Lower Cretaceous Mount Pablo Formation, Northwestern Montana

GEOLOGICAL SURVEY BULLETIN 1502-D

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By MELVILLE R. MUDGE *and* DUDLEY D. RICE

CONTRIBUTIONS TO STRATIGRAPHY

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A description of a newly established Lower Cretaceous formation of early Albian to possibly late Aptian age

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1982

UNITED STATES DEPARTMENT OF THE INTERIOR

JAMES G. WATT, *Secretary*

GEOLOGICAL SURVEY

Dallas L. Peck, *Director*

Library of Congress Cataloging in Publication Data
Mudge, Melville Rhodes, 1921–
Lower Cretaceous Mount Pablo Formation, Northwestern Montana.
(Contributions to Stratigraphy)
(Geological Survey Bulletin 1502–D)
Bibliography: p. 18
Supt. of Docs. No.: I 19.3:
1. Geology, Stratigraphic—Cretaceous. 2. Geology—Montana.
I. Rice, Dudley D. II. Title. III. Series. IV. Series: Geological Survey Bulletin 1502–D.
QE75.B9 No. 1502–D [QE686] 557.3s 81–607900 [551.7'7'097868] AACR2

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LOWER CRETACEOUS MOUNT PABLO FORMATION, NORTHWESTERN MONTANA

By MELVILLE R. MUDGE and DUDLEY D. RICE

ABSTRACT

The newly established Mount Pablo Formation includes strata that crop out in the Sawtooth Range that are equivalent to the lower part of the Kootenai Formation in and west of the Sweetgrass Arch. Palynomorphs indicate an age of early Albian to possibly late Aptian. The Mount Pablo Formation unconformably overlies Jurassic rocks and is overlain unconformably by the Lower Cretaceous Kootenai Formation. Lateral equivalents of the Mount Pablo belonging to the Kootenai are widespread in the subsurface west of the crest of the Kevin-Sunburst dome.

The Mount Pablo consists of nonmarine sandstone and conglomerate in the lower part, variegated mudstone interbedded with some sandstone in the middle part, and limestone interbedded with and overlain by mudstone in the upper part. The lower sandstone and conglomerate is the Cut Bank Sandstone Member, a previously established unit assigned as the basal member of the Kootenai Formation in the subsurface in the Cut Bank area that is extended to the Sawtooth Range and assigned to the Mount Pablo. This member ranges in thickness from 9 to 30 m (meters), whereas the formation ranges from 34 to 90 m.

The Mount Pablo Formation is correlative with the Cut Bank Sandstone Member, Lander Member as described in 1966 by M. H. Oakes, and the basal "brown lime" unit of the Moulton Member, all of which are included in the lower part of the Kootenai Formation in the Cut Bank area. Lateral equivalents of the Mount Pablo pinch out eastward onto the Kevin-Sunburst dome, where the Sunburst Sandstone Member forms the basal unit of the Kootenai Formation and is correlative with the upper part of the Moulton Member.

In the Canadian Foothills, the Cadomin Formation, which is a prominent conglomerate, correlates with the Cut Bank Sandstone Member of the Mount Pablo Formation or of the Kootenai Formation. The upper part of the Mount Pablo is equivalent to the Gladstone Formation in the southern foothills, to the Gething Formation in the northern foothills, and to the McMurray Formation in the central plains of Alberta.

The palynological assemblage in the Mount Pablo is similar to that found in other Lower Cretaceous formations in the Western Interior and is somewhat similar to assemblages in the early to early middle Albian McMurray Formation of Alberta.

INTRODUCTION

The Mount Pablo Formation is herein established as the lowest Cretaceous unit in the Sawtooth Range in northwestern Montana (fig. 1). Palynomorphs indicate an early Albian to possibly late Aptian age. Strata composing the Mount Pablo were formerly the lower part of the Kootenai Formation. The now geographically restricted and locally stratigraphically restricted Kootenai is retained as a formation. The Mount Pablo, which underlies the Kootenai and overlies Jurassic rocks, is named after Mount Pablo in the northern part of the Sawtooth Range, about 14 km (kilometers) south of East Glacier Park, in Glacier County. This report describes the Mount Pablo in outcrop and subsurface, and establishes its Early Cretaceous age and its correlation with other units elsewhere in the northern Rocky Mountains. The Kootenai Formation, as applied in the Sweetgrass Arch area and along the disturbed belt by previous workers, included all Lower Cretaceous rocks between the overlying Blackleaf Formation and the underlying Jurassic Morrison Formation. Cobban (1945, 1955) recognized two distinctive units in the Kootenai in the subsurface west of the Kevin-Sunburst dome and in a few exposures along the Rocky Mountain Front. The Mount Pablo Formation is essentially his lower unit. It mostly consists of red mudstone and whitish sandstone; the Cut Bank Sandstone Member is at the base, and beds of freshwater limestone are near the top. The

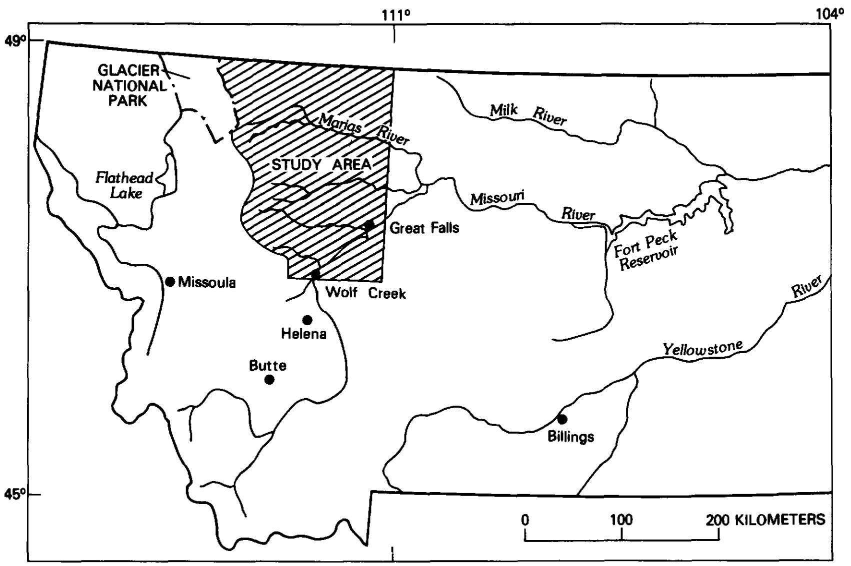


FIGURE 1.—Index map of Montana showing study area.

Cut Bank Sandstone Member, named by Bartram (1935), is an oil and gas reservoir above a post-Jurassic unconformity in the Cut Bank area. The upper unit described by Cobban (1945) is dark-bluish-green, olive-green, olive-drab, purple, and drab-maroon mudstone containing very lenticular beds of greenish-gray sandstone, and it is retained as the Kootenai Formation.

The Mount Pablo Formation has been referred to as the unnamed formation in recent reports (Mudge, Earhart, and Rice, 1977; Mudge, Earhart, and Claypool, 1977; Mudge and Earhart, 1979; and Mudge, 1979). The Cut Bank is here retained as the basal member of the Mount Pablo. Other units mapped in subsurface in the Cut Bank area have not been recognized in the Sawtooth Range.

MOUNT PABLO FORMATION

The Mount Pablo Formation forms widespread outcrops in the Sawtooth Range south to the Dearborn River (fig. 2) and in the foothills east of the mountains from the South Fork Two Medicine River south almost to Birch Creek. In the western part of the Sun River area, Mudge (1972, p. A51) erroneously assigned rocks making up the Mount Pablo to the western facies of the Jurassic Morrison Formation. South of the Sun River the Mount Pablo is present in the westernmost Cretaceous exposures along Ford and Smith Creeks and as far south as about 3 km south of Elk Creek (fig. 2).

TYPE SECTION OF MOUNT PABLO FORMATION AND REFERENCE SECTION OF CUT BANK SANDSTONE MEMBER

A completely exposed section of the Mount Pablo Formation on the north side of Badger Creek is established as the type section, even though it is overturned, of the Mount Pablo and the reference section of the Cut Bank. This section is in the NE $^1/_4$ SW $^1/_4$ sec. 3, T. 29 N., R. 11 W., in the Blackfeet Indian Reservation, Half Dome Crag $7^1/_2$-minute quadrangle, Pondera County, and is accessible by an unimproved road that terminates at Badger Creek, a few meters west of the exposure. All fossil collections are catalogued by U.S. Geological Survey Mesozoic Collection numbers. The section was measured by M. R. Mudge using steel tape where direct measurements were possible and Jacob's staff elsewhere. Where applicable, the color of the rocks was determined by use of the "Rock Color Chart" of the Geological Society of America (Goddard and others, 1948). Measurements begin at the base of the lowest greenish-gray, massive, crossbedded sandstone of the Kootenai Formation, which strikes N. 50° W. and dips 55° SW, overturned. The section is described as a normal section from top to bottom.

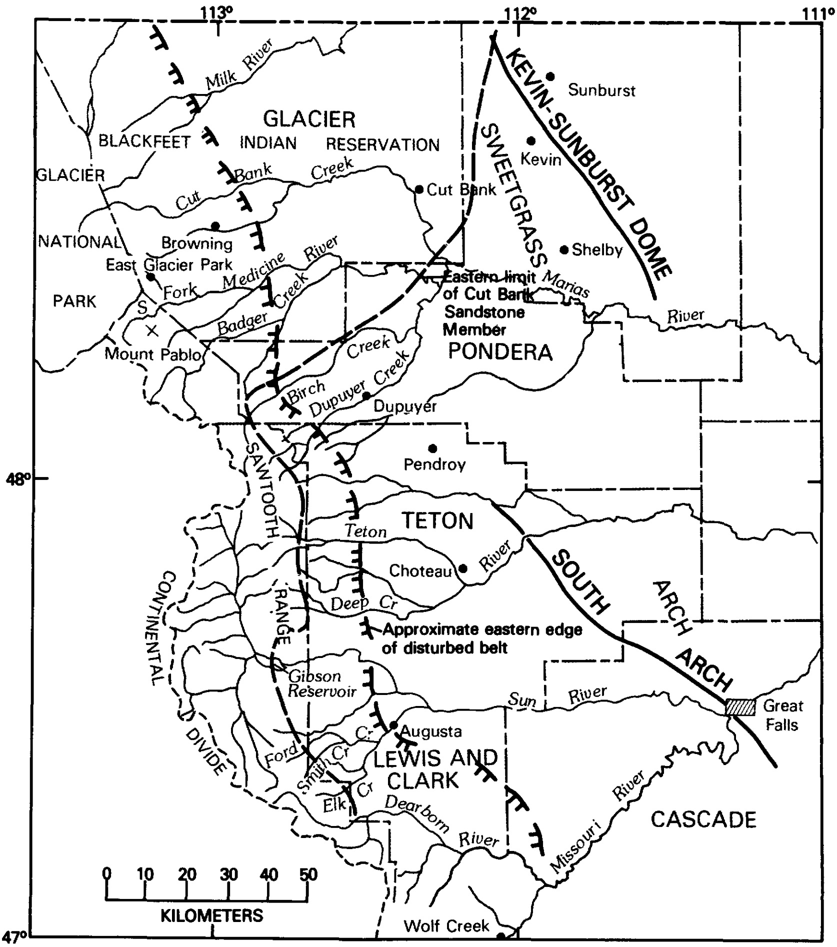


FIGURE 2.—Map showing structural features and extent of Cut Bank Sandstone Member in the Sweetgrass Arch area, northwestern Montana.

	Thickness Meters
Base of Kootenai Formation.	
Mount Pablo Formation:	
Upper and middle part:	
Siltstone, gray, massive, weathers platy, some iron stains on bedding planes	0.7
Shale, dark-gray, thinly bedded	1.8
Limestone, gray, coarsely crystalline, hard, composed of gastropods and other fossils, organic trails and burrows abundant; thin dark-gray shale lentil in middle	.4
Shale, gray, calcareous, weathers gray green, thinly laminated	.6
Limestone, light-gray, contains white pelecypods	0.3

	Thickness Meters
Mount Pablo Formation — Continued	
Upper and middle part — Continued	
Shale, dark-gray, noncalcareous, thinly laminated to fissile	1.0
Limestone, gray, argillaceous, in beds about 15 cm (centimeters) thick, weathers nodular, interbedded with gray shale	1.2
Shale, gray, calcareous, thinly laminated, some iron stains in upper part; limestone lenses of white pelecypods	2.7
Siltstone, gray, slightly calcareous, massive, abundant pyrite nodules and iron-stained areas, some wood fragments	1.7
Shale, dark-gray, silty, noncalcareous, fissile, heavily iron stained. Fossil collection D5962-A	1.0
Limestone, gray, medium-crystalline, weathers yellowish gray and blocky, in beds as much as 1.2 m; some calcite-lined fractures, abundant small fossil fragments	3.0
Shale, gray, calcareous, thinly laminated	1.0
Shale, gray, silty, calcareous, contains nodular limestone and very small mud chips, fossil fragments	1.2
Shale, gray, clayey, noncalcareous, blocky; some iron stains on fracture planes	3.6
Claystone, greenish-gray (5GY8/1), noncalcareous, weathers nodular; some iron stains on fracture planes	4.5
Claystone, dusky red (5R 3/4), noncalcareous, weathers blocky	5.9
Sandstone, medium-gray, fine- to medium-grained, poorly sorted, mostly quartz and feldspar grains, some chert; weathers light gray, massive	.4
Claystone, mostly dusky red, some greenish gray in upper part, contains some siltstone in lower part, noncalcareous; some iron stains	1.3
Sandstone, medium-gray, hard, fairly well sorted, fine-grained in upper part grading to coarse-grained in lower part; lenses of quartz and variable amounts of chert fragments, some angular yellowish-gray fine-grained sandstone fragments at base, crossbedded, abundant iron stains at base. Fossil collection D5962-B from thin, gray shale lentil 45 cm above base	6.1
Claystone, moderate-reddish-brown (10R 4/6), weathers dark reddish brown (10R 3/4), some greenish gray in upper part; gray limestone nodules that weather brown are in upper part	4.1
Siltstone, gray-green, massive, contains 45 cm of very fine grained, gray, massive sandstone in middle part; some iron stains	1.6
Claystone, reddish-brown, noncalcareous, weathers dark reddish brown, blocky; some greenish-gray silt nodules; cherty siderite nodules in middle part that weather dark brown to gray brown	3.2

	Thickness Meters
Mount Pablo Formation —Continued	
Upper and middle part — Continued	
Claystone, dark-greenish-gray, noncalcareous, weathers pale light olive green, blocky, partly nodular	1.7
Sandstone, gray, very fine grained, weathers brown, massive	.2–.5
Mudstone, like above	.3
Total thickness of upper and middle part of formation	49.5–50.0
Cut Bank Sandstone Member:	
Sandstone, gray, massive, poorly sorted, very fine grained in upper part, grading to coarse grained in lower part, low- to high-angle crossbeds	3.2
Shale, gray, fissile	.8
Sandstone, gray, coarse-grained, poorly sorted, quartz and chert grains, crossbedded; thin lenticular chert-pebble conglomerate at and near base	7.0
Total Cut Bank Sandstone Member	11.0
Total Mount Pablo Formation	60.5–61.0

Unconformity.

Sandstone member of Swift Formation (Upper Jurassic).

LITHOLOGY

The Mount Pablo Formation consists of nonmarine sandstone and conglomerate in the lower part, variegated mudstone interbedded with some sandstone in the middle part, and limestone interbedded with and overlain by mudstone in the upper part. The south-to-north lithologic variation in the formation is shown on figure 3. Most of the variation occurs within the middle part of the formation, between the Cut Bank Sandstone Member at the base and the limestone unit in the upper part.

The Cut Bank Sandstone Member in the northern outcrop area consists of a conglomeratic sandstone unit in the lower part and a sandstone unit in the upper part. A thin shale bed separates the two units only in the Badger Creek area (measured section). The member ranges in thickness from 9 to 30 m and forms a prominent cliff, especially in the northern outcrop (figs. 4 and 5). The conglomeratic sandstone is medium to coarse grained, poorly sorted, gray to yellowish gray, and highly crossbedded in most exposures, and it consists of rounded to subrounded grains of quartz and chert. The amount of chert varies considerably from one exposure to another. The unit contains numerous lenses of conglomerate as much as 30 cm thick. A basal conglomerate is widespread in the northern outcrop (fig. 6) but is locally absent in the southern outcrop. Other lenses of conglomerate are locally present in the middle and upper parts of the unit. The conglomerate is composed of well-rounded granules and small pebbles that are mostly less than 2 cm across; a few are as much as 3 cm. In the northern outcrop they are composed of chert, whereas, in the southern outcrop, Mudge (1972, p. A52) noted the conglomerate lenses to consist of granules and pebbles of chert and limestone, with some gray and red quartzite, quartz, siltstone, and ironstone.

The upper part of the Cut Bank Sandstone Member consists of very coarse grained, poorly sorted, light-gray, highly crossbedded, massive sandstone that grades upward to siltstone. This sandstone is as much as 7.5 m thick in the northern outcrop area.

In the southern and central outcrop area, the Cut Bank consists of coarse-grained, crossbedded sandstone that locally contains thin lenses of conglomerate. In most places, the sandstone is composed of quartz and some plagioclase and chert grains. Locally it also contains some fragments of red mudstone, coal, and wood. In places the chert grains are sufficiently abundant to impart a salt and pepper appearance to the sandstone. The coarse-grained sandstone grades upward to a fine-grained sandstone.

The strata between the Cut Bank Sandstone Member at the base and the limestone unit near the top is mostly mudstone with some interbedded sandstone. In the northern outcrop, the mudstone is mostly gray and greenish gray; some beds in the upper and lower parts are moderate reddish brown. In places gray fissile shale is near the top. At Mount Baldy the upper beds are dusky yellow, olive drab, dusky red, and very dark red; the reddish beds grade upward into purple. Locally the mudstone contains brown limestone nodules. In the southern outcrop the mudstones are mostly a bright, moderate reddish brown that weather to a bright reddish orange (Mudge, 1972, p. A52).

The amount of sandstone in the middle part of the formation varies from one area to another (fig. 3). Most of the beds of sandstone are gray and very fine to fine grained. In and north of the Birch Creek area one or more beds (2–6 m thick) of coarse-grained sandstone are about 4.5–18 m above the Cut Bank Sandstone Member. They resemble beds in the upper part of the member in that they are gray and crossbedded, and grade from coarse-grained sandstone upward to siltstone. They are composed of chert and quartz grains, which impart a salt and pepper appearance to the sandstone.

A widespread distinctive limestone unit near the top of the formation forms a light-gray band on the outcrop. This unit, which mostly ranges in thickness from 1.2 to 6 m but in places is 6–9 m

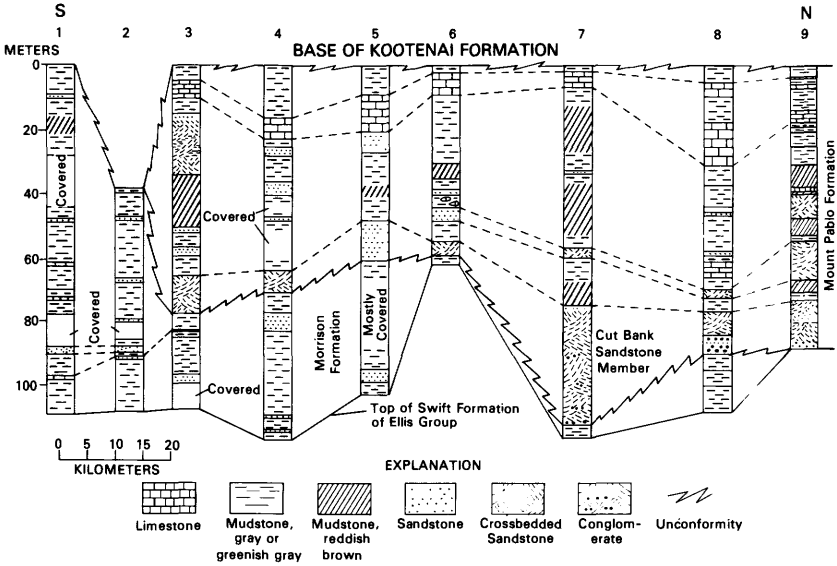
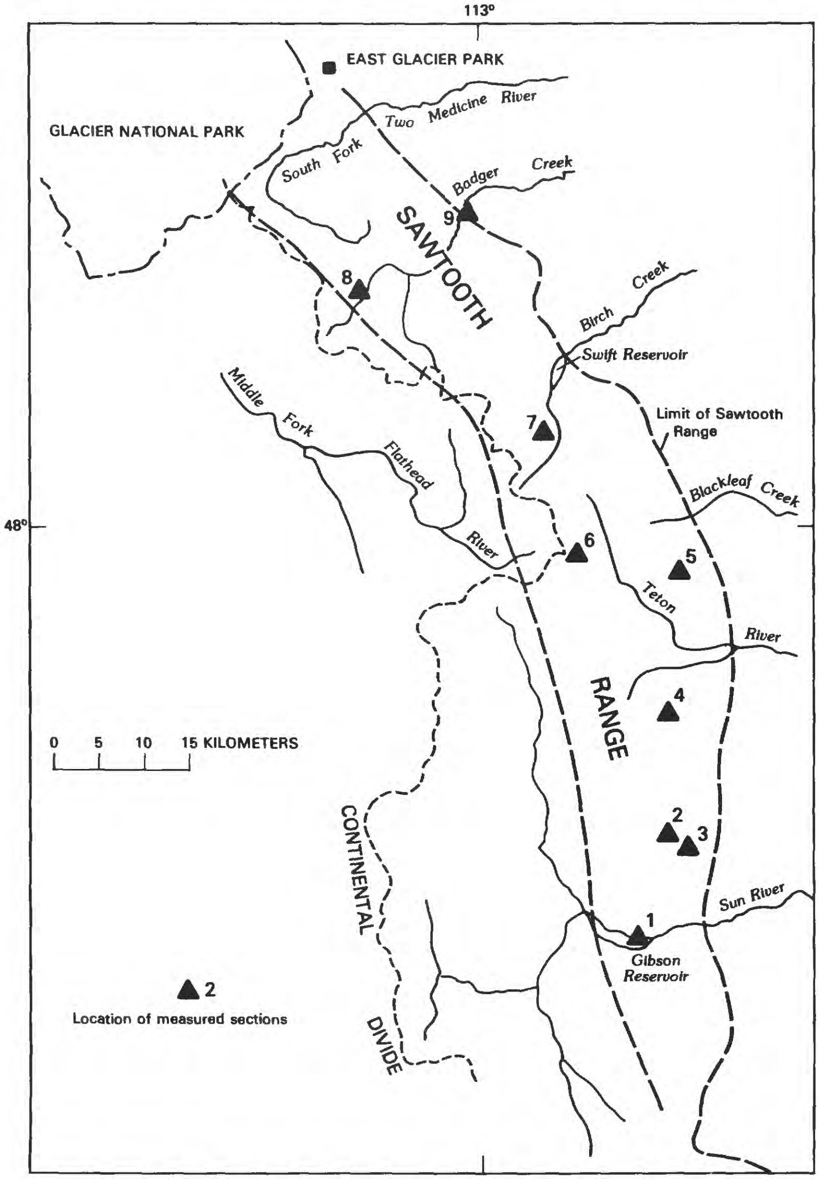


Figure 3. (above and facing page).—Location and correlation of measured sections of the Morrison and Mount Pablo Formations in the Sawtooth Range, northwestern Montana.

Description of localities of measured sections

1. Morrison Formation, north shore of Gibson Reservoir on west side of Mortimer Gulch, SW 1/4 sec. 4, T. 21 N., R. 9 W., Patricks Basin Quadrangle, Teton County. Measured section 17 described by Mudge (1972, p. A105–A106).
2. Morrison Formation, west side of upper reaches of Hannan Gulch, unsurveyed SW 1/4 sec. 26, and NW 1/4 sec. 35, T. 23 N., R. 9 W., Castle Reef Quadrangle, Teton County. Measured section 18 described by Mudge (1972, p. A106–A107).
3. Morrison and Mount Pablo Formations, head of Green Timber Gulch, in unsurveyed T. 23 N., R. 9 W., Castle Reef Quadrangle, Teton County.
4. Morrison and Mount Pablo Formations, head of Rierdon Gulch, about 2.4 km southwest of Ear Mountain, Ear Mountain Quadrangle, Teton County.
5. Morrison and Mount Pablo Formations, west of saddle at the head of Blindhorse Creek in unsurveyed T. 25 N., R. 9 W., Cave Mountain Quadrangle, Teton County.
6. Morrison and Mount Pablo Formations, west of Mount Wright, Mount Wright Quadrangle, Teton County.
7. Morrison and Mount Pablo Formations, on ridge, elevation 6,960, about 1.2 km south of Crooked Mountain, between Middle and South Forks Birch Creek, Gateway Pass Quadrangle, Teton County.
8. Morrison and Mount Pablo Formations, high on north side of Lee Creek, about 4 km southwest of Badger guard station, Crescent Cliff Quadrangle, Pondera County.
9. Reference section of Cut Bank Sandstone Member and type section of Mount Pablo Formation on Badger Creek.


113°
EAST GLACIER PARK
GLACIER NATIONAL PARK
Two Medicine River
South Fork
Badger Creek
SAWTOOTH
Birch Creek
Swift Reservoir
Limit of Sawtooth Range
Middle Fork Flathead River
Blackleaf Creek
48°
Teton River
RANGE
0 5 10 15 KILOMETERS
CONTINENTAL DIVIDE
Sun River
Gibson Reservoir
1
2
3
4
5
6
7
8
9
Location of measured sections

thick, consists of gray dense beds of limestone 30–60 cm thick that weather light gray and are commonly interbedded with gray-brown mudstone. Molds of gastropods and mollusks are locally present.

The uppermost unit of the formation is a gray to olive-gray, silty mudstone that locally contains some very thin lenses of very fine grained calcareous sandstone and dark-gray shale. The unit ranges in thickness from 4.5 to 14 m.

THICKNESS

The Mount Pablo Formation varies considerably in thickness. In most places it ranges in thickness from 45 to 60 m. It is a minimum of 34 m thick in the east-central part of the outcrop, north of the Teton River, and a maximum of 90 m at Crooked Mountain in the Birch Creek area.

LOWER CONTACT

An angular unconformity at the base of the Mount Pablo Formation reflects pre-Cretaceous uplift. In most places in the Sawtooth Range, the Cut Bank Sandstone Member rests un-

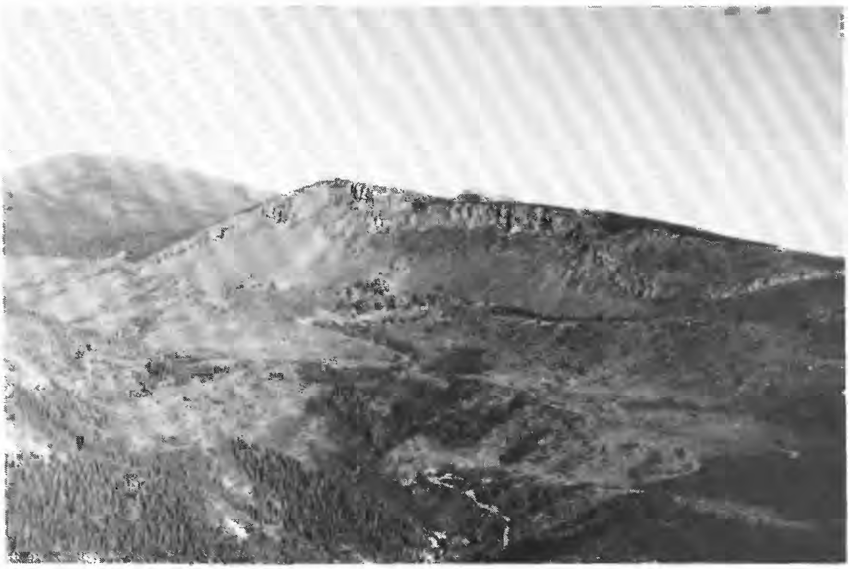


FIGURE 4.—Cliff-forming Cut Bank Sandstone Member on north side of Sawmill Creek, Pondera County, about 2.5 km northwest of the Badger Creek reference section. Member is repeated by a thrust fault. View northwest.

FIGURE 5.—Cut Bank Sandstone Member of Mount Pablo Formation exposed in roadcut near top of Mount Baldy. View northwest.

FIGURE 6.—Conglomeratic sandstone at base of Cut Bank Sandstone Member in roadcut near top of Mount Baldy. Head of geologic pick marks unconformity. Here Cut Bank rests on sandstone member of Jurassic Swift Formation.

conformably on the Upper Jurassic Morrison Formation. The amount of Morrison strata beneath the unconformity ranges from 0 to 15 m in the northern outcrop and from about 25 to 34 m in the southern outcrop. The Morrison was completely eroded prior to Cut Bank sedimentation in the Badger Creek-Mount Pablo area where the Cut Bank Sandstone Member rests unconformably on the lower strata of the upper sandstone member of the Jurassic Swift Formation. This relationship between the two units led Weimer (1959, p. 85) to erroneously interpret the Cut Bank as a nonmarine facies of the marine Swift. He (1959) therefore assigned a Jurassic age to the Cut Bank. However, more recent field evidence clearly shows the unconformable relationship between the two formations, and pollen from shales in the Mount Pablo Formation indicates an Early Cretaceous age.

UPPER CONTACT

The Mount Pablo Formation is overlain unconformably by the Kootenai Formation. The sandstone at the base of the Kootenai differs from one area to another as unconformities exist within the Kootenai. Mudge (1972, p. A53) noted that at least two and probably more unconformities are in the Kootenai. Channel-type sandstones are present but are very lenticular (Cobban, 1955, p. 109; Mudge and Sheppard, 1968; Mudge, 1972, p. A53). Conglomerates are locally present at the base of the upper and lower sandstone units (Mudge and Sheppard, 1968; Mudge, 1972).

A distinctive sandstone unit at the base of the Kootenai Formation unconformably overlies the Mount Pablo Formation in part of the southern outcrop. To the south, this unit unconformably overlies the Morrison Formation in the eastern part of the Sun River area (Mudge, 1972, p. A52), and south into the Wolf Creek area (Schmidt, 1978, p. 16). In the Sun River area, Mudge (1972, p. A52) called this sandstone unit the "Sunburst sand of subsurface usage." It is not known how this sandstone correlates with the type Sunburst Sandstone Member of the Kootenai at Kevin–Sunburst dome as assigned by Rice (1975). The unit, 0–21 m thick in the Sun River area (Mudge, 1972, p. A52) and 8–15 m thick in the Wolf Creek area (Schmidt, 1978, p. 16), consists of a hard, noncalcareous, light-gray to gray, very fine to coarse-grained sandstone with poorly sorted, rounded to subangular grains of clear quartz and a few scattered grains of chert and feldspar (Mudge, 1972; Schmidt, 1978). The beds are locally crossbedded and commonly weather grayish orange.

The sandstone unit described above is absent in the western part of the Sun River area and north of Blackleaf Creek. In these areas the basal unit of the Kootenai is greenish-gray, fine- to coarse-grained, crossbedded sandstone, composed of chert and quartz grains and varying amounts of magnetite grains. Conglomerate, locally present at the base of the sandstone unit, consists of as much as 15 m of pebbles and cobbles of quartzite, quartz, chert, and igneous rocks in a coarse-grained sandy matrix (Mudge and Sheppard, 1968; Mudge, 1972). The lithology of this sandstone and conglomerate is distinctively different from the basal Kootenai sandstone and from the sandstones and conglomerates in the Mount Pablo Formation.

CORRELATION

Cobban (1945, 1955) recognized two units in the Kootenai Formation in the subsurface west of the Kevin–Sunburst dome. His lower unit included, in ascending order, the Cut Bank Sandstone Member, Sunburst zone, and Moulton Member. These subdivisions were first described by Blixt (1941) in his paper on the Cut Bank oil and gas field. The name "Sunburst" in the Cut Bank area has since been replaced by the Lander Member by Oakes (1966), but Lander is not adopted in this report.

The Mount Pablo Formation is correlative in the subsurface with

AGE

The age of the Mount Pablo Formation is early Albian to possibly late Aptian, based on identified palynomorphs. Three samples from the type section of the Mount Pablo Formation were examined for palynomorphs by R. H. Tschudy (written commun., 1980). One sample, CBMP1 (fossil collection D5962-A) yielded abundant palynomorphs. Sample CBMP 3 (fossil collection D5962-B) yielded a few palynomorphs; sample CBMP 2 was barren.

The palynomorphs identified by Tschudy from sample CBMP-1 (USGS paleobotany loc. D5962-A) and CBMP-3 (USGS paleobotany loc. D5962-B) are:

CBMP-1 (D5962-A)	CBMP-3 (D5962-B)
Appendicisporites unicus (Markova) Singh	
Appendicisporites problematicus (Burger) Singh	
Cicatricosisporites cf. *C. hughessi* Dettmann	
Cicatricosiporites sp.	*Cicatricosisporites* sp.
*Trilobosporites** *minor* Pocock	
*Trilobosporites** *apiverrucatus* Couper	
*Trilobosporites** cf. *T. marylandensis* Brenner	*T. marylandensis* Brenner
Tigrisporites reticulatus Singh	
Cerebropollenites mesozoicus (Couper) Nilsson	
Araucariacites cf. *A. australis* Cookson	*A. australis* Cookson
Vitreisporites pallidus (Reissinger) Nilsson	
Taxodiaceaepollenites hiatus (Potonie) Kremp	
Corollina sp.	
Alisporites sp.	
Monosulcites sp.	
Osmundacidites sp.	*Osmundacidites* sp.
Botryococcus cf. *B. braunii Küzing*	*Baculatisporites* sp.
	Klukisporites sp.

*This genus should probably be included in the genus *Impardecispora*, but formal transfer has not been made.

Two core samples of rocks in the Lander Member of the Kootenai Formation in the Union Oil Co. Miller No. 24 well in NW 1/4 NW 1/4 sec. 32, T. 33 N., R. 5 W., Glacier County, Mont., in the Cut Bank field, were also examined for palynomorphs. Palynomorphs identified by

R. H. Tschudy (written commun., 1976) in samples P3 (fossil collection D5574-B) from a depth of 847 m and sample P4 (fossil collection D5574-A) between 854 and 855 m include the following:

Trilobosporites marylandensis Brenner
Trilobosporites cf. *T. purverulentus* (Verbitskaya) Dettmann
Trilobosporites cf. *T. crassus* Brenner
Trilobosporites sp.
Lycopodiumsporites reticulumsporites (Rouse) Dettmann
Corollina (*Classopollis*) sp.
Aequitriradites spinulosus (Cookson and Dettmann)
Cookson and Dettmann
Rugubivesiculites sp.
Cicatricosisporites spp. common
Gleicheniidites sp.
Stereisporites sp.
Appendicispoorites potomacensis Brenner
Contignisporites glebulentus Dettmann
Ornamentifera n. sp.
Foveotriletes sp.
Dictyotriletes cf. *D. scaberis* Dettmann
Vitreisporites pallidus (Reissinger) Nilsson
Pilosisporites trichiopapillosus (Thiergart) Delcourt and Sprumont
Rouseisporites cf. *R. reticulatus* Pocock
Cerebropollenites sp.
Januasporites sp.
Verrucosisporites rotundus Singh
Eucommiidites sp.
Foraminisporis wonthaggiensis (Cookson and Dettmann) Dettmann
Foraminisporis asymmetricus Cookson and Dettmann
Cyathidites sp.
Klukisporites sp.
Concavissimisporites sp.

All of the taxa listed by R. H. Tschudy (written commun., 1976, 1980) are commonly found in upper Lower Cretaceous rocks from the Western Interior. He stated that the presently known ranges of *Appendicisporites unicus* (Markova) Singh and *Tigrisporites reticulatus* Singh are mid-Albian to Cenomanian, that of *Trilobosporites minor* pocock is Aptian to mid-Albian; that of *Aequitriradites spinulosus* in North America is Albian and slightly younger, and that of *Contignisporites glebulentus* is Aptian to Albian. The absence of any tricolpate pollen grains in the assemblages indicates an age older than mid-Albian. Thus, the age of the Mount Pablo Formation and equivalents to the east based on palynomorph identifications is early Albian to possibly late Aptian.

The palynological assemblage including *Appendicisporites unicus* (Markova) Singh is somewhat similar to that found by Vagvolgyi and Hills (1969) in the McMurray Formation of northeastern Alberta, Canada. They concluded (p. 160) that "Palynological evidence indicates that the McMurray Formation in Socony Vacuum Hole No. 27 is of early to early middle Albian age." Older strata may, however, be present elsewhere.

The Gething Formation, considered to be correlative to the McMurray Formation (Singh, 1971, p. 11, table 1), has not yielded clear palynological evidence of its age. D. C. McGregor (*in* Stott, 1968) reported a palynomorph assemblage dominated by conifer pollen from the type section of the Gething Formation of British Columbia, Canada. The assemblage was not diagnostic, but McGregor inferred that the age of the Gething Formation is Valanginian to Aptian and possibly younger than Barremian.

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