

Molluscan Fossils and Stratigraphic Descriptions from the Upper Cretaceous Mancos Shale, West-Central Colorado

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By E.A. Merewether, D.A. Sawyer, and W.A. Cobban

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Molluscan Fossils and Stratigraphic Descriptions from the Upper Cretaceous Mancos Shale, West-Central Colorado

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Introduction

This report is based on lithostratigraphic and biostratigraphic data derived from investigations of Upper Cretaceous strata in Delta, Garfield, Mesa, and Montrose Counties in west-central Colorado (fig. 1). The data were obtained by personnel of the U.S. Geological Survey in the years 1955 through 2004, during studies of the Dakota Sandstone and the overlying Mancos Shale. Described herein are exposed strata of marine origin in the uppermost Dakota and the lower part of the Mancos (Cenomanian, Turonian, and Coniacian Stages) and related and associated collections of molluscan fossils (tables 1, 2, and 3).

The stratigraphic nomenclature used in this report for the lower part of the Mancos follows that of Molenaar and others (2002), who divided the lower Mancos into six members (table 1), from oldest to youngest, the Graneros, Bridge Creek Limestone, Blue Hill, Juana Lopez, Montezuma Valley, and Niobrara. The strata consist mainly of shale but can include chalk, calcarenite, siltstone, sandstone, and bentonite; commonly, they enclose a variety of concretions. In outcrops, the members are distinguished essentially by differences in their content of calcium carbonate (table 1) supplemented by the identity of constituent fossils.

Thicknesses of members from the measured outcrops vary in the region, which probably reflects lateral changes in facies and possibly the effects of truncation at disconformities in the stratigraphic sequence. Disconformities might mark the bases of the Juana Lopez and the Niobrara Members. Furthermore, the members at several places are poorly exposed, and dips used for the measurements may be incorrect. The Graneros Member, measured at five localities, ranges in thickness from 35 ft at the Red Rock section to 85 ft at the Peach Valley section. The Bridge Creek Limestone is 42 ft thick near Mack, 50 ft thick near Uncompahgre, and 140 ft thick at the Red Rock section. All of the Blue Hill Member was described at five of the selected outcrops where it ranges in thickness from about 100 ft near Olathe to 217 ft near Uncompahgre. The Juana Lopez is as much as 120 ft thick near Mack, but at five other outcrops to the southeast it is 40 to 86 ft thick. The Montezuma Valley Member is as much as 115 ft thick near Mack and is 52 ft thick at Alkali Creek and 100 ft thick near Olathe.

Reference Cited

Molenaar, C.M., Cobban, W.A., Merewether, E.A., Pillmore, C.L., Wolfe, D.G., and Holbrook, J.M., 2002, Regional stratigraphic cross sections of Cretaceous rocks from east-central Arizona to the Oklahoma Panhandle: U.S. Geological Survey Miscellaneous Field Studies Map 2382.

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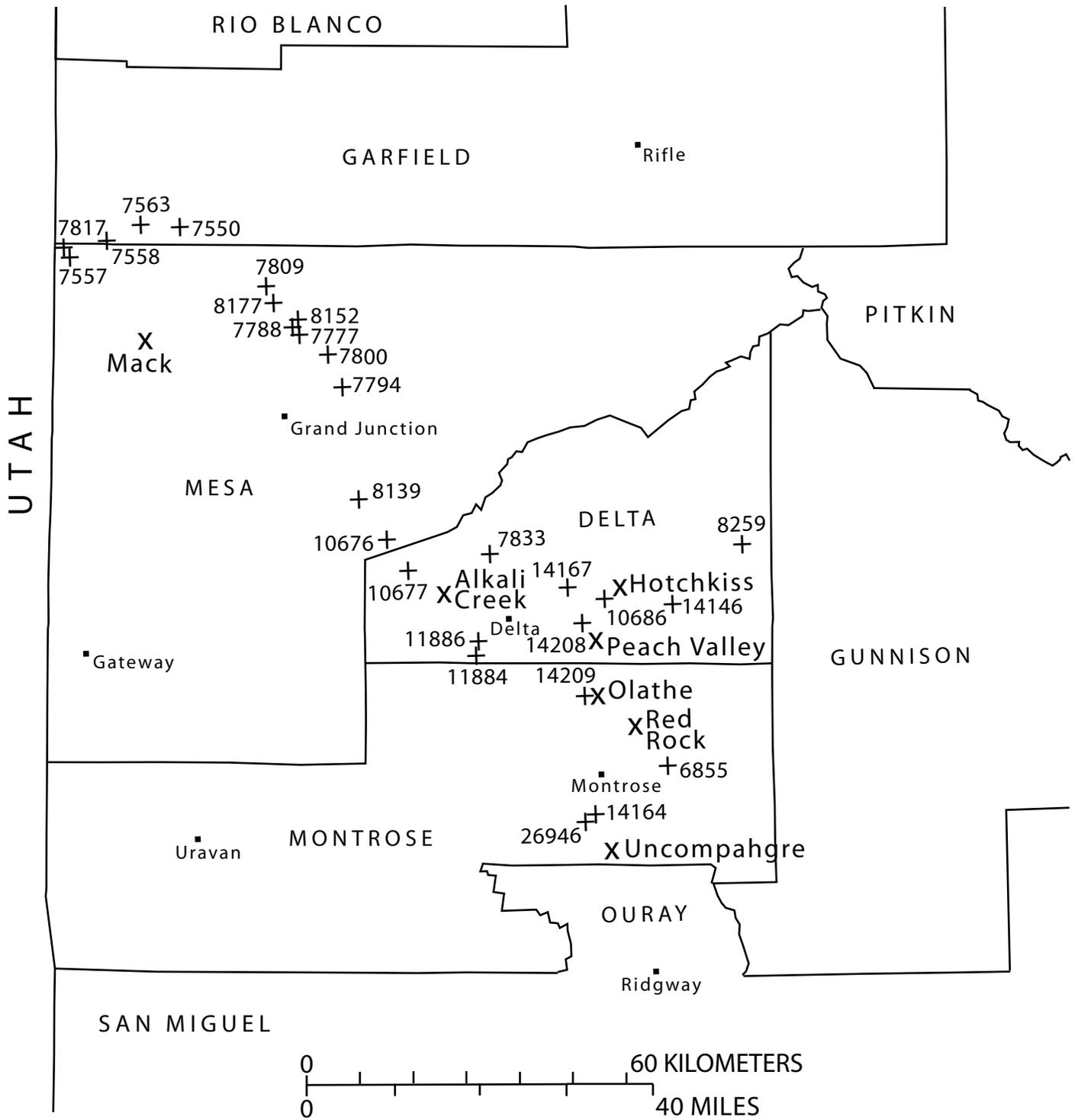


Figure 1. Measured outcrops (X) and fossil localities (+) in Upper Cretaceous strata in counties of west-central Colorado. Numbers indicated specific fossil collections.

Table 1. Members of Upper Cretaceous age in the lower part of the Mancos Shale of west-central Colorado. Names follow nomenclature of Molenaar and others (2002).

MEMBER	DOMINANT LITHOLOGY	THICKNESSES (FT.)	AGE (STAGES)
Niobrara	shale, calcareous	about 580	late Turonian and Coniacian
Montezuma Valley	shale, noncalcareous	52 TO 115	late middle and early late Turonian
Juana Lopez	shale and calcarenite	40 TO 120	late middle Turonian
Blue Hill	shale, noncalcareous	101 TO 217	early middle Turonian
Bridge Creek Limestone	shale, calcareous	42 TO 140	late Cenomanian and early Turonian
Graneros	shale, noncalcareous	35 TO 101	late Cenomanian

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Table 2. Names and locations of selected outcrops of Upper Cretaceous strata and names of associated molluscan fossils in Delta, Mesa, and Montrose Counties, west-central Colorado. Names of members of the Mancos Shale follow nomenclature of Molenaar and others (2002).

OUTCROP NAME	COUNTY	SEC.	TWN.	RNG.	USGS CATALOGUE NO.	MOLLUSCAN GUIDE FOSSILS	STRATIGRAPHIC UNIT
Alkali Creek	Delta	SE, SW 25	4S.	3E.	D10682	<i>Prionocyclus quadratus</i>	Niobrara Mbr.-Mancos Sh.
					D10683	<i>Inoceramus incertus</i>	Niobrara Mbr.-Mancos Sh.
					D10681	<i>Prionocyclus quadratus</i> <i>Inoceramus incertus</i> <i>Scaphites whitfieldi</i> <i>Inoceramus perplexus</i>	Montezuma Valley Mbr.-Mancos Sh.
					D10680	<i>Scaphites whitfieldi</i> <i>Prionocyclus novimexicanus</i> <i>Baculites yokoyamai</i> <i>Inoceramus perplexus</i>	Montezuma Valley Mbr.-Mancos Sh.
					D10679	<i>Scaphites warreni</i> <i>Prionocyclus wyomingensis</i> <i>Inoceramus dimidius</i>	Juana Lopez Mbr.-Mancos Sh.
					D10685	<i>Prionocyclus macombi</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
					D10684	<i>Inoceramus dimidius</i> <i>Prionocyclus hyatti</i> <i>Inoceramus howelli</i>	Blue Hill Mbr.-Mancos Sh.
Hotchkiss	Delta	NE, NW 31	14S.	93W.	D14167	<i>Inoceramus perplexus</i> <i>Prionocyclus novimexicanus</i> <i>Scaphites whitfieldi</i>	Montezuma Valley Mbr.-Mancos Sh.
					D8257	<i>Prionocyclus macombi</i> <i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
		SW, NE 36	14S.	94W.	D14166	<i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
					D14165	<i>Pycnodonte aff. P. kellumi</i>	
Mack	Mesa	SE, NW 31	2N.	3W.	D10442	<i>Scaphites whitfieldi</i> <i>Inoceramus perplexus</i> <i>Baculites yokoyamai</i>	Montezuma Valley Mbr.-Mancos Sh.
					D10446	<i>Prionocyclus macombi</i> <i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
		NW, NW 31	2N.	3W.	D10441	<i>Collignoniceras woollgari</i> <i>Pinna petrina</i> <i>Laternula lineata</i>	Blue Hill Mbr.-Mancos Sh.
					D10440	<i>Pycnodonte newberryi</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
Olathe	Montrose	SW, SE 9	50N.	9W.	D14168	<i>Pycnodonte newberryi</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
Peach Valley	Delta	SE 33	15S.	94W.	D11894	<i>Inoceramus dimidius</i>	Juana Lopez Mbr.-Mancos Sh.
					D11893	<i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
					D11892	<i>Prionocyclus macombi</i> <i>Inoceramus dimidius</i>	Blue Hill Mbr.-Mancos Sh.
		SE 34	15S.	94W.	D11891	<i>Prionocyclus hyatti</i>	Blue Hill Mbr.-Mancos Sh.
					D11890	<i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Blue Hill Mbr.-Mancos Sh.
					D11889 D11888	<i>Pycnodonte newberryi</i> <i>Johnsonites sulcatus</i> <i>Borissiakoceras compressum</i> <i>Inoceramus macconnelli</i>	Bridge Creek Limestone Mbr.-Mancos Sh. Graneros Mbr.-Mancos Sh.
Red Rock	Montrose	SE, SW 29	50N.	8W.	D14150	<i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
					D14149	<i>Pseudoperma congesta</i> <i>Inoceramus sp.</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
Uncompahgre	Montrose	NE, NE 3	47N.	9W.	D11883	<i>Prionocyclus macombi</i> <i>Scaphites warreni</i> <i>Inoceramus dimidius</i>	Juana Lopez Mbr.-Mancos Sh.
					D11880	<i>Prionocyclus macombi</i> <i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Juana Lopez Mbr.-Mancos Sh.
					D11879	<i>Prionocyclus macombi</i> <i>Scaphites cartilensis</i> <i>Pycnodonte newberryi</i>	Blue Hill Mbr.-Mancos Sh.
					D11878	<i>Pycnodonte newberryi</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
					D11882	<i>Pycnodonte newberryi</i>	Bridge Creek Limestone Mbr.-Mancos Sh.
					D11881	<i>Plicatula sp.</i>	Graneros Mbr.-Mancos Sh.

Table 3. Molluscan fossil localities in Upper Cretaceous strata in Delta, Garfield, Mesa, and Montrose Counties, west-central Colorado. Names of members of the Mancos Shale follow nomenclature of Molenaar and others (2002).

FOSSIL COLLECTIONS, USGS CATALOGUE NO.	COUNTY	SEC.	TWN.	RNG.	MOLLUSCAN GUIDE FOSSILS	STRATIGRAPHIC UNITS (Sh.=shale; Mbr.=member)
26946 D2040 D6855 D14164 D14209	Montrose	19 30 NW, SW 23 NW, NW 20 NW 8	48N. 48N. 49N. 48N. 50N.	9W. 9W. 8W. 9W. 9W.	<i>Plesiacanthoceras wyomingense</i> <i>Conlinoceras tarrantense</i> <i>Baculites obtusus</i> <i>Pycnodonte</i> aff. <i>P. kellumi</i> <i>Magadiceramus stantoni</i>	Dakota Sandstone Dakota Sandstone Mancos Shale Bridge Creek Limestone Mbr.-Mancos Sh. Mancos Shale
D7833 D7835 D7836 D7837	Delta	NE, SW 10	14S.	96W.	<i>Baculites obtusus</i> <i>Baculites asperiformis</i> <i>Baculites asperiformis</i> <i>Baculites asperiformis</i>	Mancos Shale
D8142 D8143 D8256 D8259 D10677		NE, SE 10 SW, NE 36 SE, NE 4 SE, SW 8	14S. 14S. 14S. 4S.	96W. 94W. 91W. 3E.	<i>Baculites perplexus</i> <i>Baculites perplexus</i> <i>Pycnodonte</i> n. sp. <i>Baculites perplexus</i> <i>Prionocyclus macombi</i> <i>Inoceramus dimidius</i> <i>Lopha lugubris</i>	Mancos Shale Mancos Shale Juana Lopez Member-Mancos Shale
D10678 D10686 D11884 D11885		SE, NW 2 SE, SE 7 SW 33	15S. 51N. 15S.	94W. 11W. 96W.	<i>Prionocyclus hyatti</i> <i>Pycnodonte</i> aff. <i>P. kellumi</i> <i>Pycnodonte newberryi</i> <i>Inoceramus howelli</i> <i>Exogyra</i> sp.	Blue Hill Member-Mancos Shale Bridge Creek Limestone Mbr.-Mancos Sh. Bridge Creek Limestone Mbr.-Mancos Sh. Blue Hill Member-Mancos Shale
D11886 D14146 D14167		SE 33 SE, SW 7 NE, NW 31	15S. 15S. 14N.	96W. 92W. 94W.	<i>Prionocyclus macombi</i> <i>Inoceramus dakotensis</i> <i>Scaphites whitfieldi</i> <i>Prionocyclus novimexicanus</i> <i>Inoceramus perplexus</i> <i>Pycnodonte</i> aff. <i>P. kellumi</i>	Juana Lopez Member-Mancos Shale Juana Lopez Member-Mancos Shale Montezuma Valley Mbr.-Mancos Shale
D14208		SE, SE 21	15S.	94W.	<i>Pycnodonte</i> aff. <i>P. kellumi</i>	Mancos Shale
D7557 D7777 D7783 D7786 D7788 D7794 D7795	Mesa	NE 29 NW, SE 2 SE, NE 2	8S. 10S. 10S.	105W. 100W. 100W.	<i>Haresiceras natronense</i> <i>Baculites asperiformis</i> <i>Baculites perplexus</i> <i>Baculites gilberti</i>	Mancos Shale Mancos Shale Mancos Shale
D7800 D7809 D7812 D7817 D7820 D7821 D7823		NW, NW 34 NE 25 SW, NW 3 SW 7 NE 18	9S. 1N. 1N. 9S. 8S.	100W. 1E. 1W. 100W. 104W.	<i>Baculites asperiformis</i> <i>Baculites</i> sp. (weak flank ribs) <i>Baculites obtusus</i> <i>Baculites perplexus</i> <i>Baculites</i> sp. (weak flank ribs) <i>Baculites asperiformis</i> <i>Baculites obtusus</i> <i>Baculites mclearnii</i> <i>Baculites asperiformis</i>	Mancos Shale Mancos Shale Mancos Shale Mancos Shale
D8139		SE, SE 32	12S.	2E.	<i>Prionocyclus macombi</i> <i>Lopha lugubris</i> <i>Inoceramus dimidius</i>	Mancos Shale
D8152 D8155 D8158		NW, SW 26 SW, SW 34	9S. 9S.	100W. 100W.	<i>Baculites perplexus</i> <i>Baculites obtusus</i> <i>Baculites asperiformis</i>	Mancos Shale Mancos Shale
D8167 D8177 D10676		NW, NE 29 NW, SE 20 NW, NE 26	8S. 9S. 3S.	2W. 100W. 2E.	<i>Baculites perplexus</i> <i>Baculites asperiformis</i> <i>Inoceramus howelli</i> <i>Crassostrea</i> sp.	Mancos Shale Mancos Shale Blue Hill Member-Mancos Shale
D7550 D7558 D7560 D7563	Garfield	SE 4 NW, NE 13 SE, NW 3	8S. 8S. 8S.	102W. 105W. 103W.	<i>Baculites perplexus</i> <i>Baculites obtusus</i> <i>Baculites asperiformis</i> <i>Baculites perplexus</i>	Mancos Shale Mancos Shale Mancos Shale

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OUTCROP DESCRIPTIONS

In the following descriptions of outcropping strata, the stratigraphic units are in descending order (youngest to oldest).

SECTION NEAR ALKALI CREEK, DELTA COUNTY

Outcrops in SE1/4 SW1/4 sec. 25, T.4 S., R.3 E. (Point Creek 7 1/2-minute quadrangle). Measured and described by E.A. Merewether and W.A. Cobban in 1978.

	Thickness (feet)
Niobrara Member (part):	
11. Chalk, light brownish gray; fossiliferous at 2 ft above base (D10682- <i>Prionocyclus quadratus</i>).	9
10. Shale, medium dark gray, calcareous; contains bentonite, 0.5 ft thick, at 3 ft above base. Fossiliferous at 5 ft above base (D10683- <i>Prionocyclus quadratus</i>).	8
Thickness of Niobrara Member (part)	17
Montezuma Valley Member:	
9. Shale, dark gray, calcareous; contains concretions. Fossiliferous concretions at base (D10681- <i>Scaphites whitfieldi</i>).	12
8. Shale, dark gray, slightly calcareous. Bentonite, 0.3 ft thick, at top of unit. Fossiliferous at 27 ft above base (D10680- <i>Scaphites whitfieldi</i>).	40
Thickness of Montezuma Valley Member	52
Juana Lopez Member:	
7. Interlaminated shale, dark gray, and less siltstone, brownish gray, and calcarenite. Fossiliferous in uppermost 5 ft. (D10679- <i>Scaphites warreni</i>).	31
6. Interbedded shale, dark gray, and less siltstone and calcarenite. Fossiliferous at 11 ft above base (D10685- <i>Prionocyclus macombi</i>).	20
Thickness of Juana Lopez Member	51

SECTION NEAR ALKALI CREEK, DELTA COUNTY (continued)

Blue Hill Member (part):

5. Interlaminated shale, dark gray, and siltstone, greenish gray to light brown. Fossiliferous limonitic concretions 19 ft above base (D10684- <i>Prionocyclus hyatti</i>).	53
4. Shale, dark gray; calcareous concretions at base and top.	18
3. Shale, dark gray, noncalcareous.	18
2. Siltstone, soft; poorly exposed; concretions at base and in upper half.	9
1. Shale, soft; poorly exposed.	50+
Thickness of Blue Hill Member (part)	<hr/> 148+

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SECTION NEAR VILLAGE OF HOTCHKISS, DELTA COUNTY

Outcrops in NE1/4 NW1/4 sec. 31, T.14 S., R.93 W. (Lazear quadrangle). Measured and described by E.A. Merewether and D.A. Sawyer, September 22-26, 2003.

	Thickness (feet)
Niobrara Member (part):	
5. Limestone.	0.5
Montezuma Valley Member:	
4. Shale, dark gray, slightly calcareous. Fossiliferous beds at 15-20 ft below top (D14167- <i>Scaphites whitfieldi</i>).	75
Juana Lopez Member:	
3. Interbedded shale, siltstone, and calcarenite. Fossiliferous in lower part (D8257- <i>Prionocyclus macombi</i>) (D14166- <i>Inoceramus dimidius</i>).	40
Blue Hill Member:	
2. Shale, gray; poorly exposed; includes bentonite and few concretions.	60+
Bridge Creek Limestone Member (part):	
1. Shale, gray, calcareous; poorly exposed. Fossiliferous near top (D14165- <i>Pycnodonte</i> aff. <i>P. kellumi</i>).	

SECTION NEAR VILLAGE OF MACK, MESA COUNTY

Outcrops in NW1/4 NW1/4 sec. 31, T.2 N., R.3 W. (Mack 7½-minute quadrangle). Measured and described by E.A. Merewether and W.A. Cobban on September 7, 1977.

	Thickness (feet)
Niobrara Member (part):	
14. Shale, gray, calcareous.	10
Thickness of Niobrara Member (part)	10
Montezuma Valley Member:	
13. Shale, medium to dark gray, slightly calcareous. Fossiliferous calcareous concretions in lowermost 50 ft and uppermost 35 ft (D10442- <i>Scaphites whitfieldi</i>).	115
Thickness of Montezuma Valley Member	115
Juana Lopez Member:	
12. Interbedded shale, siltstone, and calcarenite; poorly exposed. Fossiliferous calcarenites in uppermost 30 ft (D10446- <i>Prionocyclus macombi</i>).	65
11. Interbedded shale and siltstone; concretions in lowermost 10 ft.	55
Thickness of Juana Lopez Member	120
Blue Hill Member:	
10. Shale and siltstone, poorly exposed. Concretions in siltstone at 12 ft above base.	54
9. Siltstone, olive gray, slightly calcareous, soft; contains <i>Ophiomorpha</i> and other burrows.	31
8. Sandstone, very fine and fine grained, silty, partly calcareous; poorly exposed. Concretions at 11 ft above base. Unit contains burrows.	34
7. Sandstone, medium gray to brownish gray, very fine grained, silty, calcareous; laminated with low-angle tabular cross-beds; contains horizontal and vertical smooth burrows. Fossiliferous (D10441- <i>Collignoniceras woollgari</i>).	8
6. Siltstone, brownish gray, soft, poorly exposed.	13
Thickness of Blue Hill Member	140

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SECTION NEAR VILLAGE OF MACK, MESA COUNTY (continued)

Bridge Creek Limestone Member:

5. Siltstone, brownish gray, calcareous, soft.	28
4. Shale, medium dark gray, calcareous, poorly exposed. Fossiliferous in basal 5 ft (D10440- <i>Pycnodonte newberryi</i>).	10
3. Siltstone, clayey, calcareous; bentonite at top. Fossiliferous (<i>Pycnodonte newberryi</i>).	4
Thickness of Bridge Creek Limestone Member	<hr/> 42

Graneros Member:

2. Shale, dark gray, noncalcareous; silty shale, siltstone, and bentonite in uppermost 7 ft; poorly exposed.	50
Thickness of Graneros Member	<hr/> 50

Dakota Sandstone (part):

1. Sandstone; contains scattered black pebbles as much as 0.5 in long; beds about 1 ft thick. Abundant, horizontal, smooth, branching burrows at top.

SECTION NEAR OLATHE, MONTROSE COUNTY

Outcrops in SW1/4 SE1/4 sec. 9, T.50 N., R.9 W. (249209E, 4276795N), (Olathe 7 1/2-minute quadrangle). Measured and described by E.A. Merewether and D.A. Sawyer in September, 2003.

	Thickness (feet)
Niobrara Member (part):	
10. Shale, gray, calcareous; poorly exposed.	
Montezuma Valley Member:	
9. Shale, dark gray, noncalcareous; poorly exposed.	100
Thickness of Montezuma Valley Member	100
Juana Lopez Member:	
8. Interbedded shale, siltstone, sandstone, and calcarenite; laminated and thin bedded.	40
7. Interbedded dark gray shale and light brownish gray siltstone; laminated and thin bedded.	46
Thickness of Juana Lopez Member	86
Blue Hill Member:	
6. Shale, dark gray, noncalcareous; concretions at base.	6
5. Shale, dark gray, noncalcareous.	50
4. Shale, dark gray, noncalcareous; poorly exposed.	45
Thickness of Blue Hill Member	101
Bridge Creek Limestone Member:	
3. Shale, gray, calcareous, poorly exposed; concretions at 50 ft above base. Fossiliferous in uppermost 5 ft (D14168- <i>Pycnodonte newberryi</i> , from the upper Cenomanian zone of <i>Euomphaloceras septemseriatum</i>).	85
Thickness of Bridge Creek Limestone Member	85
Graneros Member:	
2. Shale, dark gray, noncalcareous; concretions at 15 ft and 44 ft above base; poorly exposed.	50
Thickness of Graneros Member	50
Dakota Sandstone (part):	
1. Sandstone	

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SECTION IN PEACH VALLEY, DELTA COUNTY

Outcrops in SE1/4 sec. 33 and SW1/4 sec. 34, T.15 S., R.94 W. (Olathe NW 7½-minute quadrangle). Measured and described by E.A. Merewether and W.A. Cobban on June 23, 1982.

	Thickness (feet)
Juana Lopez Member:	
18. Interbedded shale, minor calcareous siltstone, and calcarenite; poorly exposed. Fossiliferous calcarenite in uppermost 5 ft (D11894- <i>Inoceramus dimidius</i>).	32
17. Interbedded shale, medium gray, soft, and less siltstone, brownish gray, and calcarenite. Fossiliferous calcarenite at 6 ft above base (D11893- <i>Inoceramus dimidius</i>).	10
Thickness of Juana Lopez Member	42
Blue Hill Member:	
16. Interbedded shale, dark gray, and minor siltstone, light brownish gray, calcareous; fossiliferous (D11890- <i>Prionocyclus macombi</i>). Ferruginous concretions in uppermost 15 ft.	27
15. Interbedded shale, dark gray, noncalcareous, and minor siltstone, light brownish gray, calcareous. Calcareous septarian concretions in uppermost 3 ft.	20
14. Interbedded shale, dark gray, noncalcareous, well indurated, and minor siltstone, light brownish gray, calcareous, and calcarenite. Fossiliferous calcarenite near base of unit (D11890- <i>Inoceramus dimidius</i>). Fossiliferous at 4 ft. above base (D11891- <i>Prionocyclus hyatti</i>).	15
13. Shale, dark gray, noncalcareous; septarian concretions at top.	5
12. Shale, dark gray, noncalcareous; contains a few large cone-in-cone concretions.	12
11. Shale, gray, silty, noncalcareous, soft; cone-in-cone concretions at base.	15
10. Shale, gray, slightly calcareous; includes thin beds of siltstone in uppermost 5 ft; poorly exposed.	73
9. Shale, gray, poorly exposed.	30
Thickness of Blue Hill Member	197

SECTION IN PEACH VALLEY, DELTA COUNTY (continued)

Bridge Creek Limestone Member:

8. Shale, gray, calcareous, soft; thin beds of bentonite in uppermost part.	8
7. Shale, gray, slightly calcareous, soft; poorly exposed.	14
6. Shale, gray, soft; bentonites at top and 2 ft below top; poorly exposed. Fossiliferous near top (D11889- <i>Pycnodonte newberryi</i>).	20
5. Concealed, probably shale, slightly calcareous; cone-in-cone concretions in lowermost part and calcareous concretions in uppermost part.	74
Thickness of Bridge Creek Limestone Member	<hr/> 116

Graneros Member:

4. Shale, gray, soft; poorly exposed.	60
3. Interbedded shale, dark gray, noncalcareous; minor siltstone, noncalcareous, with load casts and small burrows.	5
2. Interbedded siltstone and shale, soft; contain horizontal burrows. Fossiliferous calcareous concretions at top (D11888- <i>Johnsonites sulcatus</i>).	20
Thickness of Graneros Member	<hr/> 85

Dakota Sandstone (part):

1. Sandstone; upper surface displays abundant small and large ripple marks.

14 Molluscan Fossils and Stratigraphic Descriptions from the Upper Cretaceous Mancos Shale, West-Central Colorado

SECTION NORTH OF PEACH VALLEY, DELTA COUNTY

Outcrops in S1/2 sec. 21, T.15 S., R.94 W. (Olathe NW 7 1/2-minute quadrangle). Measured and described by E.A. Merewether and D.A. Sawyer on May 14, 2004.

	Thickness (feet)
Niobrara Member (part):	
3. Shale, gray, calcareous; poorly exposed. Fossiliferous beds at about 55 ft and 120 ft above base.	350+
Thickness of Niobrara Member (part)	<hr/> 350+
Montezuma Valley Member:	
2. Shale, dark gray, noncalcareous; poorly exposed.	90
Thickness of Montezuma Valley Member	<hr/> 90
Juana Lopez Member (part):	
1. Interbedded calcareous shale and siltstone, and calcarenite.	

SECTION NEAR RED ROCK CANYON, MONTROSE COUNTY

Outcrops in SE1/4 SW1/4 sec. 29, T.50 N., R.8 W. (Red Rock Canyon 7½-minute quadrangle). Measured and described by E.A. Merewether and D.A. Sawyer on September 25, 2003.

	Thickness (feet)
Juana Lopez and Blue Hill Members, undivided:	
5. Shale, dark gray; calcarenite bed at top; poorly exposed. Fossiliferous near top (D14150- <i>Inoceramus dimidius</i>).	135
Thickness of Juana Lopez and Blue Hill Members, undivided	135
Bridge Creek Limestone Member:	
4. Shale, calcareous; poorly exposed. <i>Pycnodontes</i> in upper part.	80
3. Shale, dark gray, calcareous; calcareous concretions at top.	60
Thickness of Bridge Creek Limestone Member	140
Graneros Member:	
2. Shale, brownish gray, noncalcareous.	35
Thickness of Graneros Member	35
Dakota Sandstone (part):	
1. Sandstone, well indurated.	

16 Molluscan Fossils and Stratigraphic Descriptions from the Upper Cretaceous Mancos Shale, West-Central Colorado

SECTION NEAR UNCOMPAHGRE, MONTROSE COUNTY

Outcrops in NE1/4 NE1/4 sec. 3, T.47 N., R.9 W. (Colona 7½-minute quadrangle). Measured and described by E.A. Merewether and W.A. Cobban in June, 1982.

	Thickness (feet)
Juana Lopez Member:	
16. Shale, dark olive gray, calcareous, soft, and minor calcarenite. Fossiliferous in uppermost 15 ft (D11883- <i>Scaphites warreni</i>).	35
15. Shale, olive gray, slightly calcareous, soft, and minor calcarenite; siltstone, 1.5 ft thick, at top. Fossiliferous (D11880 - <i>Prionocyclus macombi</i>).	9
14. Shale, medium gray to olive gray, soft, noncalcareous in lowermost 5 ft, calcareous in uppermost 2 ft; concretions at top.	7
Thickness of Juana Lopez Member	51
Blue Hill Member:	
13. Interlaminated shale, dark gray, noncalcareous, jarositic, and minor siltstone. Fossiliferous ferruginous concretions near top (D11879- <i>Scaphites carlilensis</i>).	23
12. Shale, dark gray, silty, noncalcareous; few laminae and thin beds of siltstone in uppermost 5 ft; concretions 3 ft. below top.	20
11. Shale, dark gray, silty, noncalcareous; cone-in-cone concretions at base; septarian concretions at top.	20
10. Shale, dark gray, silty, noncalcareous; brownish gray, silty, calcareous concretions, 4 ft in diameter, at base.	13
9. Concealed, probably shale.	111
8. Shale, dark gray, noncalcareous, soft; poorly exposed.	30
Thickness of Blue Hill Member	217
Bridge Creek Limestone Member:	
7. Shale, gray, calcareous, and chalk, at top; bentonites in basal 4 ft. Fossiliferous at base (D11882- <i>Pycnodonte newberryi</i>) and 5 ft below top (D11878- <i>Pycnodonte newberryi</i>).	21
6. Concealed, probably shale, calcareous.	29
Thickness of Bridge Creek Limestone Member	50

SECTION NEAR UNCOMPAHGRE, MONTROSE COUNTY (continued)

Graneros Member:

5. Concealed, probably shale; septarian concretions 3 ft below top.	10
4. Concealed, probably shale; septarian concretions about 5 ft below top.	35
3. Concealed, probably shale; septarian concretions at top.	21
2. Shale; poorly exposed; concretions near base and fossiliferous calcareous concretions at top (D11881- <i>Plicatula</i> sp.).	33
1. Bentonite, dusky orange.	2
Thickness of Graneros Member	<hr/> 101