GEOLOGIC AND STRUCTURE CONTOUR MAP OF THE RICHEY 30' x 60' QUADRANGLE EASTERN MONTANA

by

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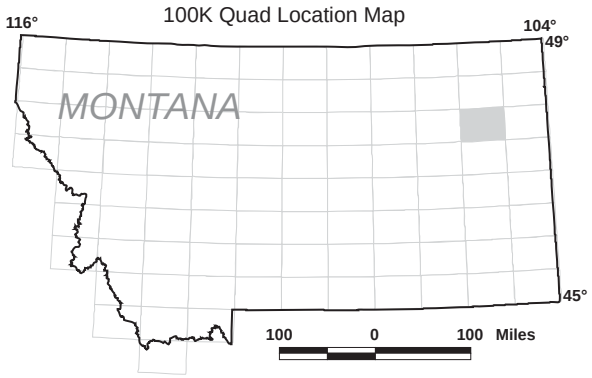
GEOLOGIC SUMMARY

The Richey quadrangle lies south of the Missouri River in northeastern Montana in parts of McCone, Dawson, and Richland Counties. Strata over most of the area have a gentle structural dip to the southeast. This trend is interrupted by the presence of Poplar Dome in the northeast quarter of the area, and by the Weldon Fault Zone in the west central part of the area.

The axis of the Poplar Dome trends in a northwesterly direction and crosses the Missouri River about twelve miles east of the northeast corner of McCone County beyond the area of this quadrangle. Outcrops along Redwater Creek in the northeastern part of the area are on the flank of this dome and have a south to southwesterly dip.

The trend of the Weldon Fault Zone is northeast-southwest. Several faults are mapped at the surface, although inferred only along much of their lengths. The faults shown are modified from those tentatively shown on Wilde and Foster (1991). Well control is inadequate to evaluate the extension of these faults at depth. However, well data do show irregular elevations of the top of the Pierre Shale in the region of the faults, suggesting structural influence. These elevation data are shown on the map but are not incorporated into the structure contouring of the formation top. The Weldon Fault (Dobbin and Erdmann, 1955; Marcuson and Krinitzsky, 1976), the primary fault within the zone, forms the apparent southeast limit of the fault zone and shows the greatest amount of vertical offset. Most faults are down-dropped on their southeast side, based on lateral offsets of dipping beds of 20 to more than 150 feet.

Across the northern part of the quadrangle a thin veneer of gravelly glacial till is recognized and mapped (Qgt). Other gravel deposits in the quadrangle appear to be reworked from higher elevations or are of uncertain origin (Qgr). The till deposits commonly occur in extensively dissected and isolated remnants of an earlier widespread cover of glacial deposits. The other gravels may also be such remnants. Along the quadrangle's north border, a map unit discontinuity exits where glacial deposits were not mapped on the north-adjacent Whitewater 30' x 60' quadrangle (Bergantino, 2002). Bergantino did, however, recognize that glacial deposits are widely distributed across the Whitewater quadrangle though his mapping had a bedrock-emphasis. Other Quaternary deposits of uncertain origin are mapped as older alluvium (Qao). Across the quadrangle, streams are commonly underfit for the valleys they occupy, suggesting that the valleys have an earlier origin as glacial outwash valleys. Today these valley floors are covered with modern alluvium and colluvium (Qac), but these deposits may overlie unexposed glacial deposits as indicated by Bergantino (2002).



Quad index

GLASGOW	WOLF POINT	CULBERT-SON
FORT PECK LAKE EAST	RICHEY	SIDNEY
JORDAN	CIRCLE	GLENDIVE

CORRELATION CHART
RICHEY 30' x 60' QUADRANGLE

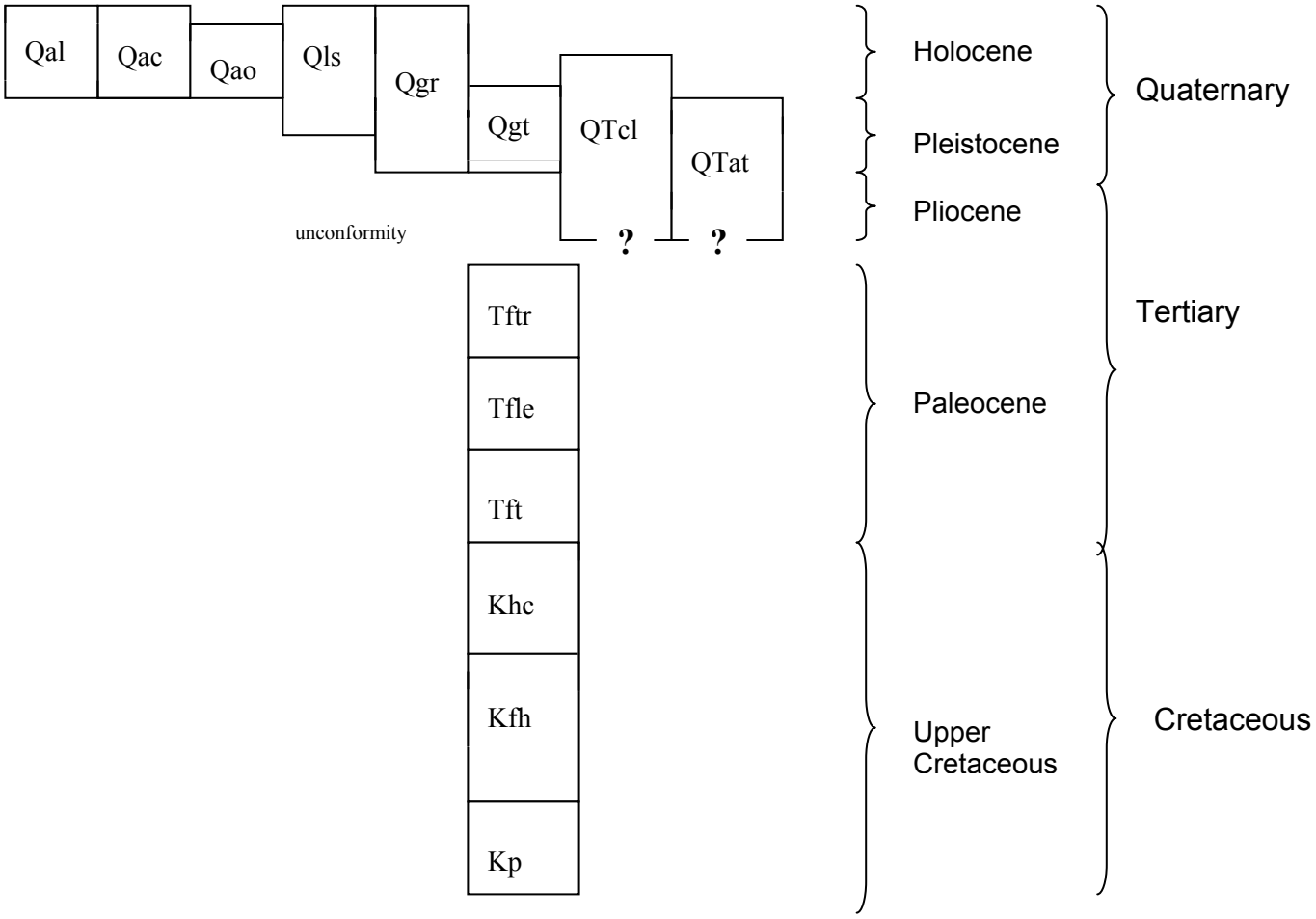


Figure 2. Correlation chart of map units.

DESCRIPTION OF MAP UNITS

Qal **Alluvium (Holocene and Pleistocene)—**Light brown, reddish-brown, yellowish-brown, grayish-brown, brown, olive gray, and light gray gravel, sand, silt, and clay deposited in modern stream and river channels and on flood plains. Clasts are well sorted to poorly sorted. Deposits are poorly to well stratified. Thickness varies from (a few inches to 25 feet).

Qac **Alluvial and colluvial deposits (Holocene)**— Light brown, reddish-brown, yellowish-brown, grayish-brown, brown, olive gray, and light gray gravel, sand, silt, and clay. Where these deposits have a different orientation than the modern drainage pattern the alluvium and colluvium may be a thin veneer overlying unexposed older, glacial outwash channel deposits as is suggested in the southeast part of the quadrangle. Thickness not measured.

Qao **Older alluvial deposits**—Similar to, and located laterally adjacent to, modern stream and flood plain alluvium at approximately the same elevation. Thickness not measured.

Qls **Landslide deposits**—These deposits were not mapped in the field, but are tentatively recognized on aerial photographs; they occur in the northwest corner of the map area.

Qgr **Gravel deposits**—Gravel deposits of multiple origins were recognized in the field but not described in detail. Thicknesses not measured.

Qgt **Glacial till**—These deposits have been distinguished on aerial photographs from other gravel deposits originally mapped as one unit in the map area. They exhibit a distinctive irregular, “lumpy” surface characteristic of glacial till. Deposits are thin, generally five feet or less, in this area (Bergantino, personal communication).

QTcl **Clinker (Holocene, Pleistocene, and Pliocene?)—**Red, pink, orange, purple, yellow and gray very resistant metamorphosed shale, siltstone, and sandstone of the Fort Union Formation. Overlying units were baked by natural burning of underlying coal, and collapsed into voids created by burning. Locally, baked rock was melted and fused to form buchite, a black, glassy, vesicular or scoriaceous rock.

QTat **Alluvial terrace deposits (Pleistocene and Pliocene?)—(**Modified from Vuke and others, 1998). Light brown, yellowish-brown, brown, and light gray gravel, sand, and silt at elevations higher than Qat. Alluvium of several terrace levels, probably of different ages, have been included in this unit. Unit also includes

sandy, silty, pebbly sheetwash alluvium in fans or aprons on highest parts of terrace remnants adjacent to bedrock outcrops. Crudely to well stratified, and poorly to moderately-well sorted. Nearly all clasts are well rounded and are mostly quartzite, chert, volcanic rocks, ironstone concretions, sandstone, and siltstone, and minor amounts of shale, agate silicified wood, jasper, chalcedony, and clinker. Thickness generally less than 5 meters (15 feet), but locally more than 15 meters (50 ft).

Fort Union Formation (Paleocene)

Tftr **Tongue River Member (Paleocene)—**Light yellowish- to orangish-brown or tan, fine- to medium-grained sandstone and thinner interbeds of light yellowish- to orangish-brown or tan siltstone and light tan or gray mudstone and claystone. Claystone is dominantly non-swelling. Contains thick to thin, poorly cemented, fluvial sandstone and moderately large-scale, trough crossbedded channel sandstones that locally weather into cavernous cliffs. Contains generally poorly cemented sediments that weather to badland topography. Plant and vertebrate fossils occur in some beds. Contains several relatively thin, but highly visible coal beds that have locally burned to form clinkered outcrops. The upper portion of this member is not present due to erosion. Exposed thicknesses reach approximately 120 meters (400 ft).

Tfle **Lebo Member (Paleocene)—**Medium to dark gray, grayish-brown and olive-gray sandstone, siltstone, and mudstone that is commonly smectitic or carbonaceous, interbedded with gray to dark gray, silty shale, thin yellowish-gray siltstone and sandstone, and very thin, lenticular coal beds. Contains small-scale, light gray, fine- to medium-grained, crossbedded channel sandstones. Clay often exhibits characteristic “popcorn” weathering. Unit typically forms gently rolling slopes except close to river cuts. Thickness varies from 55 to 73 meters (180 to 240 ft).

Tft **Tullock Member (Paleocene)—**Yellowish-gray, fine- to medium-grained, trough crossbedded to planar bedded or massive-appearing sandstone. Interbedded with brownish-gray or greenish-gray claystones and dark gray carbonaceous shale, and thin lenticular coal beds. Sandstone beds are thinner, more tabular and more persistent than those in the underlying Hell Creek Formation. Channel sequences are larger-scale than those found in the Lebo Member, but generally smaller-scale than those of the Tongue River Member. Thickness ranges from approximately 61 to 91 meters (200 to 300 ft).

Upper Cretaceous Rocks

Khc **Hell Creek Formation (Upper Cretaceous, Maastrichtian)—**Dominantly gray and grayish brown sandstone, smectitic, silty shale and mudstone, and a few thin lenticular coal beds or carbonaceous shale. Sandstones are fine- or medium-grained, and calcium carbonate-cemented concretions are typical in the fine-grained sandstones. Generally poorly cemented overall, and may weather to

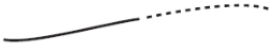
badland topography. Contact with the underlying Fox Hills may be either gradational or erosional locally. Swelling clays may produce “popcorn” weathering. Thickness ranges from 73 to 122 meters (300 – 400 ft).

Kfh **Fox Hill Formation**—Thin layers of interbedded tan sandstone, siltstone, and claystone overlain by well-sorted, very fine- to medium-grained, upward-coarsening, cross-bedded, poorly consolidated sandstone. This sequence grades downward into the sandy shales of the Bearpaw (Pierre) Formation. Thickness ranges from 24 to 60 meters (80 to 200 ft).

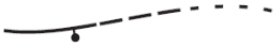
Khfh **Hell Creek and Fox Hills Formations, undivided**—Unit applies to cross section A-A’ only.

Kb **Bearpaw Formation**—Dark brownish-gray to black, bentonitic mudstone and shale. Locally contains thin stringers of jarosite, and fossiliferous limestone concretions that contain marine ammonites and pelecypods. Lower part of formation is not exposed. Exposed thickness is less than 21 meters (70 ft).

GEOLOGIC MAP SYMBOLS



Contact—Dotted where concealed



Fault—Dashed where approximate; dotted where concealed; ball and bar on downthrown side.

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