DESCRIPTION OF MAP UNITS

BELT 7.5-MINUTE QUADRANGLE, MONTANA

Qal — FLOOD PLAIN AND CHANNEL ALLUVIUM (HOLOCENE)--Yellowish-brown and gray gravel sand, silt and clay deposited in flood plains and channels. Deposits are well to poorly stratified and moderately well sorted. Thickness not measured; estimated to be as much as 5 m (15 ft).

Qls — LANDSLIDE DEPOSITS (HOLOCENE)--Slump and earthflow deposits that may be stable or unstable and generally consist of chaotic mixtures of clay to boulder size clasts but may be rotated blocks of bedrock that have retained internal integrity. Color, texture and lithology reflect that of parent rock. Thickness not measured; estimated to be generally less than 15 m (50 ft).

Qat — ALLUVIAL TERRACE DEPOSITS (HOLOCENE)--Light-brown to light-gray, crudely to well stratified, and well sorted sand and gravel present at various elevations from 3 to 6 m (10 to 20 ft) above Belt Creek. Proportion of sand and gravel variable. Thickness of deposits as much as 3 m (10 ft), but generally approximately 2 m (6 ft).

Qaf — ALLUVIAL FAN DEPOSITS (HOLOCENE)--Coarse poorly sorted and stratified to moderately sorted and stratified sandy gravel in small fans at mouths of tributaries. Thickness not measured; estimated to be as much as 15 m (50 ft).

Qcl

COLLUVIUM AND SHEETWASH ALLUVIUM (HOLOCENE and PLEISTOCENE?)--Poorly to moderately well sorted gravel or fine-grained sand, silt and clay deposited on slopes. Most gravel-size colluvium reworked from higher older gravel deposits. Most fine-grained colluvium may be reworked from glacial lake deposits. Includes significant component of windblown silt and fine-grained sand. Thickness not measured; estimated to be as much as 6 m (20 ft).

Qti

ILLINOIAN AND PRE-ILLINOIAN TILL (PLEISTOCENE)--Unstratified, compact heterogeneous mixture of brownish-gray and reddish-brown clay, silt, sand and gravel with scattered boulders, deposited at the southernmost limit of continental glaciation in this area. Dominantly clay loam, silty clay loam, and loam 2-10% pebbles, cobbles and boulders by volume. Glacial erratics chiefly limestone, dolostone, orthoquartzite, and igneous and metamorphic rocks from the Canadian Shield. Not mapped where thin and patchy. Thickness as much as 15 m (50 ft).

Qgl

GLACIAL LAKE DEPOSITS (PLEISTOCENE)--Deposits below an altitude of 1220 m (4000 ft) of dark-gray, brown and reddish-brown varved clay, silt and sand with scattered granules and pebbles, cobbles and boulders. Thickness as much as 8 m (25 ft).

Ta

ALLUVIAL TERRACE DEPOSITS (PLIOCENE?)--Light-brown to light-gray, crudely to well stratified and well sorted deposits of locally well cemented coarse sand and gravel from 67 to 85 m (220 to 280

ft) above Belt Creek. Thickness as much as 12 m (40 ft) but generally 6 m (20 ft).

COLORADO GROUP

MARIAS RIVER SHALE

Kmfe

FERDIG MEMBER (UPPER CRETACEOUS, TURONIAN)--Noncalcareous, dark-gray-weathering, fissile shale with lenticular-bedded siltstone and fine-grained sandstone and distinctive reddish-orange, or reddish-brown ferruginous dolostone concretions that weather into small chips. A fine-grained, planar-bedded sandstone is present from 12 to 24 m (40 to 80 ft) above the base of the member. Occurs only in depression below Belt Butte in this quadrangle. Thickness of member approximately 20 m (66 ft).

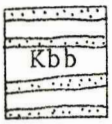
Kmc

CONE MEMBER (UPPER CRETACEOUS, CENOMANIAN and TURONIAN)--Lower part of member dark-gray-weathering calcareous shale that contains a persistent bentonite bed. Upper part of member thin-bedded platy, medium-gray- or grayish-orange-weathering petroliferous limestone that contains blue fish scales and pelecypod fragments. Occurs only in depression below Belt Butte in this quadrangle. Thickness approximately 10 m (33 ft).

Kmfl

FLOWEREE MEMBER (UPPER CRETACEOUS, CENOMANIAN)--Dark-gray-weathering, fissile shale that contains light-yellowish-gray porcellanite beds probably a result of contact metamorphism

of bentonite beds by numerous sills in this member. Also contains several thin beds of siltstone and fine-grained sandstone. Locally contains septarian concretions and limonitic dolostone concretions that weather to small chips similar to those in the Ferdig Member. Occurs only in depression below Belt Butte in this quadrangle. Thickness of member approximately 12 m (40 ft).



BLACKLEAF FORMATION

BOOTLEGGER MEMBER (LOWER CRETACEOUS ALBIAN)--Dark-gray-weathering fissile shale that contains two to six relatively prominent sandstone beds about 3 to 12 m (10 to 40 ft) thick separated by 15 to 30 m (50 to 100 ft) of shale with numerous bentonite beds. The fine- to medium-grained light-brown- to moderate-yellowish-brown-weathering sandstones are commonly flaser-bedded or ripple-laminated with abundant trace fossils on bedding surfaces. Trough and hummocky bedding also occur higher in the section, and fish scales and bones are common in the upper sandstones. Locally the tops of sandstone beds contain black chert pebbles. An upper well cemented chert-pebble conglomerate, or coarse-grained sandstone occurs at the top of the member. Sandstone beds persist over many square kilometers. The upper part of the Bootlegger near the top of Belt Butte contains the regionally extensive Arrow Creek Bed, a light-yellowish-gray porcellanite, labeled on map. Thickness of member approximately 100 m (330 ft).

Kbv

VAUGHN MEMBER (LOWER CRETACEOUS, ALBIAN)--Poorly exposed very bentonitic, silty, medium-gray-weathering shale that contains thin bentonite beds. Thickness of member ranges from 15 to 30 m (50 to 100 ft).

Kbt

TAFT HILL MEMBER (LOWER CRETACEOUS, ALBIAN)--Medium-dark-gray- to medium-light-gray-weathering, bentonitic, silty shale that contains several thin, locally glauconitic sandstone beds. Thickness of member approximately 24 m (80 ft).

Kbf

FLOOD MEMBER (LOWER CRETACEOUS, ALBIAN)--Black- to dark-gray-weathering fissile shale that contains pods and lenses of bioturbated sandstone at its base. Lacks the two prominent sandstone beds present in Great Falls area to west. Thickness of member approximately 40 m (130 ft).

base of Colorado Group

KOOTENAI FORMATION

Kk_5

FIFTH MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN AND ALBIAN?)--The uppermost part of the member consists of massive, color-banded, greenish-gray, grayish-red-purple, moderate-red and very dark-red mudstone with lenses of fine- to medium-grained, trough-crossbedded greenish-gray-weathering sandstone. Thickness of member approximately 37 m (120 ft).

Kk_4

Kk

Kbv

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Kk_4

FOURTH MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN)--Dusky-red or pale-reddish-brown fine- to medium-grained, thin- to medium-bedded micaceous, argillaceous, platy-bedded sandstone with abundant plant fragments, interbedded with very-dark-red mudstone. A persistent ostracod-rich moderate-reddish-brown limestone bed occurs in the middle of the member. Basal contact is transitional with Third member and contains interbedded gray or dusky-red siltstone and mudstone. Lowest sandstone beds are light-brown- or moderate-yellowish-brown-weathering, becoming dusky-red or pale-reddish-brown higher in the section. Low amplitude ripple marks, that are locally interference ripples, commonly occur on bedding surfaces. Thickness of member approximately 30 m (100 ft).

Kk_3

THIRD MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN)--Well sorted resistant quartz arenite with interspersed limonite specks. Scour base locally with rip-up clasts and chert pebbles cuts into Second member. Up to 20% dark chert is present at base, but higher in section it disappears almost entirely. Primary sedimentary structures include planar, tabular crossbedding with sets generally 20 to 40 cm (8 to 16 in) thick and planar-bedded, fine-grained sandstone and siltstone in 2 to 20 cm (.8 to 1.8 in) thick beds separating sets. Sinuous and straight-crested wave and interference ripple marks occur on bedding surfaces. Interbedded sandstone, siltstone and shale occur in planar beds near the top

of the member with abundant invertebrate trace fossils on bedding surfaces and within beds. Thickness of member approximately 12 m (40 ft).

Kk_2 SECOND MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN)--Poorly resistant red mudstone that overlies the First member with a sharp contact. Mudstone contains dense medium-gray micrite and argillaceous, light-brownish-gray micrite concretions that laterally become lenticular, irregular beds. Thin, lenticular chert-rich quartz arenite beds occur locally. A bed of intraformational-micrite-clast conglomerate occurs near the top of the member. Thickness of member approximately 30 m (100 ft).

Kk_1 FIRST MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN?)--Dominantly resistant festoon-crossbedded, moderately well sorted quartz arenite with 20 to 50% black, dark- and light-gray chert. Coarse-grained sandstone chert-granule-conglomerate or chert-pebble conglomerate occurs at scour base, typically with rip-up clasts of coal, plant fragments and impressions. Grain size fines upward with upper part of member generally fine- to medium-grained. Thickness of member approximately 6 to 24 m (20 to 80 ft).

Jm MORRISON FORMATION (JURASSIC, KIMMERIDGIAN)--Light-greenish-gray-weathering mudstone and shale with interbedded lenses of medium-gray micrite and fine- to medium-grained calcareous

of the member with abundant invertebrate trace fossils on bedding surfaces and within beds. Thickness of member approximately 12 m (40 ft).

Kk_2 SECOND MEMBER (informal map unit) (LOWER CRETACEOUS, APTIAN)--Poorly resistant red mudstone that overlies the First member with a sharp contact. Mudstone contains dense medium-gray micrite and argillaceous, light-brownish-gray micrite concretions that laterally become lenticular, irregular beds. Thin, lenticular chert-rich quartz arenite beds occur locally. A bed of intraformational-micrite-clast conglomerate occurs near the top of the member. Thickness of member approximately 30 m (100 ft).

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Jm MORRISON FORMATION (JURASSIC, KIMMERIDGIAN)--Light-greenish-gray-weathering mudstone and shale with interbedded lenses of medium-gray micrite and fine- to medium-grained calcareous thin-bedded, yellowish-brown-weathering sandstone with subbituminous coal bed at the top of formation. Thickness of formation approximately 30 m (100 ft).

MAP SYMBOLS

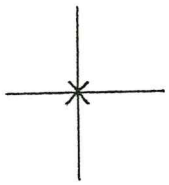
CONTACT--Dashed where approximately located.

FAULT--Showing relative displacement: U on upthrown side; D on downthrown side.

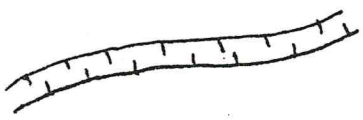
STRIKE AND DIP OF BEDDING--Showing direction and amount of dip.

ANTICLINE--Showing trace of crestline and direction of plunge; dotted where concealed. No plunge or direction of plunge unknown where plunge arrow is omitted.

SYNCLINE--Showing trace of troughline and direction of plunge, dotted where concealed. No plunge or direction of plunge unknown where plunge arrow is omitted.



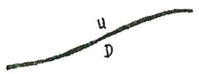
DEPRESSION--Center at X.



GLACIAL MELTWATER CHANNEL

MAP SYMBOLS

CONTACT--Dashed where approximately located.



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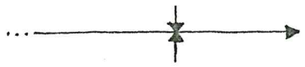

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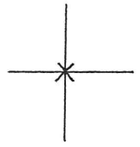
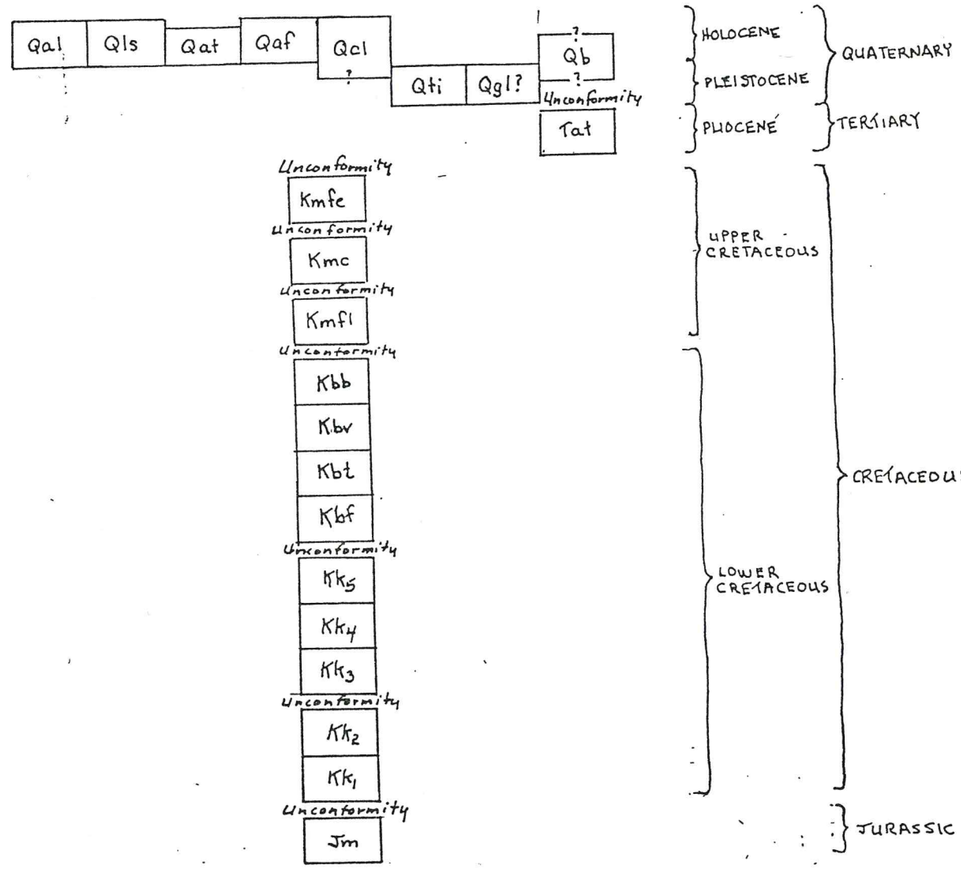


DEPRESSION--Center at X.

GLACIAL MELTWATER CHANNEL

CORRELATION OF MAP UNITS

BELT 7.5-MINUTE QUADRANGLE



PREVIOUS GEOLOGIC MAPPING, BELT 7.5-MINUTE QUADRANGLE

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Qal

Qls

Qat

Qcl