GEOLOGIC MAP OF THE BIRNEY 30' x 60' QUADRANGLE EASTERN MONTANA

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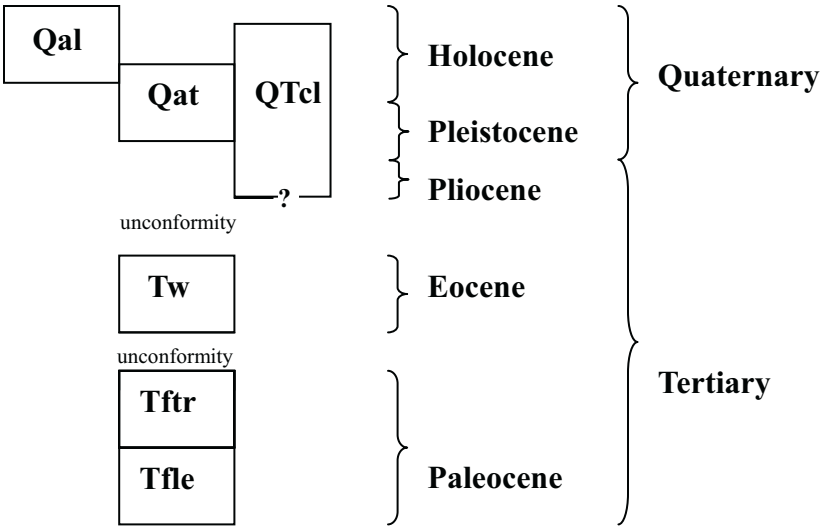
CORRELATION DIAGRAM
BIRNEY 30’ x 60’ QUADRANGLE



DESCRIPTION OF MAP UNITS
BIRNEY 30’ x 60’ QUADRANGLE

Note: Thicknesses are given in feet because original field maps were on 7.5’ quadrangles with contour intervals in feet. To convert feet to meters (the contour interval unit on this map), multiply feet x 0.3048.

Qal **Alluvium (Holocene)—**Light-gray and light-brown gravel, sand, silt, and clay deposited in stream and river channels and on their flood plains. Clasts are poorly to well sorted, and most are well rounded. Deposits are poorly to well stratified, and clasts are composed primarily of quartzite, chert, and igneous rocks. Thickness as much as 35 ft under larger floodplains, but generally less than 15 ft.

Qat **Alluvial terrace deposit** (Holocene and Pleistocene)—Light-gray to light-brown gravel, sand, silt, and clay in terrace remnants at elevations 20–150 ft above the Tongue River. Clasts are generally well rounded, and are composed of Fort Union Formation sandstone, clinker, and ironstone; brown quartzite; and gray chert. Deposits are poorly to well stratified and poorly to well sorted. Thickness 10–40 ft.

QTcl **Clinker (Holocene, Pleistocene, and Pliocene?** [Coates and Heffern, 2000]**)—**Red, pink, orange, black, and yellow, very resistant metamorphosed sandstone, siltstone, and shale of the Fort Union Formation and Wasatch Formations. Bedrock was 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. Thickness 10–500 ft.

Tw **Wasatch Formation (Eocene)—**Yellowish gray to light-gray siltstone and medium- to coarse-grained, massive, or cross-bedded sandstone interbedded with medium-gray shale, brown carbonaceous shale, coal, and associated clinker. A brown-weathering calcareous coquina, 6-8 inches thick is present about 250 ft above the base of the formation in many areas. Formation typically weathers light-gray to tan, and has a distinct heavy-mineral suite (Connor and others, 1976; Denson and others, 1990). At least four different stratigraphic criteria have been used previously to define the Wasatch-Tongue River contact (Seeland and others, 1993). The contact on this map follows that of Denson and others (1990) with some modification, and is at the stratigraphic position of a regional unconformity. It is therefore at a lower stratigraphic position than the contact of Galyardt and Murray (1979) in the Pearl School 7.5’ quadrangle (southwestern corner of this map). Thickness as much as 600 ft (Denson and others, 1990).

Fort Union Formation (Paleocene)

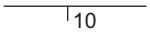
Tftr Tongue River Member—Yellow, orange, or tan, fine-grained sandstone with thinner interbeds of yellowish brown, orange, or tan siltstone; light-bluish or

light-yellowish brown mudstone and clay; and coal beds. Sandstone is massive or cross-bedded. Clay is dominantly non-swelling. Coal beds in the map area include Anderson, Dietz, Canyon, Carney, Otter, Wall, Carlson, Brewster-Arnold, and King (McLellan, 1991). Coal is mined at the Spring Creek, West Decker, and East Decker Mines. Upper part of member was removed by erosion in map area. The part of the member immediately below the Wasatch Formation weathers very light gray and locally shows regolith development as silcrete or poorly cemented paleosols with plant stems and roots. Thickness of as much as 700 ft exposed in map area.

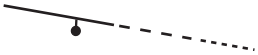
Tfle Lebo Member—Gray, smectitic shale and mudstone that contain lenses of gray and yellow, very fine to fine-grained sandstone, and a few thin coal beds. Base of member not exposed. Thickness of 70 ft exposed in map area.

MAP SYMBOLS

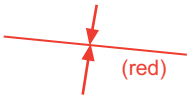
Contact—Dotted where concealed.



Strike and dip of bedding—Number indicates



Fault—Ball and bar on downthrown side, dashed where inferred, dotted where concealed.



Syncline—Showing trace of axial plane.

MAP SOURCES AND INDEX OF 7.5' QUADRANGLES

BIRNEY 30' X 60' QUADRANGLE

Numbers below correspond to index map on following page.

1. Bryson, R.P., and Bass, N.W., 1973, plate 1, scale 1:63,360.
2. Culbertson, W.C., and Klett, M.C., 1976, scale 1:24,000.
3. Culbertson, W.C., and Klett, M.C., 1979a, scale 1:24,000.
4. Culbertson, W.C., and Klett, M.C., 1979b, scale 1:24,000.
5. Culbertson, W.C., Mapel, W.J., and Klett, M.C., 1976, scale 1:24,000.

5b. Doegler, and Fahy, 1980, scale 1:24,000

6. Galyardt, G.L., and Murray, F.N., 1979, scale 1:24,000.
7. Law, B.E., and Grazis, S.L., 1972, scale 1:24,000.
8. Mapel, W.J., 1976b, scale 1:24,000.
9. Mapel, W.J., 1978, scale 1:24,000.
10. Matson, R.E., and Blumer, J.W., 1974, plates 2, 3, 4, 5a, 5B, 5C, 6, scale 1:126,720.
11. McKay, E.J., 1976a, scale 1:24,000.
12. McKay, E.J., 1976b, scale 1:24,000.
13. Robinson, L.N., and Barnum, B.E., 1986, fig. 3, scale 1:126,720.
14. Sarnecky, J.C., 1977, scale 1:24,000.
15. Thom, W.T., Jr., Hall, G.M., Wegemann, C.H., and Moulton, G.F., 1935, plate 1, scale 1:190,080.
16. Warren, W.C., 1959, plate 19, scale 1:63,360.

Entire quadrangle

Baker, A.A., 1929, plates 28 and 29, scale 1:62,500.
Denson, N.M., and Crysdale, B.L., 1991, scale 1:200,000.
Denson, N.M., Gibson, M.L, and Sims, G.L., 1992, scale 1:200,000.
Denson, N.M., Macke, D.L., Schumann, R.R., and Murrett, M.E., 1990, scale 1:100,000.
Denson, N.M., and Pierson, C.T., 1991, scale 1:200,000.
Ellis, M.S., and Colton, R.B., 1994, scale 1:500,000.
Heffern, E.L., Coates, D.A., Whiteman, J., and Ellis, M.S., 1993, scale 1:175,000.
Lewis, B.D., and Hotchkiss, W.R., 1981, scale 1:1,000,000.
Lewis, B.D., and Roberts, R.S., 1978, scale 1:250,000.
Stoner, J.D., and Lewis, B.D., 1980, scale 1:500,000.
Vuke, S.M., Bergantino, R.N., and Wilde, E.M., 1990, scale 1:100,000.

MAP SOURCES AND INDEX OF 7.5’ QUADRANGLES
BIRNEY 30’ x 60’ QUADRANGLE

107° 108°

45°30’

Birds-eye Spring 15	Bull Creek Lookout 15	Cook Creek Butte 10, 15	Club-foot Creek 10	Birney Day School 16	Green Creek 16	King Moun-tain 12, 16	Yager Butte 16
Kirby 10, 15	Taintor Desert 10, 15	Birney SW 10	Birney 7, 8, 10	Browns Moun-tain 2, 16	Poker Jim Butte 16	Fort Howes 11, 16	Good-speed Butte 16
Half Moon Hill 10, 15	Tongue River Dam 10, 15	Spring Gulch 10, 15	Lacey Gulch 10, 14, 15	Stroud Creek 1, 5, 15	Hamil-ton Draw 1, 15	Otter 1	Reanus Cone 1
Pearl School 6, 9, 10, 13, 15	Decker 6, 7, 10, 15	Holmes Ranch 5b 10, 15	Pine Butte School 8, 9, 15	Forks Ranch 1, 3, 15	Quietus 1, 4, 15	Bear Creek School 1	Sayle Hall 1

45°

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