UNITED STATES DEPARTMENT OF THE INTERIOR

GEOLOGICAL SURVEY

# MEASURED SECTIONS OF THE BROWNS PARK FORMATION (MIOCENE) IN MOFFAT COUNTY, COLORADO, 1980

by

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Illustrations

## INTRODUCTION

Eight partial sections of the Browns Park Formation of Miocene age were measured in Moffat County, northwestern Colorado, during the 1980 field season, as part of a study of the stratigraphy and depositional environments of the formation. These newly measured sections are intended to complement other surface sections of the Browns Park Formation measured (Hansen, 1965) to the west in Uintah County, Utah, and measured (Buffler, 1967) or diagrammed (Kucera, 1968) to the east in, respectively, Routt and Rio Blanco Counties, Colorado.

Rock samples collected, indicated parenthetically by 80-SL prefixes, are shown in the section descriptions purely for reference purposes; petrographic and analytical results will be reported in later publications. Color names with numbers are based on comparison with the rock-color chart by Goddard and others (1948).

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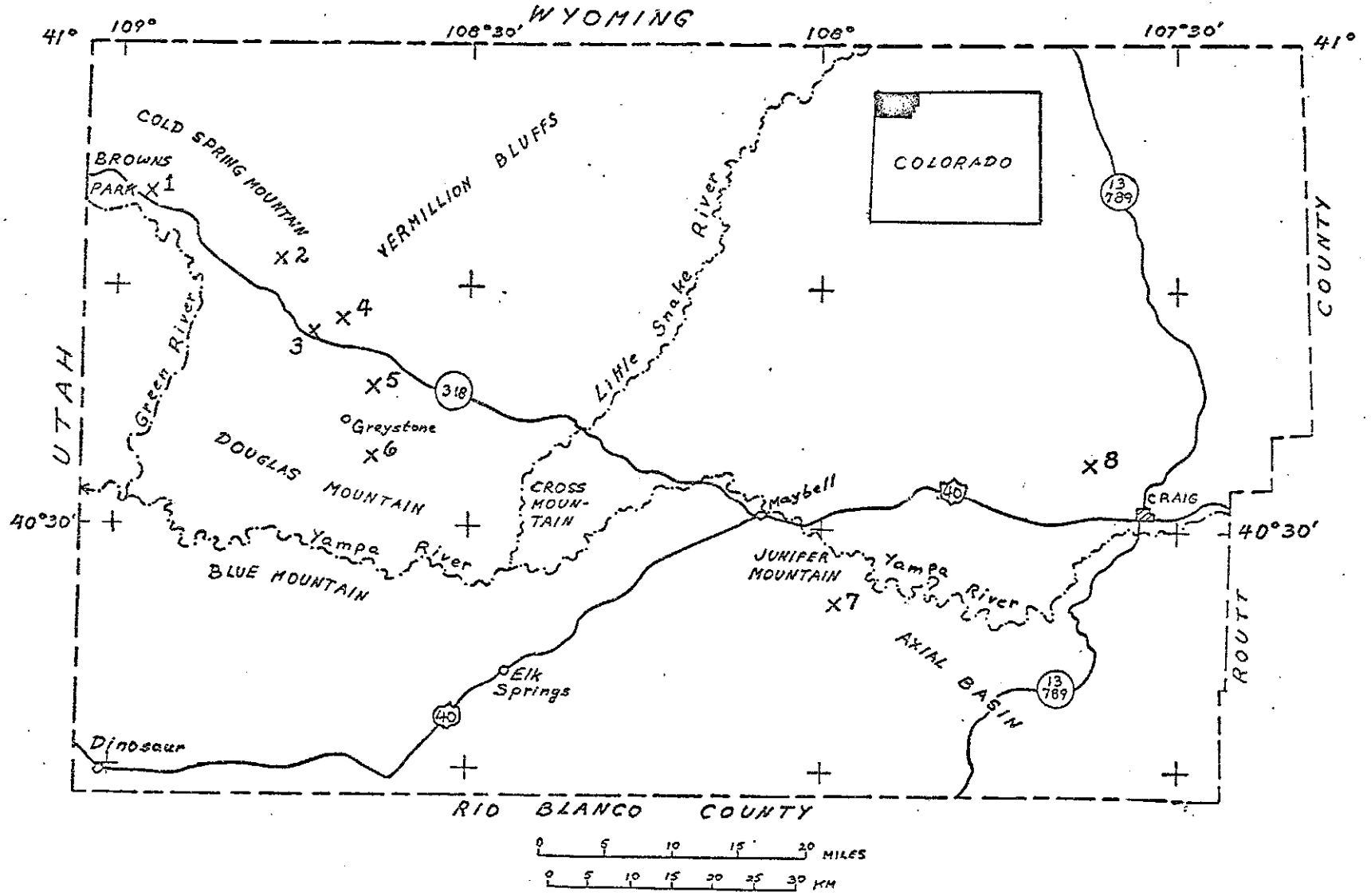


Figure 1. Map of Moffat County, Colorado showing locations of sections measured in 1980

1 Spitzie Draw section
2 Upper Bull Canyon section
3 Douglas Draw section
4 Big Bend Draw section
5 Lower Langley Draw section
6 Smelter Hill section
7 Temple Draw section
8 Upper Cedar Mountain Gulch section

## DESCRIPTIONS OF SECTIONS

### Spitzie Draw Section

Section measured along south side of butte on east side of middle part of Spitzie Draw, near NE corner Sec. 10 and SE corner Sec. 3, T. 10 N., R. 103 W., Moffat Co., Colorado (Lodore School 7 1/2-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, July 19, 1980).

| Unit | | Thickness (in feet) |
|---|---|---|
| | Pediment gravel and sand, top of butte at about 5820-ft altitude | ±8.0 |
| | Browns Park Formation: | |
| 1. | Ash, vitric, light-gray (N 7.5); disturbed cross-laminations lower 6 ft, laminated upper 10 ft; sharp, even base..... | 16.0 |
| 2. | Tuff, silty, variably sandy, locally porcelaneous; laminated.. | 12.0 |
| 3. | Sandstone, tuffaceous, calcareous, very light gray (N 8) to yellowish-gray (5 Y 8/1); mainly fine- to very fine-grained; mostly quartz; irregularly thinly bedded..... | ±3.0 |
| 4. | Covered interval; moderately steep slope; probably interbedded sandstone and ash..... | 40.0 |
| 5. | Covered interval, mainly pediment-gravel float; also irregular thin slabs of slightly sandy tuff, yellowish-gray (5 Y 8/1) with trace biotite; calcareous..... | 11.0 |
| 6. | Ash, vitric, yellowish-gray and white (N 9); locally slightly sandy; in alternating thinly bedded, laminated, and cross-laminated sets; local trace muscovite; basal 2 ft highly contorted; base slightly unconformable..... | 33.0 |

7. Ash, vitric, yellowish-gray; lower 7 ft mainly massive-appearing, consists of poorly discernible, deformed cross-laminations; local concretionary sand zone in basal 1 ft; sharp contact at base of next 7 ft, which consists of interlayered thin beds, laminae, and deformed laminae, locally rippled; pinching 0-0.5-ft lens of fine-pebble conglomerate in sandy matrix 1 ft below top; pebbles, mostly less than 4 mm, consist of commonly subrounded yellow, pink, and white quartz and of sparse subangular red and light-gray chert; current direction of ripples below conglomerate is N. 10° W.; cliff-forming.... 14.0

8. Ash, vitric, light-gray (N 7.5); generally massive-appearing, local highly contorted high-angle laminations; unit distinguished by abundant erosional vertical fluting and multidirectional perforations; (sample 80-SL-37); about 6 ft above base, contorted laminations overlain by small-scale crosscutting cross-laminations; layered zone 10.5-14.5 ft above base: interlayered and repeated (a) small-scale load features, (b) fine-grained cross-laminations, and (c) northeast-trending fine-grained climbing-ripple sets; mainly laminated, in part sandy, 14.5-22.5 ft above base; trend here is N. 85° W., 15° NE; top 3.5 ft mostly unconsolidated, laminated, vitric, non-sandy; most of unit cliff-forming; slightly irregular basal contact..... 26.0

9. Sandstone, yellowish-gray (5 Y 7/2); thinly bedded and laminated, cross-laminated, and locally rippled; common local load features; abundant white tuffaceous interbeds generally less than 0.1- ft thick; scattered clay chips in ±0.2-ft bed in top 1 ft; generally calcareous, cliff-forming..... 7.5

10. Ash, vitric, very light gray (N 8) to yellowish-gray (5 Y 8/1); laminated; (sample 80-SL-36 from 2.5 ft above base); irregularly increasingly sandy from 6 ft above base, silty and very fine grained, yellowish-gray (5 Y 7/2); top 1 ft is light-gray, vitric, cross-laminated ash; 1.5 ft below top is thin resistant ±0.2-ft bed, rippled at top; ripple crests about 5 cm apart and 1 cm deep, range from apparently oscillatory to very slightly current-rippled, with current directions of N. 55° E. and N. 80° W.; even basal contact..... 18.0

11. Ash, vitric, slightly sandy, fine to medium sand; slightly limonitized..... 3.0

12. Sandstone, tuffaceous, yellowish-gray (5 Y 7/2); very fine grained, silty; very thinly tabular-bedded to laminated; irregularly thinly bedded clayey sandstone layers near top..... 7.0

13. Ash, highly vitric, very light gray (N 8), poorly consolidated; generally laminated, in part low-angle cross-laminated; laminae accentuated by sparse limonitization; mainly covered 2-10 ft above base; (sample 80-SL-35 from 2 ft above base); top 2 ft slightly calcareous, weather to flaggy laminae..... 27.0

14. Covered interval; gentle slope at base of butte strewn with fragmented laminae of light-gray to white calcareous tuff..... 11.0

Total measured section.. 236.5

Base covered by extensive apron of colluvium and alluvium.

This section appears to be similar, in abundance of ash, and in ash textures, structures, and color, to a topographically lower section measured slightly more than 5 miles west (Section B-2, units 3 and lower, in Hansen, 1965, p. 121-122). Individual units, however, cannot be correlated.

## Upper Bull Canyon section

Section measured westward in N $\frac{1}{2}$ SE1/4 Sec. 32, T. 10 N., R. 101 W., Moffat Co., Colorado (Big Joe Basin 7 $\frac{1}{2}$-minute quadrangle), from base at altitude of about 6090 ft in lower part of Browns Park Formation. Dips are about 5° southward, off onlap on nearby Uinta Mountain Group (Proterozoic Y) of Cold Spring Mountain.

(Measured with hand level and steel tape by S. J. Luft, September 12, 1980. Because of generally poorly defined contacts between units and slight variations in dips, thicknesses are generally approximate).

| Unit | Thickness (in feet) |
|---|---|
| Top of bench at about 6430 ft; top of section; overlain, to top of ridge, by covered intervals and sandstone beds similar to underlying units. | |
| Browns Park Formation: | |
| 1. Sandstone, pale-grayish-orange (10 YR 9/1) to pale-yellowish-gray (5 Y 9/1); medium sorting, very fine to medium-grained, sparse coarse grained; mostly quartz; less than 1 percent dark minerals; mainly strongly silicified and calcareous, forming irregularly weathering, ledgy, resistant outcrops with obscure bedding planes; silica probably mainly chalcedony..... | 24.0 |
| 2. Sandstone, similar to unit 1 but less intensely silicified and calcareous; forms more subdued ledges; moderately well sorted, very fine to medium-grained; mainly rounded to subrounded quartz grains..... | 18.0 |

3. Largely covered interval, mainly silicified sandstone float; sparse outcrops similar to unit 2, slightly silicified..... 19.0

4. Sandstone, similar to unit 2; moderately well sorted, very fine to fine-grained, sparse medium-grained; calcareous; thinly bedded; not as silicified, ledgy, or well exposed as unit 1..... 29.0

5. Largely covered interval, similar to unit 3..... 14.0

6. Sandstone, pale-grayish-orange (10 YR 9/1); mainly strongly silicified and cliff-forming; medium sorting, very fine to medium-grained, sparse to rare coarse and very coarse-grained; mainly very thinly bedded, but commonly obscured; local thin to medium beds; local irregularly lenticular zones of flint-like chalcedony, yellowish-brown (10 YR 5/2) with bluish cast..... 67.0

7. Covered interval; silicified sandstone colluvium and talus..... 12.0

8. Sandstone, generally similar to overlying units; less than 1 percent dark minerals; moderately well sorted, very fine to fine-grained, sparse medium-grained; generally calcareous; irregularly silicified, thinly bedded, and ledge-forming in lower part; increasingly silicified and ledgy from about 15 ft above base; ±0.5-ft bed of light-gray (N 7) (fresher) and olive-gray (5 Y 5/1) (weathered) altered tuff 3.5-4.0 ft above base (sample 80-SL-65)..... 30.0

9. Sandstone, pale-pinkish-gray (5 YR 9/1); moderately poorly sorted, very fine grained to sparse very coarse grained; coarser grains rounded to subrounded frosted quartz; generally slightly calcareous; irregularly silicified, weakly to strongly silicified, forming slightly rounded, moderately resistant outcrops..... 6.5

10. Covered interval; mainly poorly resistant, thinly bedded sandstone slabs and chips lithologically similar to underlying unit..... 8.0

11. Sandstone, pale-pinkish-gray; medium sorting, very fine to medium-grained; mainly quartz; about 2 percent dark minerals; clayey, tuffaceous matrix; generally highly calcareous; locally slightly silicified; irregularly laminated to thinly bedded; generally poorly resistant..... 11.0

12. Sandstone, pale-pinkish-gray (5 YR 9/1) to yellowish-gray (5 Y 8/1); medium sorting, very fine to fine-grained, sparse medium-grained; clayey; tuffaceous in part; generally highly calcareous; irregularly strongly silicified, forming irregularly ledgy, differentially weathered thin beds..... 14.5

13. Covered interval; colluvium mainly of unit 14 lithology..... 14.0

14. Sandstone, pale-pinkish-gray; medium sorting, very fine to medium-grained; composition similar to unit 11; apparently tuffaceous, generally strongly calcareous, locally slightly silicified; irregularly thinly bedded to laminated; unit poorly exposed, may include other lithologies..... 18.0

15. Covered interval, mainly colluvium of strongly silicified sandstone..... 16.5

Base of section (at about 6090 ft) covered by colluvium and alluvium..... ±18.0

Total measured section.... ±319.5

NOTE: Parts of the most strongly silicified beds show radiometric values of as much as 8 X background (BG) values; less-silicified beds run about 3X BG; more tuffaceous sandstone with little silicification generally runs 1.5-2 X BG.

## Douglas Draw section

Section measured along steep hollow north of and above Colorado Hwy. 318 and Douglas Draw, west of and near Milepost 23, in SW1/4NE1/4 Sec. 35, T. 9 N., R. 101 W., Moffat Co., Colorado (Vermillion Mesa 7 $\frac{1}{2}$-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, June 14, 1980).

| Unit | | Thickness (in feet) |
|---|---|---|
| | Sandy colluvium and dune sand, covered interval about 30 ft thick at south rim of Vermillion Mesa; top of section. | |
| | Browns Park Formation: | |
| 1. | Ash, altered, light-yellowish-gray (5 Y 8/2), slightly sandy, highly calcareous; cross-laminated; very poorly exposed.... | 1.0 |
| 2. | Covered interval, mainly sand on gentle slope..... | 4.0 |
| 3. | Sandstone, pale-brown (5 YR 5/2), slightly petroliferous; very fine to fine-grained, sparse medium-grained; calcareous; forms readily recognizable float..... | 0.3 |
| 4. | Covered interval, sand and slumped sandstone on gentle slope... | 7.0 |
| 5. | Siltstone, clayey, pale-yellowish-brown (10 YR 6/2); noncalcareous; thinly bedded; very poorly exposed..... | 1.0 |
| 6. | Covered interval, mainly sand and ash on gentle slope..... | 17.0 |
| 7. | Ash, vitric, very light gray (N 8); mainly free of clastics and other impurities; slightly sandy, calcareous, upper 8 ft; trough cross-laminated 14-15 ft above base, indistinct laminations and cross-laminations below; mainly poorly indurated; (sample 80-SL-32 from about 6 ft above base).... | 23.0 |

8. Covered interval, sand and ash..... 7.0

9. Sandstone, tuffaceous, very pale orange (10 YR 8/2) to yellowish-gray (5 Y 8/1); very fine grained, silty; mostly quartz; highly calcareous; commonly well-indurated; irregularly bedded, platy-weathering, and poorly exposed in uppermost part; top is thin bed of fine-grained, well-sorted tuffaceous sandstone..... 20.0

10. Sandstone, pale-orange-brown and yellowish-brown (5-10 YR 6/2); moderately well sorted, fine- to medium-grained; scattered rounded pebbles and chips, to 8 mm, of light-gray sandstone and tuffaceous sandstone; unit apparently lenticular..... 2.0

11. Limestone, aphanitic to fine-grained, light-yellowish-gray (5 Y 8/1-2) and very light gray (N 8); slightly tuffaceous; locally sandy; laminated to unevenly (probably due to compaction) medium-bedded; commonly well-indurated; moderately sharp basal contact; (sample 80-SL-31 from lower half)..... 10.0

12. Sandstone, very pale orange; medium sorting, silty, very fine to fine-grained, sparse medium-grained; mostly quartz; medium- to thinly bedded in alternating ledgy and nonresistant beds..... 5.5

13. Tuff, light-yellowish-gray (5 Y 8/2), calcareous; indurated; thinly bedded to laminated, tabular..... 5.5

14. Sandstone, very pale orange; well-sorted, mainly very fine grained; apparently tuffaceous matrix; calcareous; forms ledgy rounded outcrops with indistinct bedding; sparse root casts and (or) irregularly linear, mainly vertical, limy concretions..... 9.0

15. Covered interval, common chips of silty to very fine grained sandstone..... 8.0

16. Ash, vitric, yellowish-gray (5 Y 8/1), very slightly sandy; calcareous..... 2.0

17. Siltstone, yellowish-gray (5 Y 7/2); noncalcareous; probably tuffaceous matrix; laminated to thinly bedded..... 6.0

18. Covered interval..... 3.0

19. Clay shale, yellowish-brown (10 YR 5/2); slightly calcareous; thinly bedded; silty at top; very poorly exposed..... 3.0

20. Sandstone, very pale orange; silty, very fine grained, sparse fine-grained; calcareous; irregularly bedded; upper half very poorly exposed..... 9.0

21. Covered interval, sand, silt, and ash..... 8.5

22. Ash, vitric, mainly light-yellowish-gray (5 Y 8/1); irregularly siltier upward, becoming tuffaceous siltstone near top; about 20 percent of unit consists of thin interbeds of sandy tuff; locally slightly porcelaneous; poorly indurated below, increasingly indurated, calcareous, laminated, above..... 18.0

23. Sandstone, very pale yellowish brown (10 YR 7/2); very fine to fine-grained; calcareous; generally thinly and irregularly bedded..... 12.0

24. Ash, vitric, light-bluish-gray (5 B 7/1); appears cross-laminated; top few inches irregularly sandy; base not exposed..... ±2.5

25. Sandstone, very pale yellowish brown; mainly well-sorted, fine- to very fine grained; crude interbeds of nonresistant, noncalcareous beds and of case-hardened, calcareous beds; locally slightly cross-laminated; cliff-forming; local zones of white root casts, mainly vertical, some horizontal, a few appear dendritic; local small, white, calcareous bedding-plane concretions..... ±23.0

26. Ash, vitric, bluish-white (5 B 9/1) to very light gray (N 8); generally free of clastics and other impurities; generally parallel laminations; local yellowish-gray calcareous zones that may be load features; persistent ±0.2-ft bed of olive-gray laminated silty tuff 5.5 ft above base; sharp, even basal contact; (sample 80-SL-33 from basal ft)..... 7.5

27. Sandstone, pale-olive-gray (5 Y 7/1), well-sorted, mainly very fine grained; highly tuffaceous; thin, tabular, calcareous, indurated beds interlayered with cross-laminated, possibly rippled, noncalcareous beds..... 5.5

28. Ash, mainly vitric, generally similar to unit 26, but lacks yellowish-gray calcareous zones and the thin, persistent silty tuff bed; slightly silty and very finely sandy; laminated; local small-scale trough and planar cross-laminations; irregularly lenticular, cross-laminated channel fill of very fine to silty tuffaceous sand at about 37-38 ft above base; thin irregular 1.5-2.0-ft sandy tuff at base; base trends N. 10° E. 5° W.; unit appears to correlate with ash dated at 9.9 to 7.2 m.y. (Naeser and others, 1980, tables 4 and 5, loc. no. 6), exposed about 3 mi. to the northwest..... 48.0

29. Sandstone, very pale orange to yellowish-gray (10 YR 8/2-5 Y 8/1); moderately well sorted, very fine to fine-grained; slightly tuffaceous; calcareous; locally well-indurated; generally thinly bedded, locally cross-laminated..... 11.5

30. Sandstone, very pale orange; generally poorly sorted, very fine to coarse-grained; calcareous; generally well-indurated and ledge-forming, with poorly indurated interbeds; irregular bedding planes locally accentuated by stringers containing pebbles and granules of porcelanite and sandstone; grades upward into about 1.5 ft of very fine grained, pale-yellowish-gray tuffaceous sandstone..... 11.0

31. Covered interval, loose sand..... 3.0

32. Sandstone, yellowish-gray, mainly fine-grained, calcareous; as single, irregularly tabular bed..... 0.5

33. Sandstone, tuffaceous, very pale orange; very fine grained and silty at base, grading upward to medium-sorted, very fine to medium-grained; calcareous; scattered sparse white pumice fragments; thin to medium irregular beds; upper half very poorly exposed..... 19.0

34. Sandy tuff, mainly vitric, yellowish-gray; calcareous; basal 0.5-0.7 ft cross-laminated; grades upward into well-indurated tuffaceous sandstone; porcelanite at top; beds generally about 0.5-ft thick; contacts regular, moderately sharp..... 6.0

35. Ash, vitric, colors as per units 26 and 28; low sand content; noncalcareous; laminated; slightly irregular basal contact; unit cut by many small high-angle normal faults with displacements generally less than 0.3 ft..... 2.2

36. Sandstone, very pale orange; fine- to very fine grained; calcareous; mainly well-indurated, cliff-forming; generally tabular, thick to thin beds; bedding units as much as 6-ft thick; texture and bedding thickness generally fining upward; top 2 ft slightly tuffaceous..... 22.5

Total measured section..... ±344.0

(base at about 5830 ft)

Base covered; about 35 ft colluvium above road level; alluvium between road and Douglas Draw channel.

## Big Bend Draw section

Section measured above north side of Big Bend Draw in E $\frac{1}{2}$ SW1/4 Sec. 19, T. 9 N., R. 100 W., Moffat Co., Colorado (Vermillion Mesa 7 $\frac{1}{2}$-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, July 25, 1980).

| Unit | Thickness (in feet) |
|---|---|
| Largely covered interval at top of section, mainly colluvium and slumped Browns Park Fm. tuffaceous sandstone. | |
| Browns Park Formation: | |
| 1. Ash, vitric, slightly sandy, very light gray (N 8); irregular small-scale cross-laminations; increasingly sandy, locally rippled upward, ripple crests about 0.25 ft apart, strike about N. 70° W.; top not exposed; farther east (upstream) unit interfingers with irregularly ledgy beds of tuffaceous sandstone; unit appears to correlate with ash-sample locality 80-SL-19, in NE1/4SW1/4 Sec. 20, where it consists of a nearly white vitric sampled ash layer overlying and partly crosscutting a laminated sandstone that exhibits very low angle planar cross-laminations, and is overlain in turn by thinly bedded tuffaceous sandstone; sampled ash 3.2 ft thick, homogeneous, very light gray, and subhorizontally laminated..... | 12.0+ |

2. Sandstone, tuffaceous, yellowish-gray (5 Y 8/1), in thin to medium, irregular, moderately resistant beds; moderately well-sorted, very fine to fine-grained; mainly quartz; mostly covered 8-25 ft above base; upper 2 ft and apparently much of covered interval tuffaceous sandstone, medium-sorted, very fine to medium-grained rounded to subangular, calcareous; sharp, slightly uneven basal contact..... 27.0

3. Sandstone, tuffaceous, similar to unit 2; laminated at base; locally wavy bedded and cross-laminated; local small-scale worm borings(?); base poorly exposed..... 7.5

4. Ash, vitric, medium-light-gray (N 6.5), weathers light gray (N 7.5); irregular cross-laminations, generally distorted; poorly defined basal contact..... 7.0

5. Sandstone, very pale grayish orange (10 YR 8/1) to yellowish-gray (5 Y 8/1); irregularly medium-bedded; poorly sorted, silty, very fine to medium-grained; grades irregularly upward to silty and very fine grained tuffaceous sandstone; calcareous; locally resistant..... 22.0

6. Ash, vitric, slightly sandy, very light gray (N 8); laminated and low-angle cross-laminated; rippled at top.... 0.7

7. Sandstone, tuffaceous, yellowish-gray; moderately well-sorted, fine- to very fine grained; medium-bedded at top and base, irregularly cross-laminated near middle..... 12.0

8. Ash, vitric, slightly sandy, bluish-white (5 B 9/1);
laminated; slightly irregular basal contact on sandstone... 1.0

Base covered by colluvium and alluvium; upper 10 ft mostly sandy soil, sandstone at extreme top..... 20.0

Total measured section..... 109.2+

Base of section in Big Bend Draw at about 6125-ft altitude.

NOTES: Because strata dip gently westward and roughly parallel to stream direction and gradient, no satisfactory upper and lower units could be added, by offset, to this section.

Section could not be correlated with Douglas Draw section only about 2 miles away. However, sample of unit 1 ash appears similar to sample of unit 7 ash from Douglas Draw section.

## Lower Langley Draw section

Section measured along steep slope north of and above county road upstream of mouth of Langley Draw, near and west of Milepost 4, in NW1/4 Sec. 16, T. 8 N., R. 100 W., Moffat Co., Colorado (Vermillion Mesa 7 $\frac{1}{2}$-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, June 13, 1980).

| Unit | Thickness (in feet) |
|---|---|
| Covered interval to top of ridge, mainly windblown sand, top of section. | |
| Browns Park Formation: | |
| 1. Sandstone, very pale orange (10 YR 8/2); very fine grained to silty, calcareous; thinly bedded..... | 5.0 |
| 2. Sandy tuff, very pale orange, calcareous, indurated; forms ±0.3-ft resistant bed at top, overlying thin zone of loose sandy tuff chips..... | ±2.0 |
| 3. Covered interval, mainly sand-covered slope..... | ±2.0 |
| 4. Sandstone, tuffaceous; very pale orange and less tuffaceous above to yellowish-gray (5 Y 8/1) below; fine- to very fine grained; thinly bedded; poorly exposed..... | ±2.0 |
| 5. Sandstone, mainly fine- to very fine grained; very tuffaceous in basal 2 ft, less tuffaceous above; calcareous; beds to 2 ft thick forming rounded outcrops; ledge-forming in basal 5 ft and upper 7 ft; sharp basal contact..... | 35.0 |

6. Ash, vitric, weathers pale bluish gray (5 B 8/1) to light gray (N 6.5); trace dark minerals; noncalcareous; sandy in basal 0.7 and top 1.0± ft; low-angle cross-laminated; load features present in basal 0.7 ft; sharply undulating base; (sample 80-SL-28 from near middle)..... 3.0

7. Sandstone; calcareous; alternating tabular thin beds and thicker (to 1.5 ft) irregular beds with poorly defined load features; thinly crossbedded in basal 1 ft..... 11.0

8. Covered interval; fine sand on slope..... 6.0

9. Ash, vitric, light-olive-gray (5 Y 5/1) (moist); mainly sandy except at top and bottom; noncalcareous; (sample 80-SL-27 from middle)..... 3.0

10. Sandstone; calcareous; similar to unit 7 but lacks crossbedding..... 15.5

11. Covered interval; very fine silty sand on slope..... 6.0

12. Sandstone, very pale orange; moderately well sorted, mainly fine-grained; rounded to subangular; mostly quartz; about 2 percent dark minerals; calcareous; mainly moderately well-indurated beds 0.2-0.7 ft thick..... 6.0

13. Covered interval; sandy slope wash..... 12.0

| | | |
|---|---|---|
| 14. | Sandstone, similar to unit 12, but less than 1 percent dark minerals; irregularly tabular beds mainly 0.3-0.5- ft thick..... | 14.5 |
| | Total measured section..... | ±123.0 |
| | (base at about 6175 ft) | |

Base covered; colluvium-covered slope down to road level at about 6155 ft; mainly alluvium below road level.

This section may be stratigraphically higher than the Douglas Draw section.

## Smelter Hill section

Section measured along north side of county road at Smelter Hill, in NW1/4NW1/4 Sec. 9, T. 7 N., R. 100 W., Moffat Co., Colorado (Greystone 7 1/2-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, June 5, 1980).

| Unit | Thickness (in feet) |
|---|---|
| Colluvium, covered interval, top of section. | |
| Browns Park Formation: | |
| 1. Limestone, aphanitic, very pale orange (10 YR 9/2), sandy; well-indurated; (sample 80-SL-3)..... | 4.0 |
| 2. Sandstone..... | ±1.0 |
| 3. Covered interval, mainly slumped sandstone..... | ±8.0 |
| 4. Sandstone, channel-fill, crossbedded (N-S, 25° E); ashy streaks near base, tuffaceous sandstone cobbles and pebbles near top; base not exposed..... | 6.0 |
| 5. Sandstone, tuffaceous; variable amounts of intermixed reworked ash, decreasing upward..... | 8.0 |
| 6. Limestone and sandstone, interbedded and locally intermixed; aphanitic limestone dominant in lower half: white (N 9), indurated, slightly sandy; laminated to thinly bedded; (sample 80-SL-11, from lower half); sandstone, tuffaceous, very pale orange (10 YR 8/2), moderately indurated..... | 12.0 |

7. Sandstone, light-orange-brown (5 YR 7/4); medium sorting, very fine to medium-grained, sparse coarse-grained; mainly rounded to subrounded; mostly quartz; poorly indurated; alternating thin to moderately thick subtabular beds; channeling present at base of some beds; local crossbedding (N. 60° W., 30° NE, leveling downward to horizontal); minor interbeds of, and grading upward into, yellowish-gray (5 Y 8/1) slightly tuffaceous fine- to very fine grained sandstone; local round zones to 0.5-ft across, of asphaltite(?)-impregnated sand near middle..... 28.0

8. Limestone, aphanitic, white (N 9) to pale-pinkish-gray (5 YR 9/1); moderately well-indurated; local partly porcelaneous tuff near top; variable amounts of fine to very fine sand; forms irregularly pinching and swelling bed, more even at top; (sample 80-SL-10)..... 0.7

9. Sandstone, grayish-orange-pink (5 YR 7/2); in several sequences that grade from coarse- to fine-grained rapidly upward into very fine grained; medium sorting; rounded to subangular; usual fluviatile Browns Park composition; poorly indurated; fining-upward sequences appear separated by micro-erosion surfaces..... 13.5

10. Tuffaceous sandstone at top and bottom, and about 1.0-ft sandstone in middle; tuffaceous beds irregular, particularly lower; yellowish- to pinkish-gray (5 YR 8/1), silty, very fine to medium-grained in pale-gray tuffaceous matrix; highly calcareous..... 2.0

11. Sandstone; crossbedded in lower part; very pale orange (10 YR 8/2), medium sorting, fine- to coarse-grained; subrounded to rounded; quartzose; noncalcareous; poorly exposed planar crossbeds (N. 50° W., 35° NE set, overlain by N. 70° E., 20° NW set); 6.5 ft above base is sharply tabular 0.5-ft bed of pale-greenish-yellow (10 Y 8/2), very fine grained to silty sandstone with sparse medium grains that appears tuffaceous; this bed overlain by poorly indurated very pale orange sandstone, medium-bedded, fine- to very fine grained; moderately well-sorted..... 27.5

12. Sandstone, very pale orange; medium sorting, fine- to very fine grained; quartzose, slightly tuffaceous; poorly indurated; local thin tuffaceous interbeds; about 0.5-ft zone at top contains abundant round, about 6 mm across, black stains of Mn and (or) Fe oxides around sand grains..... 5.5

13. Covered interval, mainly loose sand..... 7.0

14. Sandstone, pale-grayish-orange-pink (5 YR 8/2); medium sorting, fine- to medium-grained; subangular to subrounded, equant; mostly quartz; about 2% dark minerals; noncalcareous; mainly poorly indurated; local poorly defined low-angle crossbeds in lower part; grades upward into fine- to very fine grained, slightly tuffaceous sandstone with poorly defined bedding; local interbeds or lenses of about 0.1 ft thick, yellowish-gray (5 Y 7/2), very fine grained to silty sandstone; moderately sharp basal contact..... 33.0

15. Sandstone, yellowish-gray (5 Y 7/2); mostly quartz; generally tuffaceous matrix; 1-2 percent dark minerals; sparse limonitic blebs; noncalcareous; lower 3 ft well sorted, very fine grained; bulk of unit moderately well sorted, fine- to medium-grained, rounded to subrounded; near top, mainly medium-grained with sparse coarse grains..... 12.0

Total measured section about..... 168.2

(base at about 6690 ft)

Base covered; mainly slumped, poorly indurated sandstone and loose sand.

## Temple Draw section

Section measured east of Temple Draw and Moffat Co. road 53, near C SE1/4 Sec. 31, T. 6 N., R. 94 W., Moffat Co., Colorado (Juniper Hot Springs 7 1/2-minute quadrangle). Measured northeastward from base in hollow at about 6270 ft altitude.

(Measured with hand level and steel tape by S. J. Luft, September 10, 1980).

| Unit | Thickness (in feet) |
|---|---|
| Largely covered interval at top of section, mainly colluvium and local bedrock exposures of sandstone, calcareous sandstone, tuffaceous sandstone, and minor thin tuff belonging to Browns Park Fm.; moderate to gentle slope to top of ridge. | |
| Browns Park Formation: | |
| 1. Sandstone, yellowish-gray (5 Y 8/2-1); moderately well sorted, very fine to fine-grained; silty; mostly quartz; about 1 percent dark minerals; tuffaceous, weakly calcareous; mainly massive-appearing, forms rounded ledges and low cliffs; locally irregularly case-hardened; local limonite and (or) jarosite staining; 0-5 ft thick, indurated, light-olive-gray (5 Y 5/2) siltstone lens about 42 ft above base..... | ±61.0 |
| 2. Largely covered interval on moderate slope; mainly sandy colluvium, locally tuffaceous; fine- to very fine grained calcareous sandstone ledge about 24 ft above base..... | 37.0 |

3. Sandstone, yellowish-gray (5 Y 8/1-2); medium to well sorted, very fine grained to sparse medium-grained, mainly fine-grained; silty; calcareous and irregularly case-hardened basal 6 ft and locally higher; two thin (less than 0.7 ft) tuffaceous sandstone beds between 6 and 15 ft; upper 15 ft generally very poorly exposed; top 1 ft is moderately poorly sorted, well-indurated, very coarse to very fine grained sandstone containing abundant medium to coarse, rounded to subangular pink quartz; base gradational..... 35.0

4. Tuff, pale-bluish gray (5 B 8-9/1), partly devitrified; laminated; (sample 80-SL-64); sharp, slightly irregular base..... ±1.0

5. Sandstone, yellowish-gray; moderately well sorted, very fine to fine-grained; silty; generally calcareous; ledge-forming, in mainly irregular and distorted very thin to thin beds; sharply gradational base..... 5.5

6. Sandstone, grayish-dusky-yellow (5 Y 6/3); very well sorted, clean and winnowed, mainly fine-grained; laminated; poorly indurated, forms notch in lower part of cliff; slightly irregular base..... 2.0

7. Sandstone, light-yellowish-gray (5 Y 7-8/2); moderately well sorted, fine- to very fine grained; silty; tuffaceous; massive-appearing and cliff-forming; locally calcareous and case-hardened, particularly in top 4 ft..... 25.5

8. Tuff.....0.2-0.8

9. Siltstone, olive-gray (5 Y 5/1); calcareous.....0.2-0.7

10. Sandstone, similar to unit 7; calcareous, case-hardened; differentially weathered; ledge-forming; base gradational.. 5.5

11. Tuff, white (N 9), partly devitrified; laminated; sharp, even base..... 1.7

12. Sandstone, yellowish olive gray (5 Y 7/1); fine- to very fine grained; tuffaceous; massive-appearing; ledge-forming..... 5.5

13. Sandstone, yellowish-gray (5 Y 7/2); moderately well sorted, fine- to medium-grained; forms resistant rounded ledges; irregular ±1-ft white layer of devitrified tuff 2-3 ft above base; sandstone overlying tuff partly tuffaceous; highly calcareous, very irregularly weathering case-hardened zone 8-10 ft above base; top 7 ft consists of interlayered resistant and thin, weakly indurated sandstone beds..... 17.0

14. Sandstone, fine- to very fine grained; very thinly bedded; very poorly exposed..... 10.5

15. Tuff, light-greenish-gray (5 GY 7/1) to light-gray (N 7.5), vitric; distorted laminations; (sample 80-SL-63); sharp basal contact..... 2.5

16. Sandstone, fine- to very fine grained; slightly calcareous; very thinly bedded to laminated, except for 1.5-ft bed near middle; base gradational..... 5.0

17. Tuff, light-yellowish-gray (5 Y 9/1) to very light gray (N 8.5), mainly vitric, slightly sandy; irregularly laminated; slightly irregular base..... 0.7

18. Sandstone, light-yellowish-gray (5 Y 8/2); moderately well sorted, mainly very fine grained; silty; tuffaceous; very thin distorted beds and laminations; distinctive ±0.2-ft olive-gray (5 Y 5/1) silty bed 3 ft above base; above silty bed, unit more resistant, irregularly slightly calcareous, forms ±3-ft, massive-appearing, mainly very fine grained sandstone bed; upper half is very thinly bedded to laminated, slightly calcareous, fine- to very fine grained sandstone..... 12.0

19. Sandstone, tuffaceous, thinly bedded, very poorly exposed..... 3.5

20. Sandstone, yellowish-gray (5 Y 7/1), tuffaceous; moderately well sorted, mainly very fine to fine-grained; irregularly very thinly bedded; generally well indurated; 0.1-ft tuff stringer near top; calcareous, case-hardened bed at top..... 3.0

21. Tuff, very light gray (N 8), mainly vitric; uncontaminated, almost lacking in dark minerals; laminated to very thinly bedded; sharp, slightly irregular base..... 1.0

22. Sandstone, yellowish-gray, tuffaceous; moderately well sorted, mainly very fine to fine-grained; similar to unit 20; not more than 2 percent dark minerals; locally calcareous and case-hardened; common limonitized concretions, mainly less than 5 mm across; weakly to moderately indurated; massive-appearing with inconspicuous thin beds; base not exposed..... 3.5

Base covered by colluvium and alluvium..... ±5.0

Total measured section..... ±245.0

NOTE: Dips are mainly gently eastward, off Juniper Mountain on the west.

## Upper Cedar Mountain Gulch section

Section measured along west side of Moffat County road 7, above Cedar Mountain; base at about 6790 ft altitude in NE1/4NE1/4 Sec. 17; top in SE1/4 SE1/4 Sec. 8, T. 7 N., R. 91 W., Moffat Co., Colorado (Craig 7 $\frac{1}{2}$-minute quadrangle).

(Measured with hand level and steel tape by S. J. Luft and W. L. Thoen, July 27, 1980. Thicknesses of units 1, 2, 4, 7, and 8 are approximate, owing to variations in dips).

| Units | Thickness (in feet) |
|---|---|
| Gentle covered slope, top of section. | |
| Browns Park Formation: | |
| 1. Sandstone, pale-pinkish-gray (5 YR 9/1); medium sorting, very fine to medium-grained; local sparse coarse-grained; rounded to subangular; mostly quartz; about 1 percent dark minerals; calcareous; generally but irregularly well-indurated; irregular medium to thin beds, dipping about 9° westward; irregular basal contact..... | 13.0+ |
| 2. Sandstone, yellowish-gray (5 Y 8/1); generally similar to unit 1 but less resistant; generally moderately well sorted; laminated and thinly bedded; local minor distorted bedding and load features; local sparse clay chips near base; base trends about N. 40° E., 10° NW; grades upward into silty, very fine grained pale-yellowish-gray (5 Y 9/1) tuffaceous sandstone; basal contact sharp, planar..... | ±14.0 |

3. Sandstone, yellowish-gray; eolian(?) cross-laminations; moderately well sorted, very fine to fine-grained; about 1 percent dark minerals, mainly bluish-gray chert; poorly indurated; (sample 80-SL-53)..... 13.0

Sandstone, pale-pinkish-gray; poorly sorted, very fine to coarse-grained; subangular to rounded; 1-2 percent dark minerals; cross-laminated, laminated, and thinly bedded; weakly to strongly indurated; increasingly finer grained upward, to fine- and very fine grained, and more indistinctly bedded; local weakly conglomeratic zones, consisting of sparse chert pebbles and clay chips to 5 mm; poorly exposed zone of bluish grains, similar to that in unit 5, at about 12-13 ft above base; local thin silty beds and local cross-laminations in upper part; irregular pinkish clayey and silty zone about 18-20 ft above base; distinct ledgy top..... ±21.5

5. Sandstone; moderately well sorted, fine- to medium-grained; interlaminated with thin bands (to 5 mm) containing abundant grains of a pitchy black (fresh) and medium-bluish-gray (5 B 5/1) (weathered) heavy mineral of uniformly very fine grain size (sample 80-SL-62); unit may be lenticular..... ±0.8

6. Conglomeratic sandstone, consisting mainly of unoriented clay and siltstone chips to 3.5 cm, and chert and mafic volcanic-rock granules, in a sandy matrix; faint laminations discernible; irregular basal contact..... ±1.7

7. Covered interval; mainly very fine sand and sandstone blocks similar to unit 8..... ±13.5

8. Sandstone, yellowish-gray; moderately well sorted in lower part; silty, very fine to fine-grained; sparse medium-grained; variable (±1 percent) dark minerals content; generally poorly indurated; two thin clayey beds 12.5-13 ft above base; clay silty, light brown (5 YR 6/4), noncalcareous, possibly mud-cracked; upper clay bed overlain by 3.5 ft of laminated sandstone similar to lower 12.5 ft; top is irregularly lenticular (0-1.2 ft) siltstone within sandstone; siltstone grayish-orange-pink (5 YR 7/2), laminated, noncalcareous..... ±17.5

9. Sandstone, light-gray (N 7); cross-laminated; moderately poorly to well sorted, mainly very fine to medium-grained; varicolored chert grains common; matrix probably tuffaceous; calcareous; resistant at top; trends N. 10-15° E., ±25° NW in lower part and N. 60° E., ±27° NW in upper part; slightly irregular basal contact..... 3.0

10. Sandstone, tuffaceous, light-greenish-gray (5 GY 8/1) to yellowish-gray (5 Y 8/1); moderately well sorted, silty, very fine to fine-grained; sparse medium-grained; rounded to subrounded; mainly quartz; 1-2 percent dark minerals; calcareous; forms thin, irregularly tabular beds..... 2.0+

Total measured section..... ±100.0

(base about 6790 ft altitude)

Base covered; mainly colluvial sand.

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