DEPARTMENT OF THE INTERIOR

U.S. GEOLOGICAL SURVEY

Measured sections and environmental reconstructions of uppermost Jurassic to lowermost Upper Cretaceous rocks on the northern side of the San Juan basin, southwestern Colorado

by

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Open-File Report 88-231

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Measured Sections and Environmental Reconstructions of Uppermost Jurassic to Lowermost Upper Cretaceous Rocks in the Vicinity of the Southern Ute Indian Reservation, Southern Colorado

By W.M. Aubrey

Abstract

Twelve stratigraphic sections were measured on the northern side of the San Juan Basin in southwestern Colorado to determine the depositional environments of uppermost Jurassic to lower most Upper Cretaceous rocks on the Southern Ute Indian Reservation. Rocks studied include the upper part of the Upper Jurassic Brushy Basin Member of the Morrison Formation, the Lower Cretaceous Burro Canyon Formation, the Upper Cretaceous Dakota Sandstone, and the lower part of the Upper Cretaceous Mancos Shale.

Lenticular, fluvial channel sandstones and conglomerates that occur beneath the Dakota Sandstone in southwestern Colorado are generally considered to be part of the Burro Canyon Formation. In the western part of the region, however, the stratigraphically lowest of these conglomeratic sandstone bodies (including the Karla Kay Conglomerate Member of the Burro Canyon Formation) are interbedded with smectitic mudstones, bentonite beds, resistant green hard layers, and possible clinoptilolite typical of the lacustrine deposits of the underlying Brushy Basin Member of the Morrison Formation and should probably be included in the Morrison Formation. The basal Encinal Canyon Member of the Dakota Sandstone consists of crossbedded, fluvial, locally conglomeratic sandstone that fills valleys incised into the underlying the Burro Canyon Formation. The generally fine grained sandstone, siltstones, mudstone, and thin coals of the upper part of the Dakota, which overlie the Encinal Canyon Member, represent delta-plain environments in the western part of the Southern Ute Reservation and shore-zone deposits in the eastern part. The marine Mancos Shale overlies the upper part of the Dakota Sandstone.

Coarse-grained channel sandstones of the Burro Canyon Formation and fluvial valley fill of the Encinal Canyon Member are possible reservoirs for oil and gas in the Southern Ute Reservation area. The finer grained shore-zone and distributary-channel sandstones in the upper part of the Dakota may also have the potential for stratigraphic traps. Original porosity and permeability of the Dakota and Burro Canyon sandstones in the vicinity of the reservation, however, have been reduced by pervasive silica cement and by authigenic (?) clay; more work is needed to determine the potential of these sandstones as exploration targets.

INTRODUCTION

The 12 stratigraphic sections presented here were measured on the northern side of the San Juan basin (fig. 1) as part of a study to determine the history of uppermost Jurassic to lowermost Upper Cretaceous rocks in the vicinity of the Southern Ute Reservation in southwestern Colorado. Sections were measured in three general areas: (1) the Ute Mountain area, (2) the Durango area, and (3) the Coldwater Creek area (fig. 1). Sections in the Durango and Coldwater Creek areas were chosen because of their close proximity to the reservation. The Ute Mountain sections are to the west of the reservation and are included because they delineate regional facies changes that increase our understanding of rocks in the reservation area.

Rock units include, in ascending order, the upper part of the Brushy Basin Member of the Morrison Formation (Upper Jurassic), the Burro Canyon Formation (lower Cretaceous), the Dakota Sandstone (Upper Cretaceous), the lower shale member of the Mancos Shale (Upper Cretaceous), and the lower part of the Greenhorn Limestone Member of the Mancos Shale (Upper Cretaceous). The Dakota Sandstone and the Burro Canyon Formation, which is commonly undifferentiated from the Dakota Sandstone (Tweto, 1979), are important producers of oil and gas in the northern San Juan basin. The Burro Canyon Formation contains several low-grade uranium deposits. The measured sections are presented in the appendix and in plates I-IV.

STRATIGRAPHIC RELATIONSHIPS

The Upper Jurassic Brushy Basin Member of the Morrison Formation is a saline, alkaline playa-lake complex that was deposited in a basin extending 300 mi (500 km) from the southern edge of the San Juan basin to north of the present-day Uncompagre uplift, and was approximately 185 mi (300 km) wide (Turner-Peterson and others, 1986). The Brushy Basin is about 150-330 ft (50-100 m) thick in southwestern Colorado (Ekren and Houser, 1965) and consists of mostly green or olive mudstones interbedded with tuff beds that contain abundant altered volcanic ash (Bell, 1986; Turner-Peterson and others, 1986). Salinity and alkalinity variations in the paleolake caused differential alteration of ash in the lake deposits and resulted in four concentrically zoned mineral facies (Turner-Peterson and others, 1986). Ash in the central portion of the paleolake basin altered to albite, whereas ash in succeeding zones, progressing toward the edges of the lake, typically altered to analcime, clinoptilolite, and bentonite, respectively. The analcime zone is also characterized by beds of authigenic potassium-feldspar, and the clinoptilolite zone also contains bentonite beds (Turner-Peterson and other, 1986).

Several of these authigenic mineral facies occur in the vicinity of the Southern Ute Reservation. The Brushy Basin Member in the Durango and Coldwater Creek areas was deposited in the albite zone in the central part of the paleolake basin. In the Ute Mountain area, the Brushy Basin was deposited nearer the western margin of the paleolake. Strata on the eastern side of McElmo Canyon near Cortez are within the analcime facies, and the boundary between the analcime facies and the albite facies runs north-south somewhere between the Cortez and Durango areas. Strata on the western side of McElmo Canyon are within the clinoptilolite faces, and the boundary between the clinoptilolite and the analcime facies runs north-south through the middle of the Ute Mountain area (Christine Turner-Peterson, oral communication, 1987).

The albite, analcime, and clinoptilolite beds form hard resistant layers. Albite and analcime beds are green, clinoptilolite beds are orange, and bentonite beds are white. Preliminary data indicates that interbedded mudstones in the albite and analcime zones are predominantly illitic, whereas those in the clinoptilolite and bentonite zones are principally smectitic (Christine Turner-Peterson, oral communication, 1986). The smectitic beds swell when wet and are hard and frothy appearing when weathered; the nonsmectitic beds, on the other hand, have a hackly or fissile weathering character (Ekren and Houser 1959).

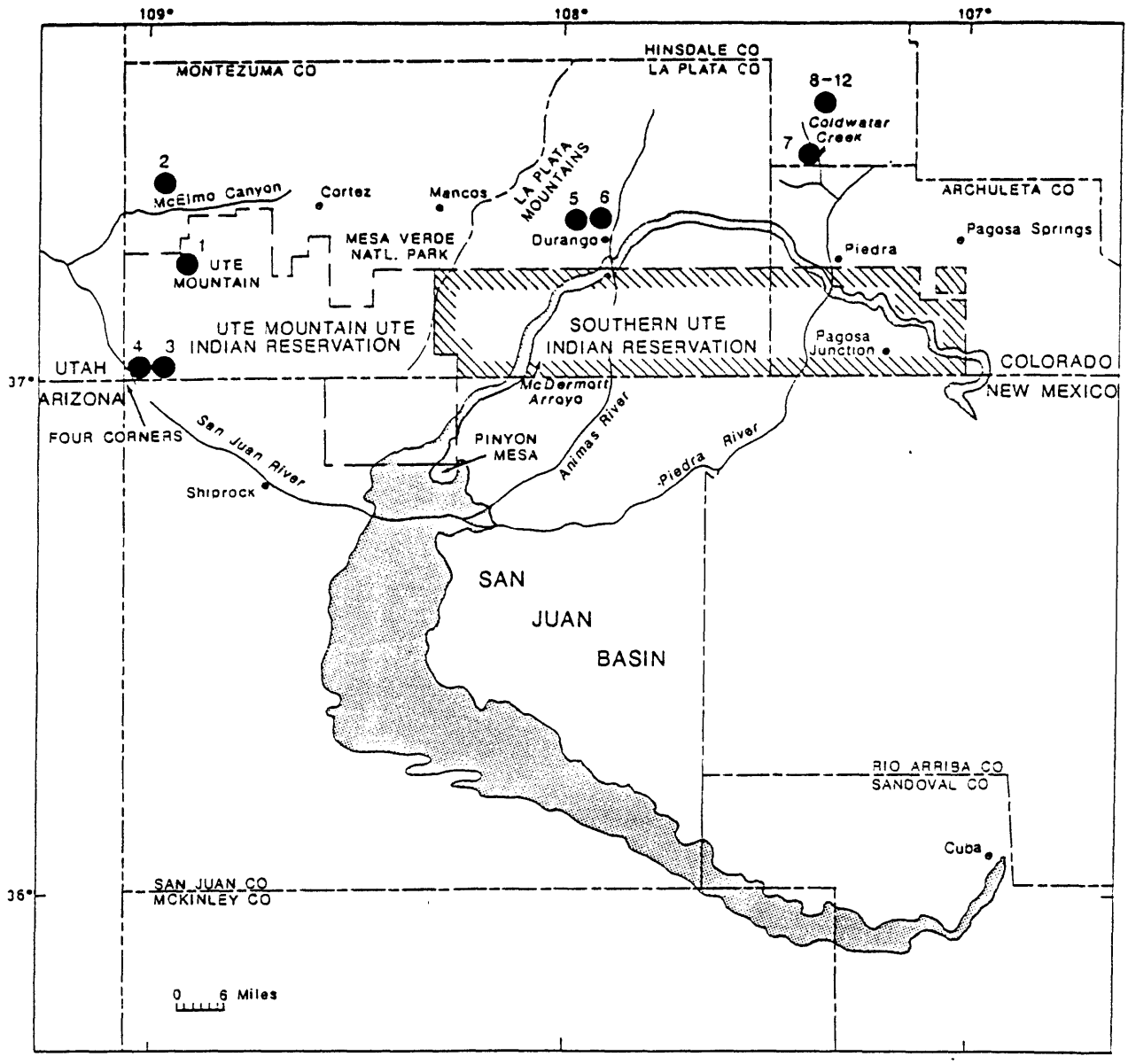


Figure 1. Map shows Southern Ute Reservation (hachured area) and vicinity: Numbered dots show location of measured sections described in the appendix and illustrated in plates 1-4. Strippled pattern shows outcrop of Fruitland Formation and Kirtland Shale and indicates location of the San Juan basin.

Lenticular, fluvial conglomerate and conglomeratic sandstone bodies that occur at or near the top of the Brushy Basin Member of the Morrison Formation in southwestern Colorado have been included in the upper Lower Cretaceous Burro Canyon Formation by Ekren and Houser (1959, 1965). The stratigraphically lowest of these bodies is the Karla Kay Conglomerate Member of the Burro Canyon Formation (fig. 2), which forms shoestring channel deposits as much as 2000 ft (610 m) wide and 65 ft (20 m) thick (Ekren and Houser, 1959). Mudstones in the Burro Canyon are commonly green or olive and nonsmectitic and have a hackly or fissile texture on a weathered surface (Ekren and Houser, 1965). Ekren and Houser (1965) interpreted the Burro Canyon to interfinger with the upper part of the Morrison because conglomerate and conglomeratic sandstone bodies and nonsmectitic mudstone are locally interbedded with smectitic mudstone. The thickness of the Burro Canyon ranges from 140 to 206 ft (42-62 m) in the four corners area (Ekren and Houser, 1965).

The lower Cenomanian (lower Upper Cretaceous) Encinal Canyon Member (Aubrey, 1987) at the base of the Dakota Sandstone fills paleovalleys incised into the top of the Burro Canyon Formation. The Encinal Canyon consists of crossbedded, fluvial, fine- to coarse-grained sandstone that is locally conglomeratic. Paleovalleys at the base of the Dakota are commonly 40-50 ft (12-15 m) deep in southwestern Colorado but can be more than 100 ft (30 m) deep in some parts of the region (Carter, 1957; Aubrey, 1986).

Younger beds of the Dakota in the northern San Juan basin are composed of fine- to medium-grained sandstone, dark-gray mudstone and siltstone, and carbonaceous shale and coal that were deposited in a variety of marginal-marine and deltaic environments. These beds range from about 60 to 180 ft (10-48.5 m) in thickness and are probably middle to early late Cenomanian in age.

Cobban and Hook 1984) used the distribution of various ammonite species to outline approximate middle and late Cenomanian Dakota shoreline positions (fig. 3). In general the shoreline trended north-south and transgressed to the west. However, a large embayment, the Seboyeta bay (Hook and other, 1980) formed in northwestern New Mexico, and the shoreline on the northern side ofthis bay trended northeast-southwest and transgressed to the northwest toward the area of the Southern Ute Reservation.

The Dakota Sandstone is conformably overlain by the marine lower shale member of the Mancos Shale. The lower shale member is latest Cenomanian in age and is equivalent to the Harland Shale Member of the Greenhorn Limestone in the Colorado Group (Sageman, 1985). The lower shale member consists primarily of medium- to olive-gray shale that is commonly calcareous, particularly in its upper part, and is about 75-100 ft (23-30 m) thick on the northern side of the San Juan basin (Ekren and Houser, 1965; Wanek, 1959). The lower shale member grades upwards into the Greenhorn Limestone Member of the Mancos Shale. The Greenhorn consists of dense, locally almost lithographic, gray or white limestone interbedded with calcareous shale (Ekren and Houser, 1965). It is late Cenomanian to early Turonian in age and is equivalent to the Bridge Creek Member of the Greenhorn Limestone of the Colorado Group (Cobban and Hook, 1984). The Greenhorn Limestone Member ranges in thickness from about 15 to 35 ft. (4.5-10.5 m) in southwestern Colorado (Ekren and Houser, 1965; Lamb. 1973).

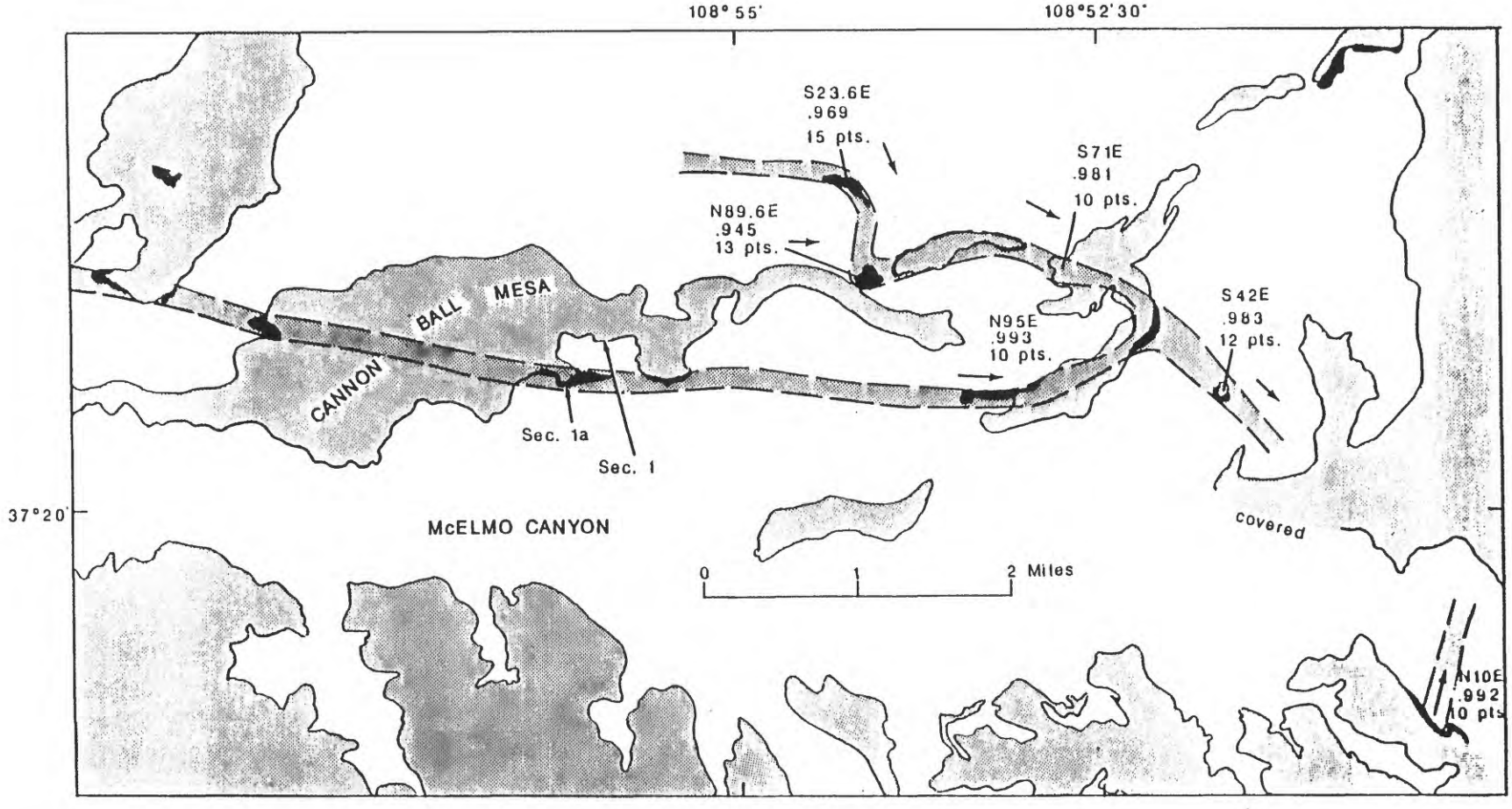


Figure 2. A map showing Karla Kay channel system (dark stippled pattern) in McElmo Canyon area. Black areas indicate outcrops of Karla Kay Conglomerate Member of the Burro Canyon Formation. Channel fill between outcrops has been undercut, but channel locations are commonly marked by large blocks of the Karla Kay on top of underlying less resistant mudstone. Average paleocurrent directions from the Karla Kay Conglomerate with confidence factors and numbers of data points are shown at several locations. Light stippled pattern shows the Burro Canyon Formation and the Dakota Sandstone; outcrop pattern is from Ekren and Houser, 1965.

UTE MOUNTAIN AREA

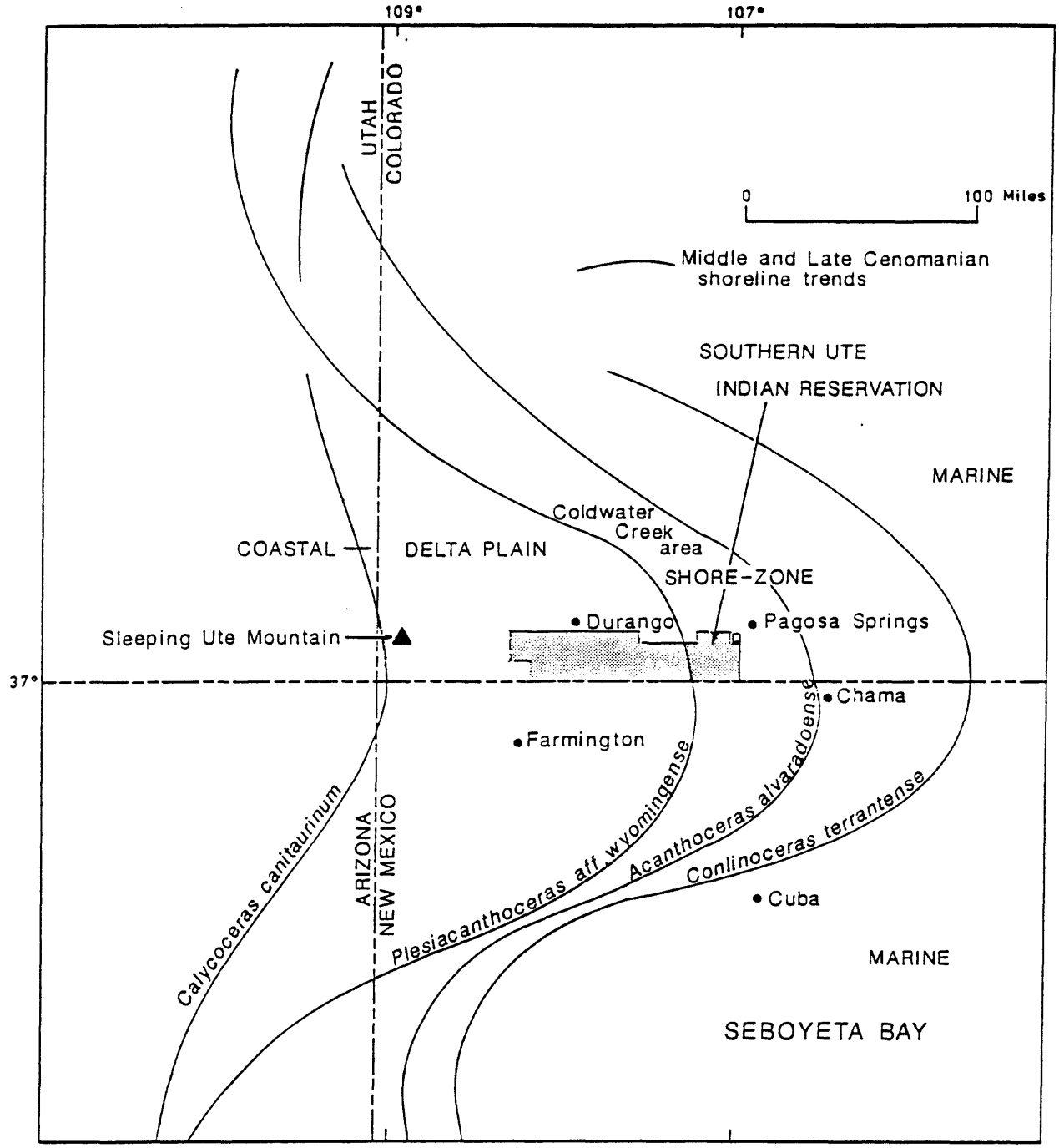
Sections in the Ute Mountain area were measured in McElmo Canyon, on the western side of Sleeping Ute Mountain, and near the Four Corners (fig. 1, plate I). Jurassic and Cretaceous rocks described in the sections are discussed below.

Rocks older than the Dakota Sandstone in the Ute Mountain area consist of channel deposits and lacustrine-overbank deposits. The lenticular conglomerate and conglomeratic sandstone bodies that compose the channel deposits have been included in the Burro Canyon Formation by Ekren and Houser (1965). These lenslike bodies are commonly cross-stratified and fluvial in origin. They are composed of quartzose fine- to coarse-grained sandstone and pebbles of colored chert, quartzite, and silicified limestone and siltstone. The lenses are more numerous and less coarse and have a more sheetlike geometry in the upper part of the section than in the lower.

The lacustrine-overbank deposits consist primarily of mudstone, siltstone and very fine grained sandstone and have been included in both the Morrison and the Burro Canyon Formations by Ekren and Houser (1965). They placed frothy weathering smectitic mudstones in the Brushy Basin Member of the Morrison Formation and hackly weathering nonbentonitic mudstones in the Burro Canyon Formation. Mudstones and siltstones in the lower part of the lacustrine-overbank facies are predominantly frothy weathering, while those in the upper part are mostly hackly weathering.

Stratigraphic relationships are less certain, however, than suggested by ekren and Houser (1965), who interpreted alternating smectitic and nonsmectitic beds as interfingering between the Burro Canyon and underlying Morrison Formation. The Brushy Basin in the Ute Mountain area is transitional between the smectitic clinoptilolite facies in the western part of the area and the nonsmectitic analcime facies in the eastern part (Christine Turner-Peterson, oral communication, 1986). The alternating smectitic and nonsmectitic beds may be better explained by lateral interfingering of the clinoptilolite and analcime Brush Basin facies.

The lacustrine-overbank facies, particularly in its lower part, probably consists of saline, alkaline playa-lake deposits of the Brush Basin Member of the Morrison Formation. Clinoptilolite beds occur near the base of the Four Corners I section (plate I, section 3), and orange specks in mudstone beds in the lower part of the Cannon Ball Mesa I section (plate I, section 1) may also be clinoptilolite. Bentonite beds and resistant green hard layers also occur in these sections, especially in the lower parts. Clinoptilolite and bentonite beds and the resistant hard layers are typical of the Brushy Basin Member in this area.



Age	Ammonite Range Zone
Late Cenomanian	*Calycoceras canitaurinum*
	Plesiacanthoceras aff. wyomingense
Middle Cenomanian	*Acanthoceras alvaradoense*
	Conlinoceras terrantense

Figure 3. Map showing shoreline positions as sea transgressed to the west across the area during deposition of the upper part of the Dakota Sandstone (from Cobban and Hook, 1984). Upper Dakota rocks on the western side of the reservation were deposited on a delta plain and those on the eastern side in a shore-zone environment.

Channel sandstones occur locally within the lacustrine deposits of the Brushy Basin Member elsewhere in the San Juan basin (Bell, 1986), and at least some of the stratigraphically lower lenticular bodies that compose the channel deposits in the Ute Mountain area are probably part of the Brushy Basin rather than the Burro Canyon. The Karla Kay Member of the Burro Canyon Formation and some of the lower sandstone and conglomerate lenses occur stratigraphically below bentonite beds and hard layers in the lacustrine-overbank facies (for example, see Cannon Ball Mesa area, plate I, section 1 and 1a). These channel sandstones and conglomerates grade laterally into the mudstones and siltstones of the lacustrine-overbank facies; although there is local scour at their bases, the channel deposits do not appear to fill valleys cut into older deposits. More work, however, is needed to determine the stratigraphic relationships between the Brushy Basin Member of the Morrison Formation and the Burro Canyon Formation in the area.

The basal Dakota surface is unconformable and locally cuts as much as 45-50 ft (15-17 m) into underlying rocks within a horizontal distance of just a few hundred feet (Cannon Ball Mesa I and II, plate I, section 1 and 1a). Valleys that occur locally at the base of the Dakota are filled with crossbedded fluvial sandstones and conglomerates of the Encinal Canyon Member. Extensive reconnaissance indicates that pebbly sandstone almost always occurs at the base of the Dakota Sandstone even in areas where there is no scour and fill. For instance, in the Four Corners I section (plate I, section 3), the unconformity is marked by a thin pebbly sandstone that is overlain by fine-grained sandstone and coal and underlain by green mudstone. Pebbles at the base of the Dakota probably were concentrated into a lag deposit during the hiatus represented by the unconformity.

The fluvial rocks of the Encinal Canyon are overlain by a unit composed of delta-plain or coastal plain deposits. This unit ranges from 95 to 180 ft (29-45 m) in thickness throughout the area and consists of three facies: (1) a channel facies, (2) a crevasse splay-levee facies, and (3) an overbank facies. The channel facies is composed of generally fine to medium grained, quartzose sandstone; it is commonly trough crossbedded although locally it may contain horizontal laminations, ripple laminations, and planar crossbeds. The crevasse splay-levee facies consists of thin, fine- to medium-grained sandstone beds that are generally ripple laminated but may locally be planar tabular or trough crossbedded. Gray to dark-gray carbonaceous mudstone and thin coal compose the overbank facies. The delta- or coastal-plain rocks in the Ute Mountain area grade upward into marine beds of the lower part of the Mancos Shale.

DURANGO AREA

In the Durango area, the Dakota Sandstone is underlain by fine- to medium-grained, locally conglomeratic sandstone interbedded with finer grained mudstone and very fine grained sandstone (plate II, section 5). These rocks have been included in the Burro Canyon Formation (Tweto, 1979). The sandstone and conglomeratic sandstone represent fluvial channel deposits. More work is needed to determine whether or not the mineralogy of hard layers and mudstone is the fine-grained facies is typical of the Brushy Basin Member of the Morrison Formation; it is uncertain whether the pre-Dakota rocks should be included in the Brushy Basin Member of the Morrison Formation or in the Burro Canyon Formation.

The Dakota Sandstone rests disconformably on underlying rocks in the Durango area. The basal Dakota unit, the Encinal Canyon Member, is a fluvial, locally conglomeratic sandstone that varies in thickness at the expense of the underlying Burro Canyon Formation. At the Junction Creek I section (plate II, section 5) the Encinal Canyon is only a few feet thick. About a mile to the west, however, it is about 30 ft (9 m) thick (fig. 4).
The Encinal Canyon Member in the Junction Creek I section (plate II, section 5) area is overlain by 10-15 ft (3-4.5 m) of coal and carbonaceous shale that was probably deposited in a coastal swamp or lagoonal environment. The coal and shale grade upward into a tabular, planar crossbedded, fine-grained sandstone unit about 30 ft (9 m) thick, which may be a distributary- or tidal-channel deposit. More work, however, is needed to determine the nature of the depositional environments of the post-Encinal Canyon Dakota rocks. The crossbedded sandstone is, in turn, overlain by the marine Mancos Shale (plate II, sections 5 and 6).

COLDWATER CREEK AREA

Channel sandstones and conglomeratic sandstones interbedded with finer grained rocks occur beneath the Dakota Sandstone in the Coldwater Creek I section (plate III, section 7; fig. 5) and are similar to those in the Durango and Four Corners areas. These rocks have been placed in the Burro Canyon Formation (Tweto, 1979), but it is possible that they are part of the Morrison Formation. The channel sandstones in the Coldwater Creek I section cannot be traced laterally because of poor exposures, but they are similar to lenticular channel sandstones represented in the Coldwater Creek II-VI sections (plate IV, sections 8-12; fig. 6) that pinchout laterally into fine-grained facies and are underlain by mudstone and interbedded hard layers that are part of the Brushy Basin Member.

The Encinal Canyon Member of the Dakota Sandstone is thin or absent in the Coldwater Creek I section (plate III, section 7), where there is only about ten ft (3 m) of local relief at the base of the Dakota. Fifteen miles to the south near the town of Piedra, the basal Dakota surface locally scours 40 ft (12 m) into the underlying mudstones of the Burro Canyon (Morrison?) Formation within a horizontal distance of about 150 ft (49 m) (fig. 7), and the scour is filled with crossbedded, locally conglomeratic fluvial sandstone of the Encinal Canyon Member.

The Encinal Canyon Member in the Coldwater Creek area is overlain by a unit composed of sandstone, siltstone, mudstone, and coal beds. Sandstones are quartzose, generally fine grained, and commonly bioturbated. They are generally flat bedded and ripple laminated, although planar tabular crossbeds are also common. The sediments were probably deposited in a variety of shore-zone environments. Bioturbated, flat-bedded, ripple-laminated, or tabular planar crossbedded sandstones were probably deposited in tidal-flat, shoreface, or offshore-bar environments. Coal beds may represent coastal swamps or lagoons, and siltstones and mudstones probably represent lagoonal or offshore environments.

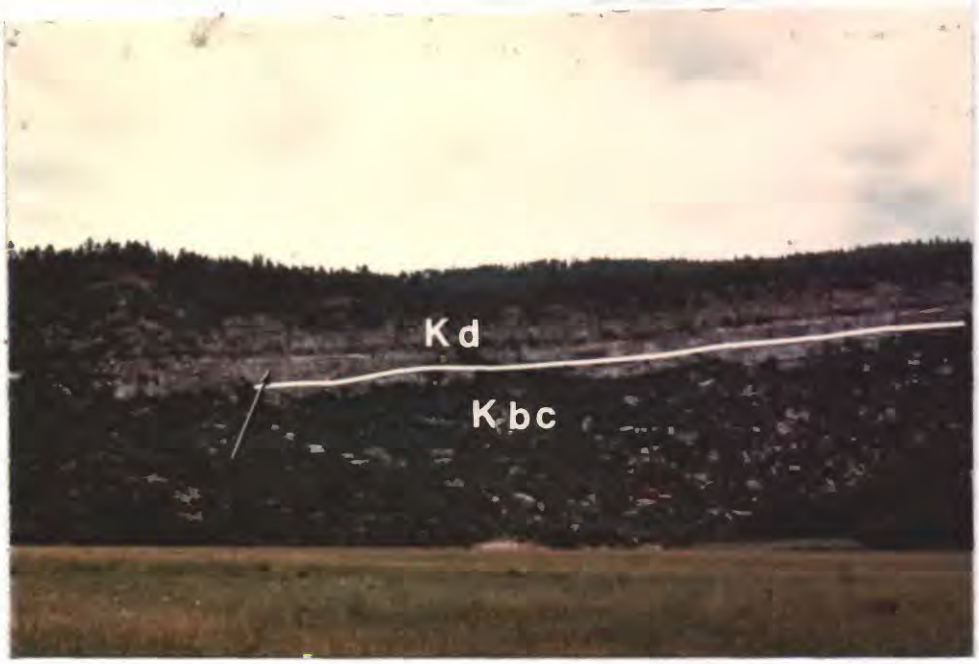


Figure 4. Photograph showing cliff containing Burro Canyon Formation (Kbc) and Dakota Sandstone (Kd) on northern side of highway in NE 1/4 sec. 6, T. 35 N., R. 9 W., about 2 mi west of the Junction Creek I section (fig. 1, 5) near Durango. Arrow points to the basal Encinal Canyon Member of the Dakota Sandstone which is separated from overlying upper part of the Dakota by dark shale and coal beds.

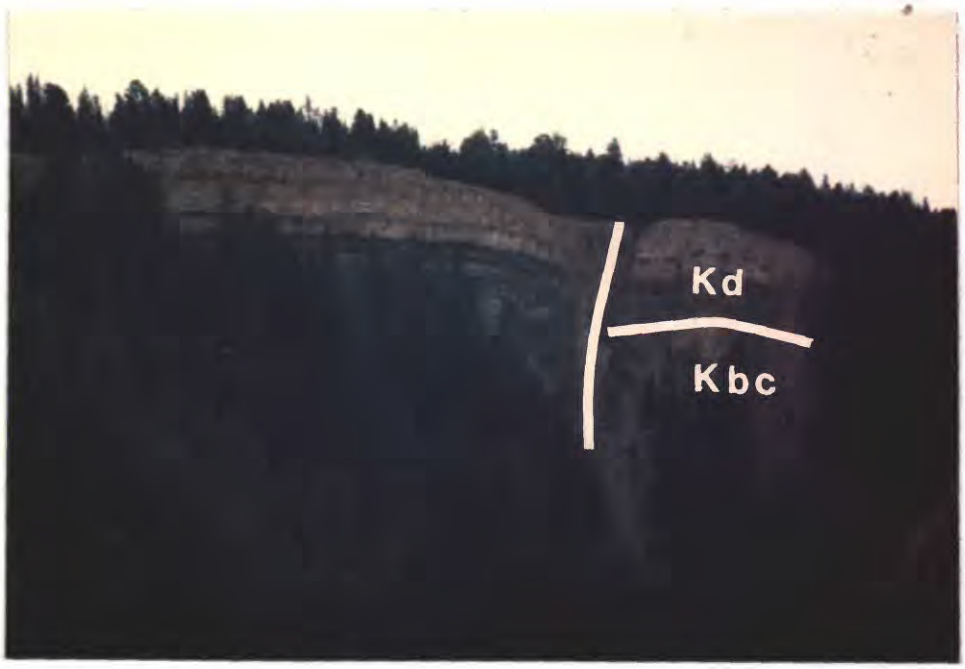


Figure 5. Photograph showing trace (vertical line) of Coldwater Creek I section (fig. 1, 7) on cliff composed of Burro Canyon Formation (Kbc) and Dakota Sandstone (Kd). Cliff is on eastern side of Coldwater Creek Canyon.

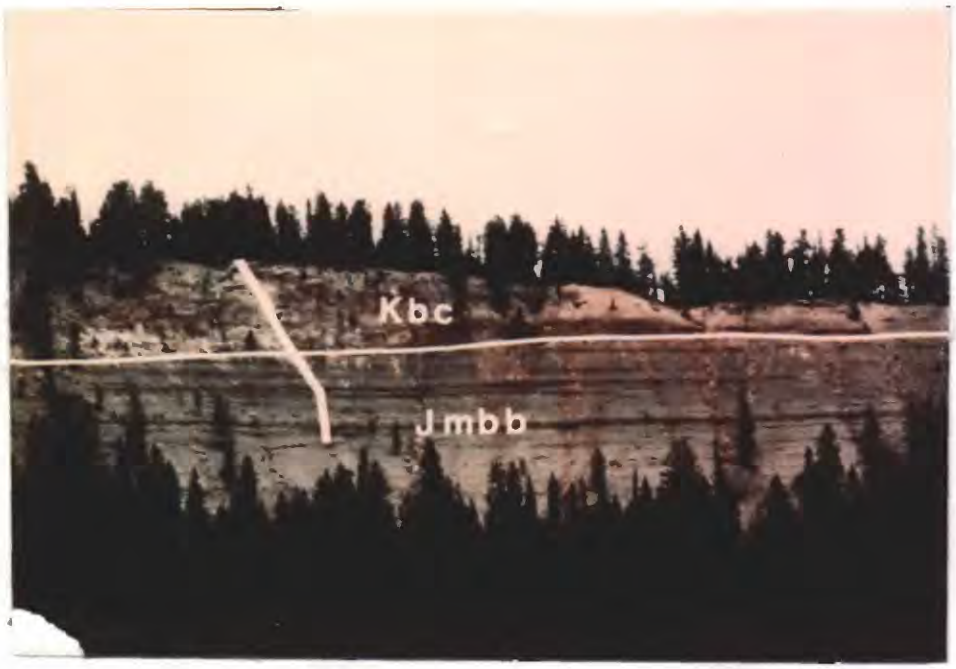


Figure 6. Photograph showing trace (vertical/diagonal line) of Coldwater Creek V section (fig. 1, 11) on cliff composed of Brushy Basin Member of the Morrison Formation (Jmbb) and Burro Canyon Formation (Kbc). Cliff is on eastern side of Coldwater Creek Canyon.

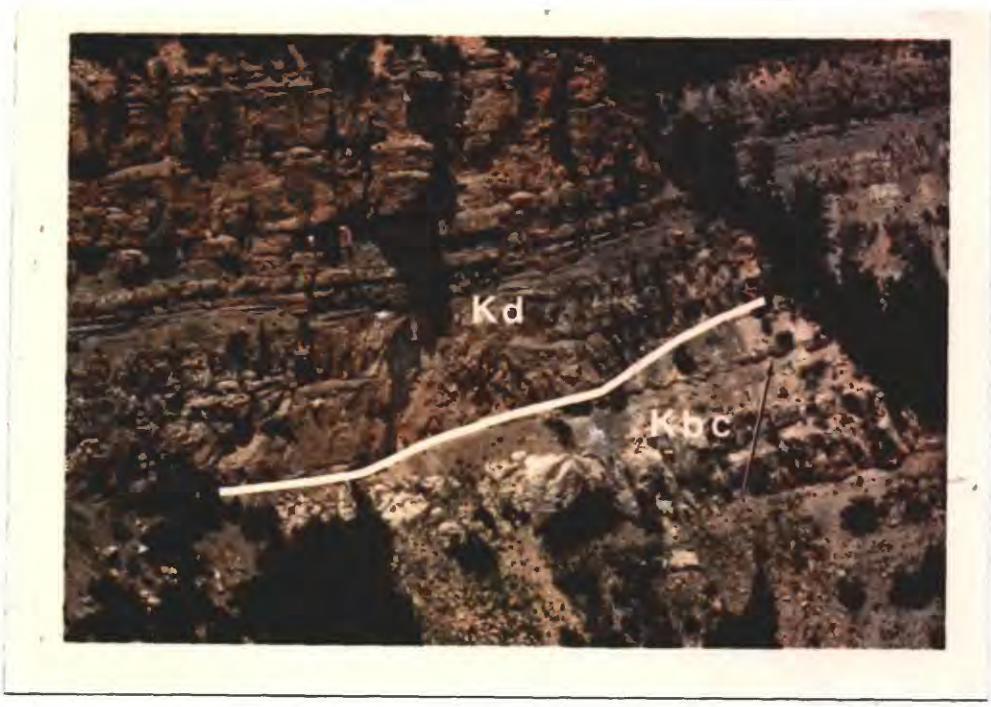


Figure 7. Photograph showing that scour at base of Dakota Sandstone (Kd) cuts out approximately 40 ft (12 m) of mudstone and siltstone (arrow) at top of Burro Canyon Formation (Kbc). Location is on western side of Piedra River about 2 mi north of U.S. Highway 160 near Piedra, Colo.

SUMMARY AND CONCLUSIONS

Lenticular, crossbedded, fluvial sandstones and conglomerates beneath the Dakota Sandstone in the northern San Juan basin have been included in the upper Lower Cretaceous Burro Canyon Formation by Ekren and Houser (1959, 1965). Examination of sections in McElmo Canyon, however, indicates that the lower lenticular sandstone and conglomerate bodies interfinger with mudstone containing bentonite beds, hard layers, and possibly clinoptilolite typical of the Upper Jurassic Brushy Basin Member of the Morrison Formation, and that these lenticular bodies should probably be included in the Morrison Formation. Sandstone and conglomeratic sandstone in the upper part of the pre-Dakota section in McElmo Canyon, on the other hand, interfinger with generally nonbentonitic mudstone and are probably part of the Burro Canyon Formation. Paleocurrent directions (fig. 2) and metamorphic rock fragments from the Karla Kay Conglomerate Member, the lowest of the lenticular sandstone and conglomerate bodies, indicate a western source area. Correlation of the Karla Kay with the Brushy Basin Member of the Morrison Formation rather than with the Burro Canyon Formation suggests that there was a brief period of uplift in the area of the Sevier orogenic belt in western Utah during the Late Jurassic.

East of McElmo Canyon in the Durango and Coldwater Creek area, stratigraphic relationships are less certain. The mudstone beds of the Brushy Basin Member are more illitic and lack bentonite beds (Christine Turner-Peterson, oral communication, 1986. Mudstones of the Brushy Basin are therefore difficult to distinguish from nonsmectitic mudstone beds of the Burro Canyon Formation. More work is needed to determine whether the lenticular sandstones and conglomerates in this area should be assigned to the Brushy Basin Member of the Morrison Formation or to the Burro Canyon Formation. More work is needed to determine whether the lenticular sandstones and conglomerates in this area should be assigned to the Brushy Basin Member of the Morrison Formation or to the Burro Canyon Formation.

The basal Dakota unit in the vicinity of the Southern Ute Indian Reservation and elsewhere in the northern part of the San Juan basin is a locally conglomeratic fluvial sandstone, the Encinal Canyon Member of the Dakota Sandstone. The Encinal Canyon Member fills valleys scoured into the underlying Burro Canyon Formation that are as deep as 45 ft (13.5 m). The lenticular coarse-grained channel sandstones and conglomerates of the Burro Canyon Formation and coarse-grained fluvial valley fill of the Encinal Canyon Member may be potential stratigraphic traps for oil and gas, particularly in areas where they are overlain by delta-plain mudstones rich in organic materials. Original porosity and permeability in these rocks have been diminished by silica cement and interstitial authigenic(?) clay, however, and more work is needed to evaluate their hydrocarbon potential.

The Encinal Canyon Member is overlain by delta-plain or coastal-plain deposits in the Ute Mountain and Durango areas to the west, and by shore-zone rocks in the Coldwater Creek area to the east. This distribution of depositional environments is consistent with the shoreline trends suggested by Cobban and Hook (1984) (fig. 3). The delta- and coastal-plain rocks and shore-zone rocks, which are probably laterally equivalent, were deposited during a stillstand of the shoreline.

North-south shoreline trends suggest that the depositional environments of upper Dakota rocks in the subsurface on the Southern Ute Indian Reservation are probably like those in the Durango and Coldwater Creek areas. Distributary channel deposits in the western part of the reservation area and sand bodies in the shore-zone system in the eastern part are possible reservoirs for oil and gas. Sand bodies in the shore-zone probably parallel north-south shoreline trends and pinch out in the landward and seaward directions; the sand bodies have potential for a least a few stratigraphic traps. The shore-zone and distributary channel sandstones are generally texturally mature. They are fine grained, however, and their porosity and permeability have been degraded by burrowing, by pervasive silica cement, and by interstitial authigenic(?) clay; more work is needed to determine their potential as exploration targets.

METHODS

Sections were measured with Jacob's staff and steel tape measure. Grain size was estimated in a field with a hand lens. Color descriptions are from the Geological Society of America Rock-Color Chart (Goddard and others, 1948).

ACKNOWLEDGMENTS

Capable assistance in the field was provided by Doug Yager, Jeff Martin, Eric Dott, and Carmen Guite. Helpful comments and constructive criticism of the manuscript were given by Jennie Ridgley and R.B. O'Sullivan.

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APPENDIX

Section 1 .--Cannon Ball Mesa I

(Located in E ½ SE ¼ sec. 28, T. 36 N., R. 19 W. in southern Colorado)

	Thickness	
	Meters	Feet
Top of Mesa		
Dakota Sandstone (Upper Cretaceous), incomplete:		
111. Sandstone, dark-yellowish-orange (10YR6/6) to dusky-yellowish-brown (10YR2/2), upper fine to lower coarse grained; poorly sorted and subrounded, quartzose; well cemented with quartz overgrowths and limonite cement; may be burrowed.....	0.46	1.5
110. Pebbly sandstone, white (N9); stained with pale-yellowish-orange (10YR8/6) limonite; lower fine to upper medium grained with scattered pebbles as long as 0.4 in. (1 cm); poorly sorted and subrounded; quartzose; pebbles are mostly tan, gray, and black chert; well indurated; noncalcareous with quartz overgrowths.....	0.46	1.5
109. Conglomerate, white (N9) to pale-yellowish-orange (10YR8/6); upper medium grained sand to cobbles as large as 8 in. (20 cm) in diameter; poorly sorted; subrounded to subangular; quartzose (with pebbles that are mostly tan, gray, orange, black, and white chert); well indurated, clay matrix; quartz overgrowths; crude horizontal bedding in lower two-thirds of unit; upper one-third is crudely crossbedded and grades upward into pebbly sandstone; unit fills a scour that cuts out a sandstone unit which is exposed laterally; large clasts of sandstone as large as 8 in. (20 cm) along the long axis occur along the scour surface; the largest chert clast, however, is only 3.75 in. (9.4 cm) along the long axis.....	1.5	5.0
Total Dakota Sandstone.....	2.46	8.0

Note that units 109-111 form a ledge.

Burro Canyon Formation (Lower Cretaceous) and upper part of Brushy Basin Member of the Morrison Formation (Upper Cretaceous), undivided:

108.	Mudstone, light-olive-gray (5Y6/1); swells slightly.....	0.6	2.0
107.	Sandstone and siltstone, yellowish-gray (5Y8/1) locally mottled dark reddish brown (10R3/4), very fine grained to upper-fine-grained; poorly sorted and subrounded; quartzose; contains less than 5% limonite flecks (biotite?) and colored chert grains; poorly indurated to moderately indurated; mostly covered.....	3.0	10.0
106.	Sandstone, very pale orange (10YR8/2), lower very fine to lower medium grained, poorly sorted and subrounded to subangular, quartzose, moderately to poorly indurated, calcareous; abundant clay matrix.....	0.1	5.0
105.	Siltstone, yellowish-gray (5Y7/2), sandy (lower very fine grained).....	0.46	1.5
104.	Siltstone, grayish-red-purple (5RP4/2), hackly weathering.....	0.3	1.0
103.	Sandstone, pinkish-gray (5YR8/1), upper-medium-grained, poorly sorted, subangular to subrounded, quartzose; less than 10% rusty flecks (biotite); contains grayish-yellow-green (5GY7/2) mudstone clasts and reddish-brown, black, tan, and white chert clasts that range in size from upper coarse sand to gravel about 1 in. (25 cm) in length; poorly cemented; locally calcareous; lower half is mostly covered.....	3.0	10.0
102.	Siltstone, light-olive-gray (5Y6/1); locally mottled dark reddish brown (10R3/4), hackly weathering.....	1.5	5.0
101.	Siltstone, dark-reddish-brown (10R3/4), hackly weathering.....	1.5	5.0
100.	Sandstone, yellowish gray (5Y8/1) to white (N9) with some local pale-yellowish-orange (10YR8/6) limonitic staining; lower very fine grained; quartzose with less than 10% rusty biotite flecks; moderate to well indurated; quartz overgrowths; clay matrix; noncalcareous; rippled; weathers flaggy.....	0.9	3.0
99.	Siltstone, light-olive-gray (5Y5/2).....	0.61	2.0

98.	Sandstone, yellowish-gray (5Y8/1) to white (N9) with some local pale-yellowish-orange (10YR8/6) limonitic staining; lower very fine grained; quartzose with less than 10% rusty biotite flecks; moderate to well indurated; quartz overgrowths; clay matrix; noncalcareous.....	0.3	1.0
97.	Siltstone, light-olive-gray (5Y6/1).....	0.3	1.0
96.	Sandstone, white (N9) locally mottled pinkish-gray (5YR8/1) and very pale orange (5YR8/2); lower very fine grained; quartzose with less than twenty 5% orange flecks (biotite); poorly to moderately indurated; slightly calcareous and abundant clay matrix.....	1.1	3.5
95.	Siltstone, with interbedded silty sandstone, yellowish-gray (5Y7/2); sandstone is lower very fine grained with abundant silty matrix; sandstone beds are usually 2 to 3 in. (5 to 7.5 cm) thick; siltstone beds are 6 to 8 in. (15 to 20 cm) thick.....	0.9	3.0
94.	Sandstone, very pale orange (10YR8/2); lower very fine grained; moderately well sorted; subrounded; quartzose with less than 10% orange limonite biotite flecks; moderate to well indurated; slightly calcareous.....	0.3	1.0
93.	Siltstone, light-olive-gray (5Y6/1); contains thin very fine grained sandstone lenses.....	0.3	1.0
	Note that units 93-108 form a slope punctuated with minor ledges.		
92.	Sandstone, white (N9); upper-fine to upper-medium-grained; poorly sorted; subrounded to subangular; quartzose with less than 2% reddish-orange accessory grains; well cemented with quartz overgrowths and abundant clay matrix.....	0.45	1.5
91.	Sandstone, locally pebbly, moderate-orange-pink (5YR8/4); upper fine grained sand to pebbles as much as 0.3 in. (7.5 mm) across; poorly sorted; subrounded to angular; quartzose; chert clasts are brown, orange, green, gray, white, tan and black; lower half of unit is crudely crossbedded with possible troughs; upper half is trough crossbedded with beds as much as 6 in. (15 cm) deep.....	0.6	2.0

90.	Sandstone, pebbly, moderate-orange-pink (5YR8/4); upper-fine sand; pebbles as much as .2 in. (5 mm) along long axis; poorly sorted; subrounded to angular; quartzose; well cemented with quartz overgrowths; chert clasts are moderate-reddish-brown, moderate-reddish-orange, green, gray, white, tan and black; crude discontinuous wavy bedding.....	0.3	1.0
89.	Sandstone and pebbly sandstone, moderate-orange-pink (5YR8/4); upper-fine sand; pebbles as much as 0.2 in. (5 mm) along long axis; poorly sorted, subrounded to angular; quartzose, chert clasts are moderate-reddish-brown, moderate-reddish-orange, green, gray, white, tan and black; well cemented with quartz overgrowths; noncalcareous; discontinuous wavy laminations.....	0.15	0.5
88.	Sandstone, pebbly, moderate-orange-pink (5YR8/4); upper-fine sand; pebbles as much as 0.2 in. (5 mm) along long axis; poorly sorted; subrounded to angular; quartzose; chert clasts are moderate-reddish-brown, moderate-reddish-orange, green, gray white, tan and black; well cemented with quartz overgrowths noncalcareous; crude horizontal bedding.....	0.3	1.0
87.	Sandstone and pebbly sandstone, moderate-orange-pink (5YR8/4); upper-fine sand to pebbles as much as 0.2 in. (5 mm) along long axis; poorly sorted; subrounded to angular; quartzose; chert clasts are moderate-reddish-brown, moderate-reddish-orange, green, gray white, tan and black; well cemented with quartz overgrowths; discontinuous wavy laminations.....	0.15	0.5
86.	Sandstone and conglomerate, moderate-orange-pink (5YR8/4); lower-medium-grained sand to pebbles as much as 2 in. (5 cm) along the long axis; poorly sorted; subrounded to angular; quartzose; characterized by abundant brown to orange chert clasts which are angular to subrounded and range in size from medium-grained sand to 0.3 in. (7.5 mm); also there are small angular clasts of green chert which are generally no larger than upper very coarse grained sand; other pebbles are gray, white, tan and black; some of the latter chert pebbles are fossiliferous and contain bits of bryozoan, possible crinoid stems and shell fragments; the average pebble size is less than 0.3 in. (7.5 mm); long axes for the five largest clasts examined are 1.9 in. (4.75 cm), 1.4 in. (3.5 cm), 1.4 in. (3.5 cm), 1.2 in. (3 cm), and 1.1 in. (2.75 cm); well indurated with quartz overgrowths; noncalcareous; crossbedding is poorly defined; upper part appears		

	to be horizontally bedded; lower part appears to be trough crossbedded; laterally from the section the upper part is scoured out and filled with crude trough crossbeds.....	1.2	4.0

Note that units 86-92 form a ledge.

85.	Siltstone, greenish-gray (5GY6/1); does not swell when wet; hackly weathering.....	0.3	1.0
84.	Siltstone, dark-reddish-brown (10R3/4); hackly weathering.....	0.15	0.5
83.	Mudstone, greenish-gray, (5GY6/1); swells when wet.....	0.15	0.5
82.	Sandstone, very light gray (N8); lower very fine grained; moderately sorted and subrounded; quartzose; well cemented; siliceous; clay matrix.....	0.15	0.5
81.	Mudstone, olive-gray (5Y4/1); swells when wet.....	0.15	0.5
80.	Sandstone, very light gray (N8); lower very fine grained; moderately sorted and subrounded; quartzose; well cemented; siliceous; clay matrix.....	0.15	0.5
79.	Mudstone, light-olive-brown (5Y5/6) to light-olive-gray (5Y5/2); hackly weathering.....	0.6	2.0
78.	Hard layer, light-greenish-gray (5GY8/1).....	0.08	0.25
77.	Mudstone, greenish-gray (5GY6/1); locally stained dark-yellowish-orange (10YR6/6); hackly weathering; locally siliceous.....	1.5	5.0
76.	Mudstone, greenish-gray (5GY6/1); swells when wet.....	0.15	0.5
75.	Mudstone, siliceous, grayish-olive (10Y4/2) to pale-olive (10Y6/2), grayish-orange (10YR7/4); limonite staining locally near top; weathers hackly.....	0.76	2.5
74.	Mudstone, yellowish-gray (5Y8/1); swells when wet; less than 1% biotite flecks; probably bentonitic.....	0.46	1.5
73.	Sandstone, very pale orange (10YR8/2); stained dark-yellowish-orange (10YR6/6) limonite; lower very fine grained; well indurated;siliceous cement; non-calcareous.....	0.15	0.5
72.	Mudstone, light-olive-gray (5Y5/2); contains a few thin silty layers that are dark-yellowish-orange (10Y6/6) limonite stained; swells when wet.....	1.5	5.0

71.	Sandstone, yellowish-gray (5Y7/2); lower very fine grained; well sorted; well indurated; siliceous; noncalcareous; locally stained a dark-yellowish-orange (10YR6/6).....	0.3	1.0
70.	Mudstone, yellowish-gray (5Y7/2); swells slightly.....	0.15	0.5
69.	Mudstones (siliceous) and interbedded hard layers; mudstone is yellowish-gray (5GY8/1); hard layers are yellowish-gray (5Y7/2) with abundant limonite stains which are dark-yellowish-orange (10Y6/6).....	0.15	0.5
68.	Mudstone, dark-greenish-gray (5GY4/2); swells when wet...	0.3	1.0
67.	Hard layer, yellowish-gray (5Y7/2) and light-gray (N7)...	0.08	0.25
66.	Mudstone, siliceous, dusky-yellow-green (5GY5/2); local light-olive-brown ((5Y5/6) limonite staining; hackly weathering.....	0.2	0.75
65.	Mudstone, light-gray (N7); retains moisture and swells when wet.....	0.6	2.0
64.	Mudstone, siliceous, light-olive-gray (5Y5/2); local dusky-yellow (5Y6/4) limonite stains; weathers hackly; contains thin hard layers which are moderate-olive-brown (5Y4/4).....	0.46	1.5
63.	Mudstone, light-gray (N7) to very light gray (N8); swells when wet.....	0.09	0.3
62.	Mudstone, yellowish-gray (5Y8/1); swells when wet, less than 1% biotite grains, probably bentonitic.....	0.15	0.5
61.	Hard layer, siliceous, grayish-yellow-green (5GY7/2); weathers hackly.....	1.3	4.25
60.	Bentonite.....	0.06	0.2
59.	Hard layer (siliceous), grayish-yellow-green (5GY7/2); weathers hackly.....	0.08	0.25
58.	Bentonite, yellowish-gray (5Y8/1) to light-greenish-gray (5GY8/1).....	0.03	0.1
57.	Hard Layer (siliceous), grayish-yellow-green (5GY7/2); weathers hackly.....	0.08	0.25
56.	Mudstone, greenish-gray (5GY6/1); appears bentonitic.....	0.06	0.2
55.	Hard layer, greenish-gray (5GY6/1).....	0.08	0.25
54.	Mudstone, greenish-gray (5GY6/1) to dark-greenish-gray (5GY4/1).....	0.53	1.75

53.	Mudstone, greenish-gray (5GY6/1); appears bentonitic.....	0.8	2.5
52.	Mudstone, greenish-gray (5GY6/1); locally limonite stained.....	1.4	4.5
51.	Hard layer, greenish-gray (5GY6/1).....	0.08	0.25
50.	Mudstone, pale-olive (10Y6/2) to grayish-olive (10Y4/2); weathers hackly.....	1.1	3.6
49.	Hard layer, greenish-gray (5G5/2).....	0.03	0.1
48.	Mudstone, grayish-yellow-green, (5GY7/2).....	0.03	0.1
47.	Hard layer, siliceous, grayish-olive-green (5BY3/2).....	0.08	0.25
46.	Mudstone, light-olive-gray (5Y6/1), limonite stains.....	1.08	3.5
45.	Sandstone, light-greenish-gray (5GY8/1), lower very fine grained to upper very fine grained; moderately sorted, subrounded to angular; quartzose; less than 5% biotite grains; poorly cemented with abundant clay matrix; non calcareous.....	0.08	0.25
44.	Mudstone, yellowish-gray (5Y8/1); swells when wet; biotite flecks.....	0.3	1.0
43.	Mudstone, light-greenish-gray (5GY8/1); scattered reddish-brown (10R4/6) flecks; biotite present locally; broken surface has rounded conchoidal fractures; swells when wet.....	1.4	4.5
42.	Mudstone, pale-olive (10YG/2).....	0.15	0.5
41.	Siliceous mudstone (hard layer) pale-olive (10Y6/2); hackly weathering.....	0.3	1.0
40.	Mudstone, light-greenish-gray, (5GY8/1).....	1.2	4.0
39.	Siltstone, sandy (lower very fine grained), light-greenish-gray (5GY8/1); biotite flecks.....	0.45	1.5
38.	Mudstone, pale-olive (10Y6/4), moderate-reddish-brown (10R4/6); probably bentonitic.....	0.3	1.0
37.	Hard layer, pale-olive (10Y6/2) to light-olive 10Y5/4....	0.08	0.25
36.	Siltstone, sandy (lower very fine grained), grayish-yellow-green (5GY7/2) to light-greenish-gray (5GY8/1).....	0.7	2.25
35.	Sandstone, greenish-gray (5G6/1), lower very fine grained; well cemented; probably siliceous.....	0.6	2.0

34.	Siltstone, sandy (very fine grained), light-olive-gray (5Y6/1).....	0.7	2.25
33.	Hard layer, yellowish gray (5Y8/1).....	0.03	0.1
32.	Mudstone, light-olive-gray (5Y6/1).....	0.08	0.25
31.	Hard layer, grayish-yellow-green (5GY7/2).....	0.15	0.5
30.	Mudstone, greenish-gray (5GY6/1), also pale-red stained (10R6/2).....	0.06	0.2
29.	Hard layer, yellowish-gray (5Y7/2); contains flecks of moderate-reddish-brown (10R4/6); some limonite staining; contains biotite flakes.....	0.15	0.5
28.	Mudstone, yellowish-gray (5Y8/1); limonite stains.....	0.8	2.6
27.	Hard layer, light gray (N7); flecks of moderate-reddish-brown (10R4/6).....	0.06	0.2
26.	Mudstone, light-olive-gray (5Y6/1).....	0.4	1.3
25.	Mudstone (swells when wet, probably bentonite) yellowish-gray (5Y8/1); biotite flecks.....	0.24	0.8
24.	Hard layer, greenish-gray (5G6/1) with flecks and streaks of moderate-reddish-brown (5R4/).....	60.06	0.2
23.	Mudstone, dusky-yellow (5Y6/4); swells when wet probably bentonite.....	0.3	1.0
22.	Siltstone, yellowish-gray (5Y8/1) to light-greenish-gray (5GY8/1); flecks of moderate-reddish-brown (10R4/6); moderately indurated; possibly siliceous.....	0.09	0.3
21.	Mudstone, light-olive-gray (5Y5/2); local specks of moderate-reddish-brown (10R4/6); limonite stains.....	0.46	1.5
20.	Mudstone, greenish-gray (5GY6/1); limonite stains; weathers hackly.....	0.6	2.0
19.	Siltstone, dusky-yellow (5Y6/4) to light-gray (N7); noncalcareous.....	0.46	1.5

Note all mudstone units in section weather frothy except where otherwise noted.

18.	Mudstone, yellowish-gray (5Y8/1); weathers frothy.....	0.76	2.5
17.	Mudstone, sandy (very fine grained), pale-olive (10Y6/2) to grayish-olive (10Y4/2).....	0.15	0.5

16.	Siltstone, grayish-yellow-green (5GY7/2), local moderate-reddish-orange (10R6/6) to moderate-reddish-brown (10R4/6).....	1.2	4.0
15.	Siltstone, pale-red (10R6/2) to grayish-red (10R4/2); local light-greenish-gray (5GY8/1) mottling; local moderate-reddish-orange (10R6/6) flecks; limonite stains; noncalcareous.....	0.9	3.0
14.	Sandstone, greenish-gray (5G6/1); lower very fine to lower-fine grained; moderately well sorted; subrounded; quartzose with less than 1% red and black (biotite?) accessory grains; poor to moderately cemented with abundant clay matrix; noncalcareous; spheroidal weathering.....	0.3	1.0
13.	Siltstone, very clayey, pale-yellowish-brown (10R6/2) with local moderate-reddish-orange (10R6/6) mottling.....	1.2	4.0
12.	Hard layer, greenish-gray (5G6/1); pyrite grains.....	0.12	0.4
11.	Siltstone, pinkish-gray (5YR8/1); mottled moderate-reddish-brown (10R4/6) (possible clinoptilolite); noncalcareous.....	0.5	1.6
10.	Sandstone, light-greenish-gray (5GY8/1); lower very fine grained; poorly to moderately cemented; abundant clay matrix.....	0.15	0.5
9.	Siltstone, pinkish-gray (5YR8/1); basal 6 in. (15 cm) mottled moderate- reddish-brown (10R4/6) (possible clinoptilolite) noncalcareous.....	0.76	2.5
8.	Siltstone, pale-red (10R6/2); lower part is cross hatched with thin (less than .05 in. (1.25 mm) burrow like structures which are colored moderate-reddish-brown (10R4/6) (possible clinoptilolite ?).....	0.6	2.0
7.	Siltstone, sandy (very fine grained) very light gray (N8); noncalcareous.....	0.9	3.0

6.	Sandstone and siltstone, interbedded. Siltstone: pale-red (10R6/2) to grayish-red (10R4/2); locally mottled grayish-yellow-green (5GY7/2) and moderate-reddish-brown (10R4/6). Sandstone: pale-red (10R6/2) to grayish-red (10R4/2), also locally mottled with grayish-yellow-green (5GY7/2); lower very fine grained; moderately well sorted; moderately well cemented; slightly calcareous; weathers to lumps 3 in. (7.5 cm) wide and several inches long possibly caused by burrowing; grayish-yellow-green mottling may also be caused by burrowing; these green burrow tubes are about .1 in. (2.5 mm) wide.....	0.76	2.5
5.	Siltstone, bluish white (5B9/1).....	0.6	2.0
4.	Sandstone and Siltstone, interbedded. Siltstone: pale-red (10R6/2) to grayish-red (10R4/2); locally mottled grayish-yellow-green (5GY7/2) and moderate-reddish-brown (10R4/6). Sandstone: pale-red (10R6/2) to grayish-red (10R4/2), also locally mottled grayish-yellow-green (5GY7/2); lower very fine grained; moderately well sorted; moderately well cemented; slightly calcareous; weathers lumpy; lumps can be 3 in. (7.5 cm) wide and several inches long and may be caused by burrowing; mottling with grayish-yellow-green may also be caused by burrowing; these green burrow tubes are on the order of .1 in. (2.5 mm); thin selenite veins are less than .15 in. (3.75 mm) in thickness (some veins are curved and mimic the shape of shell fragments).....	0.6	2.0
3.	Siltstone, pale-red (10R6/2) to grayish-red (10R4/2); top few inches mottled pale-red (10R6/2) and grayish-yellow-green (5GY7/2).....	0.36	1.2
2.	Sandstone, grayish-orange-pink (5YR7/2); lower very fine to upper very fine grained; moderately well sorted; subrounded to rounded; quartzose with less than 5% black and red accessory minerals; poorly cemented;very clayey.....	0.1	0.3

1. Sandstone, light-brownish-gray (5YR6/1) to bluish-white (B9/1); upper very fine grained to upper-fine-grained; moderately well sorted and subrounded; quartzose with less than 5% biotite grains and less than 5% green and pink accessory minerals; well cemented, abundant clay matrix and calcite cement; locally intensely burrowed with burrows approximately .1 in. (2.5 mm) in width; unit has a relatively flat bottom and ranges in thickness from 6 in. to 2 ft (15 to 60 cm) forming convex upward features approximately 10 to 15 ft (3 to 4.5 m) wide (possibly small crevasse splays).....	0.6	2.0

Note that units 1-85 form a slope punctuated with minor ledges.

Total Burro Canyon Formation and upper part of Brushy Basin Member of the Morrison Formation, undivided.....	56.8	187.7
Total thickness of section 1.....	59.25	195.7

Section 2.--West Toe

(Located in S ½ NE ¼ and N ½ SE ¼ of sec. 7, T. 33 ½ N., R. 18 W. in southwestern Colorado)

		Thickness Meters	Thickness Feet
Lower shale member of the Mancos Shale and lower part of the Greenhorn Limestone Member of the Mancos Shale (Upper Cretaceous), undivided:			
94.	Covered, to top of mesa.....	6.1	20.0
93.	Mudstone, light-olive-gray (5Y6/1), calcareous, poorly indurated.....	1.8	6.0
92.	Mudstone, very-pale-orange (YR8/2) to pale-yellowish-orange (10YR6/2), bentonitic, poorly indurated, calcareous.....	0.6	2.0
91.	Mudstone, dark-gray (N3) to medium-dark-gray (N4), calcareous.....	1.5	5.0
90.	Siltstone, light-olive-gray (5Y6/1), poorly indurated, calcareous; with thin laminations of olive-gray (5Y4/1) limestone in the bottom half of unit; unit grades into overlying mudstone.....	0.3	1.0
89.	Limestone, dark-greenish-gray (5GY4/1), micritic, well indurated.....	0.1	0.3
88.	Mudstone, light-olive-gray (5Y6/1), calcareous, poorly indurated.....	0.3	1.0
87.	Limestone, olive-gray (5GY4/1), micritic, well indurated; Inoceramus fossils.....	0.1	0.4
86.	Mudstone olive-gray (5Y4/1), calcareous, poorly indurated.....	1.2	4.0
85.	Limestone, medium-gray (N5), micritic; contains Inoceramus fossils.....	0.15	0.5
84.	Mudstone, dark-gray (N3), calcareous, poorly indurated...	0.6	2.0
83.	Limestone, medium-light-gray (N6), micritic, well indurated.....	0.06	0.2
82.	Mudstone, dusty-yellowish-brown (10YR2/2), calcareous, poorly indurated.....	0.6	2.0
81.	Limestone, light-gray (N7) to yellowish-gray (5Y8/1), well indurated, burrowed; burrows are 4 cm wide.....	0.3	1.0

80.	Mudstone, dark-yellowish-brown (10YR4/2), pale-yellowish-brown (10YR6/2), calcareous, poorly indurated.....	0.6	2.0
79.	Limestone, olive-gray (5Y4/1), micritic; shell fragments and impressions; possible burrows 0.25 cm wide.....	0.15	0.5
78.	Mudstone, dark-yellowish-brown (10YR4/2), carbonaceous, calcareous, silty.....	0.46	1.5
77.	Limestone, medium-dark-gray (N4), micritic, well indurated; fossil shell fragments and impressions.....	0.1	0.4
76.	Mudstone, olive-gray (5Y4/1), calcareous.....	0.45	1.5
75.	Bentonite, dark-yellowish-orange (10YR7/4); grades into overlying mudstone.....	0.3	1.0
74.	Mudstone, medium-dark-gray (N4), calcareous, fissile, poorly indurated; top 1 ft (30 cm) contains abundant Gryphea fossils--many are limestone casts, others replaced shells.....	2.1	7.0
73.	Bentonite, dark-yellowish-orange (10YR6/6), dark-pale-orange (10YR8/2); noncalcareous; selenite, grades into overlying mudstone.....	0.15	0.5
72.	Mudstone, olive-black (5Y2/1), calcareous.....	3.0	10.0
71.	Bentonite, yellowish-gray (5Y8/1), calcareous, Gryphea in float.....	0.06	0.2
70.	Limestone, light-olive-gray (5Y6/1), medium-dark-gray (N40 to olive-gray (5Y4/1), very indurated; borrowed with subhorizontal to horizontal tubes filled with same material as surrounding rock; burrows are .02 in. (0.5 mm) to .012 in. (0.3 mm) wide.....	0.15	0.5
69.	Mudstone, medium-gray (N5), calcareous, poorly indurated	5.0	1.5
68.	Bentonite and bentonitic mudstone. Bentonite at top and bottom of unit is yellowish-gray (5Y8/1). Bentonitic mudstone in middle of unit is olive-gray (5Y8/1).....	0.76	2.5
67.	Mudstone, olive-black (5Y2/1) at bottom to light-olive-gray at top, calcareous.....	0.76	2.5
66.	Bentonitic mudstone, olive-gray (5Y4/1), calcareous.....	0.15	0.5

65.	Mudstone, medium-dark-gray (n4), calcareous, grades into overlying bentonitic mudstone.....	0.15	0.5
64.	Sandstone, light-olive-gray (5Y6/1), medium- to upper-fine-grained, poorly sorted and rounded, quartzose.....	0.15	0.5
63.	Bentonitic mudstone, light-olive-gray (5Y6/1), calcareous.....	0.3	1.0
62.	Shale, olive-gray (5Y4/1), calcareous, carbonaceous.....	0.76	2.5
61.	Sandstone, grayish-orange (10YR7/4), upper-fine-grained to lower very fine grained, moderately sorted, rounded, poorly indurated, quartzose; clay and silt in matrix; calcareous. Coarsens upwards: upper part of unit is lower- coarse to upper-fine-grained and is poorly sorted and subrounded to rounded.....	5.3	17.5
60.	Bentonite, light-olive-gray (5Y8/1) to very light gray (N8), noncalcareous.....	0.3	1.0
59.	Sandstone, grayish-orange (10YR7/4), lower-medium to lower-fine-grained, subrounded to moderately well sorted, quartzose, poorly indurated; abundant silt and clay matrix; moderately calcareous; locally carbonaceous.....	0.76	2.5
58.	Sandstone, medium-dark-gray (N4) to light-olive-gray (5Y5/2), lower-medium to fine-grained, rounded to subrounded, quartzose, silt and clay matrix; poorly indurated; noncalcareous; carbonaceous.....	0.3	1.0
57.	Bentonite, light-olive-gray (5YR6/1).....	0.45	1.5
56.	Mudstone and sandstone, medium-gray (N5), mudstone at bottom grading into sandstone at top, lower-medium to upper-fine-grained sand. Mudstone, is micaceous, carbonaceous throughout, noncalcareous, poorly indurated. Sand is rounded to subrounded, quartzose and has abundant silt and clay in matrix.....	0.3	1.0
55.	Bentonite, pale-yellowish-brown (10YR6/2) to light-brownish-gray (5YR6/1), noncalcareous, poorly indurated.....	0.45	1.5
54.	Siltstone, medium-dark-gray (N4), carbonaceous and poorly indurated; contains some medium-grained sand grains.....	0.45	1.5

Note units 54-94 for a slope punctuated with minor limestone ledges.

53. Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/4), upper- fine-grained, well sorted, subrounded; numerous burrows (most burrows are about one centimeter in diameter); well indurated; noncalcareous; quartzose with less than 1% black accessory grains; possible horizontal bedding; faint current ripple laminations.....	2.4	8.0

Note unit 53 forms a ledge.

52. Shale, dark-yellowish-brown (10YR4/2) and brownish-gray (5YR4/1); silty; very fine grained sandstone lenses occur locally; small 2 in. (5 cm) long silt(?) nodules; qypsum; trace of sulfur; weathers frothy.....	7.6	25.0
Total lower shale member and lower part of Greenhorn Limestone Member of Mancos Shale.....	44.2	146.0

Dakota Sandstone (Upper Cretaceous):

51. Sandstone, dark-yellowish-brown (10YR4/2) and brownish-gray (5YR4/1), poorly exposed, fine- to medium-grained, moderately well sorted, subrounded; quartzose with less than 1% black flecks; moderately indurated; clay matrix; noncalcareous; crossbedded with large troughs as much as 1.5 ft (45 cm) thick; top of the unit is vertically and subhorizontally burrowed.....	0.9	3.0
50. Shale, brownish-black (5YR2/2) to brownish-gray (5YR 4/1) and medium- light-gray (N6); locally contains carbonaceous material and very fine grained sandstone lenses.....	0.9	3.0
49. Interbedded shale and sandstone; mostly covered; shale is brownish-gray (5YR4/1); sandstone is very pale orange (10YR8/2) to grayish-orange (10YR7/4), very fine to fine- grained, moderately well sorted, subrounded; some possible horizontal laminations; quartzose; weathers blocky; noncalcareous.....	1.5	5.0
48. Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/4), very fine to fine- grained, moderately will sorted, subrounded; quartzose with less than 5% black accessory grains; noncalcareous; top 0.25 in. (6 mm) thick; cemented by limonite small scale planar tabular bedding at bottom; ripples (some slightly climbing) at top; some of the beds near base are contorted.....	1.1	3.5

47.	Shale, grayish-black (N/2) to black (N/1) and medium-dark-gray (N/4).....	1.5	5.0

Note units 47- 52 form a slope with several minor ledges.

46.	Interbedded shale and sandstone; shale is brownish-gray (5YR4/1); locally sandy (very fine grained); sandstone is grayish-orange (10YR7/4); very fine to fine- grained; locally rippled; moderately well sorted; well indurated; clayey matrix; noncalcareous; quartzose.....	0.9	3.0
45.	Sandstone, very pale orange (10YR8/2), mostly covered, lower-fine-grained, moderately well sorted, subrounded, well indurated; clayey matrix; noncalcareous; quartzose with less than 5% black accessory grains (which have an aura of limonite staining around them); local woody plant impressions; flaggy; thinly bedded; possible horizontal bedding; laterally unit is generally trough cross- bedded sandstone with thin dark-gray (N/3) shale interbeds; also lateral to the section a 3 ft (90 cm) thick tabular planar and tangential crossbedded unit overlies a thin dark gray shale bed; planar beds strike N75E and dip 20NW.....	4.5	15.0
44.	Sandstone, grayish-orange-pink (5YR7/2) with grayish-orange staining (10YR7/4), partly covered, lower-medium-grained, moderately to well sorted, subrounded, well to moderately well indurated, noncalcareous; quartzose with ten to 15% black accessory minerals; crossbeds about 1 ft (30 cm) thick in lower half and about 2 ft (60 cm) thick in the upper half.....	4.9	16.0
43.	Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/4), lower-medium-grained, moderately to well sorted, subrounded, well to moderately well indurated; clayey matrix; noncalcareous; quartzose with less than 1% green and five present black accessory grains; lower half of unit is massive looking but locally shows faint crossbedding which may represent large scale troughs; the upper half appears massive but may contain small scale trough crossbeds.....	2.1	7.0
42.	Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/4), upper-fine-grained, moderately well sorted, subrounded, moderately indurated; clayey matrix; noncalcareous; quartzose with less than 5% black accessory grains; ripup clasts of shale up to 2 in. (5 cm) along the A axis occur at scour surface at base of some troughs; thin light-brownish-gray (5YR6/1) shale unit less than 1 ft (30 cm) thick occurs locally at base of unit; lower		

	four feet of unit contains large scale trough crossbeds up to 1.5 ft (45 cm) thick; upper foot (30 cm) contains smaller scale crossbedding consisting of possible troughs about 8 in. (20 cm) thick; interval lateral to section contains undulatory crossbedding (with a wavelength of 4.6 ft (1.4 mm) and an amplitude of 5 in. (12.5 cm).....	1.5	5.0
41.	Sandstone, grayish-orange (10YR7/4), partly covered, lower-medium-grained, moderately well sorted, subrounded, moderately well indurated; minor clay matrix; noncalcareous; quartzose with less than 5% black accessory grains; broad shallow trough-like features filled with small scale crossbeds; laterally some larger scale troughs are present up to 1.5 ft (45 cm) thick.....	1.5	5.0
40.	Sandstone, grayish-orange (10YR7/4) to very pale orange (10YR8/2), lower-fine to upper- fine-grained, moderately to well sorted, subrounded, clayey matrix, noncalcareous, well indurated; quartzose; lower 10 in. (25 cm) consists of horizontal and ripple laminations; middle 2.5 ft (75 cm) consists of large scale troughs up to 1.5 ft (45 cm) thick; upper 1.66 ft (50 cm) consist of smaller scale crossbeds which includes troughs and some possible tabular planar beds 6 in. (15 cm) to a foot (30 cm) in thickness.....	1.5	5.0
39.	Sandstone, very pale orange (10YR8/2) to grayish-orange (10 YR7/4), upper-fine-grained, moderately well sorted, subrounded, moderately indurated, clayey matrix; noncalcareous; quartzose with less than 2% black and less than 1% green accessory grains; lower 2 ft (60 cm) consists of crossbedded unit that appears to be tabular with planar (to tangential) cross-sets that strike N55E and dip 13N; upper foot (30 cm) consist of small scale trough crossbeds on the order of 2 or 3 in. (5 to 7.5 cm) thick.....	1.0	3.3
38.	Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/2), upper-fine-grained, moderately well sorted, subrounded, moderately indurated; clayey matrix; noncalcareous; quartzose with less than 2% black and less than 1% green accessory grains; lower 4 in. (10 cm) consists of horizontal parallel laminations which appear locally to be rippled; middle 14 in. (35 cm) consists of an apparent tabular unit with cross-sets that are planar to tangential and strike E-W and dip 14N; upper 2 in. (5 cm) consist of ripple laminations that trend N20W and have a wavelength of approximately 2.5 in. (6.25 cm)	0.5	1.7

37. Sandstone, grayish-orange (10YR7/4), lower-medium-grained, moderately to well sorted, subrounded, well indurated, clayey matrix; noncalcareous; quartzose with less than 2% black accessory grains large tabular tangential sets ranging from 1.5 to 4.5 ft (45 cm to 1.4 m) thick; the tabular sets are commonly overturned and contorted, they strike N67E and dip 15W and can be traced laterally for long distances although they can be seen to wedge out locally; lateral to section is a wedge shaped bed 3 ft (90 cm) thick and 8 or 9 ft (2.4 to 2.7 m) long with concave base (possible channel scour) with thin layer of carbonaceous debris at base 2.4 8.0

36. Sandstone, pinkish-gray (5YR8/1); partially covered near bottom; upper- fine-grained; well sorted; subrounded to rounded; moderately indurated; minor clay matrix; noncalcareous; quartzose with less than 1% orange and green accessory minerals; large scale trough crossbeds on the order of 1.5 ft (45 cm) thick; laterally slightly climbing ripple laminations on the order of one tenth of an inch thick; also laterally possible small scale tabular planar cross-sets on the order of 3 in. (7.5 cm) thick..... 1.5 5.0

35. Sandstone, light-brown (5YR6/4) to grayish-orange-pink (5YR7/2), upper-fine-grained to lower-medium-grained, moderately to well sorted, subrounded, moderately indurated, clayey matrix, noncalcareous; quartz overgrowths; quartzose with less than 5% black accessory minerals; lowest foot (30 cm) consists of a tabular wedge shaped crossbed set with tangential cross-sets (although the cross-sets are tangential parallel to flow, they are horizontal and parallel perpendicular to flow, similar to those in tabular planar sets); the next higher foot (30 cm) consists of possible small tabular sets; the next foot (30 cm) consist of two tabular sets 6 in. (15 cm) thick that strike N35W and dip 10NE and that can be traced laterally approximately 20 ft (6 m); the next foot (30 cm) consists of small scale tabular planar sets 3 to 4 in. (7.5 to 10 cm) thick with thin horizontal laminations in between them; the top 2.5 ft (75 cm) is small scale trough crossbeds (dunes appear to be preserved in their entirety on the top surface) 2.0 6.5

34. Sandstone, light-brown (5YR6/4) to grayish-orange-pink (5YR7/2), upper-fine to lower-medium-grained, moderately to well sorted, subrounded, moderately well indurated, clayey matrix, noncalcareous; quartzose with less than 5% black accessory grains; lower 2 ft (60 cm) consists of alternating small

scale tabular planar beds 3 to 4 in. (7.5 to 10 cm) thick and horizontal laminated layers (probably ripples) approximately 1.5 in. (3.75 cm) thick; ripple laminations are upper-fine-grained and planar sets are upper-fine-grained to lower-medium-grained; the next 6 in. (15 cm) consists of a tabular planar (slightly tangential) bed that thins upstream to 4.5 in. (11 cm) and thickens downstream to 18 in. (45 cm) (it appears to fill in a low area); representative strikes and dips of cross-sets are N70W 21NE and N86W 21NE; the upper 2.5 ft (75 cm) of the unit consists of large scale trough crossbeds [up to a 1.5 ft (45 cm) thick] overlain by smaller scale crossbeds [about 6 in. (.5 cm) thick]; this trough crossbedded interval thins in the downstream direction and thickens in the upstream direction at the expense of the underlying interval; axes of one large trough was oriented N10E..... 1.5 5.0

33. Sandstone, light-brown (5YR6/4), upper-fine to lower-medium-grained, moderately to well sorted, subrounded, clayey matrix, noncalcareous, quartzose with less than 5% black and less than one percent green accessory grains; tabular bed at base of unit is about 1 ft (30 cm) thick and strikes S67W and dips 18NW and can be traced 25 ft (7.5 m) perpendicular to strike; basal tabular bed is overlain by a large scale trough crossbed set approximately 1.5 ft (45 cm) thick that locally scours several inches into the underlying tabular bed; trough crossbed is in turn overlain by another tabular set; this tabular set is 4 in. (10 cm) thick in the upstream direction and thickens in the downstream direction to 1.5 ft (45 cm) (it appears to fill in a low area as it thickens); the unit appears to completely removed by a scour (laterally parallel to strike); cross-sets are planar and are lower-medium-grained; cross-sets strike N70W and dip 16NE and can can be traced 15 ft (4.5 m) perpendicular to strike..... 1.2 4.0

32. Sandstone, grayish-orange-pink (5YR7/2) to light-brown (5YR6/4), upper-fine to lower-medium-grained, moderately well sorted, subrounded, clayey matrix; noncalcareous; quartzose with less than 5% green accessory grains; at base is a large trough approximately 1.25 ft (40 cm) thick with curved tangential cross-sets (cross-sets strike N78W and dip 18NE); broad shallow scour surface at top of large trough approximately 8 in. (20 cm) deep is filled with small scale [about 3 in. (7.5 cm) thick] trough crossbeds; top 4.25 ft (1 1/3 m) of unit consists of small scale trough cross-beds

about 3 to 6 in. (7.5 to 15 cm) thick; laterally more troughs and tabular planar beds [up to a foot (30 cm)] thick, strike and dip S70W 14NW; the troughs [6 to 8 in. (15 to 20 cm) thick] scour the upper surfaces of the tabular beds.....	1.7	5.5
31. Sandstone, light-brown (5YR6/4), medium-grained, moderately well sorted, subrounded, clayey matrix; noncalcareous; quartz overgrowths; quartzose with less than 5% black and 2% green accessory grains; faint crossbedding; possible troughs.....	1.4	4.5
30. Sandstone, pale-yellowish-brown (10YR6/6); exposed in stream bed; mostly covered; fine- to medium-grained; moderately well sorted; subrounded; very calcareous; quartzose with less than 5% black accessory minerals, crossbedding unknown.....	3.0	10.0
Note units 30-46 form cliffs and ledges.		
29. Shale with interbedded siltstone and sandstone (very fine grained), generally dark-gray (N3); small fossil dinosaur(?) bones were found within light-gray (N7) very fine grained sandstone and siltstone bed which also contains abundant carbonaceous plant debris; large [1 to 2 ft (30 to 60 cm) across] calcite nodules occur near top.....	10.7	35.0
28. Sandstone, grayish-orange (10YR7/4), fine-grained, noncalcareous, moderately well sorted, subrounded, flaggy.....	0.3	1.0
27. Shale, dark-gray (N3), carbonaceous.....	1.2	4.0
Note units 27-29 form a slope.		
26. Sandstone, pale-yellowish-orange (10YR8/6) and very light gray (N8), fine- to medium- grained, fairly well sorted, subrounded to subangular; siliceous cement; abundant carbonaceous debris; faint crossbedding; possible horizontal laminations.....	0.6	2.0
25. Sandstone, very light gray (N8) and dark-yellowish-orange (10YR6/6), very fine to coarse- grained, moderately to poorly sorted, subrounded to angular; quartzose; contains local concentrations of coarse-grained sand to pebble size clasts composed of white, gray and black chert; contains locally abundant carbonaceous plant debris; plant debris is commonly concentrated along crossbed laminations, faint crossbedding; possible horizontal laminations and trough crossbeds.....	2.5	8.25
Total Dakota Sandstone.....	54.3	179.25

Note units 25-26 form a ledge.
Burro Canyon(?) Formation (Lower Cretaceous), incomplete:

24.	Siltstone and sandstone, medium-gray to light-olive-gray (5Y5/2); bottom part clayey sandstone (very fine grained); middle part sandy siltstone; top siltstone which grades up into mudstone; slightly calcareous at bottom.....	1.4	4.5
23.	Sandstone, moderate-yellowish-brown (10YR5/4); ridge former; very fine grained; slightly to moderately calcareous.....	0.15	0.5
22.	Siltstone, light-olive-gray (5Y5/2), noncalcareous.....	0.2	0.7
21.	Sandstone, dusky-yellow (5Y6/4); very fine grained; clayey matrix; slightly calcareous.....	0.06	0.25
20.	Siltstone, light-olive-gray (5Y5/2).....	0.2	0.7
19.	Sandstone, dark-yellowish-orange (10YR6/6); very fine grained; clayey matrix; moderately calcareous.....	0.33	1.1
18.	Bentonite, light-greenish-gray (5GY8/1) to greenish-gray (GY6/1).....	0.2	0.7
17.	Siltstone, light-olive-gray (5Y5/2).....	0.15	0.5
16.	Siltstone, yellowish-gray (5Y7/2), sandy.....	0.15	0.5
15.	Sandstone, dusky yellow (5Y6/4), very fine grained; clayey matrix; noncalcareous.....	0.08	0.25
14.	Siltstone, moderate-olive-brown (5Y4/4).....	0.23	0.75
13.	Mudstone, light-olive-gray (5Y5/2), sandy, very fine grained.....	0.08	0.25
12.	Siltstone, light-olive-gray (5Y5/2).....	0.3	1.0
11.	Sandstone, moderate-olive-brown (5Y4/4); ridge former; clayey matrix; moderately calcareous, lateraly to this sand is a channel shaped sandstone body approximately 2 ft (60 cm) thick; very fine grained.....	0.15	0.5
10.	Sandstone, olive-brown (5Y4/4), very fine grained; clayey matrix; slightly calcareous.....	0.08	0.25
9.	Mudstone, possibly montmorillonitic.....	0.08	0.25
8.	Sandstone, olive-brown (5Y4/4), very fine grained; clayey matrix; slightly calcareous.....	0.08	0.25

7.	Sandstone, olive-brown (5Y4/4); ridge former; very fine grained; clayey matrix; slightly calcareous; faint discontinuous subparallel laminations	0.15	0.5
6.	Mudstone, light-olive-gray (5Y5/2) to moderate olive-brown (5Y4/4), silty, noncalcareous.....	0.3	1.0
5.	Sandstone, yellowish-gray (5Y7/2); parallel laminations; very fine grained; noncalcareous.....	0.08	0.25
4.	Mudstone, moderate-olive-brown (5Y4/4).....	0.15	0.5
3.	Hard flinty layer, light-olive-gray (5Y5/2) to grayish-green (10GY5/2), fine-grained.....	0.15	0.5
2.	Mudstone, dusky-yellow (5Y6/4).....	0.08	0.25
1.	Mudstone, dusky-yellow (5Y6/4), slightly calcareous; grades into bentonite; bluish-white (5B9/1) with yellowish-orange (10YR8/6) and dark-yellowish-orange (10YR6/6) staining.....unmeasured		

Note units 1-24 form a slope punctuated with minor ledges.

Total Burro Canyon(?) Formation, incomplete.....	4.83	15.95
Total thickness of section 2.....	103.2	341.2

Section 3.--Four Corners I

(Located in NE 1/4 of NE 1/4 of sec. 22, T32N, R20W in southwestern Colorado.)

		Thickness	
		Meters	Feet
	Dakota Sandstone (Upper Cretaceous), near top of the Dakota; overlying covered slope is probably Mancos Shale (Upper Cretaceous):		
121.	Sandstone, very pale orange (10YR8/2) to light-brown (5YR5/6), upper very fine to lower-fine grained, moderately well sorted, subrounded to rounded, quartzose; well to moderately indurated with clay and silt matrix; parallel laminations.....	0.08	0.25
120.	Shale, dusky-yellow-brown (10YR2/2).....	0.9	3.0
119.	Coal, black (N1), sulfur present.....	0.6	2.0
118.	Organic debris, grayish-brown (5YR3/2), matted, fissile..	0.3	1.0
117.	Coal, black (N1).....	0.15	0.5
116.	Sandstone and shale, interbedded, dark-yellowish-brown (10YR4/2); sandstone lower very fine grained to upper very fine grained.....	0.46	1.5
115.	Sandstone, very pale orange (10YR8/2), lower very fine to upper fine grained, quartzose; poorly to moderately indurated with silt and clay matrix; discontinuous wavy laminations.....	0.3	1.0
114.	Covered slope.....	0.3	1.0
113.	Sandstone, very pale orange (10YR8/2) and grayish-orange (10YR7/4), fine-grained, subrounded to rounded, moderately well sorted, quartzose; moderately well indurated with clay and silt matrix; lower half is crossbedded; upper half contains discontinuous horizontal wavy laminations.....	0.76	2.5
112.	Covered slope.....	0.9	3.0
111.	Sandstone, grayish-orange (10YR7/4) to very pale orange (10YR8/2), lower very fine grained, quartzose, well indurated; silt and clay matrix; parallel horizontal laminations, with local wavy discontinuous laminations (ripples).....	0.9	3.0
110.	Shale and sandstone; shale is black (N1); sandstone is light-gray (N9) very fine grained sand; units grades into overlying sandstone.....	0.15	0.5
109.	Siltstone, light-brownish-gray (5YR6/1).....	0.08	0.25

108.	Sandstone, pale-yellowish-brown (10YR6/2), lower very fine grained; quartzose; poor to moderately indurated.....	0.08	0.25
107.	Siltstone, dusky-yellowish-brown (10YR2/2).....	0.2	0.75
106.	Sandstone, pale-yellowish-brown (10YR6/2), lower very fine grained, quartzose, poor to moderately indurated.....	0.2	0.7
105.	Siltstone, pale-yellowish-brown (10YR6/2) and dusky-yellowish-brown (10YR2/2).....	0.09	0.3
104.	Sandstone, very pale orange (10YR8/2), upper very fine grained, quartzose; moderately well indurated.....	0.06	0.2
103.	Siltstone to sandstone, pale-yellowish-brown (10YR6/2), sand is lower very fine grained, poorly indurated.....	0.15	0.5
102.	Sandstone, grayish-orange (10YR7/4), lower very fine to lower-fine grained, moderately to poorly sorted, subrounded to rounded; quartzose; moderately to well indurated with clay matrix; horizontal laminations with some local discontinuous wavy ripple laminations; locally crossbedded.....	0.5	1.6
101.	Siltstone, dark-yellowish-brown (10YR4/2.....	0.08	0.25
100.	Sandstone, dark-yellowish-brown (10YR4/2), lower very fine to upper very fine grained, quartzose, well indurated; parallel and discontinuous wavy laminations.....	0.08	0.25
99.	Siltstone, light-olive-brown (5Y5/6).....	0.15	0.5
98.	Hard layer, siliceous dark-reddish-brown (10R3/4); contains a few small calcite veins.....	0.15	0.5
97.	Siltstone and mudstone, light-olive-brown (5Y5/2) to pale-yellowish-brown (10YR6/2) with light-brown (5YR5/6) staining.....	0.6	2.0
96.	Sandstone, moderate-yellowish-brown (10YR5/4), lower very fine grained, well indurated.....	0.03	0.1
95.	Shale, dusky-yellowish-brown (10YR2/2).....	0.9	3.0
94.	Covered slope.....	0.6	2.0

Note units 94-121 forms a slope with minor ledges.

93.	Sandstone, grayish-orange (10YR7/4) to very pale orange (10YR8/2), upper very fine to upper-fine		

	grained, moderately well sorted, subrounded to rounded, quartzose; well indurated with clay matrix; trough crossbeds range in thickness from 4 to 6 in. (10 to 15 cm) at base to 1.5 ft (45 cm) near top of unit; top foot (30 cm) of unit consists of parallel laminations; base of unit is a scour surface overlain by sandstone containing rip up clasts of medium-gray shale (N5) up to a 2 ft (60 cm) in length; limonite cemented laminations occur near base.....	2.4	8.0
92.	Sandstone, grayish-orange (10YR7/4), upper very fine to lower very fine grained, moderately well sorted, subrounded to rounded; quartzose with some clay matrix; well indurated; horizontal laminations and some wavy discontinuous laminations.....	1.5	5.0
91.	Sandstone, grayish-orange (10YR7/4) and very pale orange (10YR8/2), upper-fine to upper very fine grained, moderately well sorted, subrounded to rounded, quartzose; well indurated with some clay matrix; poorly defined large scale crossbeds; large 5 in. (12.5 cm) rip up clasts of very fine grained sandstone near base.....	1.2	4.0
90.	Sandstone and siltstone, interlayered; sandstone is grayish-orange (10YR7/4), upper- to lower-fine grained, moderately well sorted, subrounded to rounded and moderately indurated; siltstone is medium gray (N5) and carbonaceous.....	0.3	1.0
89.	Sandstone, grayish-orange (10YR7/4), lower-fine to upper-fine grained; moderately well sorted, rounded to subrounded, quartzose; well indurated with trace of clay matrix, poorly defined crossbeds; base of unit is a scour surface; rip up clasts of very fine grained sandstone and siltstone occur near base.....	1.5	5.0
88.	Sandstone, light-gray (N7) to grayish-orange (10YR7/4), lower very fine grained to upper fine grained, moderately sorted, subrounded to rounded; quartzose; moderately indurated; silty, locally carbonaceous; bedding is obscure; possibly bioturbated.....	0.9	3.0
87.	Siltstone, olive-gray (5Y4/1).....	0.6	2.0

86.	Sandstone, very pale orange (10YR8/2) and grayish-orange (10R7/4), lower-medium to upper-medium-grained, moderately well sorted, rounded, quartzose; well indurated with clayey matrix; troughs beds approximately 1.5 ft (30 to 45 cm) thick.....	1.8	6.0
85.	Sandstone, grayish-orange (10YR7/4) and very pale orange (10YR8/2), lower-fine to lower-medium grained, subrounded to rounded, quartzose; well indurated with some clayey matrix; small scale crossbedding includes troughs and possible tabular sets 4 or 5 in. (10 to 12.5 cm) thick; some thin limonite cemented laminations containing woody plant impressions.....	1.5	5.0
84.	Shale, medium-dark-gray (N4), carbonaceous.....	0.06	0.2
83.	Sandstone, very pale orange (10YR8/2) and grayish-orange (10YR7/4); lower-fine to upper-fine grained, moderately well sorted, subrounded to rounded, quartzose; well indurated with some quartz overgrowths and clay matrix; trough crossbeds approximately 1 to 1.5 ft (30 to 45 cm) thick.....	3.0	10.0
82.	Sandstone, light-brown (5YR6/4) to very pale orange (10YR8/2), upper-lower-fine to lower-medium grained, poorly to moderately sorted, subrounded to rounded, quartzose, well indurated, silty; subhorizontal crossbedding (possible troughs); thin laminations of carbonaceous material; basal 6 in. (15 cm) of unit is conglomeratic; chert clasts are black, white, and gray and range up to .5 in. (1.5 cm) centimeters in length.....	3.0	10.0
81.	Sandstone, very pale orange (10YR8/2) and very light gray (N8); lower very fine grained; carbonaceous; fissile.....	0.5	1.6

Note units 81-93 forms a cliff.

80.	Coal, black (N1).....	1.0	3.5
79.	Sandstone, medium-dark-gray (N4) to dark-gray (N3), lower very fine to lower-coarse grained, poorly sorted, subrounded to rounded, quartzose, poorly indurated; very muddy matrix; carbonaceous; grades up into overlying coal.....	0.76	2.5
78.	Sandstone, very pale orange (10YR8/2) to pale-yellowish-orange (10YR8/6), upper very fine to upper-coarse grained, poorly sorted, subrounded to rounded, quartzose, moderately to well indurated with quartz overgrowths; conglomeratic with chert		

	pebbles that are black, white, and rusty red and are as much as 1 in. (2.5 cm) across; cross-bedding is indistinct; base of unit is a scour surface; unit thickens laterally to approximately three and one half feet at the expense of underlying units.....	0.3	1.0
	Total Dakota Sandstone.....	30.1	100.2

Burro Canyon Formation (Lower Cretaceous) and upper part of the Brushy Basin Member of Morrison Formation (Upper Cretaceous), undivided:

77.	Mudstone, moderate-yellowish-brown (10YR5/4) and brownish-gray (5YR6/1), hackly weathering.....	0.6	2.0
76.	Siltstone, light-olive-gray (5Y5/2), weathers hackly.....	1.0	3.4
75.	Sandstone, yellowish-gray (5Y7/2); lower very fine grained, well indurated.....	0.06	0.2
74.	Siltstone, yellowish-gray (5Y7/2), hackly weathering.....	0.6	2.0
73.	Sandstone, yellowish-gray (5Y7/2), lower fine grained, silty, flaggy, moderately to poorly indurated.....	0.15	0.5
72.	Mudstone and siltstone, light-olive-gray (5Y5/2), hackly weathering.....	1.2	4.0
71.	Sandstone, yellowish-gray (5Y7/2), lower very fine to lower-fine grained; moderately well sorted, quartzose, moderately to poorly indurated, silty; discontinuous wavy laminations.....	0.15	0.5
70.	Sandstone, dusky-yellow (5Y6/4), lower very fine grained, silty, poorly indurated; grades into overlying and underlying units.....	0.15	0.5
69.	Sandstone, very pale orange (10YR8/2), lower very fine to lower-fine grained, quartzose; poorly indurated with muddy matrix; locally poor to moderately indurated with discontinuous wavy ripple laminations.....	0.6	2.0
68.	Siltstone, yellowish-gray (5Y7/2), weathers hackly.....	0.6	2.0
67.	Sandstone, yellowish-gray (5Y7/2), lower-fine to upper-fine grained, quartzose; poorly to moderately indurated; very muddy.....	0.12	0.4
66.	Siltstone, light-olive-gray (5Y5/2), weathers hackly; grades upwards into overlying sandstone.....	0.12	0.4

65.	Sandstone, very pale orange (10YR8/2), lower very fine to lower-fine grained, quartzose, muddy, moderately well indurated; parallel to discontinuous wavy laminations (ripples).....	0.12	0.4
64.	Siltstone, light-olive-gray (5Y5/2), hackly weathering.....	0.15	0.5
63.	Sandstone, very pale orange (10YR8/2), lower very fine to lower-fine grained, quartzose, muddy, moderately well indurated; parallel to discontinuous wavy laminations (ripples).....	0.06	0.2
62.	Siltstone, light-olive-gray (5Y5/2), hackly weathering.....	0.15	0.5
61.	Sandstone, very pale orange (10YR8/2), lower very fine to lower-fine grained, quartzose, muddy, moderately well indurated; parallel to discontinuous wavy laminations.....	0.12	0.4
60.	Siltstone, light-olive-gray (5Y5/2), hackly weathering...	0.76	2.5
59.	Sandstone, yellowish-gray (5Y7/2), lower very fine to upper very fine grained; quartzose with accessory biotite grains; poorly to moderately indurated; contains even parallel laminations.....	0.03	0.1
58.	Sandstone, yellowish-gray (5Y7/2), lower very fine grained, quartzose; poorly indurated; silty.....	0.18	0.6
57.	Sandstone, yellowish-gray (5Y7/2), lower very fine to upper very fine grained, quartzose, moderately to poorly indurated; muddy matrix; parallel to discontinuous wavy laminations.....	0.3	1.0
56.	Siltstone, dusky-yellow (5Y6/4), hackly weathering.....	0.3	1.0
55.	Sandstone, grayish-brown (5YR3/2), lower very fine to upper-fine grained, quartzose, moderately well indurated; muddy matrix; discontinuous even subparallel laminations.....	0.12	0.4
54.	Siltstone, dusky-yellow (5Y6/4), hackly weathering.....	0.06	0.2
53.	Sandstone, very pale orange (10YR8/2), lower very fine to lower-fine grained, moderately well sorted, quartzose, moderately well indurated, silty matrix, calcareous; laterally discontinuous wavy laminations and horizontal laminations.....	0.2	0.7
52.	Siltstone, moderate-olive-brown 5Y4/4) to light-olive-gray (5Y5/2), weathers hackly.....	0.12	0.4

51.	Sandstone very pale orange (10YR8/2), lower very fine grained to lower-fine, moderately to poorly sorted; quartzose, poorly indurated;muddy matrix.....	0.18	0.6

Note units 51-80 forms slope with minor ledges.

50.	Sandstone (partially covered), very pale orange (10R8/2) to grayish-orange (10YR7/4), lower-fine to upper-coarse grained, poorly sorted, subrounded to angular, quartzose, moderately to well indurated; crossbedding not distinct; possible horizontal laminations; locally contains small pebbles as much .3 in. (7.5 mm) across; pebbles are tan and gray chert.....	0.15	0.5
49.	Sandstone, grayish-yellow (5Y8/4), upper very fine to lower-fine grained, moderately well sorted, quartzose; moderately well indurated with muddy matrix; laterally, unit thickens to about 4 ft (1.2 m); unit is a large trough or scour and fill feature in which the cross bed laminations conform to the shape of the scour.....	0.46	1.5
48.	Sandstone, moderate-yellowish-brown (10YR5/4), upper very fine to lower-medium grained, moderately well to poorly sorted, subrounded to subangular, quartzose, well indurated; locally contains interclasts of lower very fine grained sandstone as much as 1.25 in. (3 cm) length; crudely crossbedded with small scale troughs as much as one foot in thickness.....	2.1	7.0
47.	Sandstone, and pebbly sandstone, moderate-brown (5YR4/4), lower very fine grained sand to pebbles as large as 1 in. (2.5 cm) in length, poorly sorted, rounded to angular, quartzose; well indurated with quartz overgrowths and some clay in matrix; chert clasts are white, gray and black; base of unit is a scour surface; rip up clasts of underlying siltstone are up to 3 in. (7.5 cm) across; crudely crossbedded with troughs as much as 2.5 ft (75 cm) in thickness.....	1.2	4.0

Note units 47-50 form a ledge.

46.	Siltstone, pinkish-gray (5YR8/1); swells when wet; contains some lower very fine grained sand and biotite flecks; approximately half way up the unit is a 1 ft (30 cm) thick bed with light red (5R6/6) flecks; the upper 3 ft (90 cm) of the unit becomes finer grained upwards; contains local lenses of poorly sorted sandstone that are lower very fine grained and very silty.....	7.9	26.0

45.	Sandstone, grayish-red (10R4/2), upper very fine grained to lower-medium, poorly sorted, quartzose; very well indurated with a siliceous matrix.....	0.15	0.5
44.	Sandstone, pinkish-gray (5YR8/1); light red flecks (5R6/6); upper very fine to lower-medium grained; poorly sorted; quartzose; poorly consolidated; abundant clay.....	0.3	1.0
43.	Mudstone, pale-yellowish-brown (10YR6/2), locally light-red (5R6/6) stained; grades into overlying unit.....	0.15	0.5
42.	Siltstone, pinkish-gray (5YR8/1), fractures conchoidally.....	0.15	0.5
41.	Sandstone, yellowish-gray (5Y8/1); local moderate-reddish-brown (10R4/6) flecks; upper very fine to lower-fine grained; poorly to moderately sorted; quartzose; poorly indurated; very muddy matrix.....	0.3	1.0
40.	Siltstone, pinkish-gray (5YR8/1).....	0.3	1.0
39.	Sandstone, light-greenish-gray (5GY8/1), lower very fine to lower medium grained, poorly sorted, quartzose, poorly indurated; very muddy matrix.....	0.9	3.0
38.	Mudstone and sandstone, very pale orange (10YR8/2) with some moderate-reddish-brown (10R4/6) flecks; sand is lower very fine grained to upper-fine grained; quartzose.....	1.1	3.5
37.	Siltstone, yellowish-gray (5Y7/2); swells when wet.....	0.76	2.5
36.	Sandstone, light-greenish-gray (5GY8/1), lower very fine to lower-medium grained, poorly sorted, quartzose, poorly consolidated; very muddy matrix.....	1.2	4.0
35.	Siltstone, very light gray (N8) to light gray (N7).....	1.4	4.5
34.	Shale, light-olive-gray (5Y5/2).....	0.12	0.4
33.	Hard layer, light-olive-gray (5Y6/1).....	0.2	0.7
32.	Mudstone, light-olive-gray (5Y6/1); stained moderate-reddish-brown (10YR5/4); weathers hackly.....	0.15	0.5
31.	Siltstone, greenish-gray (5GY6/1), siliceous.....	0.15	0.5
30.	Mudstone, brownish-black (5YR2/1); grades into the underlying hard layer.....	0.08	0.25
29.	Hard layer, brownish-black (5YR2/1); grades into underlying mudstones.....	0.08	0.25

28.	Mudstone, brownish-black (5YR2/1).....	0.15	0.5
27.	Hard layer, greenish-gray (5GY6/1) and minor medium-bluish-gray (5B5/1).....	0.2	0.7
26.	Siltstone, pale-yellowish-brown (10YR6/2).....	0.2	0.7
25.	Hard layer, light-olive-gray (5Y6/1); silicified mudstone.....	0.3	1.0
24.	Mudstone, dark-yellowish-brown (10YR4/2).....	0.3	1.0
23.	Hard layer, light-olive-gray (5Y5/2).....	0.06	0.2
22.	Siltstone, white (N9).....	1.5	5.0
21.	Sandstone, pale-reddish-brown (10R5/4) and dark-reddish-brown (10R2/4), upper-fine to upper-medium grained, poorly sorted, subrounded to subangular, quartzose, well indurated.....	0.1	0.3
20.	Siltstone and mudstone, light-olive-gray (5Y6/1); locally very siliceous.....	0.6	1.9
19.	Hard layer, light-olive-gray (5Y6/1).....	0.03	0.1
18.	Mudstone, light-olive-gray (5Y6/1).....	0.46	1.5
17.	Siltstone, yellowish-gray (5Y8/2); contains some lower very fine grained sand; less than 15% biotite....	0.46	1.5
16.	Hard layer, light-olive-gray (5Y6/1).....	0.06	0.2
15.	Siltstone and mudstone, yellowish-gray (5Y7/2) and moderate-orange-pink (10R7/4).....	0.27	0.9
14.	Hard layer, yellowish-gray (5Y7/2).....	0.09	0.3
13.	Sandstone and siltstone, yellowish-gray (5Y8/1) and pale-red (10R6/2); the sandstone is lower very fine grained and very silty; quartzose with less than 5% biotite grains; poorly consolidated.....	0.46	1.5
12.	Hard layer, light-gray (N7).....	0.06	0.2
11.	Siltstone, very light gray (N8).....	0.3	1.0
10.	Sandstone, white (N9); lower-fine to upper-medium-grained; poorly sorted; subrounded to subangular; quartzose with less than 15% mica; moderately to poorly consolidated.....	0.46	1.5

9.	Sandstone, white (N9) and moderate-orange-pink (10R7/4), upper very fine to upper-fine-grained, poorly sorted; quartzose with abundant black accessory grains and less than 5% mica; poorly consolidated, very clayey.....	0.43	1.4
8.	Hard layer.....	0.09	0.3
7.	Mudstone, yellowish-gray (5Y7/2).....	0.09	0.3
6.	Hard layer, pale-reddish-brown (10R5/4).....	0.06	0.2
5.	Mudstone, light-olive-gray (5Y5/2).....	0.09	0.3
4.	Sandstone, pale-olive (10Y6/2) and moderate-orange-pink (10R7/4), lower very fine to lower-fine grained, poorly sorted, quartzose; poorly consolidated and very clayey matrix.....	0.3	1.0
3.	Hard layer, yellowish-gray (5Y7/2); siliceous mudstone...	0.09	0.3
2.	Mudstone, grayish-yellow-green (5GY7/2) to dusky-yellow-green (5GY5/2).....	0.15	0.5

Note that units 1-46 form a slope with minor ledges.

1.	Sandstone, light-olive-gray (5Y6/1), lower very fine to lower-fine grained, moderately well sorted, quartzose; moderately well consolidated.....	0.06	0.2
	Total Burro Canyon Formation and upper part of the Morrison (Undivided).....	34.95	115.5
	Total thickness of section.....	65.0	215.7

Section 4.--Four Corners II

(Located in NW 1/4 NW 1/4 of sec. 23, T. 32 N., R. 20 W. in southwestern Colorado.)

	Thickness Meters	Feet
Mancos Shale (Upper Cretaceous)	Not Measured	
Dakota Sandstone (Upper Cretaceous), incomplete:		
56. Sandstone, pinkish-gray (5YR8/1) to white N9, lower-fine to upper-fine grained; contains abundant fossil pieces including gryphea fragments.....	unmeasured	
55. Sandstone and siltstone, light olive gray (5Y5/2); sandstone is lower very fine grained; unit is not described in detail.....	6.7	22.0
54. Shale, brownish-gray (5YR4/1) to brownish-black (5YR2/1); selenite crystals up to 2 in. (3 cm) along long axis.....	1.5	5.0
53. Sandstone, yellowish-gray (5Y8/1) and dark-yellowish-orange (10YR6/6); stained moderate-yellowish-brown (10YR5/4); lower very fine grained to upper very fine grained; well sorted; quartzose; moderately to well consolidated with quartz overgrowths and moderate amount of clay matrix; interbedded with thin siltstone layers at base; discontinuous wavy laminations (slightly climbing ripples-ripple sets are about 0.2 in. [0.5 cm] half centimeter thick).....	0.3	1.0
52. Shale, black (N9); carbonaceous.....	1.8	6.0
Note units 52-56 form slope with minor ledges.		
51. Sandstone, grayish-orange (10YR7/4); lower-fine- to lower-medium- grained at bottom; lower very fine to upper very fine grained at top; moderately to well sorted; rounded to subrounded; quartzose; well to moderately consolidated with quartz overgrowths and moderate amount of clay matrix; even parallel and discontinuous wavy horizontal laminations interbedded with tabular planar cross sets up to 10 in. (25 cm) thick, strike and dip of the cross sets are 1) NS, 24°E 2) N30°W, 20°NE.....	1.5	5.0
Note unit 51 forms ledge.		
50. Mudstone, pale-yellowish-brown (10YR6/2); abundant carbonaceous debris; gradational contact with underlying coal.....	0.6	2.0

49.	Coal, black (N1).....	0.15	0.5
48.	Siltstone, dark-yellowish-brown (10YR4/2).....	0.6	2.0

Note units 48-50 form slope.

47.	Sandstone, very-pale-orange (10YR8/2) to grayish-orange (10YR7/4), lower-fine- to lower-medium-grained, moderately well sorted, subrounded to rounded, quartzose, well indurated; quartz overgrowths; minor amounts of clay matrix; trough crossbeds up to 8 in. (20 cm) thick; blocks of sandstone are shifted slightly but paleocurrent directions (trough axes) appear to be north-northwest; this unit appears to be laterally equivalent to some thicker channel sands to the northwest.....	0.76	2.5

Note unit 47 forms ledge.

46.	Shale, grayish-black (N2); middle part is sandy and very light gray (N8) to white (N9); sand is very fine grained.....	1.5	5.0

Note unit 46 forms slope.

45.	Sandstone, pinkish-gray (5YR8/1) with grayish-orange (10YR7/4), lower very fine grained, well sorted, quartzose; well indurated with quartz overgrowths; wavy discontinuous horizontal ripple laminations; weathers flaggy.....	0.76	2.5

Note unit 45 forms ledge.

44.	Shale, black (N1), carbonaceous.....	1.2	4.0
43.	Siltstone, light-olive-gray (5Y5/2).....	0.15	0.5
42.	Hard layer, dark-reddish-brown (10R3/4) to very dusky red (10R2/2); contains thin veins of crystalline moderate-brown (5YR4/4) calcite.....	0.15	0.5
41.	Shale, olive-gray (5Y4/1).....	2.4	8.0
40.	Mudstone, olive-gray (5Y4/1); swells when wet.....	0.6	2.0

Note units 40-44 form slope.

39.	Sandstone, yellowish-gray (5Y8/1) to pinkish-gray (5YR8/1), lower-fine- to lower-medium-grained, moderately well sorted, subrounded to rounded, quartzose; well indurated with quartz overgrowths and moderate amount of clay cement; consist in ascending order of a 5 in. (10 cm) thick tabular		

	set overlain by 8 in. (20 cm) of wavy discontinuous nearly horizontal ripple laminations overlain by a large 3 ft (90 cm) thick tabular set that strikes N25°W and dips 24° to the NE; this large set is overlain by 2.5 ft (75 cm) of sandstone containing poorly defined crossbedding.....	2.0	6.5

Note unit 39 forms a ledge.

38.	Siltstone, moderate-reddish-orange (10R6/6) and grayish-orange (5YR7/2); brick-red color due to clinker.....	2.1	7.0
37.	Mudstone, very pale orange (10YR8/2) stained grayish-orange (10YR7/4); siliceous (cherty, flinty).....	0.3	0.9
36.	Mudstone, white (N9); chalky.....	0.03	0.1
35.	Mudstone, very pale orange (10YR8/2) stained grayish-orange (10YR7/4) siliceous (cherty, flinty)....	1.2	4.0
34.	Sandstone, pale-yellowish-orange (10YR8/5) to moderate-reddish-brown (10R6/6), lower very fine to lower-fine grained, moderately well sorted, subrounded to subangular, quartzose; moderately to well consolidated with quartz overgrowths; faintly crossbedded; possible troughs overlain by possible horizontal laminations.....	0.3	1.0
33.	Siltstone, moderate-reddish-orange (10R6/6) to moderate-reddish-brown (10R4/6) to light-brown (5YR6/4), siliceous.....	0.15	0.5
32.	Sandstone, light-brown (5YR5/6), lower very fine grained, moderately consolidated, noncalcareous.....	0.23	0.75
31.	Sandstone, moderate-reddish-brown (brick-red) (10R4/6), lower very fine to upper very fine grained, poorly sorted, subrounded, poorly consolidated, clayey.....	0.03	0.1
30.	Siltstone, moderate-yellowish-brown (10YR5/4) to grayish-orange (10YR7/4), mostly covered.....	2.3	7.5
29.	Siltstone and sandstone, pale-yellowish-brown (10YR6/2); some moderate-yellowish-brown (10YR5/4) staining; poor to moderately consolidated.....	0.15	0.5
28.	Mudstone, and siltstone, grayish-black (N2).....	0.3	1.0
27.	Siltstone, moderate-yellowish-brown (10YR5/4) to pale-yellowish-brown (10YR6/2); some light-brown (5YR10/6) staining; siliceous;.....	0.45	1.5

26.	Siltstone and mudstone; siltstone is very pale orange (10YR8/2); moderate-reddish-orange (10R6/6) staining; mudstone is white (N9); siltstone beds are about 3 in. (7.6 cm) thick and alternate with 4 to 5 in. (10 to 12.5 cm) thick mudstone beds; siltstone beds are poorly to moderately indurated and horizontally laminated; the mudstone is poorly indurated with chalky texture (may be an ash residue, laterally it is overlain by clinker).....	1.5	5.0
25.	Mudstone, very pale orange (10YR8/2).....	0.15	0.5
24.	Shale and coal, dusky-yellowish-brown (10YR2/2) to dark-gray (N3) with some moderate-reddish-brown (10R4/6) staining.....	0.46	1.5
23.	Sandstone, medium-light-gray (N6) to medium-gray (N5), lower-medium- to upper-fine-grained, poorly sorted, subrounded to subangular, quartzose, poor to moderately indurated; clay cement; non-calcareous; abundant carbonaceous debris.....	0.15	0.5

Note units 23-38 forms slope.

22.	Sandstone and conglomeratic sandstone, pinkish gray (5YR8/1) to light-brown (5YR5/6) and dusky-yellowish-brown (10YR2/2); upper-fine- grained to pebbles as large as 3 in. (7.5 cm) across; poorly sorted, subrounded to angular; quartzose with chert pebbles that are white (smooth), gray, and black; well indurated; noncalcareous; siliceous with quartz overgrowths; locally contains black carbonaceous debris; lower half of unit is very conglomeratic; top half contains a few scattered pebbles; crossbedding is poorly defined, may be scour and fill structures 1 to 2 ft (30 to 60 cm) thick.....	1.2	4.0

Note unit 22 forms a ledge.

Total Dakota Sandstone, incomplete.....	33.7	111.4

Burro Canyon Formation (Lower Cretaceous) and upper part of the Brushy Basin Member of the Morrison Formation (Upper Jurassic), undivided:

21.	Mudstone, dark-greenish-gray (5GY4/1), non-swelling; weathers hackly.....	0.46	1.5
20.	Siltstone, yellowish-gray (5Y7/2), siliceous; weathers hackly.....	1.1	3.5
19.	Hard layer grayish-olive (10Y4/2) with moderate-yellowish-brown (10YR5/4) staining.....	0.15	0.5

18.	Mudstone, olive-gray (5Y3/2), hackly weathering.....	0.15	0.5
17.	Hard layer, grayish-olive (10Y4/2); stained moderate-yellowish-brown (10YR5/4); contains some very fine grained sand.....	0.24	0.8
16.	Mudstone, dark-greenish-gray (5GY4/1); tends to weather hackly; siliceous.....	0.6	2.0
15.	Hard layer grayish-olive (10Y4/2) stained moderate-yellowish-brown (10YR5/4).....	0.06	0.2
14.	Bentonite, light-olive-gray (5Y6/1) to olive-gray (5Y4/1).....	0.3	1.0
13.	Mudstone, light-olive-gray (5Y6/1); swells slightly when wet; hackly weathering.....	1.5	5.0
12.	Mudstone, dark-greenish-gray (5GY4/1), hackly weathering; local limonite stains.....	0.9	3.0
11.	Bentonite, poorly exposed.....	0.2	0.6
10.	Siltstone, greenish-gray (5GY6/1), non-swelling; probably siliceous.....	0.46	1.5
9.	Mudstone, pale-olive-gray (5Y6/1); swells when wet.....	0.76	2.5
8.	Mudstone, light-olive-gray (5/Y5/2); swells when wet.....	0.76	2.5
7.	Mudstone, grayish-olive (10Y4/2; swells when wet; locally siliceous.....	0.76	2.5
6.	Sandstone, yellowish-gray (5Y7/2), lower very fine to upper very fine grained, moderate to well sorted and subrounded, quartzose; poorly consolidated with clayey matrix.....	0.76	2.5
5.	Mudstone, pale-olive (10Y6/2) to grayish-olive (10Y4/2); swells; weathers to a hard gummy surface, difficult to dig through; mostly covered.....	2.0	6.5
4.	Bentonite, yellowish-gray (5Y7/2); swells when wet; waxy looking.....	0.3	1.0
3.	Mudstone, light-olive-gray (5Y5/2); swells when wets; siliceous.....	1.1	3.5
2.	Mudstone, pale-yellowish-brown (10YR6/2) with grayish-red (10R4/2); swells when wet.....	0.6	2.0

Note units 1-21 form a slope.

1. Mudstone, light-olive-gray (5Y5/2); swells slightly when wet; locally sandy, very fine grained.....	0.6	2.0
Total Burro Canyon Formation and upper part of Brushy Basin Member of the Morrison Formation, undivided.....	13.76	45.1
Total thickness of section 4.....	47.4	156.5
Lower part of the Brushy Basin Member.....	Not Measured	

Section 5.--Junction Creek I

(Located in SW 1/4 of sec. 36, T. 36 N., R. 10 W. in southwestern Colorado.)

	Thickness	
	Meters	Feet
Lower part of lower shale member of the Mancos Shale (Upper Cretaceous), upper part not measured:		
33. Sandstone, pale-yellowish-brown (10YR6/2), very fine grained, moderately well sorted, rounded to subrounded, quartzose, well indurated; contains silica overgrowths; massive blocky weathering.....	2.23	7.5
Note unit 33 forms a ledge.		
32. Covered slope; probably mostly gray fissile shale.....	14.3	47.0
Total lower shale member of the Mancos Shale; incomplete...	16.53	54.5
Note unit 32 forms a slope.		
Dakota Sandstone (Upper Cretaceous):		
31. Sandstone, very pale orange (10YR8/2), fine-grained, moderately well sorted, subrounded to rounded, quartzose, well indurated, moderately calcareous, locally carbonaceous; contains some clay matrix; abundant tabular crossbeds that are up to 1.5 ft (45 cm) thick and have southeast dips; some thin mottled sand and shale interbeds.....	9.1	30.0
30. Interbedded sandstone and shale: Sandstone is very pale orange (10YR8/2), lower-fine to very fine grained, moderately sorted, rounded, well indurated; has quartz overgrowths and clayey matrix; quartzose with abundant hematite specks; low angle subhorizontal laminations. Interbedded shale units are lenticular and up to about a foot (30 cm) in thickness. Shale is grayish black (N2) and is sometimes mottled with sandstone (possible small scale flaser bedding). Unit grades up into overlying unit.....	1.5	5.0
Note units 30-31 form a cliff.		
29. Coal and Shale; partly covered; top foot and one half feet is coal and black (N1) shale.....	4.9	16.0
Note unit 29 forms a slope.		

28.	Sandstone, brownish-orange, well indurated; forms inaccessible cliff face; thin black streaks on cliff may be carbonaceous; base of unit is irregular and appears to scour into underlying unit....	3.6	12.0

Note unit 28 forms a cliff.

	Total Dakota Sandstone.....	19.1	63.0

Burro Canyon(?) Formation (Lower Cretaceous), incomplete:

27.	Interbedded sandstone, shale and hard layers; on inaccessible cliff; visually unit can be divided into 9 units based on color and induration; in descending order the units are i-a; units a-c are described from large boulder at base of cliff; units d-i are described from a distance and their thicknesses are estimated.		
27i.	Sandstone, green, moderately indurated, looks similar moderately indurated, looks similar to 27a.....	0.76	2.5
27h.	Hard layer, gray, moderately indurated, looks similar to 27b.....	0.15	0.5
27g.	Sandstone, orange and green, poorly to moderately indurated; looks similar to 27c.....	0.3	1.0
27f.	Siltstone or mudstone, green, slope former, poorly indurated.....	0.6	2.0
27e.	Sandstone, orange, well indurated.....	0.46	1.5
27d.	Mudstone or siltstone, green, poorly indurated, forms a slope.....	0.9	3.0
27c.	Sandstone, dusky-yellow (5Y6/4) to olive gray (5Y6/1) coarse- to fine-grained, poorly sorted, rounded to subrounded, poorly to moderately indurated, quartzose, noncalcareous; clayey matrix; fractured.....	0.46	1.5
27b.	Hard layer, olive-gray (5Y4/1); grades into overlying unit.....	0.46	1.5
27a.	Sandstone, pale-green (NG6/2) to dark-greenish-gray (5GY4/1), coarse to fine-grained, poorly sorted, rounded to subrounded, poor to moderately indurated, friable, noncalcareous, clayey, quartzose; contains white, gray, and orange chert pebbles up to 0.8 in. (2 cm) in length; contact is sharp with underlying unit and gradational with overlying unit.....	0.9	3.0

Total thickness unit 27.....	5.0	16.5

Note unit 27 forms a slope or recess.

26. Sandstone and conglomerate, very light gray (N8), very pale-orange (10YR8/2) and dark-yellowish-orange (10YR6/6), light-green (5G7/4) locally near top, medium-grained, rounded to subrounded, moderately well sorted, quartzose; locally contains abundant hematite flakes; rock and chert fragments range in size from very coarse sand to pebbles at least 2 in. (5 cm) long and consist of gray, white, tan, green and red, chert and purple quartzite; mudstone and very fine grained sandstone intraclasts are up to 1 ft (30 cm) in length; clasts are rounded to subangular; chert clast are generally larger near the base of the unit than at the top; also the unit is generally more conglomeratic at the base of the unit than at the top; scour surfaces marked by intraclast lag deposits occur within the unit; there are rare lenses of fine grained sand; crossbedded; unit forms a generally inaccessible cliff.....	12.8	42.0

Note unit 26 forms a cliff.

25. Mudstone, medium-dark-gray (N4), poorly indurated.....	0.6	2.0
24. Sandstone, greenish-gray (5GY6/1), pale-yellowish-brown (10YR6/2) and pale-yellowish-brown (10YR5/4), fine to very fine grained, well indurated, highly siliceous, quartzose; abundant orange and black and rare green accessory grains.....	0.06	0.2
23. Mudstone, light-olive-gray (5Y6/1), poorly indurated, noncalcareous, fissile.....	0.03	0.1
22. Sandstone, light-olive-gray (5Y6/1), fine-grained, poorly sorted, rounded to subrounded, poorly sorted, noncalcareous, abundantly clayey, quartzose; abundant black and orange accessory grains; horizontally bedded; grades into the underlying unit.....	0.3	0.9
21. Mudstone, greenish-gray (5GY6/1), poorly indurated, noncalcareous; grades into underlying unit.....	0.15	0.5
20. Mudstone, grayish-red (10R4/2), poorly indurated, noncalcareous.....	0.15	0.5
19. Sandstone, pinkish-gray (5YR8/1), fine-grained, moderately well sorted, rounded to subrounded,		

	extremely well indurated, very siliceous, quartzose; contains orange and black accessory grains; is faintly crossbedded.....	0.15	0.5
18.	Siltstone, greenish-gray (5GY6/1), fissile, calcareous, poorly indurated.....	0.03	0.1
17.	Sandstone, pale-yellowish-brown (10YR6/2), very fine grained, moderately well sorted, rounded to subrounded, well indurated, very siliceous, quartzose, horizontally bedded.....	0.06	0.2
16.	Siltstone, greenish-gray (5GY6/1), calcareous, poorly indurated.....	0.06	0.2
15.	Sandstone, pale-yellowish-brown (10YR6/2), very fine grained, moderately well sorted, rounded to subrounded, well indurated, very siliceous, quartzose, horizontally bedded.....	0.15	0.5
14.	Mudstone and siltstone; grayish-red (5R4/2) mottled with light-olive-gray (5Y5/2) near bottom and top; bottom and top part of unit is mudstone which grades into siltstone in the middle; the entire unit is noncalcareous and poorly indurated.....	0.46	1.5
13.	Hard layer, grayish-red (10R4/2) to dusky-yellow-green (5GY5/2); contains clasts of fine grained material up to about .4 in. (1 cm) in length; clasts are subrounded to angular; grades into underlying mudstone.....	0.46	1.5
12.	Mudstone, olive-gray (5Y4/1) poorly indurated, non-calcareous,.....	0.6	2.0
11.	Interbedded mudstone and sandstone, medium-dark-gray (N4) to olive-gray (5Y4/1); beds interfinger and range from about 0.25 to 3 in. (6 mm to 7.5 cm) in thickness; shale is medium-dark-gray (N4) to olive-gray (5Y4/1), poorly indurated, noncalcareous, sightly fissile; sandstone is light-olive-gray (5Y6/1) and moderate-yellowish-brown (10YR5/4), very fine to fine- grained (with sparse medium grains), rounded, poorly sorted, moderately indurated, quartzose; sandstone contains abundant hematite cement.....	0.3	1.0
10.	Sandstone, light-olive-gray (5Y6/1), medium to very fine grained, poorly sorted, rounded, poorly indurated, quartzose; abundant clay; abundant orange and black accessory minerals; grades into underlying unit.....	0.49	1.6

9.	Sandstone, grayish-yellow (5Y8/4) to yellowish-gray (5Y7/2); lower fine to very fine grained, poor to moderately sorted, moderately indurated, slightly calcareous, clayey, quartzose, fractured; grades into underlying unit.....	0.76	2.5
8.	Mudstone, light-gray (N7) to light-olive-gray (5Y6/1); contains 2 hard layers (siliceous mudstone) 3 in. (7.5 cm) thick.....	0.49	1.6
7.	Sandstone, light-olive-gray (5Y6/1), lower- fine- to very fine grained, rounded, moderately to poorly sorted, moderately to well indurated, noncalcareous, clayey, quartzose; abundant black and orange accessory grains.....	0.15	0.5
6.	Mudstone, light-olive-gray (5Y6/1), poorly indurated, noncalcareous, abundant very fine grained sand; grades into underlying unit.....	0.15	0.5
5.	Sandstone, light-gray (N7), very fine to medium-grained, poorly sorted, rounded, moderately to well indurated, noncalcareous, quartzose; abundant black and orange and rare green accessory minerals; thickens laterally to a maximum of 1 ft (30 cm); lenticular in both directions; horizontal base and convex top.....	0.15	0.5
4.	Mudstone, light-gray (N7), poorly indurated, noncalcareous, slightly sandy, fissile.....	0.15	0.5
3.	Sandstone, light-gray (N7) and grayish-orange (10YR7/4), very fine to lower-fine-grained, moderately to poorly sorted, rounded, moderately to poorly indurated, clayey, noncalcareous, quartzose; abundant orange and black accessory grains; lenticular.....	0.3	0.9
2.	Mudstone, greenish-gray (5GY6/1), noncalcareous.....	0.06	0.2

Note unit 1 is a cliff former. Units 2-25 form a slope with minor ledges.

1. Sandstone, grayish-orange-pink (5YR7/2), very pale orange (10YR8/2) and white (N9) and some grayish-orange (10YR7/4) staining; lower part of unit is very fine to medium- grained, poorly sorted, rounded to subrounded, quartzose (with less than 5% black and green accessory grains), well indurated, noncalcareous, siliceous, clayey; upper part of unit is fine to very fine grained, moderately to poorly sorted, rounded to sub-rounded, quartzose (contains abundant limonite flakes which may be altered biotite), well-indurated, noncalcareous,

clayey; entire unit is faintly crossbeds; unit lateral to the section contains troughs that are about 6 to 12 in. (15 to 30 cm) thick.....	6.7	22.0
Total Burro Canyon(?) Formation.....	30.8	101.0
Total thickness of section 5.....	66.4	218.5

Section 6.--Junction Creek II

(Located in sec. 7, T. 35 N., R, 9 W. in southwestern Colorado.)

	Thickness Meters	Thickness Feet
Mancos Shale (Upper Cretaceous):		
Upper part of the Greenhorn Limestone Member.....	Not Measured	
Lower part of the Greenhorn Limestone Member and upper part of the lower shale member:		
16. Mudstone, medium-dark-gray (N4), very calcareous, poorly indurated; unit is ten's of feet thick.....	not measured	
15. Bentonite, grayish-orange (10YR7/4) to very-pale-orange (10YR8/2).....	0.06	0.2
14. Mudstone, medium-dark-gray (N4), calcareous, poorly indurated.....	0.3	1.0
13. Limestone, yellowish-gray (5Y8/1) and light-gray (N7), poorly indurated, fractured, fissile; fresh surface is fetid and medium-dark-gray.....	0.46	1.5
12. Mudstone, medium-dark-gray (N4), very calcareous, grades into underlying limestone, poorly indurated.....	0.46	1.5
11. Limestone, yellowish-gray (5Y8/1) to light-gray (N7), moderate to well indurated, fractured and fissile; fresh surface is fetid and medium-dark-gray (N7); small brachiopod fossils about 0.7 in. (1.75 cm) in length; several shells partially replaced by pyrite and copper(?).....	0.76	2.5
10. Limestone and siltstone, medium-dark-gray (N4), yellowish-gray, and light-gray (N7), poor to moderately indurated; well indurated in lower part of unit; contains fossil shell impressions.....	1.5	5.0
9. Mudstone, pale-yellowish-brown (10YR6/2) to light-gray (N7), very calcareous, poorly indurated, flaggy weathering; contains brachiopod impressions (inoceramus).....	3.4	11.0
8. Limestone, yellowish-gray (5Y8/1), light-gray and medium-dark-gray, micritic, moderately to well indurated; fetid when broken; large black inoceramus shells at least 4 in. (10 cm) in length.....	0.15	0.5
7. Covered.....	7.0	23.0

6.	Mudstone, dark-yellowish-brown (10YR4/2) to dusky-yellow-brown (10YR2/2), hackly weathering, poorly indurated, moderately to very calcareous; fossil bed half way up unit contains brachiopod and possibly gastropod(?) or ammonite(?) impressions.....	6.1	20.0
5.	Covered.....	9.1	30.0
4.	Mudstone, olive-gray (5Y4/1), hackly weathering, poorly indurated, locally calcareous.....	6.1	20.0
3.	Covered.....	0.6	2.0
2.	Mudstone, dark-gray (N3), poorly indurated, noncalcareous.....	1.5	5.0

Note units 1-16 form slope with minor ledges.

Note basal sandstone unit probably correlates with top sandstone unit in section 5.

1.	Sandstone, very pale orange (10YR8/2) to dark-yellowish-orange (10YR6/6), fine to very fine grained, moderately well sorted, rounded, quartzose (with less than 2% black accessory grains, abundant hematite flakes), well indurated, siliceous; abundant calcite cement; weathering masks sedimentary structures; slickensides.....	0.76	2.5
	Total Thickness of Mancos Shale, incomplete.....	38.3	125.7

Dakota Sandstone (Upper Cretaceous).....Not Measured

Section 7.--Coldwater Creek I

(Located in NW 1/4 SE 1/4 sec. 18, T. 37 N., R. 4 W. in southwestern Colorado.)

	Thickness Meters	Thickness Feet
Top of Mesa Dakota Sandstone (Upper Cretaceous), incomplete:		
37. Sandstone, very light gray (N8) to very pale orange (10YR8/2), upper-fine- to lower-fine-grained, well to moderately well sorted, rounded, quartzose (with less than 2% rusty brown hematite flecks), well indurated, siliceous; quartz overgrowths; minor clay; woody plant impressions; trough crossbeds that range from 4 in. to 1 foot (10 to 30) in thickness; hematitic crust about 0.25 in. (6 mm) thick at top of unit; top of unit is undulatory and burrowed.....	3.0	10.0
36. Sandstone, very light gray (N8) to grayish-orange (10YR7/4), very fine grained to fine-grained, moderately to poorly sorted, rounded to subrounded, quartzose (with less than 2% black accessory grains), well indurated; very clayey and silty matrix; wedge shaped horizontal or subhorizontal beds; highly burrowed; burrows form complex interlacing patterns and are about .02 to 0.2 in. (.5 to 5 mm) in diameter; faint crossbedding; possible herringbone crossbeds about a foot thick.....	2.7	9.0
35. Mudstone, shaley, black (N1), poorly indurated, noncalcareous.....	0.3	1.0
34. Sandstone, very pale orange (10YR7/4) to grayish-orange (10YR7/4), fine to very fine grained, moderately well sorted, rounded to subrounded, quartzose, well indurated; abundant silt and clay matrix; noncalcareous; silica overgrowths; trough cross-sets form discontinuous subhorizontal beds that range from 2 in. to 2 ft (5 cm to 60 cm) in thickness; asymmetric ripples on some subhorizontal surfaces between large cross-sets trend N-S suggest a westward current direction; interference ripples on some surfaces; elongate burrows especially on underside of some bedding planes are about 0.1 to 0.6 in. (2 to 1.5 mm) in diameter.....	6.1	20.0
33. Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR6/4), fine-grained to medium-grained, moderately sorted, rounded to subrounded, quartzose, well indurated; quartz overgrowths with abundant silty matrix; noncalcareous; trough		

crossbeds up to about 1 ft (30 cm) thick; woody plant impressions on some surfaces; weathered out mud chip interclasts along base of some troughs; set of interference ripples at very top of unit; weathers blocky and massive.....	4.0	13.0
32. Sandstone and siltstone, interbedded. Sandstone is very light gray (N8), very fine grained, moderately well sorted, rounded to subrounded, quartzose, poorly indurated, silty and clayey, noncalcareous, carbonaceous; flaggy weathering. Siltstone is medium-dark-gray (N4) to very light gray (N8), carbonaceous, poorly indurated. Locally white sandstone is mottled with gray shale by burrowing. White sandstone forms burrow fill. One burrow is curved, 0.6 in. (1.5 cm) wide and 4 in. (10 cm) long on bedding plane.....	0.9	3.0
31. Sandstone, very pale orange (10YR8/2), grayish-orange (10YR7/4) and very light gray (N8), fine to very fine grained, moderately well sorted, rounded, quartzose, well indurated, siliceous, clayey and silty, noncalcareous, locally carbonaceous, horizontally bedded; beds are about 1 in. to 2 ft (2.5 cm to 60 cm) thick; burrows vary in size from 0.3 to .04 in. (7 mm to 1 mm) wide and form a complex intertwining patterns; ripple form sets on several bedding planes throughout unit; one ripple set trends N20E and has a wavelength of .3 in. (7 cm) and an amplitude .16 in. (4 mm).....	5.6	18.5
Note that units 31-37 form a cliff.		
30. Mudstone, black (N1), noncalcareous, poorly indurated....	0.6	2.0
29. Sandstone and shale, interbedded. Sandstone is very light gray (N8), very fine grained, moderately sorted and has clayey and silty matrix. Shale is medium-dark-gray (N4) fissile, and is locally silty or sandy. The unit is poorly indurated, noncalcareous, horizontally laminated, flaggy, burrowed. Burrows are tubular and are up to .06 in. (1.5 mm) wide and .8 + 1.2 in. (2-3 cm) long. They are generally parallel or subparallel to the bedding plane.....	2.3	7.5
28. Coal, black (N1), weathers crumbly and blocky.....	1.4	4.5
Note units 28-30 form a recessed slope.		
27. Sandstone, light gray (N7), lower very fine grained to lower fine grained, moderately well sorted, rounded to subrounded, quartzose (with less than 10% black accessory grains and minor red and green		

	grains), well indurated, siliceous, noncalcareous; silty and clayey matrix; weathers into massive horizontal beds that range from about an inch to a foot (30 cm) in thickness; small scale crossbedding; cross laminations are lined by carbonaceous material; thin shale laminations commonly occur between bed sets and are about 0.08 to 0.12 (2 to 3 mm) thick; ripple form sets commonly at top or base of beds; one ripple set strikes N62E, another N17E; vertical burrows about .06 in. (1.5 mm) in diameter are filled with same sandstone as the host rock; burrows are tubular in cross section with wall of tubes marked by dark carbonaceous material; maximum length burrows about .6 in. (1.5 cm).....	1.8	6.0
26.	Sandstone, grayish-black (N2), lower very fine grained, very silty, poorly indurated, noncalcareous, carbonaceous, quartzose; thin horizontal laminations.....	0.15	0.5
25.	Sandstone and siltstone, interbedded. Siltstone, grayish-black (N2), well indurated and siliceous; locally contains some very fine grained sand. Sandstone, very light gray (N8) and grayish-orange (10YR7/4), lower fine to upper very fine grained, moderately well sorted, rounded to subrounded, quartzose (with less than 10% black accessory grains), well indurated, siliceous; clayey and silty matrix. Unit is noncalcareous and is composed of discontinuous parallel laminations of siltstone and sandstone; locally sandstone and siltstone are mottled indicating burrowing. Unit weathers massively except at top and bottom where 3 in. (7.5 cm) thick siltstone and sandstone beds are separated by .04 in. (1 mm) thick mudstone laminations. Ripple form set near top is fairly symmetrical and trends N54E.....	1.5	5.0
24.	Mudstone, grayish-black (N2), noncalcareous.....	0.1	0.33
23.	Sandstone, very pale orange (10YR8/2), grayish-orange (10YR7/4) and brownish-black (5YR2/1), very fine to lower-fine-grained, moderately well sorted, rounded to subrounded, quartzose, well indurated, non calcareous, siliceous, clayey matrix; weathers massively; carbonaceous debris; some parallel laminations of carbonaceous debris and mudstone about .04 in. (1 mm) thick; woody plant fragments; possible leaf impression 1.6 in. (4 cm) long and 0.6 in. (1.25 cm) wide, tapers to a rounded point; vertical and subhorizontal burrows up to .16 in. (4 mm) in diameter; burrow filling is fine grained and		

	coarser than the host rock; burrow filling is white or very light gray (N8).....	0.3	1.0
22.	Shale and sandstone, interbedded. Shale is dark-gray (N3), sandy, silty, fissile, carbonaceous, noncalcareous. Sandstone is white, (N9), light-gray (N7) to very pale orange (10YR8/2), very fine grained, moderately well sorted, locally calcareous, silty, siliceous. Unit is poorly indurated and consists of interbedded, discontinuous, horizontal laminations of sandstone and shale; locally rippled; vertical tubular burrows about .12 in. (3 mm) in diameter in dark-gray (N9), carbonaceous, very fine grained, sandy siltstone host rock are white (N9), fine-grained and coarser than host.....	0.46	1.5
21.	Sandstone and shale, interbedded. Sandstone is medium-light-gray (N6), grayish-black (N2), and grayish-orange (10YR7/4), very fine grained, moderately sorted, quartzose, moderately indurated, clayey and silty matrix, noncalcareous, very carbonaceous. Sandstone is horizontally bedded with thin intercalations of shale about .12 in. (3 mm) thick; shale is a medium-dark-gray (N6), fissile; sandstone beds separated by shale intercalations range from about 1 in. (2.5 cm) thick at base to 1 ft (30 cm) thick at top of unit; ripple form sets on some bedding surfaces; one slightly asymmetric ripple set strikes N30E; burrows generally occur on bedding plane surfaces; burrows are tubular and up to about .2 in. (.5 cm) in diameter; burrows are filled with the same material as host rock and commonly bifurcate to form complex patterns; one burrow is U-shaped; some woody plant debris.....	1.4	4.5
20.	Sandstone, light-gray (N7) to brownish-black (5YR2/1), very fine grained, moderately well sorted, poorly indurated, quartzose, noncalcareous; clayey matrix; horizontally laminated, extremely carbonaceous.....	0.46	1.5
19.	Sandstone, light gray (N7) to light-brownish gray (5YR6/1), fine-grained with a few scattered medium grains, moderately well sorted, rounded to subrounded, quartzose (minor rusty black flecks), well indurated, noncalcareous, siliceous (quartz overgrowths); clayey matrix; weathers blocky, massive; burrowed especially near top; vertical burrows are .08 in. (2 mm) in diameter and up to 1.6 in. (4 cm) long; locally there is some carbonaceous debris; very well jointed; joints are filled with hematite.....	1.5	5.0

Laterally along cliff face, another Dakota Sandstone unit appears beneath unit 19. It increases from 0 to 7 ft (2.1 m) in thickness within 100 ft (30 m) before it disappears beneath the debris slope. It thickens at the expense of the underlying Burro Canyon Formation. The unit is sandstone, light-gray (N7), very pale orange (10YR8/2) and dark-yellowish-orange (10YR6/6), locally pebbly, lower-medium to coarse-grained, poorly to moderately sorted, rounded to subrounded, moderately to poorly indurated, noncalcareous, quartzose; contains white clay nests; pebbles near base are as much as 1.4 in. (3.5 cm) long; pebbles near base are white, gray tan and red chert; trough crossbeds are 1 to 2 ft (30 to 60 cm) deep.

Total Dakota Sandstone, incomplete.....	34.6	113.8

Burro Canyon Formation (Lower Cretaceous), incomplete:

18.	Siltstone, greenish-gray (5GY6/1) and locally moderate-reddish-brown (10R4/6) and dark-yellowish-orange (10R6/6), poorly indurated, noncalcareous.....	0.6	2.0
17.	Sandstone, very pale orange (10YR8/2) to dark-yellowish-orange (10YR6/6), medium to very fine grained, moderately well sorted, rounded to subrounded, quartzose, well to moderately indurated; abundant clay matrix; noncalcareous; massive blocky weathering; crossbedded; possible burrows. In top half of unit there are several lenticular, less well indurated, sandstone beds about 1 ft (30 cm) thick. These beds are very pale orange (10YR8/2) and dusky-yellowish-brown (desert varnish) on weathered surface, very fine grained, very silty and clayey.....	15.9	52.0

Note units 17-27 form a cliff.

16.	Sandstone, very light gray (N8) to very pale orange (10YR8/2), lower-medium- to fine-grained, poorly sorted, rounded, quartzose (less than 5% black and red accessory grains), poorly indurated, noncalcareous, abundant clay and silt matrix.....	0.9	3.0
15.	Covered, probably sandstone similar to unit 16.....	2.7	9.0

14.	Mudstone, grayish-red-purple (5RP4/2) to greenish-gray (5GY6/1). Contains 2 in. (5 cm) thick sandstone layers that are yellowish-gray (5Y8/1), fine to very fine grained, moderately to poorly sorted, poor to moderately indurated, noncalcareous, quartzose; abundant silt and clay matrix. Mudstone is noncalcareous; grades into a claystone at top of unit.....	1.1	3.5
13.	Sandstone, yellowish-gray (5Y7/2), very fine grained, moderately sorted, rounded to subrounded, quartzose, poor to moderately indurated, noncalcareous; abundant silt and clay matrix.....	0.15	0.5
12.	Mudstone, grayish-red-purple (5RP4/2), poorly indurated, weathers hackly, calcareous.....	1.5	5.0
11.	Siltstone, grayish-red (5R4/2), sandy (sand grains are very fine to upper-medium-grained, rounded), poorly indurated, noncalcareous.....	0.3	1.0
10.	Siltstone, dark-reddish-brown (10R3/4), poorly indurated, noncalcareous, hackly weathering.....	0.3	1.0
9.	Sandstone, moderate-reddish-brown (10R3/4) to dark-reddish-brown (10R3/4), mottled with grayish-green (10GY5/2), medium to very fine grained, poorly sorted, rounded to subrounded, poorly indurated, slightly calcareous, quartzose; abundant silt and clay.....	0.9	3.0
8.	Siltstone, sandy, very-dusky-red (10R2/2), fine to very fine grained, poorly indurated; noncalcareous, hackly weathering.....	1.2	4.0
7.	Sandstone, light gray (N7), dark-yellowish-orange (10YR6/2) and moderate-reddish-brown (10R4/6), lower fine to very fine grained, moderate to poorly sorted, rounded to subrounded, quartzose, poorly indurated; abundant clay and silt matrix.....	0.3	1.0
6.	Sandstone, mostly covered, dark-yellowish-orange (10YR6/6), upper-medium to very fine grained, poorly sorted, rounded to subangular, quartzose, hematite staining, poor to moderately indurated, noncalcareous; clayey and silty.....	1.2	4.0
5.	Covered, probably the same sandstone as in unit 4.....	2.4	8.0

4. Sandstone, mostly covered, light-olive-gray (5Y6/1) to grayish-orange (10YR7/4), medium-grained, moderately well sorted, rounded to subrounded, quartzose (with less than 5% green, black and red accessory grains), poorly indurated, clayey and silty,noncalcareous.....	2.1	7.0

Note units 4-16 form steep slope.

3. Sandstone and Pebbly Sandstone, very pale orange (10YR8/2) to grayish-orange (10YR7/4). Sandstone is upper-medium- to upper-fine-grained. Pebbly sandstone is upper-fine to coarse-grained with pebbles as long as 1 1/5 in. (3 cm); pebbles are gray, tan and red chert. Sandstone and pebbly sandstone is moderately to poorly sorted, rounded to angular, quartzose, moderately indurated, noncalcareous; silty matrix; trough crossbeds; grades into overlying unit.....	2.1	7.0

Note unit 3 forms ledge.

2. Covered.....	4.8	16.0

Note unit 1 forms ledge and unit 2 forms steep slope.

1. Sandstone and pebbly sandstone, very light gray (N8) to grayish-orange (10YR7/4). Sandstone is fine to very fine grained. Pebbly sandstone is fine-grained to coarse-grained with pebbles as large as 3.2 in. (8 cm) in length; pebbles include black, white, gray, and red chert and white quartzite. Sandstone and pebbly sandstone is poorly sorted, rounded to angular, quartzose, well indurated, noncalcareous, siliceous; clayey matrix; trough crossbeds.....	2.1	7.0
Total Burro Canyon (incomplete).....	38.5	126.0
Total thickness of section 7.....	25.1	246.8

Section 8.--Coldwater Creek II

(Located in SW 1/4 sec. 7, T. 37 N., R. 4 W. in southwestern Colorado.)

	Thickness Meters	Thickness Feet
Top of Mesa		
Burro Canyon(?) Formation (Lower Cretaceous), incomplete:		
6. Sandstone and conglomerate (equivalent to units 38 and 39 in Coldwater Creek V section), white.....	Not Measured	
Note unit 6 forms ledge.		
5. Mudstone (equivalent to unit 5 in Coldwater Creek V section), red; pinches out to north.....	0.3	1.0
Note unit 5 forms slope.		
4. Sandstone (equivalent to units 35 and 36 of Coldwater Creek V section).....	5.5	18.0
3. Shale (equivalent of unit 32 in Coldwater Creek V section).....	0.09	0.3
2. Sandstone (equivalent of unit 31 in Coldwater V section), rippled.....	0.9	3.0
Note units 2-4 form ledge.		
1. Mudstone (equivalent to unit 30c in Coldwater Creek V section).....	0.9	3.0
Note unit 1 forms slope.		
Unit 1 rests on equivalent of unit 30b in Coldwater Creek V section.		
Total Burro Canyon(?) Formation, incomplete.....	7.7	25.3
Brushy Basin Member of the Morrison Formation (Upper Jurassic)	Not Measured	

Section 9.--Coldwater Creek III

(Located in SW 1/4 sec. 7, T. 37 N. R. 4 W. in southwestern Colorado.)

	Thickness	
	Meters	Feet
Top of Mesa		
Burro Canyon(?) Formation (Lower Cretaceous), incomplete:		
6. Sandstone and conglomeratic sandstone, mostly covered (equivalent to unit 39 of Coldwater Creek V section)...	7.6	25.0
Note unit 6 forms cliff at top of mesa.		
5. Mudstone (equivalent to unit 5 of Coldwater Creek V section), red.....	1.8	6.0
Note unit 5 forms a slope.		
4. Sandstone (equivalent to units 35 and 36 in Coldwater Creek V section); finer grained than equivalent units in section V; rare conglomeratic layers, oscillation ripples.....	3.7	12.0
3. Mudstone (equivalent to unit 32 in Coldwater Creek V section).....	0.06	0.2
2. Sandstone (equivalent to rippled sandstone in unit 31 in Coldwater Creek V section).....	0.6	2.0
Note units 2-5 form a ledge.		
1. Mudstone and siltstone, red.....	1.8	6.0
Note unit 1 is a slope former.		
Unit one rests on equivalent to unit 30b in Coldwater Creek V section.		
Total Burro Canyon(?) Formation, incomplete.....	15.5	51.2
Brushy Basin Member of the Morrison Formation (Upper Jurassic)	Not Measured	

Section 10.--Coldwater Creek IV

(Located in SW 1/4 sec. 7, T. 37 N., R.4 W. in southwestern Colorado.)

	Thickness Meters	Feet
Top of Mesa:		
Burro Canyon(?) Formation (Lower Cretaceous), incomplete:		
6. Sandstone and conglomeratic sandstone (lateral equivalent of unit 39 of Coldwater Creek V section), pinkish-gray (5YR8/1), medium- to fine-grained, quartzose, poorly sorted, rounded to subrounded; clasts are rounded to angular, as large as 2.8 in. (7 cm) in length and consist of abundant white tripolitic chert and black, gray, and green chert and orange-brown quartzite.....	3.0	10.0
5. Mudstone and siltstone, grayish-red (5R4/2), top 6 in. (15 cm) greenish-gray (5GY6/1)], poorly indurated, noncalcareous, hackly weathering; siltstone at base grades into mudstone at top.....	3.0	10.0
4. Sandstone (equivalent to unit 35 and 36 in Coldwater Creek V section), light-greenish-gray (5G8/1) to pale-red (5R6/2), very fine grained, moderately to well sorted, quartzose, well indurated, siliceous; abundant clay and silt in matrix, noncalcareous; generally horizontally crossbedded; oscillation ripples at top; pockets in upper part of unit formed from weathered out intraclasts; burrows on some bedding planes that form complex intertwining patterns; burrows are about 1.2 in. (3 cm) wide and subhorizontal.....	1.4	4.5
3. Mudstone, silty, light-brownish-gray (5YR6/1) and medium-bluish-gray (5B5/1).....	0.3	1.0
2. Sandstone (probable equivalent to unit 31 of Coldwater Creek V section), grayish-orange (10YR7/4) to pale-reddish-brown (10R5/4), very fine grained, moderately well sorted, rounded, quartzose, well indurated, noncalcareous; siliceous with quartz overgrowths; clay and silt in matrix; discontinuous wavy climbing ripples laminations.....	1.4	4.6

Note units 2-6 form a cliff.

1. Mudstone, silty, medium-bluish-gray (5B5/1), poorly indurated, noncalcareous; hackly weathering.....	0.3	1.0

Note unit 1 forms a slope.

Total Burro Canyon(?) Formation, incomplete.....	9.4	31.1
Brushy Basin Member of the Morrison Formation (Upper Jurassic)	Not Measured	

Section 11.--Coldwater Creek V

(Located in SW 1/4 of sec. 7, T.37 N., R. 4 W. in southwestern Colorado.)

	Thickness Meters	Thickness Feet
Top of Mesa Burro Canyon(?) Formation (Lower Cretaceous), incomplete:		
42. Mudstone, grayish-red (5R4/2), poorly indurated, noncalcareous.....	0.6	2.0
41. Shale and sandstone, interbedded. Sandstone is white (N9) to pinkish-gray (5YR8/1) to grayish orange-pink (5YR7/1), very fine grained to fine-grained, moderately well sorted, quartzose (with less than 10% orange flecks), moderately indurated, noncalcareous; muddy matrix. Mudstone interbeds are light-greenish-gray (5GY8/2) to grayish-red-purple (5RP4/2), poorly indurated, noncalcareous. Unit generally weathers to flaggy slabs; beds are horizontal; sandstone beds range from about 4 in. to 1 ft (10 to 30 cm) in thickness; mudstone beds range from about 1 in. to 6 in. (2.5 to 15 cm) in thickness; top of unit contains oscillation ripple form sets. Unit interfingers laterally with a thin lenticular conglomeratic sandstone that ranges from 0 to 1.5 ft (0 to 45 cm) in thickness. Conglomeratic sandstone is pinkish-gray (5YR8/1) to very light-gray (N8), lower-coarse-grained to lower-medium-grained, poorly sorted, subrounded to sub angular, moderately to well indurated, noncalcareous, siliceous; muddy matrix; contains tan, green, red, orange, black, and gray chert clasts as much as 1.6 in. (4 cm) long; also small angular intraclasts up to 0.6 in. (1.5 cm) that are composed of fine-grained sandstone with abundant muddy matrix. Conglomeratic sandstone is probably a small channel sandstone.....	2.7	9.0
40. Mudstone, greenish-gray (5GY6/1) and grayish-red (5R4/2), poorly indurated, noncalcareous, hackly weathering.....	0.3	1.0
39. Sandstone, white (N9) to very pale orange (10YR8/2), fine-grained to very fine grained, locally conglomeratic, poorly sorted, rounded, well indurated, noncalcareous; abundant clay and silty matrix; quartzose with chert and quartzite clasts; clasts consist primarily of tripolitic white chert but also include tan, gray and red chert and brown quartzite; clasts range from coarse-grained sand to pebbles as large as 1.6 in. (4 cm) across; local		

	mudstone intraclasts are as large as 6.4 in. (16 cm) across; minor black and orange accessory grains; trough crossbeds up to 1.5 ft (45 cm) deep; some contorted bedding.....	11.0	36.0
38.	Conglomerate, very pale orange (10YR7/2) to grayish-orange (10YR7/4), matrix supported. Matrix is lower-medium to very fine grained, poorly sorted, rounded to subrounded, quartzose, moderately well to well indurated, noncalcareous, clayey. Chert clasts are cryptocrystalline and as much as 1.6 in. (4 cm) in length and consist of tripolitic chert, white, gray, tan, and orange chert, and some orange and purple quartzite; abundant light-greenish-gray (5G8/1) mudstone intraclasts are as large as 13 in. (32 cm); some intraclasts are fine-to very fine grained, greenish-gray sandstone; unit thickens and thins, laterally; scour surface at base is base of a large channel.....	0.6	2.0
37.	Sandstone, grayish-orange (10YR8/2), upper-medium to upper-fine-grained, poorly sorted, rounded to subrounded, quartzose (contains less than 5% orange and red accessory grains), well indurated, noncalcareous, siliceous; white clay nests; locally contains chert clasts that range in size from coarse-grained sand to pebbles as large as 0.4 in. (1 cm) across; clasts mainly consist of white tripolitic chert; contains trough cross-beds which range from about 4 in. to 1 ft (10 to 30 cm) in thickness.....	3.2	10.5
36.	Conglomerate, white (N1), matrix supported. Matrix is quartzose, lower-coarse- to upper-fine-grained, rounded to subrounded, poorly sorted, moderately to well indurated, noncalcareous, clayey, siliceous. Clasts range in size from upper-medium-grained to pebbles as large as 1.4 in. (3.5 cm) across; greenish-gray (5GY8/1) clasts of sandstone and mudstone are up to about 13 in. (32 cm) in length; clasts are well rounded to angular and consist predominantly of orange, tan, red, black and tripolitic white chert; there are also a few orange to tan quartzite pebbles. Base of unit scours into underlying unit; unit thickens and thins laterally and is locally absent; scour surface at base of unit is base of large channel.....	0.6	2.0
35.	Sandstone, very pale orange (10YR8/2) to white (N9), lower-fine-grained, moderately well sorted, rounded to subrounded, noncalcareous, well indurated; quartzose with less than 2% black accessory grains; clay matrix; climbing ripple forsets. Unit thickens along cliff face to the north to about 6		

	ft (1.8 m) and thins to the south to about 3 ft (90 cm) over a distance of 75 ft (23 m) and then thins to 0 ft in less than 4 ft (1.2 m) (at a point that appears to be a reactivation surface); oscillation ripples occur at base of unit.....	1.2	4.0
34.	Sandstone, yellowish-gray (5Y7/2), very fine grained, moderately to poorly sorted, poorly indurated, noncalcareous, locally very silty, quartzose, horizontal bedded, weathers flaggy.....	0.12	0.4

Note units 33-42 form cliff.

33.	Sandstone, light-olive-gray (5Y6/1) to light-greenish-gray (5GY8/1), lower-fine to upper very fine grained, moderately to poorly sorted, rounded, quartzose, noncalcareous, moderately well indurated; abundant clay and silt; rare oscillation ripple form sets on some bedding surfaces; some climbing ripple forsets; predominately horizontal bedding; burrow trace on one bedding plane is .08 in. (2 mm) wide and 1.2 in. (8 cm) long.....	0.6	2.0
	Total Burro Canyon(?) Formation, incomplete.....	20.9	68.9

Brushy Basin Member of the Morrison Formation (Upper Jurassic), incomplete:

32.	Mudstone, greenish-gray (5GY6/1) to grayish-red (5R4/2), poorly indurated, siliceous, noncalcareous, hackly weathering.....	1.2	4.0
31.	Sandstone, light-greenish-gray (5G8/1), upper-fine-grained, well indurated, extremely siliceous; thickens laterally to south along outcrop.....	0.15	0.5
30.	Mudstone, greenish-gray (5GY6/1) and grayish red (5R4/2), poorly indurated, noncalcareous, hackly weathering.....	0.76	2.5
29.	Hard layer, greenish-gray, well indurated, blocky weathering, siliceous.....	0.3	1.0
28.	Mudstone, grayish-red (5R4/2), poorly indurated, noncalcareous; hackly weathering.....	0.3	1.0
27.	Hard layer, light-olive-gray (5Y6/1) to light-brownish-gray (5YR6/1), well indurated, siliceous, blocky weathering.....	0.15	0.5
26.	Mudstone, grayish-green (10GY7/2) and grayish-red (5R4/2), locally siliceous especially in lower part, poorly indurated; grades into overlying unit.....	1.4	4.5

25.	Hard layer, medium-gray (N5), very well indurated, blocky weathering.....	0.12	0.4
24.	Mudstone, olive-gray (5Y4/1) to brownish-gray (5Y4/8), siliceous; more siliceous toward top; basal part poorly indurated; top part moderately indurated; noncalcareous; hackly weathering.....	2.4	8.0
23.	Sandstone, pale-brown (5YR5/2) to light-brownish-gray (5YR5/1), lower very fine grained, extremely well indurated, siliceous, quartzose; weathers blocky; thickens and thins laterally.....	1.2	4.0
22.	Mudstone, mottled light-greenish-gray (5G8/1) and light-brownish-gray (5YR6/1), very siliceous, well indurated, highly fractured; grades laterally into sandstone.....	1.5	5.0
21.	Bentonite, pale-red-purple (5RP6/2) to light-gray (N7), poorly indurated.....	0.15	0.5
20.	Hard layer, grayish-yellow-green (5GY7/2), well indurated, siliceous; weathers blocky.....	0.3	1.0
19.	Mudstone, olive-gray (5Y4/1) to light-brownish-gray (5YR6/1), poorly indurated; locally very siliceous, particularly near base.....	1.2	4.0
18.	Hard layer, light-olive-gray (5Y6/1), with moderate-reddish-brown (10R4/6) flecks, well indurated.....	0.3	0.9
17.	Mudstone, possibly bentonite, light-olive-gray (5Y5/2) and moderate-yellow (5Y5/2), poorly indurated.....	0.12	0.4
16.	Hard layer and sandstone. Sandstone is very pale orange (10YR4/2) to grayish-orange (10YR7/4), very fine-grained, quartzose, extremely siliceous, well indurated, blockly weathering, lenticular. Hard layer is light-greenish-gray (5G8/1), siliceous, moderate-reddish-brown (10R4/6) flecks, well indurated, weathers blocky.....	1.2	4.0
15.	Hard layer, light-greenish-gray (5GY8/1), well indurated, weathers blocky.....	0.3	1.0
14.	Siltstone, light-brownish-gray (5YR6/1) and olive-gray (5Y4/1), locally very siliceous, poorly indurated, hackly weathering, noncalcareous; locally has medium-reddish-brown (10R4/6) spots; grades up into hard layer.....	1.5	5.0

13.	Mudstone, very pale orange (10YR8/2) to pinkish-gray (5YR8/1), siliceous, fractured, poorly to moderately indurated, hackly weathering.....	1.2	4.0
12.	Hard layer, greenish-gray (5GY6/1) and light-brownish-gray, extremely well indurated; very fractured; forms prominent cliff; separates into two layers laterally.....	3.4	11.0
11.	Siltstone, olive-gray (5Y4/1) and light-brownish-gray (5YR6/1), very siliceous, poorly indurated; noncalcareous, orange flecks, hackly weathering, grades into overlying unit.....	0.9	3.0
10.	Hard layer, greenish-gray (5GY6/1) very well indurated; weather blocky.....	0.6	2.0
9.	Hard layer and sandstone. Sandstone is pale-yellowish-brown (10YR6/2), very fine grained, extremely well indurated; very siliceous; thickens and thins laterally; appears to scour-out a hard layer laterally. Hard layer is greenish-gray (5GY5/1) and weathers blocky.....	0.6	2.0
8.	Mudstone, light-brownish-gray (5YR6/1) and olive-gray (5YR4/1), noncalcareous, poorly indurated, hackly weathering, locally siliceous.....	0.9	3.0
7.	Mudstone, pale-brown (5YR5/2), noncalcareous, poorly indurated, hackly weathering.....	0.6	2.0
6.	Hard layer, siliceous mudstone, greenish-gray (5GY5/1), locally little orange possible hematite flecks.....	0.15	0.5
5.	Bentonite, light-gray (N7), very poorly indurated, noncalcareous.....	0.15	0.5
4.	Siltstone, olive-gray (5Y4/1), orange flecks are moderate-reddish-brown (10RY4/6), very siliceous, moderately to well indurated, blocky weathering.....	1.8	6.0
3.	Mudstone, pale-red (10R6/2) and olive-gray (5Y4/1); generally very siliceous and locally very siliceous; crumbly weathering; highly fractured.....	1.8	6.0
2.	Sandstone, pinkish-gray (5YR8/1), very fine grained, rounded to subrounded, moderately to poorly sorted, quartzose (with less than 10% black accessory grains and biotite flecks, and scarce green grains and blebs of hematite which appear to be weathered biotite), poor to moderately indurated, very slightly calcareous, clayey; weathers blocky; forms a persistent ledge.....	0.46	1.5

Note units 1-32 form slope with minor ledges.

1. Mudstone, pinkish-gray (5YR8/1, poorly indurated, noncalcareous; scattered moderate-reddish-brown (10R4/6) spots; locally very siliceous; overall unit is siliceous also highly fractured and crumbly....	5.2	17.0
Total Brushy Basin Member, incomplete.....	32.3	106.7
Total thickness.....	53.3	175.6

Section 12.--Coldwater Creek VI

(Located in SW 1/4 sec. 7, T. 37 N., R. 4 W. in southwestern Colorado.)

	Thickness	
	Meters	Feet
Top of Mesa		
Burro Canyon(?) Formation (Lower Cretaceous), incomplete:		
4. Sandstone and conglomerate.....unmeasured		
3. Sandstone and conglomerate (equivalent to? units 35 and 36 in Coldwater Creek V section).....	4.9	16.0
2. Sandstone (equivalent to unit 33 of Coldwater Creek V section), rippled.....	2.0	6.5
Note units 1-4 form cliff.		
1. Sandstone (equivalent to unit 31 of Coldwater Creek V section), rippled.....	0.3	1.0
Total Burro Canyon(?) Formation.....	7.2	23.5
Brushy Basin Member of the Morrison Formation (Upper Jurassic)	Not Measured	