the Broadway mine the contact which is nearly parallel with the bedding, dips thirty degrees southwest for first five hundred feet on incline, and then straightens up to sixty five degrees for the next one hundred fifty feet, beyond which development has not proceeded.

#### 5. Mineral Deposits

Types of ore deposits:

The ore deposit of Silver Star district are of two types., the ores of the Broadway and neighboring mines, Hudson, Delaware, Fagin,



are contact deposit between limestone and quartz monzonite. The ores from irregular shoots and bunches along the contact and in the limestone adjoining the contact. On the monzonite side of the contact, there is an altered granite zone of from two to twenty feet. This zone was strongly epidotized. On the limestone side, there is an altered limestone zone ranging from five to thirty feet. The contact zone is altered by secondary enrichment. The secondary zone is fifty to sixty feet deep. Sulfides come in at two hundred to four hundred feet.

The ores of the Green Campbell and Iron Rod properties are in fissure veins, which cut through a series of metamorphic rocks, chiefly schists. The ores are more regular in form, occupying well defined fissure veins with high grade ore in shoots. At the Iron Rod and Green Campbell the vein deposits dip and strike with the schistosity and approximately with the apparent bedding of the formation in which they occur. At the Green Campbell the lead is a slaty shale having a quartzite footwall and a mica schist hanging wall. The vein on the Green Campbell strikes due East and dips twenty to forty degrees south.

#### Origin

The ore deposit of the Silver Star occur in rocks which seem to be marginal remnants of the roof of the Boulder batholith and is evident that the ore deposit of the Broadway group are of contact origin and are due to the mineralizing effects of the igneous intrusion to the north. The origin of the ores in the Green Campbell and similar properties is not so clear. They are located near an igneous contact, but do not contain the minerals characteristic of contact deposit. On the contrary, they have the characteristics of deposits formed by circulating waters in



fissure.

That the ores of the Green Campbell were not formed by solutions escaping from the magna of neighboring batholith but existed before the batholiths came into place is suggested by the indications that recrystallization, probably due to the metamorphosing effect of the Batholith has converted the clay of the fissure veins into serpentine and chlorite. It appears probable therefore that some of the ores of the Silver Star district date from the time of formation of the batholith, and that others originated before, perhaps long before that date.

#### Mineralogy

The contact ore deposit contain magnetite, as well as sulfides of the metals below the oxidized zone. They are further characterized by the presence of such minerals as garnet, epidote, siderite, asbestos, serpentine, and calcite in the gangue.

The most important constituent of the ores is gold with minor amounts of silver, lead, and copper.

The gold in the oxidized ore is free and associated with quartz, limonite, siderite, and hematite, but in unoxidized it is chiefly in pyrite, which occur alone in quartz or with magnetite, bornite, serpentine, and galena. The silver is closely associated with gold or lead. The copper is in malachite, azurite, and chrysocolla in the oxidized zone, and chiefly in bornite in the sulfide zone. The lead occurs as cerusite in the oxidized, and as galena in the sulfide.

The oxidized ores of the Iron Road have yielded small amounts of copper, as well as gold. In the form of malachite, mixed with Smithsonite and quartz. The gangue of the vein deposit is chiefly quartz with some serpentine and chlorite.



## 6. Mines and Prospects

The ore deposit of Silver Star district are not exhausted.

Mining has thus far penetrated to very shallow depths, three hundred fifty feet on Broadway, two hundred feet on Green Campbell, four hundred feet on Iron Rod. Enrichment by downward moving surface waters, has increased the metallic content of the surface ores, and has been more effective in contact ores than in the veins, as the former deposit are more pervious than the latter. The values below the enrichment zone are therefore likely to fall off more rapidly in ores of contact origin; which hitherto have been mined almost exclusively from the oxidized zone.

It is a fact that looks well for the future of the district that recent work in a relatively impervious portion of the contact zone has disclosed sulfide ores of sufficiently high grade to be profitable.



### iii Alameda Mine

#### 1. Introduction

Location Alameda Mine is located about one and half miles southwest of Virginia City, over the first low ridge in the Fairweather and Highland mining district.

Past development. Two veins, approximately three hundred to four hundred feet apart were developed; the north vein, being of low grade, was worked by shaft and tunnel, and the Alameda vein, of very high grade oxidized quartz gold ore running as much as \$1000 to the ton, was worked by drift along the vein, with gophering stoping methods leaving pillars of low grade ore for a distance of "?" where a cross fault cut and displaced the ore body for a heretofore unknown distance and direction. Stopes up to the fault were carried through to surface. Ore of insufficiently high grade to warrant extraction was found on the other side of the fault in a vein which was not believed to be the continuation of the Alameda lead. Near the mouth of the Bamboo tunnel a low grade vein, which was thought to be the north vein, was encountered; farther in a high grade lead was cut and stoped to surface as far as the fault. Float from the outcrop was plowed up from the side hill and shipped, netting as much as \$20 a day to workmen.

Present development- optimistic leasers have several times worked in hopes of picking up the faulted portion of the high grade vein.

#### 2. Physiography

Located in an area of sharp relife; contour variations of three hundred to four hundred feet.

#### 3. General Geology



Stratigraphy -none

Petrology- the veins are found in an area of Archean schists and gneisses, cut by pegmatites dikes.

#### 4. Structural Geology

No folding.

A series of parallel, complementary faults exist in a general northly direction through the region, cutting and displacing the ore bodies. Strike faulting is found along the Alameda vein and along the north vein.

The two veins, north, and Alameda, which are three to four hundred feet apart, are cut by cross faulting, nearly vertical, with displacement ( of three to four hundred feet), with the east side (Alameda) northward, and the west side (Bamboo) shifted southward.

The high grade vein in the Bamboo tunnel is of approximately the same general strike and dip as the Alameda vein to the east of the cross fault.

Strike faults follow each vein, the A B vein strike fault carrying eight to ten inches of a brown clay gauge and dipping about forty to fifty five degrees with over of forty five degrees to the north; the north vein strike fault carries one inch of gauge and has a generally flatter dip. These strike faults are distinct and separate, and are probably pre-mineral. For detailed explanation of faulting, see end of report.

#### Geologic Column:

1. Pegmatite
2. East West faults (strike)
3. Mineralization along E- W faults.



4. Probably additional movement along strike faults.
  5. Further mineralization.
  6. Major cross faulting with displacement of veins (vertical).
  7. Minor faulting
  8. Erosion. Development of oxide enrichments.
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## 5. Mineral Deposits

1. Types of ore bodies- An enriched gold quartz veins three to four feet in width, and having a general dip of fifty degrees north, in the case of the Alameda Bamboo occurs as a true fissure type of intermediate depth in Archean schists and gneisses. The north vein, of the same type, has a flatter dip ( forty to forty five degrees north).

The pegmatites, which are abundant and in one case actually forms the hanging wall of the vein, are not mineralized.

2. Mineralogy - Vein not of high temperature origin but of intermediate, because of absence of high temperature minerals.

Ore minerals- gold bearing quartz, limonite, some primary pyrite, quartz veins are vugiferous.

Pegmatites are coarse grained feldspars with biotites, Due to coarse texture of pegmatites, they can easily be distinguished from the quartz which is massive.

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## Recommendations-

Get direction and amount of displacement of major cross fault by:

1. Careful mapping and study of Alameda surface- Bamboo



Chief claims

2. Careful mapping and study of Alameda and Bamboo underground workings, including shafts, tunnels, and other openings.

3. Drifting along fault plane.

Alameda- sink on vein in vicinity of fault and along pay shoots. Look at small segments of drag ore along fault, and obtain evidence of direction of movement (east side north, west side south) by richness of drag ore.

Bamboo- fine ends of pay shoot of A B vein in Bamboo tunnel near fault. Obtain evidence as to direction of movement. Sink on vein.



## Structural Geology

### Veins and Faults on Alameda Property

As mentioned before and as seen by Geologic Surface Maps of Alameda Tunnel and as shown by accompanying maps on fault problem, the faulting and the displacing of the ore bodies were the result of complex movements.

The North Vein is three to four feet wide, has a general dip of forty five degrees to the North and is not sufficiently mineralized to be profitable. The strike fault found near and in this vein is characterized by one inch of a brown gouge, which is found throughout its exposed length in the underground workings. The strike fault comes from the country rock into the vein, forms the hanging wall of the vein, and then goes back into the country rock again. This happens twice.

The Alameda- Bamboo Vein ( A B Vein) is also three to four feet wide, has a generally steeper dip of from forty to fifty five degrees to the north and was extremely rich (\$1000 per ton). Coming into the vein from the country rock and forming the hanging wall of the vein is a strike fault, which is characterized by eight to twelve inches of brown, damp clayish gouge. This strike fault has the same general dip as the vein. The two strike faults are distinct and separate, and were probably formed at the same time.

The latter strike fault and the A B Vein were cut by a major cross fault which displaced the east side of A B Vein northward and the west side of the A B Vein southward, the displacement being in the neighborhood of three to four hundred feet. The east side of the vein actually bend into the cross fault, giving a clue as to the direction of movement, and also location of drag ore. The maps show the bending of veins on vicinity of fault.

The major cross fault as seen underground at the Alameda is nearly vertical, has one to five feet of a black clayish gouge and forms a zone ten to twenty five feet wide.



The north vein was probably subjected to the same action, but there has not been sufficient work to show what has actually happened.

The above statements in regard to the manner of ore disposition and faulting, together with the solution of the fault problem as shown on fault diagram map are not claimed to be the exact duplicate of the actual happenings and conditions, but in view of the limited available information it is likely (both possible and probable) solution.