

UNITED STATES DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

Measured Stratigraphic Sections In The Ouray
Area, Western San Juan Mountains, Colorado

by

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Open-File Report 94-583

1994

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Illustration

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Introduction

The glacier-carved deeply incised valley of the Uncompahgre River from just south of Ouray northwesterly to Ridgway (fig. 1), a distance of about 11½ mi, exposes a nearly complete stratigraphic section ranging in age from Precambrian to the middle Cenozoic. Located on the northwest flank of the San Juan Mountains, this section is one of the very few northernmost exposures of middle and upper Paleozoic rocks in southwestern Colorado and, as noted by Franczyk (1993) for particularly rocks of Pennsylvanian age, nearest to the western margin of the Uncompahgre Uplift. Within this rather unique exposure the layered sequence includes metamorphic, sedimentary, and igneous (volcanic) rocks that have been structurally deformed, cut by both concordant and discordant igneous intrusive rocks, and extensively altered and mineralized during several distinct but separate episodes.

Geologic setting

The great variety of rocks exposed within and near the Ouray 7½-minute quadrangle reflect the many aspects of geologic development typical of not only the western San Juan Mountains but southwestern Colorado as a whole. They record a long, complex, and fairly complete sequence of geologic events that affected the region throughout geologic time. The exposed Precambrian rocks represent only a small segment of the many types of metamorphic and igneous rocks within this time frame found throughout the western San Juan Mountains; however, the exposed Paleozoic, Mesozoic, and Cenozoic rocks are in most aspects representative of the region, differing mainly in thicknesses and local details.

The oldest exposed rocks in the area consist of metasedimentary quartzites and slate-argillites of Precambrian (Proterozoic) age. They occur as alternating bands each several hundred feet thick that have been tightly folded, faulted, and locally intruded by diabase and granite dikes. The Precambrian terrane was extensively eroded to a probable gently rolling plain prior to inundation by the Late Cambrian sea.

The second major group of rocks includes the Paleozoic sedimentary strata that are divisible into two general sequences. The lower or older sequence comprises several hundred of feet of thin widespread sandstones, dolomites, limestones, and some shales of Cambrian through Mississippian ages that were deposited under fluctuating shallow marine conditions; several discontinuities exist within this sequence. The first unit to be deposited in this succession of Paleozoic strata consisted of several tens of feet of thin-bedded quartzitic sandstones and conglomerates of the Ignacio Quartzite of Late Cambrian age. Epeirogenic uplift of the region resulted in withdrawal of the sea and the subsequent erosion of this unit in the Ouray area. Because no Ordovician, Silurian, or Lower and Middle Devonian rocks have been recognized in the western San Juans, the 50 ft or

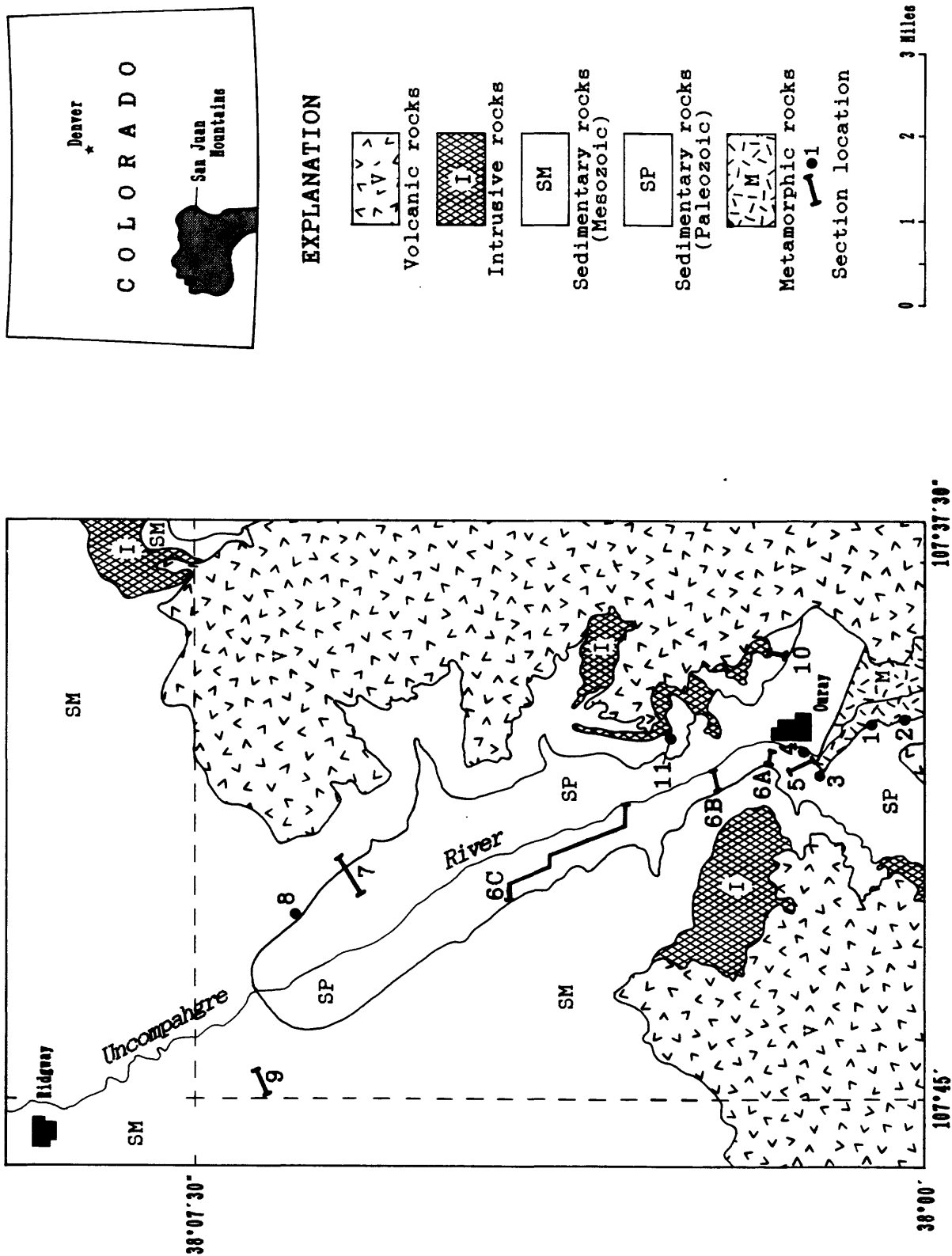


Figure 1.--Generalized geologic map, exclusive of Quaternary cover, of the Ouray 7½-minute quadrangle (dashed line) and adjacent area, southwestern Colorado. Modified from Luedke and Burbank (1962) and Steven and Hail (1989).

less of thin-bedded marine sandstones and shales of the Elbert Formation of Late Devonian age lie with acute angular unconformity upon the underlying beveled Precambrian rocks. These beds grade upward into about 70 ft of limestone beds with some shaly partings, comprising the Ouray Limestone, also of Late Devonian age. Disconformably overlying the Ouray are 250 ft or less of massive to thick-bedded dolomites and limestones of the Leadville Limestone of Mississippian age. Again there was uplift of the region and withdrawal of the sea; erosion and extensive weathering developed a karst topography upon the surface of the exposed limestones.

The upper or younger sequence comprises several thousand feet of arkosic conglomerates, sandstones, and siltstones, some shale, salt, and gypsum of Pennsylvanian and Permian ages that were deposited marginally to the "ancestral Rockies" Uncompahgre Highland to the east. This highland probably served as a source of sediments during late Paleozoic and part of Mesozoic times. The Molas Formation of Pennsylvanian age, consisting of sandstone and shale and including the residual materials accumulated on the underlying Mississippian weathered limestone surface, mostly were deposited before advancement of the Pennsylvanian seas. The next succession of sedimentary rocks, comprising the Hermosa and Cutler Formations of Pennsylvanian and Permian ages respectively, indicates a gradual and continuous uplift of the highland and records a transition from marine to continental deposition. Domal uplift of the ancestral mountain core ended Paleozoic time with accompanying local deformation consisting of monoclinal folds, subsidiary axial folds, some faulting, little of no igneous activity, and extensive erosion, particularly on this northwest flank of the San Juan Mountains.

The basal Mesozoic formation, the Dolores Formation of Triassic age, rests upon and transgresses the Cutler, Hermosa, and perhaps older formations, resulting in a very pronounced angular unconformity in the vicinity of the town of Ouray. Continental deposition continued during much of the Triassic and Jurassic and represented deposition in both terrestrial and lagoonal or near-shore environments. Unconformably overlying the Dolores Formation, the succession of Jurassic strata includes the Entrada Sandstone, the Wanakah Formation which includes at its base the Pony Express Limestone Member and in the middle the Bilk Creek Sandstone Member, and the Morrison Formation which includes in ascending order the Salt Wash Sandstone Member, and Brushy Basin Shale Member. These units are widespread and include beds of sandstone, siltstone, shale, mudstone, and some limestone that total about 1500 ft in thickness. In contrast, rocks in the Dakota Sandstone and Mancos Shale of Cretaceous age are characteristic of mostly marine, near-shore, and coastal swamp deposition, and consist of a very thick sequence of sandstone, shale, and minor shaly limestone; much of the presumed former Cretaceous section is missing in the Ouray area owing to renewed domal uplift and resultant erosion in the western San Juan region. This Late Cretaceous and early Tertiary (Laramide) uplift also was

accompanied by monoclinial and axial folding with slightly different orientations and positions from that at the close of the Paleozoic, faulting, and much intrusive igneous activity. Very important locally, this intrusive igneous activity was accompanied or closely followed by genetically related ore deposition (Burbank, 1940).

The youngest sequence of rocks to be deposited in the western San Juan region, representing the Cenozoic era, consisted dominantly of volcanic rocks. At the base of this sequence but not everywhere present is a residual thin sedimentary formation called the Telluride Conglomerate (Eocene) that unconformably overlies the early Tertiary erosion surface. The layered volcanic rock succession, aggregating several thousand feet in thickness, consists of many rock types and depositional types. The present rugged mountainous topography in the area was developed by several stages of glacial, stream, and mass-wasting activities.

Discussion

A discussion and early interpretation of the geology in the Ouray area may be found in the report by Cross and others (1907). More recent discussions and maps, pertinent to the interpretation and presentation of geology, are those by Luedke and Burbank (1962, 1981). Other studies have been particularly concerned with the sedimentary rock units, stratigraphic correlation, and related geologic studies, e.g., Armstrong and Mamet (1976), O'Sullivan (1992), and Franczyk (1993). Because of the wide interest in the geology of the area, we are reporting here our mostly unpublished measured sections of the different stratigraphic units. A few of the included measured sections were used in preliminary revision and interpretation of the Ouray areal geology published earlier by Burbank (1930).

The representative stratigraphic sections are presented by geologic age and by locality number for the different formations measured by us in the Ouray 7½-minute quadrangle area (fig. 1). Most of the sections were measured with a Brunton compass, tape, or Abney hand level; part of one of the sections (section 6) was measured using planetable methods. Except where otherwise indicated, most of the sections were measured by W.S. Burbank.

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Measured Sections

Section 1 - Elbert Formation in cliffs west of
Uncompahgre River south of Ouray

Thickness
(feet)

Ouray Limestone:

Elbert Formation:

- | | |
|--------------------------------------------------------------------------------------------------------------------------------------|------|
| 11. Limestone; sandy and marly, buff; weathers into rounded forms; contains in places beds of purplish limy shale and sandstone..... | 15.0 |
| 10. Limestone; sandy, weathers dark brown..... | 3.0 |
| 9. Shale; siliceous, greenish..... | 3.0 |
| 8. Shale; somewhat limy, soft, chocolate brown..... | 1.5 |
| 7. Quartzite; greenish..... | 1.6 |

6. Limestone; dense, siliceous; gray, weathers buff	1.0
5. Sandstone; soft marly partings and grit lenses; at base 2 ft reddish and white shaly and limy partings.....	6.0
4. Shales; thin bedded, with siliceous limestone beds 2-5 in. thick and soft marly layers.....	8.0
3. Conglomerate; lenticular; contains pebbles $\frac{1}{2}$ -5 in. in diameter.....	1.5
2. Shale; calcareous, gray to buff.....	2.0
1. Sandstone and quartzite; greenish and reddish brown, with shale partings; 1-2 ft of coarse grit at base.....	7.0

Total thickness of Elbert Formation..... 49.6

Base of section; angular unconformity on upturned beds of
Uncompahgre Formation.

Section 2 - Ouray and Leadville Limestones in cliffs about 1 mile south of Ouray

Thickness
(feet)

Molas Formation:

Leadville Limestone:

14. Limestone; gray, coarsely crystalline with interlayered breccia beds and reddish clay seams; overlain by coarse- and fine-grained limestone interlayered with red shaly beds; sandy and cherty beds near top, weathering with limonite stained surface.....	50.0
13. Limestone; massive, gray to black, with large chert nodules a foot or more in diameter; chert beds; sandy layer at top.....	25.0
12. Limestone; gray crystalline.....	10.0
11. Limestone breccia; intraformational; red sand and clay matrix.....	5.0
10. Limestone; gray crystalline, massive.....	40.0
9. Limestone; thick bedded to massive.....	35.0
8. Limestone; grayish white to brown, thin- to medium-bedded.....	45.0
7. Limestone; blue gray to black, fine-grained.....	10.0
6. Limestone; siliceous or sandy, gray.....	7.0
5. Limestone; dark gray to black, brecciated or crackly with small black cherts; weathers with pitted surface.....	8.0

Total thickness of Leadville Limestone.... 235.0

Ouray Limestone:

4. Limestone, dolomitic; white, thin bedded, weathers buff.....	8.0
3. Limestone, dolomitic; impure, gray to white, fine crystalline, thin- to medium-bedded; weathers buff on smooth surfaces without solution pits.....	22.0
2. Limestone; locally dolomitic, greenish gray to white, fine crystalline; weathers buff.....	19.0
1. Dolomite; impure, yellowish white to buff, sandy, thin bedded.....	19.0
Total thickness of Ouray Limestone.....	<u>68.0</u>

Base of section.

Section 3 - Elbert Formation and Ouray and Leadville Limestones near Box Canyon

Thickness
(feet)

Molas Formation:

Leadville Limestone;

15. Limestone; variable thickness of argillaceous and nodular, with reddish brown shales, black shales and near top ferruginous shales and fine banded chert and impure limestone. Upper beds eroded at many places.....	75.0
14. Limestone; thick to massive; gray to brown, some beds sandy and crossbedded, others crystalline; intercalated reddish shaly and sandy beds 1-2 ft thick between massive limestone beds 10-20 ft thick; chert in some beds.....	85.0
13. Limestone; massive gray crystalline and clastic, with fossil fragments; weathers with rough fluted surface.....	30.0
12. Limestone; massive blue gray; with interlayered pinkish crystalline limestone beds and sandy layers; chert in some beds.....	48.0
11. Limestone; sandy, pinkish crystalline, with gray chert.....	1.0
10. Limestone; blue thin bedded to crackly.....	13.0
9. Limestone; banded blue gray to black crystalline	7.0
Total thickness of Leadville Limestone....	<u>259.0</u>

Ouray Limestone:

8. Limestone, dolomitic; even bedded massive gray crystalline.....	10.0
7. Limestone, impure dolomitic; thin bedded gray, nodular and argillaceous.....	20.0
6. Dolomite or dolomitic limestone; massive, impure crystalline, dark gray to white; unevenly bedded with beds from 2 in. to 3 ft thick.....	30.0
Total thickness of Ouray Limestone.....	<u>60.0</u>

Elbert Formation:

5. Quartzite and limy sandstone; generally white or buff, with purplish shaly and nodular limy layers.....	22.0
4. Shale; variegated, sandy and limy, thin bedded; lower part reddish brown micaceous shale overlain by calcareous shale with alternations of red and gray layers and thin limestone beds.	6.0
3. Limestone; brownish gray.....	.3
2. Shale; reddish brown calcareous; weathers to small chips.....	1.0
1. Quartzite; green; grains 1-10 mm, averaging 2 mm	.7
Total thickness of Elbert Formation.....	<u>30.0</u>

Base of section; angular unconformity on vertical beds of Uncompahgre Formation.

Section 4 - Molas Formation on north side of Canyon Creek below Box Canyon

Thickness
(feet)

Hermosa Formation:

Molas Formation:

16. Shale; gray.....	2.5
15. Sandstone; green, shaly partings.....	1.0
14. Shale; red, grading up into sandstone.....	5.0
13. Conglomerate; chert fragments with red cement; lenticular.....	1.5
12. Shale; red.....	3.0
11. Conglomerate; sandy, grading up into red shaly sandstone and red shale; many quartzite pebbles probably from Uncompahgre Formation.....	1.0

10. Shale; red and sandy; contains chert pebbles scattered through it.....	10.5
9. Conglomerate; cemented with red sandy matrix; chert and quartzite pebbles.....	2.0
8. Shale; reddish brown.....	2.5
7. Conglomerate; red sandy matrix; chert pebbles...	1.2
6. Shale; sandy, reddish brown.....	4.5
5. Conglomerate; calcareous cement; chert pebbles..	1.4
4. Shale; sandy and calcareous; blocky.....	2.7
3. Conglomerate; many chert pebbles; reddish cementing material.....	1.4
2. Shale; red; contains many scattered chert pebbles from less than an inch to 3 in. in diameter; fractures blocky.....	3.5
1. Conglomerate; coarse; composed mostly of chert pebbles ¼-6 in. in diameter; cemented by red sandy material.....	3.7
Total thickness of Molas Formation.....	<u>47.4</u>

Base of section.

Section 5 - Hermosa Formation in cliffs north
of Box Canyon southwest of Ouray

Thickness
(feet)

Cutler Formation:

Hermosa Formation:

Upper Hermosa:

62. Sandstone, conglomeratic; coarse, gritty with conglomeratic lenses and a few thin shale partings; at base conglomeratic layer few feet thick with cobbles 3-6 in. in diameter.....	120.0
61. Shale; red micaceous shale parting.....	5.0
60. Sandstone; coarse, gritty.....	12.0
59. Shale and limestone; at base 10 ft interbedded red shales and green sandstone; 2½ ft greenish gray massive limestone with crinoid stems; at top mottled purple and green shale, containing fossils in collection 6766 (O-26344) of Hermosa species, with large proportion of pelecypods...	18.0
58. Sandstone, conglomeratic; coarse gritty.....	40.0
57. Shale and limestone; at base 2-3 ft green shale; 3½ ft dark silicified limestone; 10 ft green micaceous shale, with round gray limy	

	concretions and fossils; at top grades into sandstone.....	17.0
56.	Sandstone, conglomeratic; coarse gritty, with conglomeratic lenses; pebbles and cobbles 1-5 in. of quartzite, pegmatite, vein quartz, schist, granite, and chert; upper part of massive 1-5 mm grit.....	103.0
55.	Shale and limestone; black bituminous shale, and fossiliferous limestone; collection 6765 (O-26343) of Hermosa species from these beds; interval largely covered with talus.....	30.0
54.	Sandstone, conglomeratic; coarse 1-5 mm feldspathic grit; well-rounded cobbles of quartzite, banded chert, granite, and pegmatite, 5-6 in. in diameter.....	40.0
53.	Limestone; impure, mottled green; fossiliferous.	4.0
52.	Shale; lower 9 ft silvery micaceous red shale becoming sandy at top; 2 ft red gritty sandstone at top of interval.....	11.0
51.	Limestone; at base 3 ft dark shale; mottled and layered greenish colors; fossiliferous.....	13.0
50.	Sandstone; green, fine 0.5-1.0 mm grains.....	22.0
49.	Shale; dark gray, micaceous; fossiliferous.....	12.0
48.	Sandstone; green, indurated; pyritic.....	4.0
47.	Shale; dark gray, with sandy layers.....	10.0
46.	Sandstone; coarse 1-5 mm grains with pink feldspars; pebbles $\frac{1}{4}$ - $\frac{1}{2}$ in. of aplitic granite; scattered pebbles 1-2 in. of shale, chert, schist, and quartzite.....	53.0
45.	Shale and sandstone; lower 5 ft red shaly sandstone with brick red shale streaks; 4-5 ft lenticular gritty sandstone with scattered pebbles; 6-8 ft alternations of green sandstone and sandy and micaceous red shale; lenses of coarse sandstone.....	35.0
44.	Sandstone; red and gray 2-3 mm grains with conglomeratic layers; pebbles of pegmatite, granite, schist, chert, and quartz several inches in diameter.....	18.0
43.	Shale; red, with sandy micaceous layer at base..	8.0
42.	Sandstone; coarse, gritty with pebble conglomerate at base; pebbles $\frac{1}{2}$ -1 in. maximum diameter in lensy streaks.....	12.0
41.	Limestone; gnarly, impure, pink to red; contains crinoid stems and shaly debris.....	2.5
40.	Shale; micaceous, maroon, streaked with gray sandy layers.....	14.5
39.	Sandstone; greenish gray; 1-3 mm even-grained, with red feldspar grains.....	12.0
38.	Shale and sandstone; chiefly gray shale grading up to 10 ft platy green even-grained sandstone; 3 ft maroon sandy shale at top.....	57.0

37. Sandstone; grayish blue-green to gray gritty sandstone with scattered white quartz pebbles 1-2½ in. in size.....	15.0
36. Limestone; dark gray, gnarly.....	3.0
35. Shale; red and green, with limy nodules.....	9.0

Total Upper Hermosa 700.0

[Note: At this position the Hermosa section is broken by an east-west fault of about 150 ft dip-slip displacement, crossing Oak Creek. The thickness of interval no. 34 and its correlation across the fault introduces a possible error in the total thickness of the formation; there may possibly be omission of some beds. Correlation of the faulted portions of the conglomeratic sandstone is probably correct, although no other section spanning this interval is exposed in the Ouray area.]

Lower Hermosa:

34. Sandstone, conglomeratic; arkosic; gritty coarse grains with scattered 1-2 in. pebbles; near base conglomerate lenses, 6-8 ft thick, with cobbles of quartzite, schist, granite, shale, chert, and quartz to 5 in. maximum size; upper part interlayered with several partings of shaly sandstone and red and green sandy shale.....	135.0
33. Limestone and shale; several feet thick limestone at base, overlain by thin-bedded micaceous and sandy shales which grade at top to impure sandstone.....	12.0
32. Sandstone and shale; base of interval coarse white quartz sandstone; middle of interval largely covered; upper part chiefly red micaceous sandy shales.....	80.0
31. Limestone; gray, dense.....	5.0
30. Sandstone, shaly; red shaly sandstone with shale partings.....	30.0
29. Sandstone; coarse, massive, partly crossbedded..	37.0
28. Shale; gray but becoming red and sandy near top.	6.0
27. Limestone; gnarly, gray; fossiliferous.....	16.0
26. Sandstone; shaly, banded; at base shaly grading upwards to green micaceous sandstone.....	12.0
25. Sandstone; white, gritty grading in upper part to fine grained green micaceous sandstone.....	17.0
24. Shale; green.....	3.0
23. Limestone, gnarly, gray.....	2.0
22. Shale and sandstone; thin sandy and shaly beds, largely covered interval.....	16.0
21. Limestone; thin-bedded, shaly, carbonaceous at base; gnarly and nodular with siliceous cement in upper part; fossils poorly preserved.....	10.0

20. Shale and sandstone; at base 8 ft thick shale with lime nodules in lower part; overlain by about 10 ft red and green shaly sandstones, which are overlain by 12 ft thick red and green even-bedded sandstone; top partly covered.....	37.0
19. Limestone; gray somewhat gnarly; bedding 1-4 in. thick; fossiliferous.....	3.0
18. Shale and sandstone; at base lenticular bed of coarse sandstone overlain by red shales and green shaly sandstones.....	22.0
17. Shale and sandstone; largely covered, but mainly red shale and thin sandstone beds.....	34.0
16. Sandstone, conglomeratic; red coarse and gritty with small pebbles; lower part massive; upper part crossbedded.....	18.0
15. Sandstone and shale; at base coarse white partly crossbedded sandstone; above covered, probably thin shale and sandstone beds; upper 10 ft has 1-2 ft limestone bed and 8 ft thin limy sandstone, green shaly sandstone, and shale....	36.0
14. Limestone; dark gray, dense.....	2.0
13. Sandstone and shale; at base green sandstone overlain by covered beds of mainly shale.....	24.0
12. Limestone; dark gray, gnarly.....	5.0
11. Shale and sandstone; chiefly shales with thin sandstone layers and calcareous beds; interval largely covered.....	80.0
10. Sandstone; coarse gritty, partly crossbedded....	17.0
9. Shale; calcareous, gray. sandy.....	7.4
8. Sandstone; calcareous, greenish gray.....	2.6
7. Shale and sandstone; alternations of shales and soft green sandstones; partly covered.....	9.0
6. Shale; sandy, red.....	4.0
5. Sandstone; lenticular, coarse to gritty.....	3.0
4. Limestone and shale; alternations of green and gray shales and thin sandy beds; one limestone bed several feet thick; interval partly covered.....	17.4
3. Sandstone; greenish gray; grains 2 mm in size; locally calcareous.....	9.6
2. Sandstone; green micaceous sandstone with shaly and limy beds; at top several feet carbonaceous shale.....	17.0
1. Sandstone, conglomeratic; greenish gray, coarse grit with grains 2 mm in size; chert-pebble conglomerate at base.....	4.0
Total Lower Hermosa.....	<u>733.0</u>
Total thickness of Hermosa Formation.....	<u>1433.0</u>

Base of section.

Section 6 - Cutler Formation on cliffs
north and west of Ouray

Thickness
(feet)

End of section, beds covered.

Cutler Formation:

[Cutler--Part (upper) C: Measured on the west side of Uncompahgre River valley about 4,500 ft northwest of Bachelor Switch. This part was correlated with the underlying Part B by lateral tracing of beds; there is some lensing out and overlapping of conglomeratic beds in the intervening distance.]

86. Sandstone and shale; fissile to platy sandy shale, and shaly sandstone; grades upward to crossbedded sandstone.....	26.0
85. Sandstone; coarse, platy to crossbedded; variegated.....	14.0
84. Shale; fissile, micaceous, sandy; bright brick-red.....	5.5
83. Sandstone, conglomeratic; conglomeratic sandstone at base, grading through crossbedded and platy sandstone to shaly sandstone at top..	26.5
82. Covered interval.....	58.0
81. Shale; platy to blocky; limy and sandy; orange to brick red.....	21.2
80. Conglomerate; chiefly pebbles and cobbles.....	11.0
79. Shale and sandstone; lower 20 ft platy and shaly; upper part fissile shales and interbedded sandy layers.....	33.0
78. Shale; blocky and limy.....	30.5
77. Shale; at base 5 ft blocky and nodular limy shale; upper part red sandy and micaceous, platy to slightly crossbedded.....	21.2
76. Shale; 2 ft fissile shale at base overlain by feldspathic sandstone and shale layers.....	13.0
75. Sandstone; pink, variegated, coarse grained and crossbedded; scattered pebbles.....	16.9
74. Shale; thin, platy to fissile; orange to brick red; some platy sandy shale.....	14.0
73. Conglomerate; pebbles and cobbles up to 8-10 in. in diameter in coarse sand matrix.....	21.5
72. Shale; platy, micaceous and calcareous; orange to brick red; limy nodules in upper part.....	16.0

71.	Conglomerate; mostly pebbles and cobbles in sandy matrix, with some crossbedded pebbly sandstone layers.....	11.0
70.	Sandstone, conglomeratic; lower 16 ft red, variegated, and crossbedded; remainder pebbly sandstone mostly covered.....	28.6
69.	Shale and limestone; platy shale and shaly sandstone beds, partly covered; at top 5 ft thick nodular limestone breccia.....	21.0
68.	Sandstone; with few pebbles; crossbedded.....	5.0
67.	Shale and sandstone; lower part platy and limy shales with sandstone ledges; upper part platy shales.....	55.0
66.	Shale; lower part maroon platy to blocky sandy shales and shaly sandstones, with some crossbedded layers and intraformational edgewise conglomerates; upper part brick red thin bedded and platy shales with limestone nodules and layers.....	54.0
[65]	Conglomerate and conglomeratic sandstone; at base variegated and crossbedded sandstone with conglomerate lenses; near top, 10 ft heavy conglomerate; at top a few feet of red sandstone. Corresponds to interval 65 of Part B....	[36.0]
Total thickness Part C.....		<u>502.9</u>

[Cutler--Part (middle) B: Measured on cliffs west of American Nettie mill. The correlation between Parts B and A was made by lateral tracing, although with some cover and inaccessibility; a possible small error therefore may exist.]

65.	Conglomerate and conglomeratic sandstone; at base 20 ft coarse cobble (8-10 in. maximum diameter) conglomerate stained by desert varnish; in middle 17 ft variegated sandstone; at top 9 ft pebble and cobble (to 1 foot in diameter) conglomerate stained by desert varnish; some limestone cobbles.....	46.0
64.	Shale; sandy with limy nodules.....	5.5
63.	Sandstone; crossbedded and variegated by bleaching.....	6.0
62.	Shale; at base 5-6 ft brick red limy shale overlain by 4 ft maroon platy sandstone; remainder nodular and platy calcareous shale with sandy layers; at top 2 ft massive nodular limestone.....	55.5
61.	Conglomerate; rounded to subangular cobbles in sandy matrix; some crossbedded sandstone.....	24.6
60.	Shale; sandy and limy with limy nodules in lower part; brick red calcareous upper part with	

	about 2-3 ft maroon sandy shale at top; 8.4 ft thick porphyry sill intruded between lower and upper parts.....	16.5
59.	Sandstone; crossbedded and massive; maroon but variegated near top by selective bleaching.....	30.0
58.	Shale and sandstone; at base 3-4 ft calcareous shale with large limy concretions (algal growths-?); crossbedded maroon sandstone and shaly sandstone with conglomerate filled channels; at top thin bedded sandstone, knobby sandstone, and shale partings.....	14.5
57.	Sandstone; crossbedded with conglomerate lenses; variegated by bleaching.....	15.5
56.	Shale; sandy shale partings; brick red; some small limy nodules.....	6.4
55.	Sandstone; crossbedded, becoming conglomeratic at top; strongly variegated by bleaching.....	17.8
54.	Shale; blocky to platy with sandstone lenses; calcareous.....	27.0
53.	Sandstone, conglomeratic; crossbedded and channel cut-and-fill with limestone, gneiss, quartzite, schist, and granite pebbles to 3 in. maximum size.....	18.1
52.	Shale; at base 10½ ft blocky and sandy grading upwards to limy and nodular; in middle 16½ ft sandy, with sandstone lense at top; upper 17½ ft brick red and calcareous with some sandy layers.....	44.5
51.	Sandstone; laminated and crossbedded; pink and gray to variegated by selective bleaching; maroon shaly sandstone at top.....	36.4
50.	Sandstone, conglomeratic; at base 1½ ft pebble conglomerate with pebbles less than 1 inch in size, overlain by 4 ft thick sandy shale; rest of unit platy to pink crossbedded sandstone with conglomerate lenses; selective bleaching..	32.7
49.	Shale; thin bedded, calcareous, brick red; sandy layers finely laminated, crossbedded, and ripple marked, with ripples indicating current direction N. 20° E.....	30.0
48.	Shale; maroon to brick red; upper 13 ft sandy, and largely covered.....	29.4
47.	Sandstone; platy and jointed; grades to sandy shale at top.....	13.4
46.	Sandstone and conglomerate; 2 ft pebble conglomerate overlain by sandstone with scattered pebbles.....	18.0
45.	Sandstone; pebbly, thin-bedded, dark maroon alternating with bands of gray or pink sandstone; locally crossbedded.....	16.0
44.	Sandstone, conglomeratic; scattered pebbles and cobbles to 6 inches in size; ripple-marked	

	shale parting in middle; crossbedded conglomeratic sandstone above.....	23.0
43.	Shale; sandy, calcareous, maroon to dark orange, poorly bedded to blocky.....	32.0
42.	Sandstone; lower part red and thin bedded; upper few feet crossbedded; locally bleached.....	19.0
41.	Sandstone; crossbedded and minor conglomerate in lower part; shale parting 20 ft above base; gray variegated by selective bleaching.....	40.0
40.	Sandstone, conglomeratic; shale parting at top..	4.0
39.	Sandstone, conglomeratic; pebbles 2 in. or less in sandy matrix; pink to gray; irregular shale parting at top.....	12.7
38.	Shale; calcareous and knobby with limestone and sandy limestone layers; dark orange.....	9.0
37.	Sandstone; shaly, blocky to platy, maroon.....	4.0
36.	Shale; platy, calcareous, maroon.....	9.4
35.	Sandstone, conglomeratic; pink, crossbedded; pebbles and cobbles 1-3 in. in diameter in lenses; selective bleaching in upper layers....	17.4
34.	Shale; brick red; limy and nodular at base; sandy in middle and upper parts; weathers knobby.....	6.4
33.	Sandstone; pink, crossbedded; weathers knobby; selectively bleached.....	2.5
32.	Sandstone, conglomeratic; pink, coarse grained; scattered pebbles 2-3 in. in diameter.....	6.8
31.	Sandstone; light maroon, platy to crossbedded; shaly toward top with 2 ft thick limy shale at top.....	18.0
30.	Shale; sandy and platy at base, grading to fissile calcareous shale at top.....	7.0
29.	Sandstone; reddish maroon, crossbedded with shaly lenses; platy at top; selectively bleached to grayish white; weathers knobby.....	18.5
28.	Shale; maroon, thin bedded, calcareous.....	2.5
27.	Sandstone; pink to red massive; coarse grained at base with small conglomerate lenses; laminated and crossbedded.....	9.4
26.	Shale; with calcareous nodules.....	2.5
25.	Sandstone, conglomeratic; pink, crossbedded; fills channel cut into underlying shale; cobbles 3-4 in. maximum diameter.....	24.0
24.	Sandstone; shaly, brownish maroon, fine grained and evenly laminated; crossbedded at base; calcareous in upper part.....	16.0
23.	Shale; 2 ft sandy shale at base grading up through mud-cracked shale to 6 ft of calcareous shale with limestone nodules; remainder brick red nodular limy shale with a thin sandy lens at base.....	19.0

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|------|----------------------------------------------------------------------------------------------------------------------------------------|-------|
| 22. | Sandstone; crossbedded, with shale fragments in lower part; variegated by prominent selective bleaching..... | 15.0 |
| [21] | Shale; brick red, in part thin bedded and in part blocky; calcareous with limestone nodules. Corresponds to interval 21 of Part A..... | [7.5] |

Total thickness Part B..... 821.9

[Cutler--Part (lower) A: Measured on cliffs west of town of Ouray. Top of the underlying Hermosa arbitrarily chosen at about 130 ft above the uppermost fossiliferous horizon, and where beds correspond more closely in lithologies characteristic of the Cutler "red beds" above.]

- | | | |
|-----|---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|------|
| 21. | Shale; calcareous, gray and brick red to variegated; blocky and nodular limestone at top. [This shale overlain by 20-25 ft thick selectively bleached sandstone, somewhat conglomeratic at base.]..... | 9.0 |
| 20. | Sandstone; variegated and crossbedded; red color strongly bleached in some layers..... | 8.5 |
| 19. | Shale; maroon, calcareous, thin bedded and nodular..... | 17.0 |
| 18. | Shale; maroon, thin bedded, with limestone lenses and nodules; sandy in middle part; 3 ft thick sandstone lens at top..... | 22.5 |
| 17. | Sandstone; red, coarse grained with small pebbles of quartz $\frac{1}{4}$ - $\frac{1}{2}$ in. in diameter; some bleaching at top and base..... | 5.5 |
| 16. | Sandstone; crossbedded; pebbly with inclusions of shale at base; grades up to pink even beds, often variegated near top; weathers knobby..... | 25.0 |
| 15. | Shale; maroon, lenticular; locally contains carbonaceous plant remains..... | 3.5 |
| 14. | Sandstone, conglomeratic; about 6 ft conglomerate at base of chiefly cobbles from presumed Precambrian terrane; upper part coarse grained with lenses of conglomerate containing limestone pebbles..... | 35.0 |
| 13. | Shale; maroon to brick red; fissile to thin even beds; limestone layers and nodules; intruded by thin porphyry sill..... | 77.0 |
| 12. | Sandstone; coarse grained and massive; partly crossbedded..... | 45.0 |
| 11. | Sandstone; gray, coarse grained and crossbedded with maroon shale lenses..... | 25.0 |
| 10. | Shale; micaceous, maroon to brick red..... | 4.0 |
| 9. | Sandstone; coarse grained, gray to red; platy becoming crossbedded near top..... | 27.0 |
| 8. | Shale; maroon..... | 4.0 |

7. Sandstone; conglomeratic at base grading to coarse grained at top; cobbles 3-4 in. in maximum diameter..... 35.0
6. Shale; 4 ft maroon micaceous shale at base; 5 ft irregular thin bedded and locally crossbedded red sandstone in middle; overlain by 21 ft maroon shale; a 40-50 ft thick porphyry sill has intruded unit at the base of the upper shale, altering maroon color to greenish gray..... 30.0
5. Sandstone, conglomeratic; coarse conglomerate of 3-4 in. diameter cobbles particularly at base grading upwards to conglomerate with coarse sandy matrix..... 14.6
4. Sandstone, shaly; light maroon to variegated; micaceous; thin bedded and locally crossbedded. 25.0
3. Sandstone and conglomeratic sandstone; with two shale partings; beds inaccessible on cliffs and not examined in detail..... 70.0
2. Sandstone; coarse grained, feldspathic; with scattered pebbles and shale parting at top..... 38.0
1. Shale; maroon to brick red; sandy layers near base and in upper half; few limestone layers and concretions near top..... 115.0

Total thickness Part A..... 635.6

Total thickness Cutler Formation..... 1960.4

Base of section.

Section 7 - Cutler Formation (partial), Dolores Formation, and Entrada Sandstone on cliffs north and east of Ouray

[Section measured by R.G. Luedke and R.A. Yund]

Thickness
(feet)

Wanakah Formation:

Pony Express Limestone Member:

92. Limestone; highly deformed thin beds; black; fetid smell on fresh surface; interbedded with thin beds of black fissile shale; overlain by shaly breccia with some calcite and gypsum.

Entrada Sandstone:

91. Sandstone; frosted, even, and fine- to medium-sized grains in crossbedded massive unit; light gray to yellowish gray; friable; many thin black carbonaceous(?) streaks near top; upper contact sharp but even..... 68.9
- Total thickness Entrada Sandstone..... 68.9

Dolores Formation:

90. Sandstone and mudstone; alternating very fine grained reddish brown sandstones and sandy mudstones in thin laminated beds; calcareous; upper 3 ft fissile shale altered greenish gray and yellow; upper contact sharp and uneven; weathers as slope but where exposed as ledges with knobby surface..... 87.3
89. Sandstone; red medium- to coarse-grained with thin gravel streaks or layers; thick even bedded to massive; calcareous; red and green shale partings 6-12 in. thick; at base less than 3 ft thick white very coarse gravel and pebble conglomerate..... 42.1
- Total thickness Dolores Formation..... 129.4

Unconformity (erosional) marked by slight angularity.

Cutler Formation:

[Cutler--Part (upper) C: Measured on the east side of Uncompahgre River valley behind cemetery and about 1 mi north of Cutler Creek. Correlation between this locality and top of Part B, Section 6 locality, on west side of valley west of American Nettie mill was by lateral tracing of beds; a discrepancy in thickness of interval 65 between the two localities is because the conglomeratic beds laterally pinch and swell, and change lithology by lensing out and overlapping in the intervening distance.]

88. Sandstone, conglomeratic; coarse grained, pinkish gray; moderately conglomeratic with pebbles and cobbles averaging 3 in. in size; grades laterally into coarse conglomerate; sharp uneven upper contact with top 2 in. bleached green; interval truncated and cut out laterally to south of section..... 15.0
87. Sandstone and mudstone; grayish red alternating beds; crossbedded and lenticular; micaceous; calcareous cement..... 70.9

86. Sandstone, conglomeratic; coarse grained, arkosic, pinkish-gray; moderately conglomeratic with pebbles and cobbles averaging 3 in. in diameter; beds grade laterally into massive coarse conglomerate.....	9.4
85. Sandstone; fine grained, silty and clayey, reddish brown; thin bedded.....	3.5
84. Sandstone, conglomeratic; coarse grained, arkosic, medium bedded, lenticular; gravel size conglomerate of quartz, quartzite, and feldspar; pale red; few 1 in. thick reddish brown shale partings and lenses; uneven upper contact.....	4.7
83. Sandstone and mudstone; alternating thin to medium bedded; some crossbedding; grayish red, some selective bleaching; mudstone predominates in upper part; very uneven upper contact with 2 ft deep cut-and-fill scours.....	31.5
82. Sandstone, conglomeratic; reddish brown, fine-to coarse-grained; conglomeratic in lower half with rounded cobbles 6 in. in diameter; grades laterally into coarse conglomerate.....	21.8
81. Sandstone and mudstone; alternating thin to medium even beds; micaceous; calcareous cement; some selective bleaching; some crossbedding; grayish red.....	78.5
80. Sandstone; coarse grained, arkosic, streaked white and reddish brown; some conglomerate layers of gravel size; weathers as massive ledge.....	18.7
79. Mudstone; pale reddish-brown, sandy; few thin sandstone beds; slightly shaly.....	7.3
78. Conglomerate; pebbles and cobbles of Precambrian basement material up to 6 in. in diameter in coarse-grained arkosic sandstone matrix; some arkosic sandstone lenses; even upper contact...	6.0
77. Mudstone; pale reddish brown, silty and sandy; upper contact irregular.....	5.0
76. Conglomerate; pebbles and cobbles of Precambrian basement material up to 6 in. in diameter in coarse-grained arkosic sandstone matrix; reddish brown; lower contact irregular scour and fill surface, upper fairly even.....	4.5
75. Sandstone and mudstone; pale reddish brown with sandstones dominant in lower half, mudstones in upper half; sandstone fine grained, thin bedded. crossbedded; some sandstone cobbles up to 6 in. in diameter.....	27.3
74. Conglomerate; limestone and mudstone flat pellets of 1 in. size in coarse-grained sandstone matrix; pale reddish brown; weathers as ledge.....	1.6

73.	Sandstone; fine- to medium-grained, thin bedded, crossbedded; pale reddish brown; slightly conglomeratic but along strike grades into coarse pebble conglomerate with rounded fragments averaging 2 in. in diameter.....	14.9
72.	Sandstone and mudstone; grayish red alternating beds; crossbedded and lenticular; micaceous; calcareous cement; some selective bleaching....	7.5
71.	Sandstone; fine- to medium-grained, arkosic, grayish red; crossbedded; some conglomerate with pebbles 1 in. in diameter; weathers as massive ledge.....	14.0
70.	Sandstone and mudstone; grayish red alternating beds; lenticular and crossbedded; micaceous; calcareous cement.....	62.7
69.	Sandstone, conglomeratic; reddish brown, fine- to coarse-grained; conglomeratic in lower half with rounded fragments averaging 3 in. in diameter; mottled with greenish gray patches; forms continuous ledge.....	3.0
68.	Sandstone and mudstone; grayish red alternating beds; crossbedded and lenticular; micaceous; calcareous cement.....	72.1
67.	Sandstone; coarse grained, arkosic, grayish red; crossbedded; massive in lower part, thinner bedded in upper part.....	12.5
66.	Sandstone and mudstone; grayish red alternating beds; crossbedded and lenticular; micaceous; calcareous cement; more dominantly sandstone at top and bleached white.....	38.7
[65]	Sandstone, conglomeratic; coarse grained, arkosic; stained red; moderately conglomeratic with pebbles and cobbles averaging 3 in. but up to 10 in. in diameter; grades laterally to more massive conglomerate; corresponds to interval 65 of Part B in Section 6.....	[5.5]
Total thickness Part C.....		531.1

[Exposed upper Part B at this locality consists of thin to thick bedded, lenticular fine-grained crossbedded grayish red sandstones and silty and sandy mudstones. Some conglomerate in lenses; fragments are schist, quartzite, slate, mudstone, and limestone.]

Total thickness Part B, Section 6.....	821.9
Total thickness Part A, Section 6.....	635.6
Total thickness Cutler formation (Parts A, B, and this section).....	1988.6

Section 8 - Wanakah Formation on east side
of Uncompahgre River valley about 6 miles north of Ouray

Thickness
(feet)

Morrison Formation:

Massive sandstone or quartzite; basal contact;
appears conformable on underlying beds.

Wanakah Formation:

Mudstone member (unnamed):

19. Mudstone; brown massive bed; weathers to small angular yellowish brown fragments.....	1.5
18. Limestone; brown, crystalline, with a few shale pellets; weathers rusty brown.....	.5
17. Mudstone; brown; breaks into angular fragments..	1.3
16. Limestone; white and crystalline; lenticular bed; weathers brown.....	.3
15. Mudstone; brown; breaks into angular fragments..	.7
14. Limestone; brown, nodular and crystalline.....	.3
13. Mudstone; limy and sandy layers; breaks into angular fragments; reddish to yellowish brown; contains brown and gray crystalline limestone nodules and lenses, with a few limy layers persistent enough to form thin limestone beds; some nodules near top are partly altered to red chert and quartz.....	26.0
12. Limestone; gray and dense.....	.6
11. Shale; greenish gray.....	1.8
10. Shale; brown and sandy at top grading down into fine blocky green mudstone at base.....	6.5
9. Shale, brown.....	.5
8. Shale; sandy and olive gray; impregnated with gypsum in cracks.....	2.4
7. Sandstone and sandy shale; alternating green and brown beds; partly slumped.....	4.0
6. Sandstone; hard, greenish gray; clean quartz and bright red chert grains; appears glauconitic...	1.0
Thickness mudstone member.....	<u>47.4</u>

Bilk Creek Sandstone Member:

5. Sandstone; soft and friable; olive gray clayey layers near top; lower part gray weathering buff.....	19.0
Thickness Bilk Creek Sandstone Member.....	<u>19.0</u>

Pony Express Limestone Member:

4. Gypsum; white, banded, with black shaly layers..	1.7
3. Gypsum; nodular, crudely bedded, with thin black interstitial shale layers and irregular shale partings.....	50.0
2. Shale and limestone; breccia of small angular fragments partly cemented with calcite; very porous.....	1.8
1. Limestone and shale; thin alternating beds of black shale and dark gray limestone; limestone beds have a petroliferous smell when struck on surface.....	5.0
Thickness Pony Express Limestone Member...	<u>58.5</u>
Total thickness Wanakah Formation.....	<u>124.9</u>

Entrada Sandstone:

Gray crossbedded sandstone; upper conformable contact.

Base of section.

Section 9 - Wanakah and Morrison Formations on the west side of the Uncompahgre River valley about 7 miles northwest of Ouray

[Section measured by R.G. Luedke and T.H. Foss]

Thickness
(feet)

Dakota Sandstone:

Sandstone, conglomeratic; quartzitic; coarse grained with pebbles of quartz and chert in streaks and lenses; buff; thick to massive bedded; contact with Morrison Formation irregular and undulating with 1½ ft relief in 10-15 ft horizontal distance.

Disconformity.

Morrison Formation:

Brushy Basin Shale Member:

16. Mudstone; silty, variegated; medium- to thick-bedded; weathers as hackly and knobby slope; interbedded with ½-2 ft thick pale red nodular limestone and 1-2 ft thick yellowish

	brown non-calcareous siltstone beds; uppermost 1½ ft altered greenish gray and conforms to irregular contact with overlying Dakota; slope mostly covered.....	148.5
15.	Sandstone; fine grained, greenish gray, slightly calcareous; thick bedded to massive; a few 2-3 in. thick conglomeratic lenses; weathers blocky with rounded surfaces.....	9.5
14.	Mudstone; brown, calcareous; with many grayish green dense limestone lenticular beds 6-8 in. thick; weathers hackly in angular pellets; mostly covered slope.....	99.0
	Thickness Brushy Basin Shale Member.....	257.0

Salt Wash Sandstone Member:

13.	Sandstone; light gray, very fine grained, very calcareous in thick to massive beds; has two interbedded brown and slightly calcareous mudstone beds about 10 ft thick each; weathers rounded and blocky; a few calcite veinlets.....	74.7
12.	Mudstone; pale brown and calcareous; weathers hackly in angular pellets.....	41.5
11.	Sandstone; olive gray to grayish orange; fine- to coarse-grained; calcareous; contains streaks or thin lenses of clay pellets; massive, cliff former; upper part a 3 ft thick white sandstone separated from below by 6 in. thick dusky red shale.....	30.5
10.	Mudstone; calcareous, silty and sandy; lower and upper parts yellowish gray or olive mottled brown; poorly indurated and massive; calcareous; separated by 10 ft thick ledge-forming fine-grained calcareous crossbedded yellow sandstone; upper mudstone weathers hackly in angular fragments.....	134.0
9.	Sandstone; pinkish gray speckled with brown limonite; fine grained; calcareous; thin even bedded; prominent ledge or cliff.....	27.5
8.	Mudstone; brown, calcareous; weathers as hackly pellets; contains thin beds (4 in. thick) of pale orange fine-grained calcareous sandstone..	23.0
7.	Sandstone; white to light gray, fine grained, calcareous; frosted well-rounded quartz grains; lower 13½ ft forms massive ledge; upper 8½ ft occurs as thin-bedded ledges.....	22.0
6.	Sandstone and mudstone; alternating calcareous yellow and gray to grayish red and yellowish brown ledges and slopes; sandstone beds are somewhat lenticular and weather blocky.....	73.5

5. Sandstone; white to pale orange or yellow; fine grained; slightly calcareous; some interstitial gray clay or silt streaks or bands; thin to medium bedded but along strike appear irregular and lenticular with small scale scour and fill features; locally crossbedded; weathers as ledgy slope.....	71.5
4. Quartzite; medium-sized rounded and frosted quartz grains variably cemented by carbonate or silica; medium to massive bedded; yellow to buff; some crossbedding; weathers as very prominent cliff throughout area; known to the miners as "lower quartzite".....	19.0
Thickness Salt Wash Sandstone Member.....	<u>517.0</u>
Total thickness Morrison Formation.....	<u>774.0</u>

Wanakah Formation:

Mudstone member (unnamed):

3. Mudstone and limestone; alternating brown calcareous mudstone, weathering as hackly equidimensional pellets, and pale brown clayey and silty limestone beds; some fine-grained thin sandstone beds in upper part with specks and clusters of red jasper; uppermost 1 ft bleached greenish gray; upper contact sharp and mostly even.....	50.6
Thickness mudstone member.....	<u>50.6</u>

Bilk Creek Sandstone Member:

2. Sandstone; yellowish gray; very fine to fine grained; medium bedded; friable but lower few centimeters silicified.....	13.4
Thickness Bilk Creek Sandstone Member.....	<u>13.4</u>

Pony Express Limestone Member:

1. Limestone; impure, dark gray to black, thin to medium bedded; beds very irregular, wavy, or crenulated; fetid smell on fresh surface; sharp uneven contact with overlying member.....	7.5
Thickness Pony Express Limestone Member...	<u>7.5</u>
Total thickness Wanakah Formation.....	<u>71.5</u>

Entrada Sandstone:

Sandstone; yellow, calcareous, fine grained; quartz grains subrounded and slightly frosted; local gray clay or silt streaks; massive bedded and cross-bedded; sharp but irregular upper contact.

Base of section.

Section 10 - Morrison Formation in cliffs north of The Amphitheater east of Ouray

Thickness
(feet)

Dakota Sandstone:

Quartzite resting apparently conformably on the underlying Morrison.

Morrison Formation:

Brushy Basin Shale Member:

26. Mudstone; dominantly mottled green and red in upper part grading to red in lower part; some beds cherty and others limy.....	60.0
25. Shale; alternating beds of mostly red and green calcareous shales.....	48.0
24. Quartzite; green.....	2.0
23. Limestone, impure; red and shaly with red shale at base.....	15.0
22. Sandstone; red and shaly.....	5.0
21. Shale; red and sandy.....	10.0
20. Quartzite; green and massive.....	15.0
19. Shales; red and limy with interbedded sandstones a 2 ft thick lenticular sandstone bed at base..	24.0
18. Shales, impure limestones, and sandstones; alternating beds; shales and limestones mostly reddish brown; thin sandstones gray or green...	44.0
17. Sandstone; gray and massive.....	26.0
16. Sandstones and shales; alternating gray thin sandstones and red shales.....	55.0
15. Shales; reddish brown limy shales with some interbedded impure limestone layers.....	15.0
14. Sandstone; gray.....	12.0
13. Sandstones; with some red shales.....	19.0
12. Sandstone; gray with red shale layers.....	15.0
11. Shale; reddish brown and limy.....	2.0

Thickness Brushy Basin Shale Member..... 367.0

Salt Wash Sandstone Member:

10. Sandstone; white, fine grained, massive and evenly bedded; red shaly layers near top.....	61.0
9. Mudstones; red; breaks into small chips.....	24.0
8. Sandstone; gray and thin bedded.....	10.0
7. Sandstone; shaly; mostly gray with red shaly layers.....	27.0
6. Sandstone; white.....	5.0
5. Mudstone; mostly red; some layers limy and some sandy.....	33.0
4. Sandstone; white to gray; crossbedded.....	31.0
3. Limestone; dense, bluish gray; locally nodular..	5.0
2. Sandstones; lenticular beds with red shales.....	26.0
1. Quartzite; very massive; medium grained; interspersed with pyrite specks; weathered surface stained bluish black (desert varnish); lower contact conformable on shales of underlying Wanakah; locally called by miners the "lower quartzite".....	29.0
Thickness Salt Wash Sandstone Member.....	<u>251.0</u>
Total thickness Morrison Formation.....	<u>618.0</u>

Base of section.

 Section 11 - Dakota Sandstone and Mancos Shale (partial)
 near the Schofield tunnel of the American Nettie
 mine, about 1½ miles north of Ouray

Thickness
(feet)

Porphyritic granodiorite; laccolithic body, about 550 ft thick.

Mancos Shale:

27. Shales; dark gray to black; very fissile and soft.....	25.0
26. Shales; sandy with thin pebble beds consisting quartzite pebbles; contains fragments of bituminous matter and shark's teeth; marine....	2.0
Total thickness Mancos Shale (exposed)....	<u>27.0</u>

Unconformity (local).

Dakota Sandstone:

25. Quartzite; very fine grained; light gray.....	1.5
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24. Shale; sandy, gray to black.....	5.0
23. Quartzite; fine grained; somewhat argillaceous..	4.0
22. Shale; some layers sandy.....	4.0
21. Quartzite; dark gray to black, with thin black shale partings; carbonaceous.....	10.0
20. Shale; black and dark gray; with carbonaceous matter and leaf impressions.....	15.0
19. Quartzite; dark gray to black; shale partings have white streaks from sandy lenses in carbonaceous material.....	5.0
18. Quartzite; gray to greenish gray, with thin black shale partings; irregular bedding surfaces from ripple marks or crumpling; has markings resembling worm burrows.....	13.0
17. Shale; dark gray, with numerous thin quartzite and sandy shale layers; sandstones brown due to iron stain, and finely banded with gray streaks of shale partings.....	20.0
16. Shale; dark gray to black; lenticular beds of quartzite interbedded at same horizon.....	3.0
15. Quartzite; white and massive.....	25.0
14. Quartzite; gray, with shale partings.....	1.0
13. Quartzite; white to gray.....	5.0
12. Shale; gray, sandy.....	.5
11. Quartzite; white.....	5.0
10. Shale; with quartzite layers.....	.5
9. Quartzite; white, massive.....	18.0
8. Shale and sandstone; lenticular beds.....	5.0
7. Quartzite; gray.....	3.0
6. Shale; altered; probably originally green or gray.....	1.0
5. Sandstone; shaly and quartzitic.....	2.0
4. Shale; green, bleached.....	1.0
3. Sandstone; quartzitic and argillaceous, gray and brown.....	1.8
2. Shale; sandy, purplish gray; green sandy shales at top; contains small chert pebbles.....	10.0
1. Sandstone; quartzitic, with $\frac{1}{4}$ in. round pebbles of chert, gray shale and quartz; upper part fine grained and green; basal contact with green shales of underlying Morrison Formation..	17.0

Total thickness Dakota Sandstone..... 176.3

Base of section.