GEOLOGIC MAP OF THE VALIER 30' x 60' QUADRANGLE

NORTHWESTERN MONTANA

Compiled and Mapped

by

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Revised map and text 2011

This map has had preliminary reviews for conformity with technical and editorial standards of the Montana Bureau of Mines and Geology.

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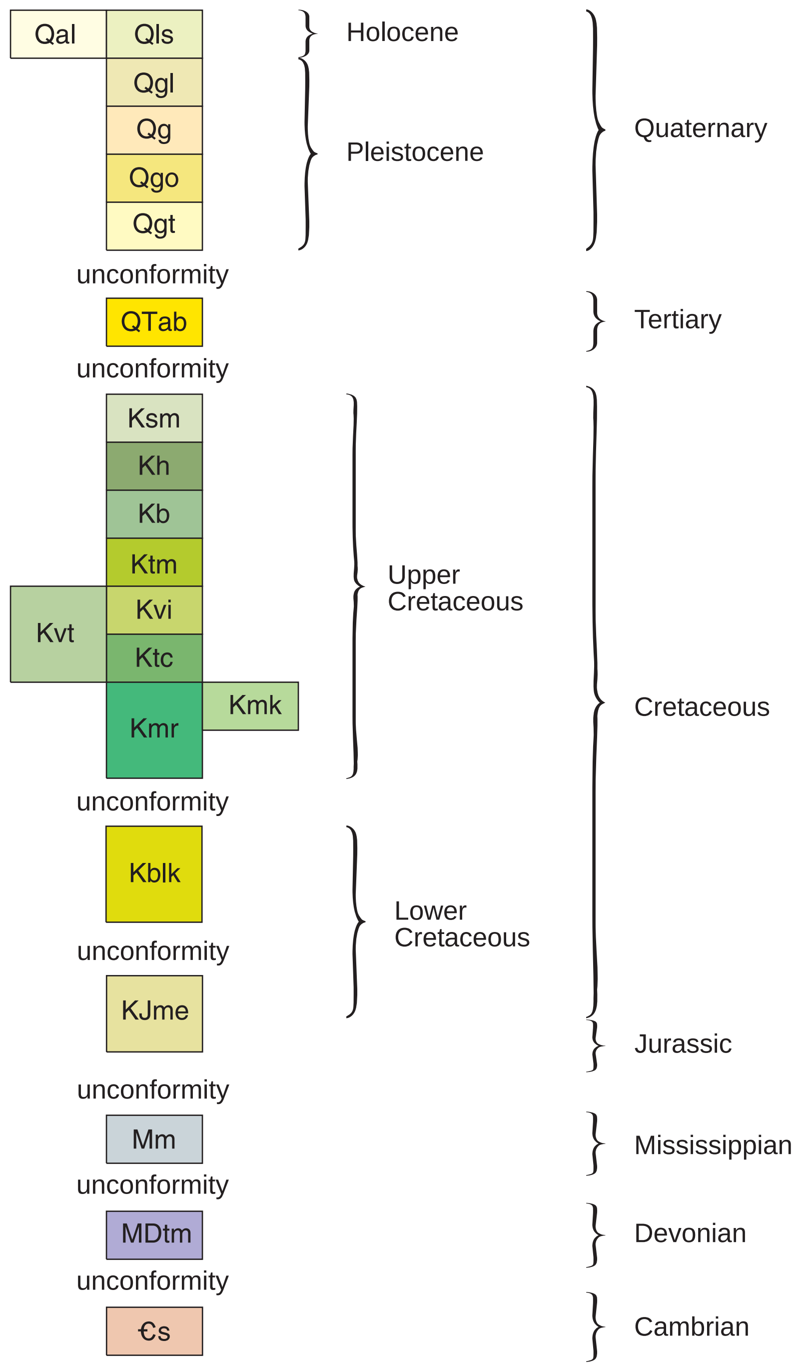
Introduction

The geology of that part of the Valier quadrangle within the Blackfeet Indian Reservation was taken with some modification from Cannon (1996). Geology for the southwestern part of the Valier quadrangle is from Harrison, Whipple, and Lidke (1998), and Mudge and Earhart (1983), with some adjustment where these two maps joined. Reconnaissance geologic mapping of the remainder of the Valier quadrangle was accomplished during 15 days in September and October 2000 and 2 days in October 2001.

Imbricate thrust faults of the Montana Disturbed Belt are exposed in the low hills and mountains in the southwestern part of the quadrangle. The rest of the Valier quadrangle is typical of the northern Montana plains; nearly flat-lying Cretaceous beds partly covered with till deposited by the continental ice sheet. Thin deposits of till deposited by piedmont glaciers cover much of the northwestern part of the quadrangle. However small exposures of bedrock along intermittent streams and gullies have made it possible to map the bedrock in this area of till deposited by piedmont glaciers (Cannon, personal communication, 2002). Prominent benches in the southern part of the Valier quadrangle are covered with gravel deposits derived from the mountains to the west. Gray limestone clasts derived from exposures of the Madison Group predominate in the gravel deposits

Reviews by Michael R. Cannon, Karen Porter, Richard Gibson, Wayne Van Voast, and Edmond Deal improved the map and are appreciated.

CORRELATION of Units
Valier 30' x 60' Quadrangle



Descriptions of Map Units

Qal Alluvial sand, silt, and clay deposits along major streams (Quaternary)

Qls Landslide deposit (Quaternary)

Qgl Glacial lake deposit– These sediments consist of brown to black silt and clay.

Qg Glacial deposits undivided (Pleistocene) - Till deposited by continental ice sheets is pebbly clay loam or loam till that contains numerous granitic and metamorphic pebbles, cobbles, and boulders from Canada. This till is 15 to 70 feet thick in the lower Birch Creek and Two Medicine River drainage basins and includes till deposited during the late Wisconsin and Illinoian glaciations. Wisconsin stage piedmont glaciers deposited till that is gravelly to clayey in the western part of the quadrangle. This till accumulated in ground moraine and in terminal, recessional, and lateral moraines. Thickness of till deposited by piedmont glaciers typically is from 1 to 15 feet, although in small areas thickness may be more than 50 feet (Cannon, 1996).

Qgo Glacial outwash (Pleistocene) - Chiefly coarse gravel and cobbles in sand matrix. Includes nonglacial fluvial terrace and pediment gravel deposits that were reworked by glacial meltwater. Also includes sand and gravel deposited as outwash from melting glaciers. Thickness of sand and gravel locally is more than 38 feet (Cannon, 1996).

Qgt **Glacial till**–Includes both till near the Rocky Mountain Front deposited by mountain glaciers and that to the east deposited by the continentaice sheet. The extent of till deposited by the continental ice sheet is recognized by the hummocky topography and the occurrence of pebbles, cobblers, and boulders of granitic igneous rocks and metamorphic rocks.

QTab Alluvial deposits of braided streams that spread out onto the plains from the mountains to the west (Quaternary and Tertiary) - This unit includes the Tg2 and Tg1 gravel deposits as shown by Cannon (1996). These deposits do not form distinct terrace levels, but are remnants of alluvial surfaces covered by generally less than 15 feet of gravel. The gravel is composed mainly of limestone or quartzite clasts, with less abundant metamorphic rocks transported from the Canadian Shield. Gradients of the bedrock surfaces on which the gravels were deposited range from 80 feet/mile near the mountain front to 25 feet/mile for those most distant from the mountains. The general down-gradient trend of these surfaces as now preserved is east to slightly north of east.

Ksm St. Mary River Formation (Upper Cretaceous) - Mostly greenish-gray to grayish olive mudstone interbedded with thin beds of fine-grained sandstone. Some poorly indurated, gray-brown to tan-gray, crossbedded sandstone beds fill small channels within the formation. Thin (3 feet) bed of carbonaceous shale, near the base of the St. Mary River Formation, commonly is overlain by a thin (3 feet) oyster bed (Mudge and Earhart, 1983). The St. Mary River Formation weathers to badlands topography. Thickness is about 980 feet in the northern part of the Blackfeet Indian Reservation (Stebinger, 1916). The St. Mary River Formation is similar to the Two Medicine Formation; both consist of nonmarine sedimentary rocks (Cannon, 1996).

Kh Horsethief Formation and Horsethief-Bearpaw transition unit (Upper Cretaceous) - The Horsethief Formation is gray to gray-brown, fine- to medium-grained marine sandstone, commonly crossbedded. Titaniferous magnetite sandstone is locally present in the upper 20 - 40 feet of the formation and large calcareous concretions are locally present in the middle part (Mudge and Earhart, 1983). The Horsethief Formation is as thick as 165 feet and it forms prominent bluffs and ridges.

The Horsethief- Bearpaw transition unit is dark-gray marine mudstone, interbedded with thin, fine-to medium-grained sandstone (Cobban, 1955). The sandstone beds are thicker and more abundant in the upper part. The unit is as thick as 400 feet in northern areas and it thins southward (Cannon, 1996).

Kb Bearpaw Shale (Upper Cretaceous) - The Bearpaw Shale is mostly dark-gray marine shale with ferruginous concretions, bentonite beds, and thin layers of sandstone (Cobban, 1955). Selenite (gypsum) crystals are common on weathered surfaces. The Bearpaw Shale is nearly 400 feet thick north of the Two Medicine River; it thins southward to about 225 feet along Blacktail Creek where it is much sandier and contains beds of fine-grained, crossbedded sandstone as thick as 15 feet (Cannon, 1996).

Ktm Two Medicine Formation (Upper Cretaceous) - Nonmarine mudstone with some sandstone. Upper and middle parts mostly gray-green to gray mudstone with reddish-gray, red-brown, and purple interbeds. Fossils, including dinosaur bones and pelecypods, are common in the upper 490 feet. The lower 560 feet contain many thick beds of gray to greenish-gray sandstone intebedded with gray-green, olive-drab, and gray mudstone (Mudge and Earhart, 1983). Sandstone beds in the lower part are poorly indurated, fine to medium grained, massive to thinly bedded, and locally as thick as 165 feet. Thin coal beds are present at the top and base of the formation and in a zone about 250 feet above the base (Stebinger, 1916). The Two Medicine Formation has a maximum thickness of about 2,200 feet. Where outcrops are extensive, the Two Medicine Formation erodes into badlands topography (Cannon, 1996). The Two Medicine Formation is generally poorly exposed.

Kvt Virgelle Formation and Telegraph Creek Formation undivided.

Kvi Virgelle Formation (Upper Cretaceous) - The Virgelle Formation is light-gray, moderately thick-bedded, fine-grained marine sandstone (Mudge and Earhart, 1983). Locally it contains crossbedded, iron-impregnated beds that weather to form large concretions. Dark brownish-gray, resistant titaniferous magnetite sandstone as thick as 20 feet is present at the top of the formation. The Virgelle Formation is 165 to 200 feet thick and it forms conspicuous hogbacks and escarpments (Cannon, 1996).

Ktc Telegraph Creek Formation (Upper Cretaceous) - The Telegraph Creek Formation is a transitional unit between underlying Marias River Shale and the overlying Virgelle Formation. It is similar to the transitional unit between the Bearpaw Shale and the Horsethief Formation (Mudge and Earhart, 1983). The Telegraph Creek consists mainly of gray mudstone interbedded with fine-grained sandstone. Sandstone beds are thicker toward the top of the formation and locally are crossbedded and ripple-marked. The thickness of the Telegraph Creek Formation ranges from about 120 to 165 feet (Erdmann and others, 1946).

Kmr Marias River Shale (Upper Cretaceous) - Chiefly dark-gray marine mudstone from about 900 to 1,200 feet thick (Cannon,1996).

Kmk Kevin Member of the Marias River Shale - The Kevin Member can be subdivided into three units on the basis of bentonite and the type of concretions. The lowest unit, 175 to180 feet thick, is characterized by many beds of bentonite, calcareous concretions, and concretionary limestone. The middle unit, about 200 feet thick, is characterized by numerous beds of reddish-weathering ferruginous concretions and concretionary limestone and dolostone. The upper unit, about 200 feet thick, consists of dark-gray shale that contains many beds of yellowish-gray-weathering concretionary limestone and a few thin layers of shaly sandstone and bentonite (Cobban, 1976). The Kevin Member is covered by glacial till and only very poorly exposed in the Valier quadrangle

Kblk Lower Cretaceous sedimentary rocks undivided - Predominantly gray to olive mudstone and gray sandstone interbedded with some limestone. Includes the Blackleaf and Kootenai formations. Thickness about 1,500 feet (Cannon, 1996).

KJme **Mount Pablo Formation(Lower Cretaceous), Morrison Formation (Upper Jurassic), and Ellis Group (Upper and Middle Jurassic) undivided**. Includes siltstone, sandstone, and shale accompanied by minor limestone and thin conglomerate at base of some units as mapped and described by Mudge and Earhart (1983). About 1,500 feet thick (Cannon, 1996).

Mm **Madison Group (Upper and Lower Mississippian)** - Upper part is the Castle Reef Dolomite and lower part is the Allan Mountain Limestone as mapped and described by Mudge and Earhart (1983). About 1,200 feet thick (Cannon, 1996).

MDtm **Sedimentary Rocks Undivided (Mississippian and Devonian)** - Includes Three Forks, Jefferson, and Maywood Formations as mapped by Mudge and Earhart (1983).

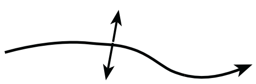
Ꞓs **Upper and Middle Cambrian sedimentary rocks, undivided** - Alternating units of carbonate and shale above a basal sandstone (Cannon, 1996).

Map Symbols

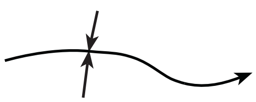
Contact - Approximately located. Dashed where inferred beneath glacial deposits and alluvium.

Tear Fault - Arrows show relative horizontal movement.

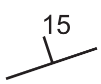
Thrust fault - Sawteeth on upper plate. Dashed where concealed.



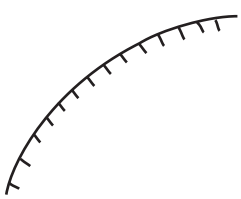
Anticline - Showing trace of axial plane and direction of plunge.



Syncline - Showing trace of axial plane and direction of plunge.

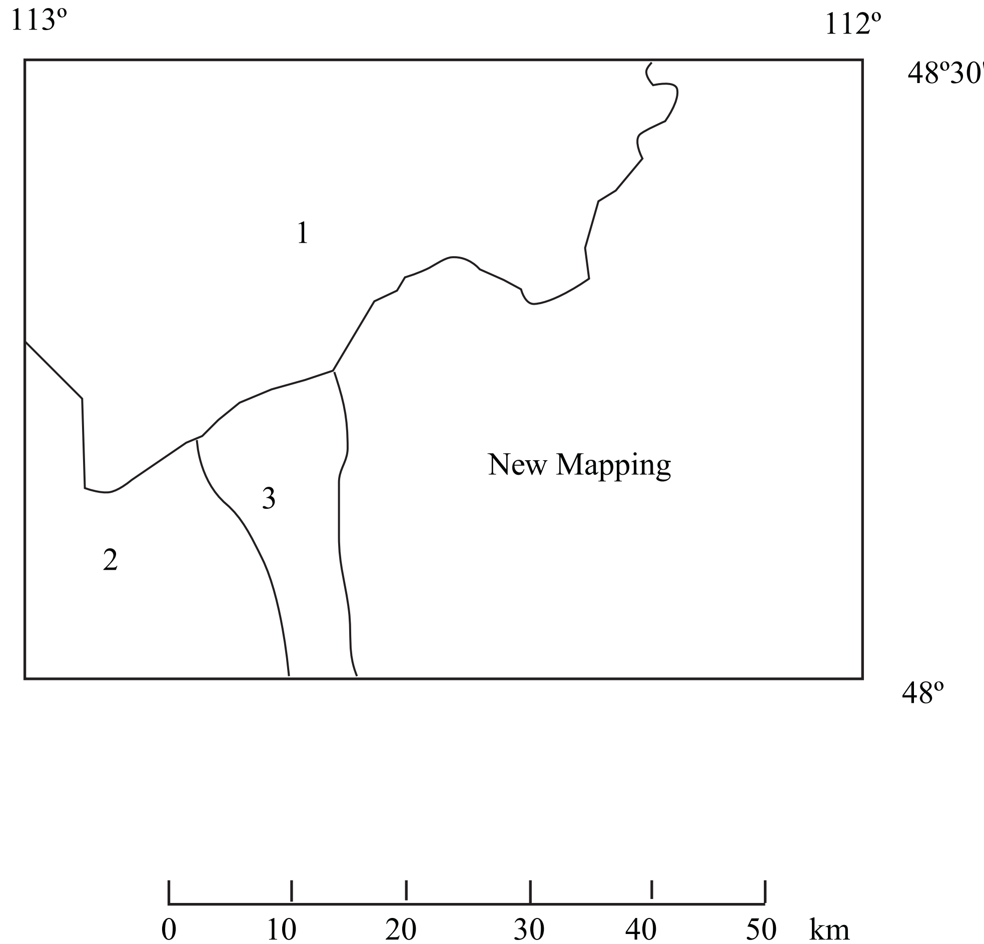


Strike and dip of beds



Glacial Lake Cut Bank (Pleistocene) - Discontinuous lake deposits include laminated clay and silt, some stratified sand and gravel, and scattered granitic pebbles, cobbles, and boulders (Cannon, 1996). The shoreline of Glacial Lake Cut Bank for the area east of the Blackfeet Indian Reservation is inferred on the basis of an outlet of approximately 3,900 feet (Horberg, 1954). Hachures on lake side of shoreline.

Published Geologic Maps Used in Compilation



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