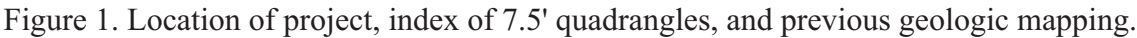


GEOLOGIC MAP OF THE LAUREL AREA YELLOWSTONE COUNTY, MONTANA

mapped by
David A. Lopez

Montana Bureau of Mines and Geology
Open File Report MBMG 580
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DESCRIPTION OF MAP UNITS

SURFICIAL DEPOSITS

- Qal** **Alluvium (Holocene)**—Gravel, sand, silt, and clay along active channels of rivers, creeks, and tributaries. Coarse, well-rounded gravel restricted mainly to the Yellowstone River drainage. Most sediment in tributary drainages is sand, silt, and clay derived from local Cretaceous sandstone and shale bedrock.
- Qc** **Colluvium (Holocene and Pleistocene)**—Locally derived slope-wash deposits mainly of sand, silt, and clay. Usually thin veneer concealing bedrock, but locally as much as 9 m (30 ft) thick. Locally contains well-rounded cobbles derived from alluvial terrace gravel.
- Qaf** **Alluvial fan deposits (Holocene and Pleistocene)**—Deposits along valley margins at base of steep tributary drainages. Display characteristic fan-shaped map pattern. Typically grade upstream into Qal. Locally, along the steep valley margin on the south side of the Yellowstone River, there are small alluvial fans that are mapped with Qal or with Qat1. Thickness ranges from very thin at toe to as much as 15 m (50 ft) at heads of fans.
- Qls** **Landslide deposit (Holocene and Pleistocene)**—Unstable mixture of soil and blocks of bedrock transported down steep slopes. Characteristic hummocky surface form with concentric swales and ridges near down-slope limits. Common along steep slopes underlain by Cretaceous shales; many are present below Eagle Sandstone cliffs but are too small to show at the scale of this map.
- Qat1** **Alluvial terrace gravel 1 (Holocene and Pleistocene)**—Gravel underlying terraces about 3-6 m (10-20 ft) above present elevation of Yellowstone River. Mostly cobbles and pebbles with minor amounts of sand and silt. Clasts predominantly granitic igneous rocks, granitic gneiss, schist, and quartzite, with lesser amounts of limestone and sandstones. Thickness 6-12 m (20-40 ft) (Gosling and Pashley, 1973).
- Qat2** **Alluvial terrace gravel 2 (Pleistocene)**—Gravel underlying terraces

about 6-12 m (20-40 ft) above present elevation of Yellowstone River. Mostly cobbles and pebbles with minor amounts of sand and silt. Clasts predominantly granitic igneous rocks, granitic gneiss, schist, and quartzite, with lesser amounts of limestone and sandstone. Thickness 12-18 m (40-60 ft) (Gosling and Pashley, 1973)

Qat3 Alluvial terrace gravel 3 (Pleistocene)—Gravel underlying terraces about 15-27 m (50 to 90 ft) above present elevation of the Yellowstone River. Mostly cobbles and pebbles with matrix of sand and silt. Clasts predominantly granitic igneous rocks, granitic gneiss, schist, and quartzite, with lesser amounts of limestone and sandstone. Deposit grades from about 6-9 m (20-30 ft) of clean gravel at its southern edge to about 50 cm (5 ft) at its northern limit (Gosling and Pashley, 1973) where it is overlain by colluvium and alluvial fan deposits of silty clay.

Qat3cc Alluvial terrace deposits 3 of Canyon Creek (Pleistocene)—Sediment underlying terraces about 5 m (50 ft) above present elevation of Canyon Creek. Mostly clay, silt, and fine sand, 3-9 m (10-30 ft) thick. These terrace deposits are graded to the Qat3 surface. They occur in the canyon of Canyon Creek and extend eastward almost to edge of Qat3.

Qat4a, 4b Alluvial terrace gravel 4a and 4b (Pleistocene)—Gravel underlying terraces about 60-90 m (200-300 ft) above present elevation of the Yellowstone River. Cobble- and pebble-size clasts are mainly granite, granitic gneiss, schist, quartzite, and volcanic rocks. Thickness as much as about 6 m (20 ft) (after Lopez, 2000). Terrace gravel 4 (Lopez, 2000) was found to actually be two separate terrace deposits about 18 m (60 ft) apart. They are mapped here as Qat4a and Qat4b.

Qat5 Alluvial terrace gravel 5 (Pleistocene)—Gravel underlying terraces about 120-150 m (400-500 ft) above Yellowstone River. Cobble- and pebble-size clasts are mainly granite, granitic gneiss, schist, and quartzite. Local calcite cement, especially at base. Thickness ranges from a very thin remnant to about 6 m (20 ft).

CRETACEOUS BEDROCK

Kjr Judith River Formation (Upper Cretaceous)—Interbedded brownish gray (5YR4/1)* sandy shale and light brown (5YR6/4) to pale yellowish brown (10YR7/2), argillaceous, very fine to fine-grained sandstone in beds as much as 3m (10 ft) thick. Sandstone friable to moderately well indurated, crossbedded, and burrowed to bioturbated. Exposed thickness 90-180 m (300-600 ft), thickening to the west.

- Kcl **Claggett Shale (Upper Cretaceous)**—Brownish gray (5YR4/1) fissile shale with minor interbeds of light brownish gray (5YR6/1), very argillaceous sandstone. Light brownish gray (5YR6/1) to light brown (5YR5/6), calcareous concretions common, often fossiliferous. The upper contact placed at the change to ledge-forming sandstones of the Judith River Formation. Thickness 30-60 m (100-200 ft), thickening eastward.
- Ke **Eagle Sandstone (Upper Cretaceous)**—Light brownish gray (5YR6/1) to very pale orange (10YR8/2), very fine to fine-grained, crossbedded sandstone, burrowed to bioturbated in part. Locally contains calcareous, light brown (5YR6/4) sandstone concretions up to 4.5 m (15 ft) in diameter. As many as four sandstone intervals 3-15 m (10-50 ft) thick present with interbedded sandy shale as much as 15 m (50 ft) thick. Thickness 76-106 m (250-350 ft).
- Ktc **Telegraph Creek Formation (Upper Cretaceous)**—Shale and sandy shale, brownish gray (5YR4/1) to medium dark gray (N4) with thin interbedded sandstone. Dusky red (5R2/6) concretions common near base. Sandstone beds thicker and more abundant upward, grading into Eagle Sandstone. Contact with Eagle placed at base of lowest cliff-forming sandstone. Thickness as much as 45 m (150 ft).
- Kn **Niobrara Shale (Upper Cretaceous)**—Shale, olive gray (5Y4/1) and dark brownish gray (5YR3/1), fissile, with abundant thin bentonite beds. Upper half calcareous, containing few very thin bentonite beds, and near top contains laminae and thin beds of calcareous sandstone and sandy limestone. Concretions medium light gray (N6) to pale yellowish brown (10YR6/2) and from about 5 cm (2 in) to 30-60 cm (1-2 ft) in diameter commonly present. *Inoceramus* prisms common. Upper contact placed at change from calcareous shales to noncalcareous shales of Telegraph Creek Formation. Zone of dusky red (5R2/6) concretions just above contact also help establish its position. Thickness about 210 m (700 ft).
- Carlile Shale (Upper Cretaceous)**—Not exposed in the map area but present beneath surficial deposits in the Yellowstone Valley. Description from exposures east of map area (Lopez, 2002): Shale, dark gray (N3) to dark bluish gray (5B3/1), fissile. Interval about mid-section contains laminae and thin beds of argillaceous, platy, light brownish gray (5YR6/1) to light olive gray (5Y6/1) sandstone that supports thick growth of pine trees, but otherwise nearly bare of soil and vegetation. Septarian nodules and concretions common, ranging from light gray (N7) to dark yellowish orange (10YR6/6). Upper contact marked by zone of closely spaced, gray septarian concretions with veins of brown calcite at base of Niobrara. Thickness 75-90 m (250 to 300 ft).

Greenhorn Formation (Upper Cretaceous)--Not exposed in the map area but present beneath surficial deposits in the Yellowstone Valley. Description from exposures east of map area (Lopez, 2002): Shale, dark bluish gray (5B3/1), calcareous, fossiliferous. Typically poorly exposed, but weathers to very light brownish gray (5YR7/1) soil. Locally base is marked by zone of closely spaced, gray, calcareous, septarian concretions above a very light greenish gray bentonite bed about 60 cm (2 ft) thick in underlying Belle Fourche Shale. Contact with Carlile marked by change to non-calcareous shale. Thickness about 22 m (75 ft).

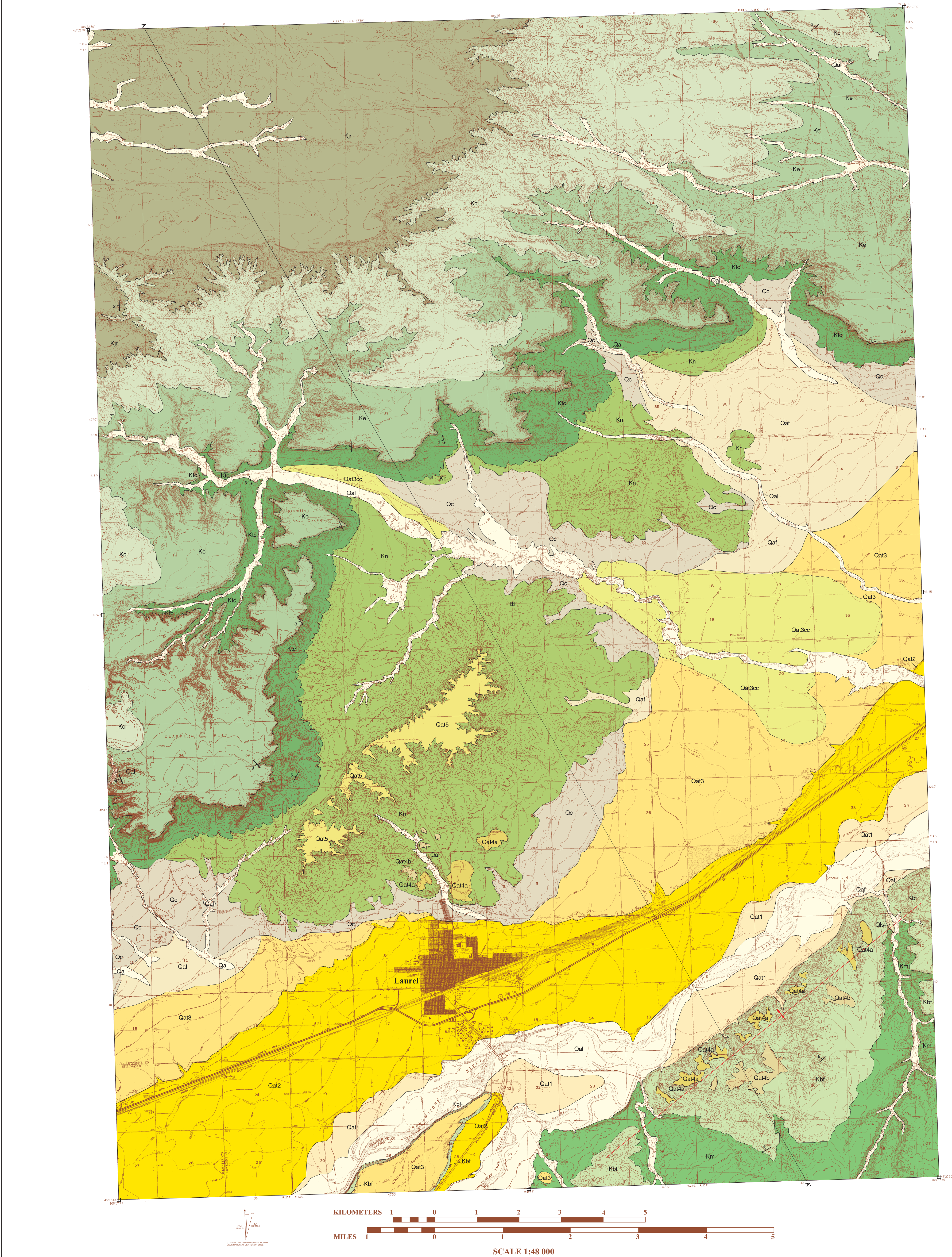
Kbf Belle Fourche Shale (Upper Cretaceous)—Shale, dark gray (N3), fissile, containing several thick bentonite beds in lower part. Thin sandstone bed commonly containing small chert pebbles, and zone of very dusky purple (5P2/2) to glossy grayish black (N2), ironstone concretions near base. Light gray (N7), brownish gray (5YR4/1), and large (up to 4 feet in diameter) light brown (5YR5/6) to dark yellowish orange (10YR6/6) concretions characteristic. Contact with Greenhorn marked by abrupt change to very calcareous shale. Thickness 105-120 m (350-400 ft).

Km Mowry Shale (Upper Cretaceous)—Interbedded, siliceous, very fine- to fine-grained sandstone, siltstone, and shale. Sandstone and siltstone mostly light gray (N7) to medium gray (N5), with a "silvery" sheen. Some sandstone beds east of map area highly silicified resulting in very hard quartzite used locally for landscape rock and building stone. Shale is fissile, and mainly medium dark gray (N4). Bentonite beds common, 30-120 cm (1-4 ft) thick, including prominent beds at base and near top. Fish scales on bedding planes of sandstones and siltstones nearly ubiquitous and characteristic of the formation. Thin coarse lag deposit containing fish bones, fish teeth, and chert pebbles near the middle of the formation. Upper contact of Mowry mapped at top of thick bentonite bed above last fish-scale-bearing sandstone. Basal contact not exposed in map area, but in nearby areas is placed at change from dark-gray fissile Thermopolis Shale to characteristic "silvery" sandstone and siltstone of Mowry containing fish scales in nearby areas (Lopez, 2000). Exposed thickness about 76 m (250 ft).

*Colors and numerical color values from Goddard and others (1948).

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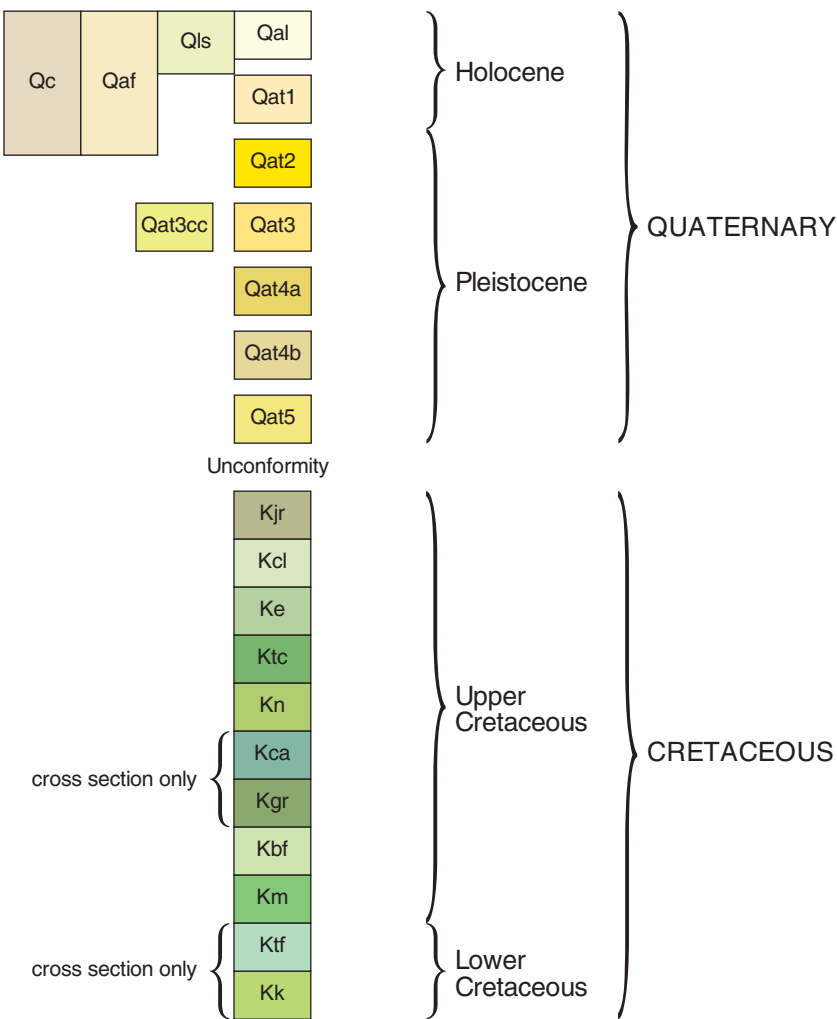


Map Units

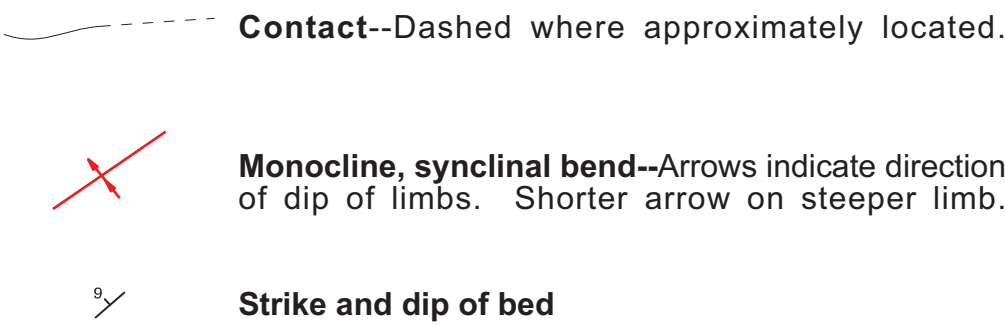
Qal	Alluvium of modern channels and flood plains
Qc	Colluvium
Qaf	Alluvial fan deposits
Qls	Landslide deposits
Qat1	Alluvial terrace gravel 1
Qat2	Alluvial terrace gravel 2
Qat3	Alluvial terrace gravel 3
Qat3oc	Alluvial terrace deposits of Canyon Creek
Qat4a	Alluvial terrace gravel 4, younger
Qat4b	Alluvial terrace gravel 4, older
Qat5	Alluvial terrace gravel 5
Kjr	Judith River Formation
Kcl	Claggett Shale
Ke	Eagle Sandstone
Ktc	Telegraph Creek Formation
Kn	Niobrara Shale
Kbf	Belle Fouché Shale
Km	Mowry Shale

For a more detailed description of the map units and symbols, please refer to the text accompanying this map.

Correlation Chart

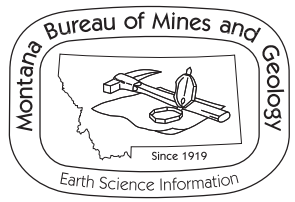
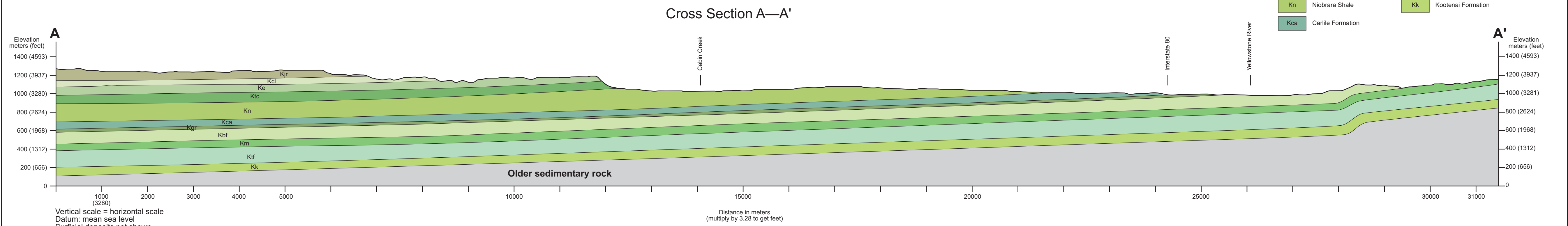
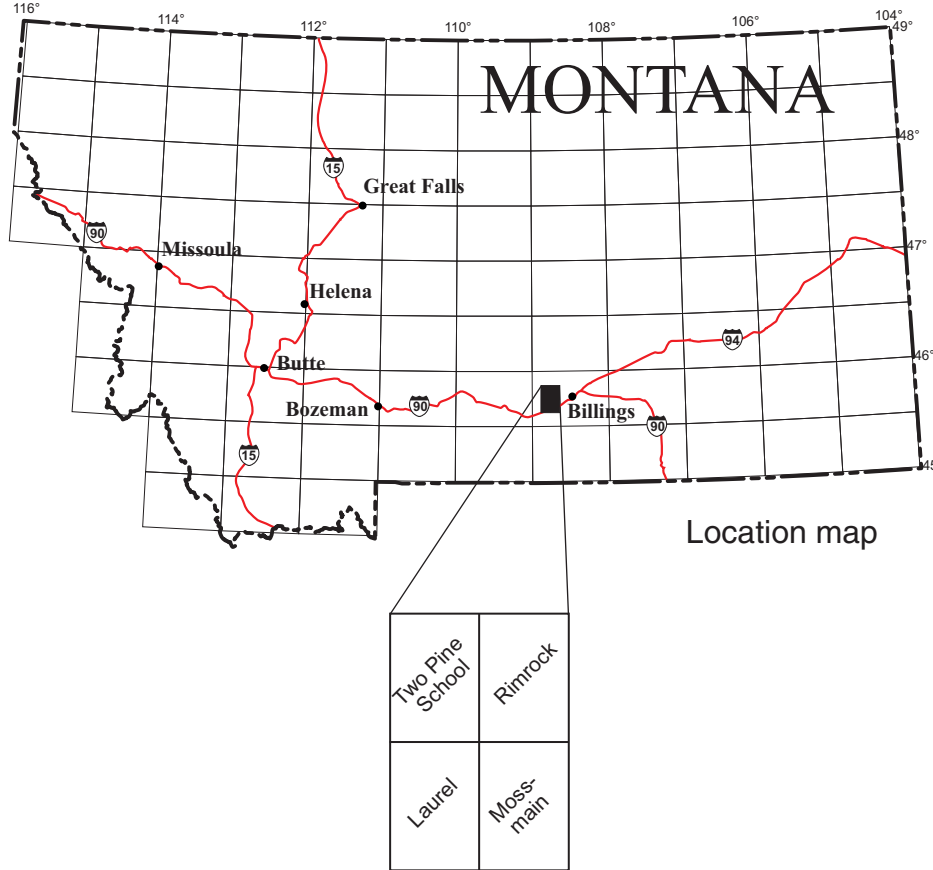


Map Symbols



Base maps from U.S. Geological Survey

Two Pine School 7.5' topographic quadrangle
Map date: 1956
Projection: Polyconic
UTM zone 12; 1927 NAD
Contour Interval: 20 feet
Rimrock 7.5' topographic quadrangle
Map date: 1956
Projection: Polyconic
UTM zone 12; 1927 NAD
Contour Interval: 20 feet
Laurel 7.5' topographic quadrangle
Map date: 1956 (photorevised 1969)
Projection: Lambert Conformal Conic
UTM zone 12; 1927 NAD
Contour Interval: 20 feet
Supplementary Contour Interval: 10 feet
Mossmain 7.5' topographic quadrangle
Map date: 1956 (photorevised 1969)
Projection: Lambert Conformal Conic
UTM zone 12; 1927 NAD
Contour Interval: 20 feet
Supplementary Contour Interval: 10 feet



Maps may be obtained from: Publications Office
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1300 West Park Street
Butte, Montana 59701-8997
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GIS production: Ken Sandau and Paul Thale, MBMG. Map layout: Susan Smith, MBMG.

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