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ILLUSTRATIONS

[Presented before the Society January 23, 1932]

PRELIMINARY GEOLOGIC NOTES ON GALENA MOUNTAIN, A PART OF SNOWMASS MOUNTAIN AREA, COLORADO[1]

JOHN W. VANDERWILT[2]

INTRODUCTION

A detailed study of the geology of Snowmass Mountain was begun in the summer of 1930 as one of the projects of the cooperative program of the State of Colorado, the Colorado Metal Mining Fund, and the United States Geological Survey. The area has never been mapped in detail nor has a geologic description ever been published, although mineralization was recognized in the early seventies. Much prospecting and a little mining have been done. Reliable data on production are not available, but it is evident that all mining operations were small. Under these conditions a thorough geologic study and detailed geologic mapping are justified in order to determine whether the area is or is not worthy of continued expenditures of money in search of ore.

The project was planned in 1929 and a topographic map of Snowmass Mountain area on a scale of 1 to 48,000 was begun in that year, but the field work was not completed until July, 1930. A special topographic map of Galena Mountain, covering about 5 square miles within the main area, was completed on a scale of 1 to 12,000 in 1929, and was available for the writer's use in 1930.

In 1930 the writer spent about seven weeks in geologic work in the area. During this time the geology of

[1]Published by permission of the Director of the U. S. Geological Survey.
[2]Assistant Geologist, U. S. Geological Survey.

Galena Mountain was mapped in detail, and reconnaissance studies were made in preparation for mapping the main area. Inasmuch as there is no geologic description in print of any part of the area a preliminary statement is given here chiefly in regard to the smaller unit already mapped. However, because of the very early stage of the field studies the statement is necessarily brief and includes only the more important geologic features which it was possible to work out in one short field season. It is hoped that the facts presented may be of general interest as well as of practical value to those interested in developing local mineral deposits.

I wish to acknowledge valuable suggestions received from Dr. B. S. Butler, who accompanied me during several days of field work. Mr. F. M. Johnson, supervisor of surveys, Denver, Colorado, kindly plotted the mining claims on the topographic base shown on Plate II. Mr. E. W. Keith and Mr. G. Sessinghaus kindly offered information and accommodations. With the field work I was ably assisted by Mr. Harry C. Fuller, of Boulder, Colorado.

LOCATION

Galena Mountain is a northeast shoulder or spur of Treasury Mountain, at the north end of the West Elk Mountains, in northern Gunnison County, Colorado. Figure 1 shows the position of Galena Mountain in the Snowmass Mountain area and also the relations of that area to well known places in Colorado. About one mile northwest of Treasury Mountain is Treasure Mountain, and because of similarity the two names are often confused. Both Treasure Mountain and Galena Mountain are in reality parts of a larger structural mountain which in 1876[3] was referred to as Treasury Mountain by the Hayden Survey.

Galena Mountain is 11 miles by road from Marble and 17 miles from Crested Butte. For several years the road from Marble has been impassable for wagon hauling. The road from Crested Butte is in poor repair and during wet weather is almost impassable for automobiles but it would not require

[3]Holmes, W. H., U. S. Geol. and Geog. Survey Terr. Eighth Ann. Rept., p. 67, 1876.

a great deal of work to correct this condition. However, during the winter the road is closed with snow not only between Galena Mountain and Crested Butte but also between Crested Butte and Gunnison and even between Marble and Glenwood Springs. The area is truly "snowed in" and virtually inaccessible from about December to April.

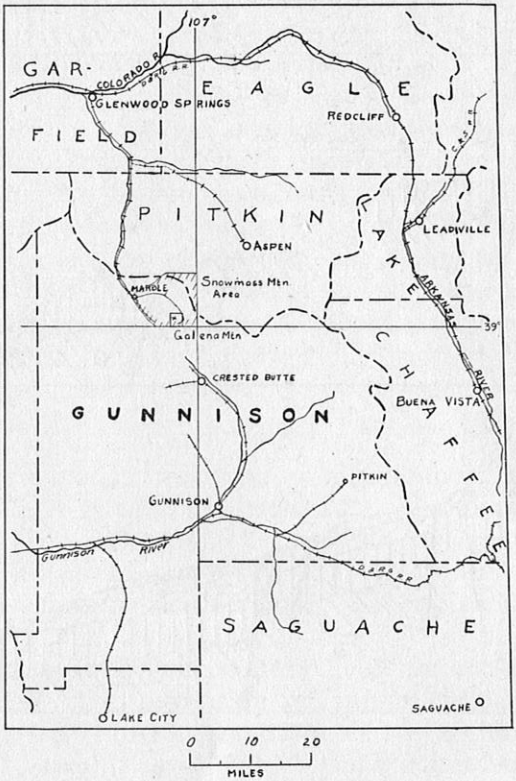


Figure 1—Index map of a part of Colorado showing location of Snowmass Mountain area and Galena Mountain.

SURFACE FEATURES

The general area under consideration has a rugged and very attractive topography. The entire sky line is serrated, and there are several peaks over 14,000 feet in elevation. The

PLATE II—Cross sections of geologic map.

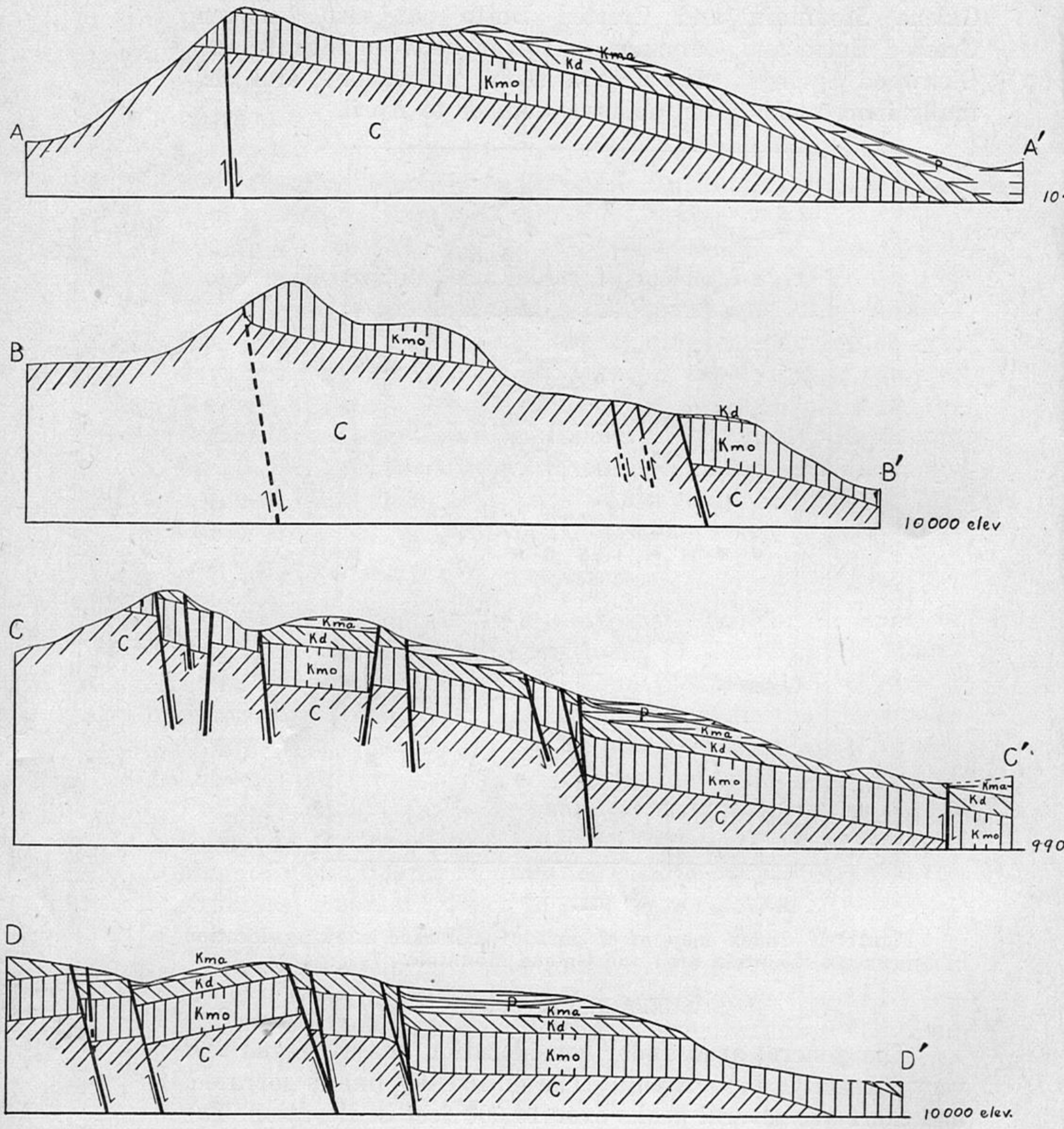
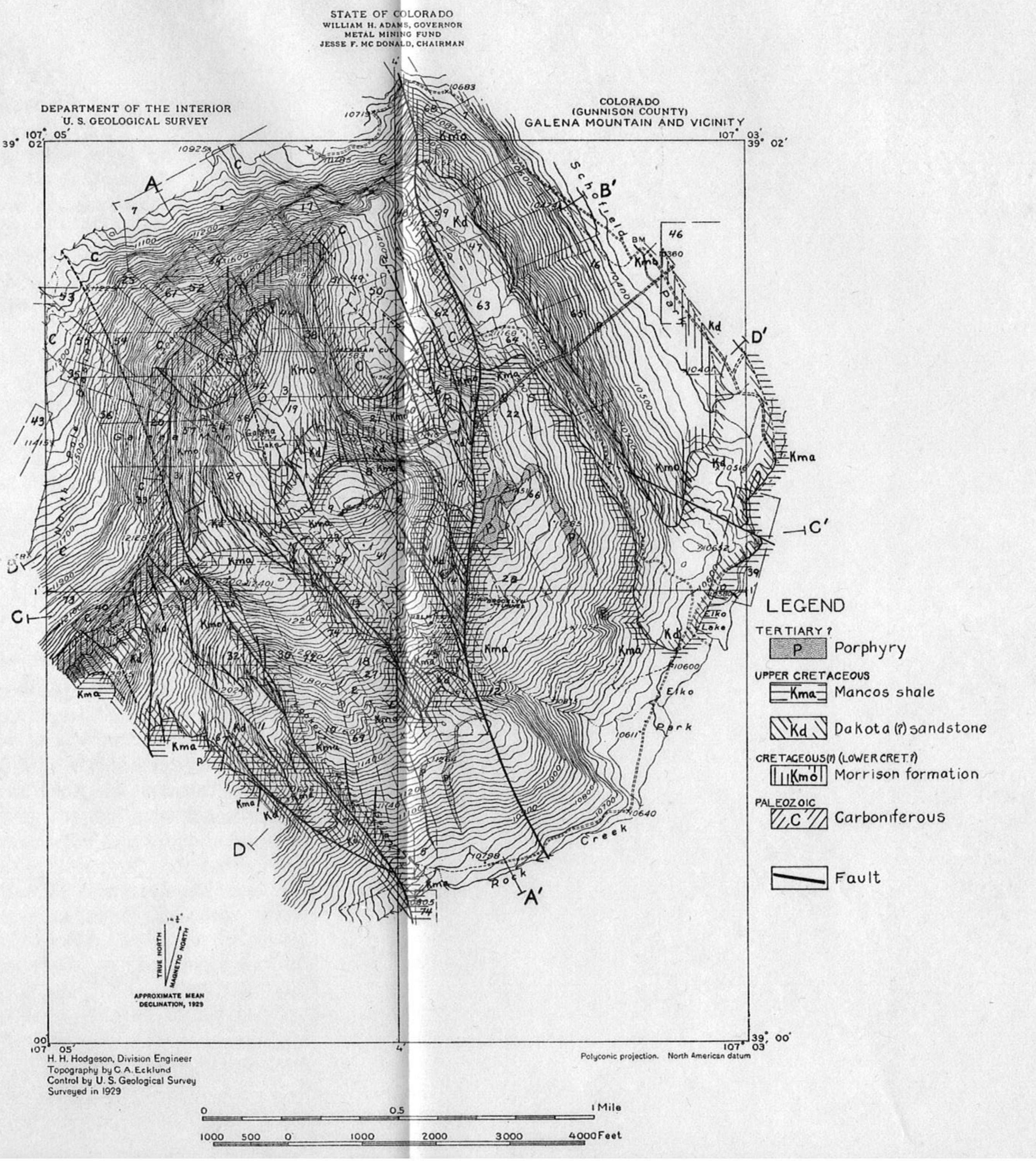


PLATE I—Geologic map of Galena Mountain.

PATENTED CLAIMS ON GALENA MOUNTAIN

1. Ajax
2. Anna
3. Blue Jay
4. Cameron
5. Central
6. Chesapeake
7. Commonwealth Placer
8. Cora
9. Climax
10. Dixie Queen
11. Dixie Queen No. 2
12. Duke of Wellington
13. Echo
14. Emma
15. Four
16. Galena Park
17. Golden Rule
18. Grand View
19. Grasshopper
20. Greenback
21. Hiawatha
22. Homestake
23. Indicator
24. Ira Way
25. Iron
26. Jennie Lynd
27. King of the West
28. Log Cabin
29. Lookout
30. Lookout No. 2
31. Lookout No. 3
32. Lookout No. 4
33. Lookout No. 5
34. Mammoth No. 1
35. Mammoth No. 3
36. Mancos
37. Mayflower
38. Mexican
39. Millsite
40. Mountain Quail
41. New Discovery
42. New York
43. North Pole No. 13
44. Oriental
45. Osceola
46. Outwest
47. Puritan No. 1
48. Puritan No. 2
49. Puritan No. 3
50. Puritan No. 4
51. Puritan No. 5
52. Puritan No. 6
53. Puritan No. 7
54. Puritan No. 8
55. Puritan No. 9
56. Puritan No. 10
57. Puritan No. 11
58. Puritan No. 12
59. Puritan No. 13
60. Rocket
61. Sara Barnhardt
62. Setz
63. Setz No. 2
64. Setz No. 3
65. Setz No. 4
66. Setz No. 5
67. Shetland
68. Silent Star
69. Solodad
70. Standard
71. Toledo
72. Tyro
73. Yelm
74. Zacatacus



divides are sharp ridges, and the valley walls are steep. Glaciation has locally widened the valleys, forming grassy open parks, commonly containing one or more lakes. In places there are steep-walled gorges with numerous cascades and waterfalls produced by post glacial erosion. In places heavy timber covers the slopes, and abundant grass as well as a large variety of flowers cover the open slopes above and below timber line.

Galena Mountain covers only 5 square miles and yet it has a relief of about 2,500 feet. Its topographic form is due mainly to glaciation. On its east side are two glacial cirques, both containing rock-basin lakes, and the shoulder or knob southeast of Galena Lake owes its smooth round top to ice action. Evidence, though not complete, suggests that at one time ice from the large cirque of North Pole Basin overflowed a large part or possibly all of Galena Mountain.

Geology

General Features

Carboniferous "red beds", Morrison formation, Dakota(?) sandstone, and Mancos shale, all well-known formations in Colorado, are found on Galena Mountain, but owing to metamorphism the beds have locally lost those characteristic features by means of which they are generally recognized in the field. The red of the "red beds" is replaced by drab-gray. The Morrison is light gray to pale greenish gray instead of variegated red and green, with a basal sandstone 45 feet thick. In places the bedding planes of the shales have been effaced by induration or partial recrystallization of the rock. Quartzose sandstones are changed to dense hard quartzites. Certain limestones, however, although in places completely replaced by silicates, show on the whole less alteration than the sandstone or shales. The formations can generally be identified if the changes they have undergone are understood. One or more of four strata—the top and base of the Dakota (?) sandstone, a limestone in the lower part of the Morrison, and the sandstone at the base of the Morrison —can be recognized anywhere in the area.

The distribution of the sedimentary formations on Galena Mountain is shown on Plate I.

Sedimentary Rocks

Carboniferous "red beds"

Only a small part of the Carboniferous formations occurring in the Snowmass Mountain area is present on Galena Mountain. In addition to the alteration of the sediments a large angular unconformity at the base of the Morrison prevented an identification of the particular part of the Carboniferous section that the beds may represent. "Red beds," unaltered and identified as Carboniferous, crop out over wide areas several miles to the east and also to the north. A detailed stratigraphic sequence of these "red beds" has not been worked out, and until this can be done the correlation of the altered beds represented on Galena Mountain can not be expected.

The rocks are medium-grained feldspathic sandstone, which weathers to light-gray surfaces and is dark gray on fresh fractures. Not a trace of the original red color can be found. In places the beds are slightly conglomeratic, with quartz pebbles as much as half an inch across. Extensive conglomerates with pebbles of marble have been observed at stratigraphically lower horizons on Crystal Mountain and in Crystal Canyon north and northwest of the area under consideration. Although well bedded and in places forming dip slopes, the rocks in cliffs and on some steep slopes appear massive.

The composition on the whole is uniform, although individual beds vary in the relative content of quartz, feldspar, and muscovite. Thin beds of fine-grained micaceous rock, less than 6 inches thick, which probably represent altered shaly beds, occur at irregular intervals. East and north of the small lakes east of Galena Lake there is a bed of limestone 4 to 6 feet thick, that could be traced only a few hundred feet. This bed is similar to and may be mistaken for a limestone that occurs in the lower part of the Morrison, which is described in a later paragraph.

Morrison Formation

The Morrison formation is 431 to 445 feet thick. It is composed of a thin basal sandstone overlain by several hundred feet of shales with some sandstone and a little limestone. The shale is calcareous in places and contains sandy zones, sandstone beds, and some limestone. Locally horizontal changes of certain members within the formation are abrupt, but the average thickness and composition is very uniform. Where the formation crops out as a unit it is easily recognized, but some of the sandstone members are very similar to the Dakota (?) sandstone as well as to some of the Carboniferous sandstones. A thin-bedded limestone with intercalated shale occurs, usually within 15 to 20 feet of the top of the basal sandstone member, throughout the Snowmass Mountain area, and because it can be easily recognized this limestone is a useful horizon marker on Galena Mountain.

The base of the Morrison is a sandstone 35 to 45 feet thick. The rock weathers to a light gray but is dark gray on fresh fractures without any appreciable color contrast between it and the underlying or overlying rocks. The beds are composed mainly of a fine quartz sand, the individual grains of which can be seen with a hand lens. The beds average 2 to 4 feet in thickness and in some places form ledges where they crop out, whereas in other places the entire formation appears massive. Where the underlying Carboniferous is fine grained and the overlying shale of the Morrison is very sandy exact contacts are difficult and in places even impossible to determine.

Due to alteration the beds are uniformly gray to green. The variegated colors so characteristic of the unaltered formation in adjoining areas are not to be found. Nor does the altered Morrison shale crop out on gentle slopes covered with soil, such as those that usually mark a normal shale, but instead the beds commonly crop out in sheer cliffs, indicative of hard, strong rocks. Major bedding planes are preserved, but the shale bedding has been obliterated. The altered shale, except for a few calcareous beds, is hard like chert, and it has a dense porcelainlike texture. On weathered surfaces it is light gray to nearly white, in many places with a pale green cast. Fresh surfaces are gray to light gray and locally in calcareous zones may have a maroon to purple color. Gray quartzite, which does not stand out in contrast with the altered shale, represents the former sandstones, all of which were fine grained.

The only persistent limestone bed that is present, as already stated, has remained relatively unchanged. However, the intercalated shale bands have been altered to a hard cherty rock. These bands are commonly less than an inch thick and are roughly parallel to the bedding but have very irregular contacts. Individual bands are discontinuous and because they stand out in relief are very conspicuous on weathered surfaces of the bed. The limestone between the altered shale bands is free from sand or clay and is white. This bed crops out in the cliffs at Mexican Cut and can be seen from some distance as a conspicuous white layer, interrupted where it is replaced by silicates.

The sandstone beds in the Morrison that are similar in appearance to the Dakota (?) sandstone, are with the exception of the basal member less than 10 feet thick and not of great extent along dip or strike, whereas the Dakota (?) is uniformly about 200 feet thick.

Dakota (?) Sandstone

The Dakota (?) is the most satisfactory horizon marker in the area. The formation is at least 200 feet thick, uniformly fine grained, gray, and composed of quartz, all of which tend to make the formation easy to recognize. In addition, the basal conglomerate of small quartz pebbles, known to be characteristic of the Dakota in other areas, is present on Galena Mountain. This conglomerate may be less than an inch thick over considerable areas, but it is nevertheless, an almost infallible marker of the base of the Dakota

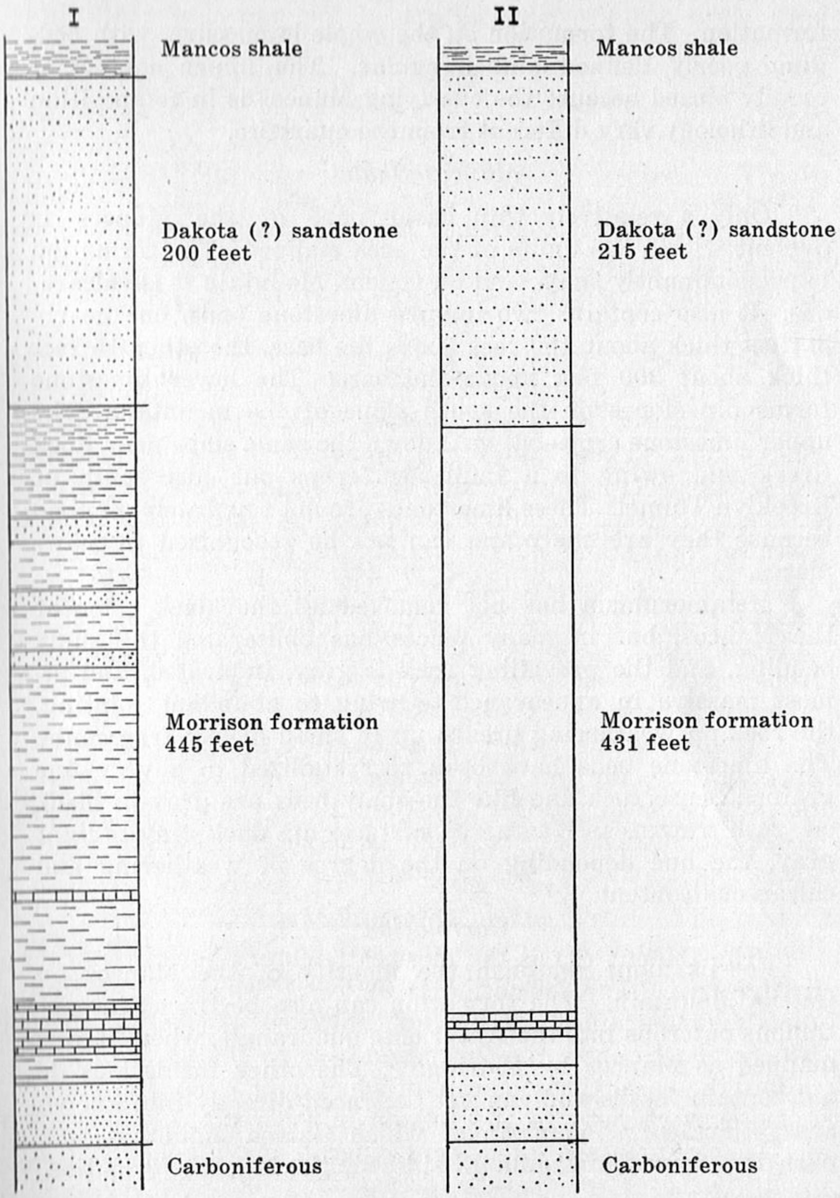


Figure 2—Columnar sections. I. Section measured on divide on northwest side of Copper Creek about 1½ miles northeast of Gothic, Crested Butte Quadrangle (Folio 9). II. Section measured on Galena Mountain.

formation. The formation on the whole is massive, with bedding poorly defined and irregular. The upper contact is readily placed because the overlying Mancos is in composition and lithology very different from the quartzite.

Mancos Shale

Only a relatively thin basal part of the Mancos is present within the limits of the area mapped. The formation is predominantly shale, and on Galena Mountain it is calcareous. It also contains two impure limestone beds, one nearly 30 feet thick about 150 feet above the base, the other 15 feet thick about 300 feet above the base. The lower limestone forms dip slopes on the south slope of the mountain. The upper limestone crops out well down the same slope near Rock Creek and owing to a fault also crops out just south of Brooklyn Tunnel. These limestones are not separately mapped because they are shaly and can not be recognized in many places.

Metamorphism has not removed all the black color of the Mancos, but in many places has obliterated the shaly bedding, and the prevailing rock is gray, indurated, and almost massive in appearance. Owing to abundant jointing, the rock on weathering breaks up in small blocky fragments. The limestone beds have been recrystallized to a very fine grained dense rock and like the shaly beds are gray to black on fresh fractures. Weathered surfaces are dark gray to light gray, the hue depending on the degree of weathering and calcareous content.

Correlation

Fossils alone establish the identify of the Mancos on Galena Mountain. The formation can also be traced in continuous outcrops into the Anthracite quadrangle, where it was mapped as Mancos by Eldridge[4]. The other formations do not contain fossils and can not be traced directly into known areas. Treasury Mountain of which Galena Mountain is a part, is a dome flanked on all sides by the Mancos formation,

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[4]U. S. Geol. Survey Geologic Atlas, Anthracite-Crested Butte folio (No. 9), 1894.

and older beds can not be traced outward into areas previously mapped. The Dakota (?), Morrison, and Carboniferous beds are therefore correlated by their stratigraphic sequences as well as by their relation to the base of the Mancos. A section measured by the writer in the Crested Butte quadrangle, southeast of Galena Mountain, is given in Figure 2 for comparison with a section measured on Galena Mountain. The correlation of the two sections is evident from their similarity. In the Anthracite-Crested Butte folio the "Gunnison" formation is the same as the Morrison formation of this report.

IGNEOUS ROCKS

Porphyry

Porphyries occur in dikes and sills of considerable size, but they are not numerous. Quartz phenocrysts are an abundant and conspicuous feature at all outcrops observed, and feldspar phenocrysts are also commonly present. The porphyry does not stand out in contrasting color or in topographic form from the surrounding rock but can be easily recognized by means of the quartz and feldspar phenocrysts.

STRUCTURE

Galena Mountain is the southeast end of a domelike uplift about 4 by 6 miles in area that has a northwestward trend. Tertiary (?) granite crops out in the central portion of the dome, which is undoubtedly of intrusive origin. The sedimentary formations dip 10° – 30° E., SE., and S. (Plate II) away from the higher part of the dome. The part of Rock Creek shown on the map has cut a valley essentially parallel to the strike of the beds, which changes from east in the southern part of the area to north in the eastern part.

Minor Folds

Minor flexures or cross folds occur with their axes approximately parallel to the dip of the beds, superimposed on the major structure. One of these cross folds occurs just north of Galena Lake with its crest a little north of the highest point on Galena Mountain, and it is also very well exposed in North Pole Basin. The axis pitches a little north of east, with the dip of the beds. On the south flank of Galena Mountain the cross folds plunge south, approximately parallel to faults in the area, which tends to confuse the outline of the folds or at least to make them difficult to trace on the surface.

Faults

Faults are numerous. Their relation to the regional structure or even to the local cross folds has not been worked out well enough for discussion here. The writer has, therefore, confined the description to local features of the faults as mapped on Galena Mountain.

The faults show parallelism in strike and to some extent in dip. The strikes are northwest, and the dips are steep. The larger faults, about four in number, have a northeast dip and normal displacement, but the displacement decreases to the south, ending in the Mancos shale.

The total movement along the faults is generally less than 40 feet and difficult to determine because of drag folds in both foot and hanging walls and drag faults that branch to the northwest into the foot walls of the major faults. These drag faults die out within 2,000 feet along their strike from the main fault, and the drag folding appears to be confined to a still narrower zone. Small fissures or faults, along which displacement could not be determined and which could not be traced any distance on the surface, are not shown on the map. Many of these unmapped fissures occur, especially on the upper south slopes of the mountain. The strike of the smaller faults is west of north, like that of the major faults, and the dip is either west or east and invariably steep. Wedges bounded by faults, one of which shows a reverse and the other a normal displacement, are common. However, only small displacements are involved in examples of this kind; all the larger faults have normal displacement, with the downthrown side on the east.

METAMORPHISM

Metamorphism of the rocks has been referred to in preceding paragraphs. Shale has altered to a hard rock with a porcelainlike texture, sandstone to quartzite, and the red coloring has been removed. The marble quarried in Yule Creek, 3 or 4 miles west of Galena Mountain, is in this same area of matamorphism. In places diopside, hedenbergite, tourmaline, hornblende, tremolite, garnet, and other contact-metamorphic minerals have been observed. A Tertiary (?) granite which occurs near by in Treasury Mountain has produced the metamorphism.

MINERALIZATION

Further work in adjoining areas is essential for a satisfactory discussion of the mineralization in the area, but the following may be of interest at this time.

Mineralization has affected an area several times larger than Galena Mountain. The most characteristic feature on Galena Mountain is the presence of large quartz veins, with calcite conspicuous in a few places. Mineralization has also occurred to some extent along certain beds, the most conspicuous example of which is at Mexican Cut in the limestone in the lower part of the Morrison. The chief sulphides deposited are those of lead and zinc. Prospectors' claims that some veins contain chiefly gold have not been verified. Sulphide mineralization related to the porphyry dikes on sills was not observed. All the faulting appears to have occurred before mineralization. Almost all of the faults have quartz along them in places and show other signs of mineralization as well. The quartz veins commonly contain abundant specularite, with the sulphides occurring only locally. The most intensive prospecting appears to have been done along small faults, many of which were too poorly defined to be mapped, in the limestone and calcareous shale of the Mancos on the south slope of the mountain. Dumps generally showed sphalerite, galena, chalcopyrite, pyrite, and specularite in a quartz gangue which is either massive or spongy. The value of ore mined from deposits in the Mancos is not known, but little actual mining appears to have been done.