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Mesozoic stratigraphy at Durango, Colorado

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New Mexico Geological Society, 56th Field Conference Guidebook, Geology of the Chama Basin, 2005, p. 160-169.

MESOZOIC STRATIGRAPHY AT DURANGO, COLORADO

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Abstract.—A nearly 3-km-thick section of Mesozoic sedimentary rocks is exposed at Durango, Colorado. This section consists of Upper Triassic, Middle-Upper Jurassic and Cretaceous strata that well record the geological history of southwestern Colorado during much of the Mesozoic. At Durango, Upper Triassic strata of the Chinle Group are ~ 300 m of red beds deposited in mostly fluvial paleoenvironments. Overlying Middle-Upper Jurassic strata of the San Rafael Group are ~ 300 m thick and consist of eolian sandstone, salina limestone and siltstone/sandstone deposited on an arid coastal plain. The Upper Jurassic Morrison Formation is ~ 187 m thick and consists of sandstone and mudstone deposited in fluvial environments. The only Lower Cretaceous strata at Durango are fluvial sandstone and conglomerate of the Burro Canyon Formation. Most of the overlying Upper Cretaceous section (Dakota, Mancos, Mesaverde, Lewis, Fruitland and Kirtland units) represents deposition in and along the western margin of the Western Interior seaway during Cenomanian-Campanian time. Volcaniclastic strata of the overlying McDermott Formation are the youngest Mesozoic strata at Durango.

INTRODUCTION

Durango, Colorado, sits in the Animas River Valley on the northern flank of the San Juan Basin and in the southern foothills of the San Juan and La Plata Mountains. Beginning at the northern end of the city, and extending to the southern end of town (from north of Animas City Mountain to just south of Smelter Mountain), the Animas River cuts in an essentially downdip direction through a homoclinal Mesozoic section of sedimentary rocks about 3 km thick (Figs. 1-2). This section encompasses nonmarine red beds of the Upper Triassic Chinle Group; eolian sandstones, salina limestones and arid coastal plain deposits of the Middle-Upper Jurassic San Rafael Group; fluvial sandstones and mudstones of the Upper Jurassic Morrison Formation; and marginal marine sandstones, marine shale and nonmarine coal-bearing strata of the Upper Cretaceous Dakota, Mancos, Mesaverde, Lewis and other formations. As Larsen and Cross (1956, p. 48) noted, "an excellent place to study the complete Mesozoic section is near Durango" (also see Kottlowski, 1957). Here, we provide a review of the stratigraphy of this section.

TRIASSIC SYSTEM

Chinle Group

Upper Triassic strata in southwestern Colorado were originally referred to the Dolores Formation of Cross (1899). Nevertheless, it has long been clear that the Dolores Formation, usually divided into three informal members, can be correlated with Chinle Group units in nearby southeastern Utah and northeastern Arizona (e.g., Stewart et al., 1972; Lucas, 1993; Lucas et al., 1997) (Fig. 3).

The "lower member of the Dolores Formation" is as much as 30 m of greenish-gray to tan, fine-grained quartzose sandstone and calcrete-pebble conglomerate, which locally contains siliceous pebbles. It rests unconformably on the Lower Permian Cutler Group, and is demonstrably correlative to the Moss Back Formation of the Chinle Group in southeastern Utah (Stewart et al., 1972; Lucas et al., 1997).

The overlying "middle member of the Dolores Formation" is up to 90 m of grayish red siltstone, mudstone, trough-crossbedded fine-grained sandstone and limestone-pebble conglomerate.

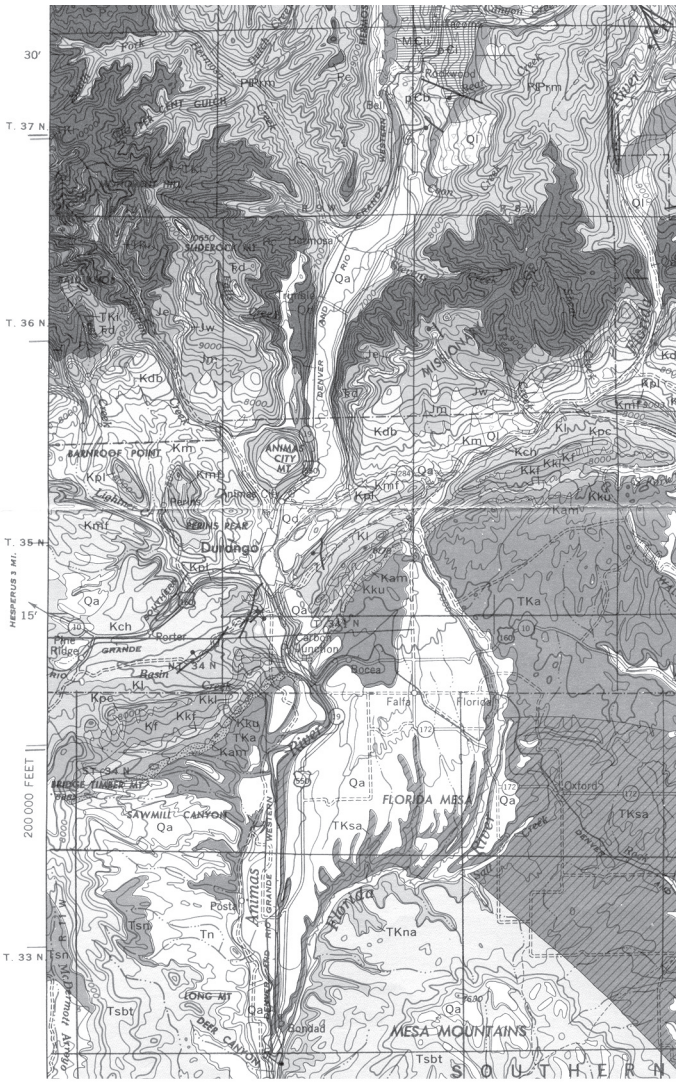


FIGURE 1. Geologic map of the Durango area (after Steven et al., 1974). Unit acronyms (in ascending stratigraphic order) are: TRd = Chinle Group, Jw = San Rafael Group, Jm = Morrison Formation, Kd = Burro Canyon and Dakota formations, Km = Mancos Shale, Kpl = Point Lookout Sandstone, Kch = Cliff House Sandstone, Kmf = Menefee Formation, Kpc = Pictured Cliffs Sandstone, Kl = Lewis Shale, Kf = Fruitland Formation, Kk = Kirtland Formation, Kam = McDermott Formation and Tka = Animas Formation.

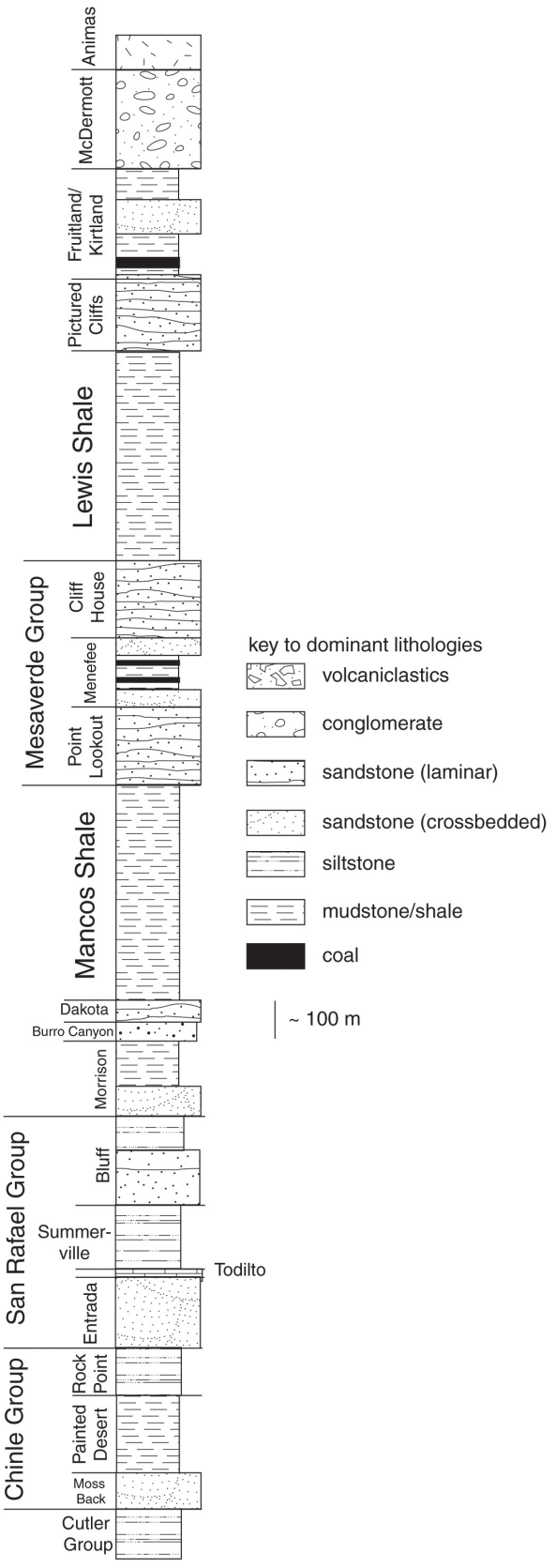


FIGURE 2. Generalized Mesozoic stratigraphic section at Durango.

The conglomerate beds are the "saurian conglomerates" of earlier workers and yield phytosaurs and other vertebrate fossils of Revueltian (Norian) age (Lucas, 1993). Stratigraphic position, lithotypes and paleontology correlate the "middle member" to the upper part of the Petrified Forest Formation (Painted Desert Member) of the Chinle Group in northeastern Arizona (Stewart et al., 1972; Lucas et al., 1997).

The "upper member of the Dolores Formation" is as much as 177 m of repetitively bedded light brown and reddish brown siltstone and sandy siltstone. Siltstone beds contain diverse evidence of calcrete pedogenesis (Blodgett, 1988), and a fluvial sandstone interval at the top of the Rock Point Formation may correlate to the Hite Bed in Utah. The stratigraphic position, lithotypes and paleontology of the "upper member" equate it to the Rock Point Formation of the Chinle Group in adjacent states (Stewart et al., 1972; Lucas et al., 1997).

JURASSIC SYSTEM

San Rafael Group

Like the Triassic strata, much of the Jurassic section around Durango embodies a local and unnecessary (redundant) stratigraphic nomenclature that was created for the Jurassic rocks in this part of southwestern Colorado and can be abandoned (Lucas and Anderson, 1997). These are units of the San Rafael Group (Figs. 4-5) that can now be assigned to the (in ascending order): Entrada, Todilto, Summerville and Bluff formations. The base of the San Rafael Group (= base of the Entrada Sandstone) is a regional unconformity on the Rock Point Formation of the Chinle Group. This is the J-2 unconformity of Pipiringos and O'Sullivan (1978). Deposition may have taken place in the Durango area during the Early Jurassic, but erosion associated with the J-2 unconformity removed the Lower Jurassic deposits.

At Durango, the Entrada Sandstone is about 87 m of light gray to white, fine- to coarse-grained sandstone with trough crossbeds. These strata of eolian origin form a prominent cliff or bench.

The overlying Luciano Mesa Member of the Todilto Formation is about 1.5 m of dark gray, thinly laminated, kerogenic limestone. It represents deposition in a vast salina lake that covered much of northern New Mexico and part of southwestern Colorado (Lucas et al., 1985; Kirkland et al., 1995; Lucas and Anderson, 1996).

The Summerville Formation is about 31 m of red-bed siltstone, sandstone and shale in thin, repetitive beds. Goldman and Spencer (1941) named the prominent sandstone at its base (about 5 m thick) the Bilk Creek Sandstone Member. Summerville deposition took place on a vast arid coastal plain that extended from Utah to Oklahoma (Anderson and Lucas, 1992, 1994; Lucas and Anderson, 1997).

The overlying Bluff Sandstone consists of two members. The lower member is about 66 m of eolian sandstone that was the Junction Creek Sandstone of Goldman and Spencer (1941) and is here considered the Junction Creek Member of the Bluff Sandstone. About 33 m above the base of the sandstone there is a

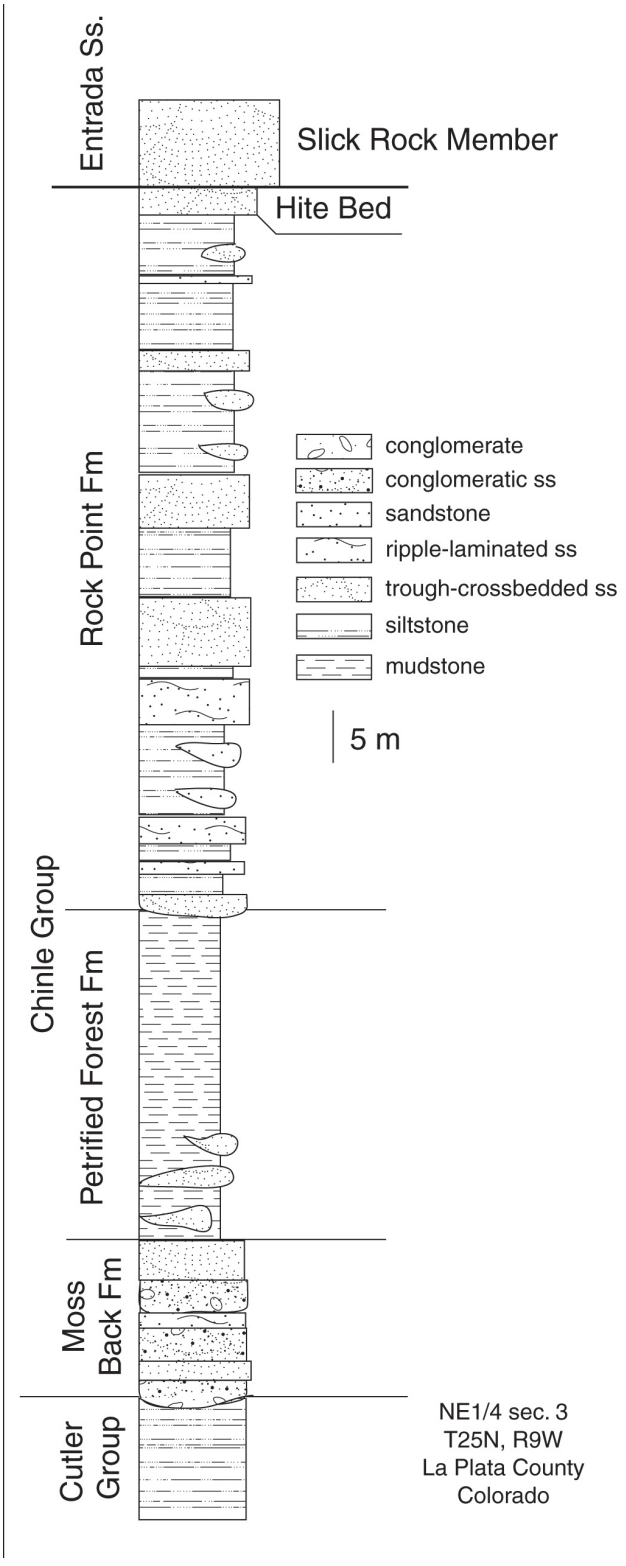


FIGURE 3. Measured stratigraphic section of Upper Triassic Chinle Group north of Durango in NW ¼ NE ¼ sec. 3, T35N, R9W. Measured in September 1996 by Spencer G. Lucas and Orin J. Anderson.

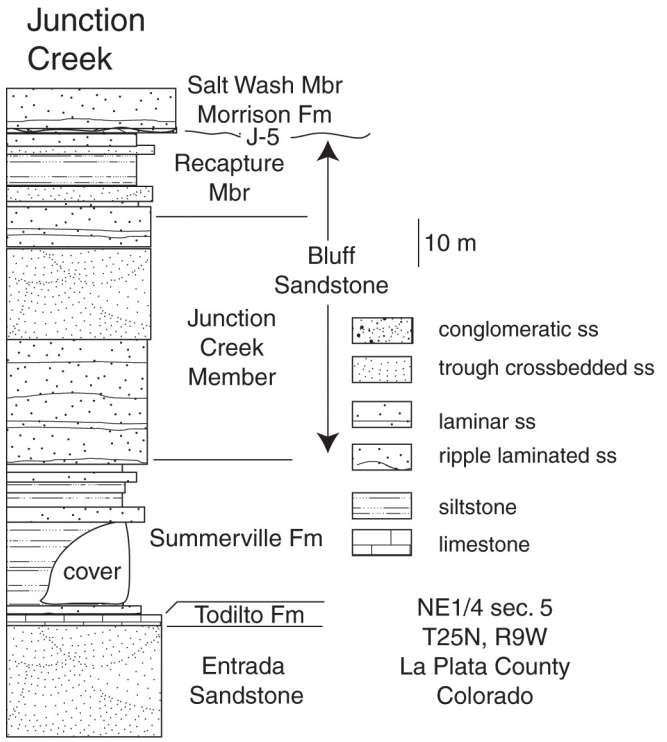


FIGURE 4. Measured stratigraphic section of Jurassic San Rafael Group at Junction Creek north of Durango in NE ¼ sec. 5, T35N, R9W. Measured in September 1996 by Spencer G. Lucas and Orin J. Anderson.

significant bedform change, from laminar/massive beds below to east-dipping foresets above. The overlying, Recapture Member of the Bluff is about 16 m thick and consists of strata remarkably similar to the underlying Summerville.

The eolian, salina and arid coastal plain deposits of the San Rafael Group have not yielded fossils in the Durango area, and yield relatively few fossils regionally. However, regional stratigraphic relationships, some biostratigraphy and radioisotopic dates indicate the Entrada and Todilto are of Middle Jurassic (Callovian) age, the Summerville may encompass the Middle-Upper Jurassic boundary (it is Callovian-Oxfordian in age) and the Bluff Sandstone is of Late Jurassic (Oxfordian?) age (Anderson and Lucas, 1997; Lucas and Anderson, 1997).

Morrison Formation

At Durango, the Morrison Formation consists of two members, Salt Wash (below) and Brushy Basin (above). The Salt Wash Member rests with marked unconformity on the Recapture Member of the Bluff. This is the J-5 unconformity of Pipiringos and O'Sullivan (1978), and we consider it to be the base of the Morrison tectonosequence above the San Rafael Group (Anderson and Lucas, 1995, 1996, 1997).

At Durango, the Salt Wash Member is about 82 m thick and consists of crossbedded sandstone and conglomeratic sandstone with interbeds of reddish brown mudstone. The Brushy Basin

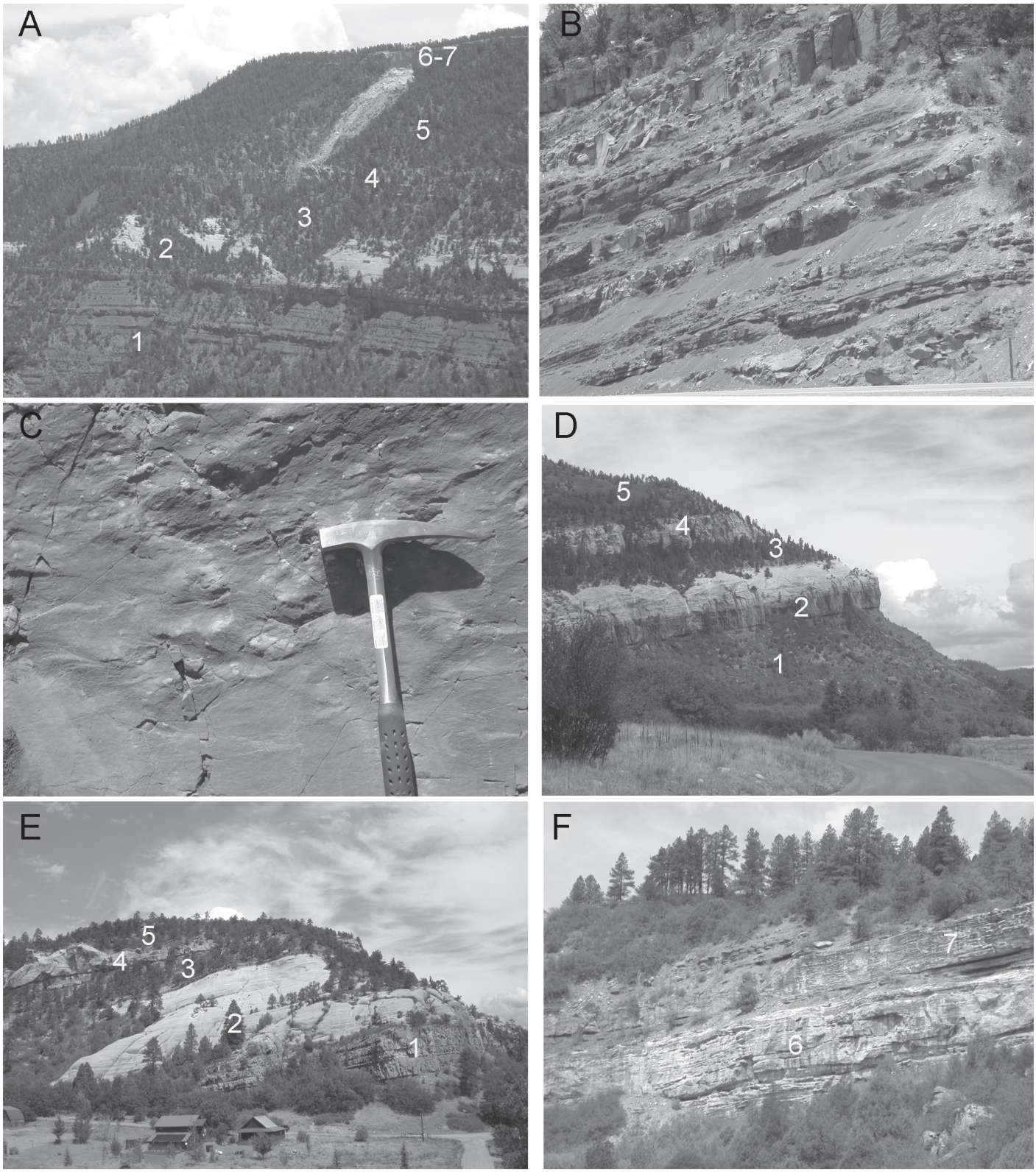


FIGURE 5. Selected Mesozoic outcrops in the Durango area. **A,** Chinle Group (1), Entrada Sandstone (2), Todilto-Summerville formations (3), Bluff Sandstone (4), Morrison Formation (5) and Burro Canyon-Dakota formations (6-7) northeast of Animas City Mountain, east of the Animas River. **B,** Rock Point Formation of Chinle Group in roadcut of Highway 550 in NE ¼ NE ¼ sec. 9, T35N, R9W. **C,** Calcrete nodules in Chinle siltstone at outcrop in B. **D,** Chinle Group (1), Entrada Sandstone (2), Todilto-Summerville formations (3), Bluff Sandstone (4) and Morrison Formation (5) near Falls Creek. **E,** Chinle Group (1), Entrada Sandstone (2), Todilto-Summerville formations (3), Bluff Sandstone (4) and Morrison Formation (5) at Junction Creek, NE ¼ sec. 5, T35N, R9W. **F,** Burro Canyon (6) and Dakota (7) formations north of Chapman Lake in NE ¼ sec. 6, T35N, R9W.

Member is about 105 m thick and is mostly greenish gray bentonitic mudstone with a few interbeds of arkosic sandstone and silica-pebble conglomerate. Regional biostratigraphy, magnetostratigraphy and radioisotopic dates from the Morrsion Formation indicate it is of Late Jurassic age (Anderson and Lucas, 1997).

CRETACEOUS SYSTEM

The Cretaceous section exposed at Durango (Figs. 6-7) is 2267 m thick and consists of the following units (in ascending order): Burro Canyon Formation, Dakota Sandstone, Mancos Shale (with several subdivisions), Mesaverde Group (Point Lookout Sandstone, Menefee Formation and Cliff House Sandstone), Lewis Shale, Pictured Cliffs Sandstone, Fruitland Formation, Kirtland Formation and McDermott Formation.

Burro Canyon Formation

At Durango, the Burro Canyon Formation is about 22 m thick and is mostly trough-crossbedded sandstone and chert-pebble conglomerate and minor green claystone (Steven et al., 1974). The Burro Canyon Formation encompasses Lower Cretaceous nonmarine strata deposited in a foreland basin of the Sevier fold and thrust belt (Aubrey, 1996). Palynology and regional stratigraphic correlation indicates the Burro Canyon is of Early Cretaceous age. The unconformity at the base of the Burro Canyon Formation is the K1 unconformity, and the K3 unconformity separates it from the overlying Dakota Sandstone.

Dakota Sandstone

At Durango, the Dakota Sandstone is up to 48 m thick and consists of a lower unit of sandstone and carbonaceous shale with thin discontinuous coal lenses capped by sandstone with carbonaceous lenses. Essentially all of these strata are assigned to the "main body" of the Dakota Formation and are of Late Cretaceous (Cenomanian) age. However, a meter or so of bioturbated shoreface sandstone at the top of the Dakota Formation is a thin edge of the Paguate Sandstone Tongue onlapping the Dakota main body (D. Owen, written commun., 2003). Dakota strata represent the onset of deposition along the western margin of the Western Interior seaway.

Mancos Shale

The total thickness of the Mancos Shale at Durango is about 623 m, and it is mostly slope and valley-forming dark gray to black shale, silty/sandy shale and lesser amounts of dark gray, clayey limestone in lenses and concretions that weather yellowish-brown. No effort has been made to map the various subdivisions of the Mancos Shale in the Durango area, but the subdivisions delineated near Cortez, Colorado (about 50 km west of Durango) by Leckie et al. (1997) can be recognized in the Mancos Shale section at Durango.

Thus, the lower 46 m of the Mancos Shale at Durango are grayish black shale with some limey lenses assigned to the Gra-

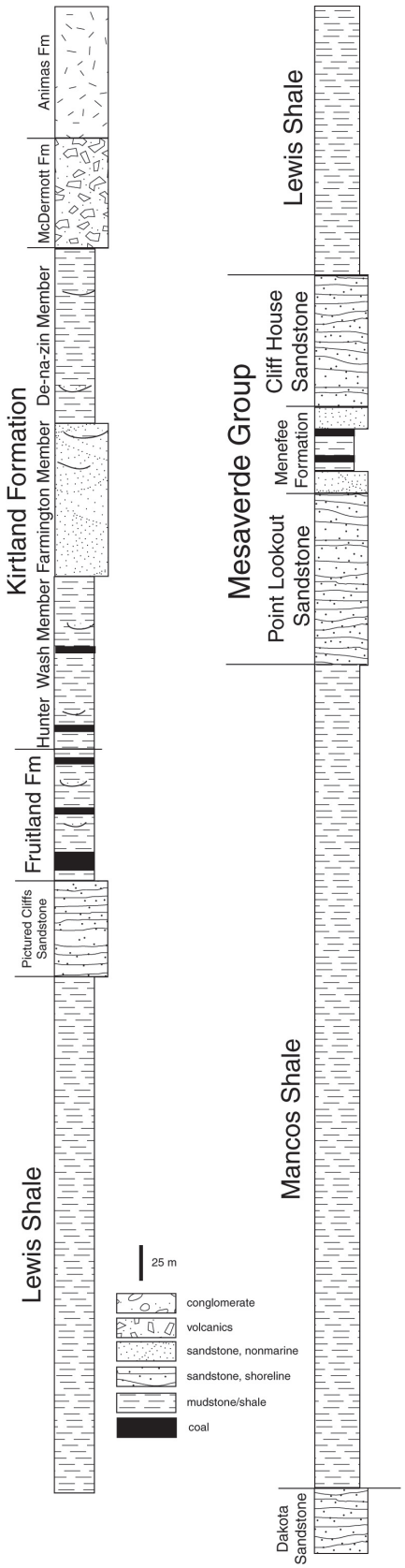


FIGURE 6. Generalized Cretaceous stratigraphic section at Durango (after Zapp, 1949).

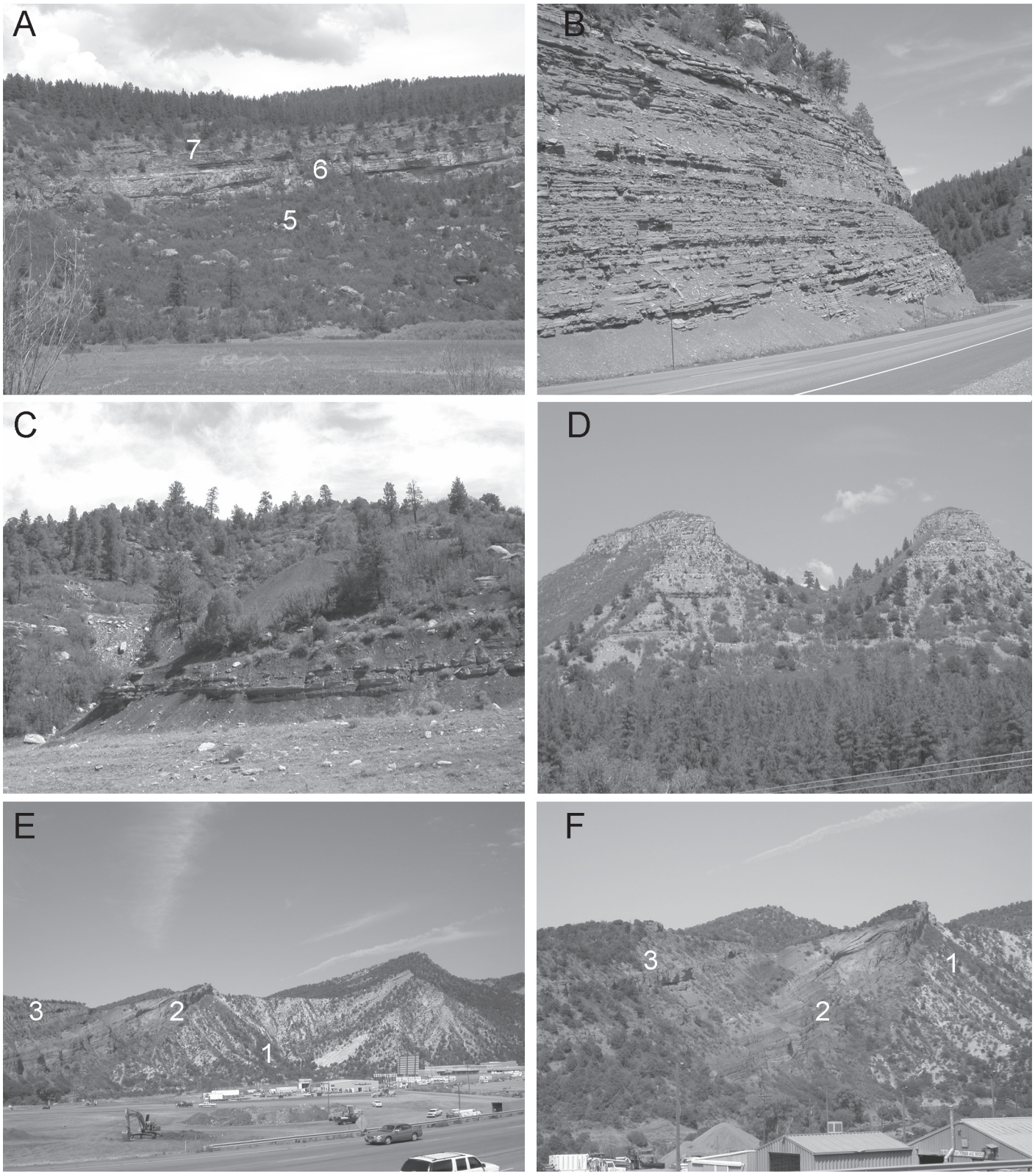


FIGURE 7. Selected Cretaceous outcrops at Durango. **A,** Morrison (5), Burro Canyon (6) and Dakota (7) formations north of Chapman Lake in NE ¼ sec. 6, T35N, R9W. **B,** Lower shoreface interval of Point Lookout Sandstone on Highway 160 (NW ¼ NE ¼ sec. 22, T35N, R10W). **C**, Coal-bearing strata of Menefee Formation at the Victory Mine, NE ¼ sec. 21, T35N, R10W. **D,** Point Lookout Sandstone capping Twin Buttes, NE ¼ sec. 23, T35N, R10W. **E-F,** Kirtland (1), McDermott (2) and Animas (3) formations south of Smelter Mountain and west of the Animas River, secs. 5-6, T34N, R9W.

neros Member. The overlying Bridge Creek Limestone Member (= Greeenhorn Limestone) is an 8-m-thick interval of very calcareous shale and thin beds of clayey limestone. The overlying 85-m-thick gray shale unit is equivalent to the Carlile Shale, though the Fairport and Blue Hill members recognized at Cortez have not been delineated at Durango. The overlying 28-m-thick interval of fossiliferous calcarenites and shale belong to the Juana Lopez and Montezuma Valley members.

A substantial unconformity is present within the Mancos Shale that separates the strata just described (which are Cenomanian-Turonian in age) from overlying Coniacian strata. Strata immediately above the unconformity are ~ 90 m of gray calcareous shale assigned to the Smoky Hill Member. Above that are 366 m of yellowish-brown-weathering, thinly-laminated calcareous shale and silty shale assigned to the Cortez Member.

Leckie et al. (1997) provided detailed age control (based mostly on ammonites and inoceramid bivalves) of the Mancos Shale at Cortez, and these ages apply to the section at Durango as well. Thus, the Graneros Member is Cenomanian; the Bridge Creek, Carlile, Juana Lopez and Montezuma Valley members are Turonian; the Smoky Hill Member is Coniacian-Santonian; and the Cortez Member is Santonian-early Campanian.

Mesaverde Group

The Mesaverde Group consists of three formations (Point Lookout, Menefee and Cliff House) that represent a regression (Point Lookout-lower Menefee) and transgression (upper Menefee-Cliff House) cycle of the Western Interior seaway. A variety of biostratigraphic constraints indicate that these are rocks of early Campanian age.

Point Lookout Sandstone

The basal unit of the Mesaverde Group, the Point Lookout Sandstone base is picked at the lowest thin ledge of sandstone above the shale slope of the Mancos Shale (Cross, 1899; Zapp, 1949). The Point Lookout thus consists of two members: (1) a lower unit of thinly bedded sandstone and shale; and (2) an upper unit of massive sandstone consisting of thick beds of medium-grained sandstone that form conspicuous cliffs. Maximum Point Lookout thickness in the Durango area is 131 m, but the upper sandstone unit thins markedly from west to east (paleo-seaward). Thus, this sandstone is ~ 33 m thick west of town, ~ 23 m thick at the Animas River and only 11 m thick in the Florida River Valley (Zapp, 1949).

Menefee Formation

The middle unit of the Mesaverde Group, the Menefee Formation is a lithologically complex interval of lenticular beds of trough-crossbedded sandstone, shale and coal. It thins from ~ 115 m (at Cherry Creek Valley) to 40 m (sec. 8, T35N, R8W) and becomes a single interval of sandstone in R8W, where the early Campanian shoreline turnaround is located.

Cliff House Sandstone

The upper unit of the Mesaverde Group, the Cliff House Sandstone averages 106 m thick in the Durango area, and only thins slightly eastward. It is irregular and lenticular ledges of indurated, fine- to medium-grained calcareous sandstone with minor interbeds of clayey fine-grained sandstone, mudstone and silty shale. The sandstone is gray and weathers yellowish-brown to reddish-brown, and thus has a "rusty" color on outcrop. It has a gradational to interfingering contact with the overlying Lewis Shale.

Lewis Shale

The marine Lewis Shale conformably overlies the Cliff House Sandstone and is very thick—about 600 m in the Durango area. It consists of dark gray to black shale with rusty limestone concretions and a few thin beds of bentonite. The upper 100 m of the Lewis Shale is sandy and transitional to the overlying Pictured Cliffs Sandstone. In the San Juan Basin, the Lewis Shale yields ammonites of middle to late Campanian age.

Pictured Cliffs Sandstone

Up to 70 m thick, the Pictured Cliffs Sandstone is generally similar to the older Point Lookout Sandstone. Its upper third is massive beds of light-colored sandstone; the lower two thirds are ledgy interbeds of sandstone, shale and sandy shale. The Pictured Cliffs Sandstone thickens eastward to more than 98 m east of the Animas River, and it undergoes a stratigraphic rise of about 33 m along that transect. This thickening is in part due to intertonguing with the Fruitland Formation, though the carbonaceous tongue of the Fruitland Formation disappears eastward (east of the Florida River), where there is about 66 m of massive sandstone of the Pictured Cliffs Sandstone. The Pictured Cliffs Sandstone is late Campanian based on its stratigraphic relationships to the Lewis Shale and ammonites (e.g., Fassett and Hinds, 1971).

Fruitland Formation

The Fruitland Formation is about 103 m thick at Durango. It consists of irregular and lenticular beds of sandstone, shale and coal. The lower part of the Fruitland is similar to the older Menefee Formation, but the upper part includes grayish-green and olive-gray shale and fine-grained, grayish-green sandstone with chlorite and feldspar grains. The Fruitland intertongues with the underlying Pictured Cliffs Sandstone and has a gradational (arbitrary) upper contact with the Kirtland Formation. The Fruitland Formation is late Campanian based primarily on ammonite biotsratigraphy of the underlying and in part laterally equivalent Lewis Shale and Pictured Cliffs Sandstone, and on radioisotopic

ages, magnetostratigraphy and vertebrate biostratigraphy (e.g., Fassett and Steiner, 1997; Sullivan and Lucas, 2003).

Coal Geology

Two coal-bearing units have been mined in the Durango area, the Menefee and the Fruitland formations, and both have yielded some high quality coals, some of which were even used to make coke. Geologists of the U. S. Geological Survey wrote extensively on the Durango coal field, especially in the early 1900s (Schrader, 1906; Shaler, 1907; Taff, 1907; Gardner, 1909; Collier, 1919; Resside, 1924; Zapp, 1949). Coal was mined from the Menefee just west of Durango from two zones, one in the lower, the other in the upper part of the formation. Most of the mineable coal beds are 1 to 2 m thick and are high volatile bituminous.

Fruitland coals are in the lower 33 m of the formation in three zones. These coal beds are thicker than those of the Menefee but generally of poorer quality because of their high ash content.

Kirtland Formation

At Durango, the Kirtland Formation is ~ 371 m of nonmarine mudstone, shale and sandstone divisible into three members. The lower member, the Hunter Wash Member, is ~126 m thick and is primarily grayish-green to olive-gray shale, sandy shale and lenticular sandstone with some beds of carbonaceous shale and a few thin coal seams.

The Farmington Member is ~ 106 m thick and is mostly sandstone with minor interbeds of shale and mudstone. The sandstone beds are mostly light gray to greenish gray, locally weather brown, indurated, medium grained and contain substantial feldspar and biotite grains.

The De-na-zin Member is poorly exposed and consists of a mixture of poorly indurated gray, olive and yellow feldspathic sandstone and mudstone as much as 138 m thick.

The relatively thick section of the Kirtland Formation at Durango can be correlated lithologically to sections of the Kirtland Formation to the south in the San Juan Basin (Hunt and Lucas, 1992). Therefore, the late Campanian age of the Kirtland Formation in the San Juan Basin, which is constrained by radioisotopic dates, magnetostratigraphy, palynostratigraphy and vertebrate biostratigraphy (e..g, Sullivan and Lucas, 2003) can be applied to the Kirtland section at Durango.

McDermott Formation

The McDermott Formation (also called McDermott Member of Animas Formation) is about 78 m thick at Durango. It is a sequence of andesitic debris, ranging from coarse boulder conglomerates to shale, all colored various shades of purple. The base of the McDermott Member is a bed of conglomerate of siliceous pebbles of chert and quartzite. This bed is generally less than 1.5 thick, but in an erosional scour in NW corner of sec. 3, T34N, R9W is as much as 18 m thick.

The overlying Animas Formation is olive-brown, olive-green and grayish-green tuffaceous sediments, and the contact between it and the underlying McDermott appears conformable. Dinosaur bones from the McDermott Formation indicate it is of Late Cretaceous age (Reeside, 1924), and it is at least partially correlative to the Late Cretaceous (Maastrichtian) Naashoibito Member of the Ojo Alamo Formation in the San Juan Basin (Lehman, 1985). The Animas Formation contains plant and vertebrate fossils of Paleocene age, but whether or not the Cretaceous-Paleogene boundary corresponds to the McDermott-Animas contact is not clear.

ROAD LOG

This one-day fieldtrip is a tour of the Meoszoic section exposed at Durango.

0.0	Start at the first stop, which is on La Plata County Road 250 (Missionary Ridge Road) where a two-track dirt road takes off to the east just north of the "Flying Jay Ranch." (at UTM 13, 248373E, 4135639N, NAD 27, in the NW ¼ NE ¼ sec. 3, T35N, R9W). Here, we can examine a complete Upper Triassic Chinle Group section (Figs. 3, 5A). Note also the view of Animas City Mountain across the valley to the west. After the stop, proceed north on County Road 250.	0.2
0.2	At 10:00, across the valley, note the bold, light-colored cliffs of the Middle Jurassic Entrada Sandstone overlying Chinle Group red beds at Falls Creek. The higher, somewhat thinner, light-colored sandstone cliff is the Upper Jurassic Bluff Sandstone. Here, we are driving north and down through the Pennsylvanian-Permian Cutler Group section.	1.9
2.1	Note the burned area on the right from the 2002 Missionary Ridge fire.	0.2
2.3	Road curves right. Note the Hermosa Cliffs ahead, which expose gray-colored Pennsylvanian Hermosa Group strata under the Pennsylvanian-Permian Cutler red beds. Note the burned area across the river at 9:30, another part of the 2002 Missionary Ridge fire.	1.0
3.3	Stop sign; turn left.	0.1
3.4	Note Hermosa-Cutler contact ahead, across the river.	0.1
3.5	Cross Animas River.	0.7
4.2	Junction with Highway 550 at Trimble; cross railroad tracks, turn left at stop sign and proceed south on Highway 550, the "San Juan Skyway."	0.6
4.8	The burned area comes down to the highway on the right; we are now driving up through the Cutler Group section.	1.0
5.8	Animas City Mountain at 1:00 is capped by the Cretaceous Dakota Sandstone. The white sandstone midway up its slope is the Entrada Sandstone.	1.1
6.9	Alpen Rose RV Park on right; Moss Back Formation (tan/gray sandstone), the local base of the Chinle Group, caps Cutler red beds to right.	1.6
8.5	Sign for Durango city limit; get into right lane and slow down to prepare for stop.	0.3
8.8	STOP 2 on right at Highway 550 sign (at UTM 13, 247395E, 4133964N, in the NE ¼ NE ¼ sec. 9, T35N,	

R9W). Examine Upper Triassic Rock Point Formation of Chinle Group sediments and paleosols.. Note calcretes here in Rock Point Formation (Fig. 5B-C). Examine Chinle-Entrada contact. Be careful of traffic. After stop, continue south on Highway 550 into the city of Durango. 0.2

9.0 Chinle-Entrada contact on right. 0.9

9.9 Durango welcome sign. Note strata of Bluff Sandstone and Upper Jurassic Morrison Formation up hill to right. 1.4

11.3 Fairgrounds to left. Traffic light at 25th Street; turn right. 0.2

11.5 25th Street now magically is transformed into Junction Street. 0.7

12.2 Road curves left. Note crossbedded sandstone of Cretaceous Dakota Sandstone in bluff on left. 0.5

12.7 Note colluvium blocks of Dakota Sandstone on right. 1.2

13.9 Note Dakota on Morrison Formation above Chapman Lake. 0.2

14.1 Turn right on County Road 205 (Falls Creek Road). 0.2

14.3 Chapman Lake ahead on right; note Dakota Sandstone above Morrison Formation ahead. 1.0

15.3 Bluff Sandstone on right ahead, and Chinle Group red beds in valley ahead. 0.5

15.8 STOP 3 (at UTM 13, 245520E, 4135632N, in the NE ¼ sec. 5, T35N, R9W). Magpie Trail on right. Stop on right to examine Jurassic section (Figs. 4, 5D-E). After stop, turn around and begin to retrace route on County Road 205. 0.9

16.7 OPTIONAL STOP. Driveway on right. Pull off on right for optional stop to examine Burro Canyon-Dakota contact (Figs. 5F, 7A). Stop at UTM 13, 244012E, 4135322N (NE ¼ sec. 6, T35N, R9W). After stop, continue on County Road 205 back to its intersection with Junction Street. 0.7

17.4 Yield sign; turn left to go south on Junction Street. 2.0

19.4 Note cuesta of Upper Cretaceous Cliff House Sandstone ahead; the view ahead is down dip into the Cretaceous. 0.8

20.2 Traffic light at intersection with highway 550. Stop, turn right to proceed south on 550. After the turn, note ahead the Cliff House Sandstone above the Upper Cretaceous Menefee Formation on the slopes of Smelter Mountain. 0.7

20.9 Cross Animas River; prepare to go right on Camino del Rio (south 550). 0.1

21.0 Go to the right at light to continue on south 550. 0.8

21.8 Junction 160. Note uranium tailings pile ahead. We have driven up through the Dakota-Mancos-Point Lookout section, and we are now on the Menefee, which is also exposed on the slopes of Smelter Mountain ahead. Turn right to go west on 160 (towards Cortez). 0.1

21.9 Cross Animas River; Upper Cretaceous Mancos Shale slopes on right. 0.1

22.0 Good view ahead of bluffs of Mancos Shale and Perkins Peak, which is capped by the Upper Cretaceous Point Lookout Sandstone. 1.8

23.8 Road to left to Wildcat Canyon; continue straight. 0.2

24.0 Twin Buttes to right at 2:00 are capped by the Point Lookout Sandstone (Fig. 7D). 1.1

25.1 Lightner Creek Road on right. Get into left lane. 0.4

25.5 STOP 4 at UTM 13, 239027E, 4129510N (SW ¼ NE ¼ sec. 22, T35N, R10W). Pull off to right at "Falling Rock" sign. Examine lower shoreface sandstones of Point Lookout Sandstone (Fig. 7B). After Stop, continue west on Highway 160. 0.6

26.1 Coal mine in Menefee Formation to right. 0.1261.2

STOP 5 at dirt road to coal mine on right. Stop at UTM 13, 237998E, 4129769N (NE ¼ NE ¼ sec. 21, T35N, R10W). Victory Mine. Note thick coal in Menefee right above Point Lookout Sandstone. After stop, make u-turn and go east on 160 back to Durango. 0.5

26.7 Stop 4 is on the left now. 2.1

28.8 Durango city limits. 0.4

29.2 Colorado Department of Transportation yard on left with good exposures of Mancos Shale behind it. 0.7

29.9 Welcome to Durango sign on right. 0.6

30.5 Cross Animas River. 0.1

30.6 Junction 550, turn right. 0.3

30.9 Menefee-Cliff House section on Smelter Mountain to right. 0.6

31.5 Good exposures of Menefee coals on left. 0.4

31.9 We are now in the Upper Cretaceous Lewis Shale strike valley. Note good outcrops of Lewis Shale on left. 0.6

32.5 Traffic light at intersection with Sawyer Drive. Turn right, then immediately turn left on County Road 213 to the Animas Air Park. 0.2

32.7 Across the river to the left, note the Lewis Shale outcrops (gray and tan shales) overlain by the sandstone cliff of the Pictured Cliffs Sandstone capped by coals in the Upper Cretaceous Fruitland Formation. 0.1

32.8 Stop sign; continue straight. 0.3

33.1 Old coal dump on right is in Fruitland Formation. 0.3

33.4 Approximate Fruitland-Kirtland contact on right. 0.3

33.7 Pull off on left for STOP at UTM 13, 245652E, 4123500N. Examine McDermott and Cretaceous-Paleogene boundary (Figs. 7E-F). End of road log.

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