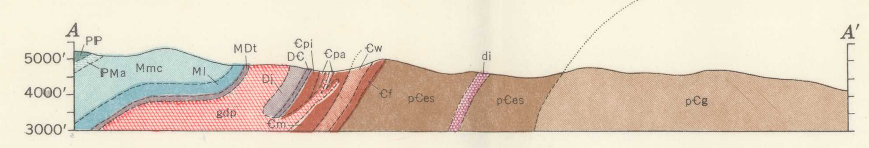
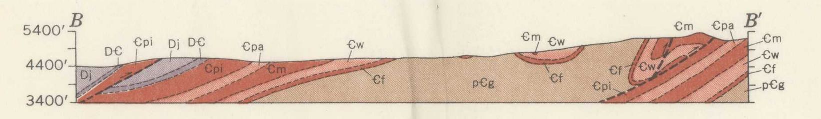
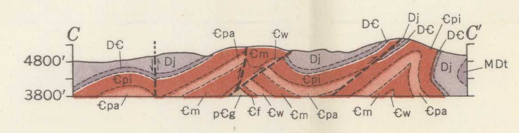
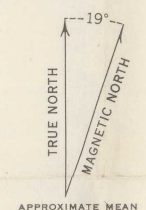








APPROXIMATE MEAN DECLINATION 1950

EXPLANATION

SEDIMENTARY ROCKS

Pleistocene and Recent — QUATERNARY

Qt — Tailings from placer mining operations

Mantle — *Mainly eolian silt, terrace gravel, and hill wash*

Qfa — Recent fan deposits — *Gravel and sand; mostly reworked material from older fan and terrace gravels*

Qal — Alluvium — *Gravel, sand, and clay*

Qf2 — Recent to younger Pleistocene fan deposits — *Gravel and sand, mostly derived from Elkhorn Mountains volcanics*

Qf1 — Older Pleistocene fan deposits — *Mainly coarse gravel derived from Elkhorn Mountains volcanics*

QTf — Pediment and fan gravels — *Gravel mostly derived from Elkhorn Mountains volcanics and Paleozoic formations. Underlying formation indicated by symbols in parentheses, (Kv)*

QTg — Flood plain gravel — *Gravel derived from headwaters of Missouri River and from Limestone Hills*

Miocene and Pliocene — TERTIARY

Tp — Sedimentary tuff — *Light-colored, poorly sorted sedimentary tuff containing gravel beds near base*

Tun — Undifferentiated sedimentary tuff, silt, clay, and gravel; age uncertain

EROSIONAL UNCONFORMITY

Oligocene

Tu3 — Tertiary unit 3 — *Very pale yellowish-brown tuffaceous clay and silt containing scattered pebbles; probably Oligocene in age*

To — Sedimentary tuff — *Light-colored sedimentary rhyolite tuff containing a thick lens of bentonitic clay. Underlying formation indicated by symbol in parentheses, (Pp)*

Tu2 — Tertiary unit 2 — *Bentonitic clay, silty clay, silt, sand, and gravel*

Upper Cretaceous — CRETACEOUS

Kv, Kvf — Elkhorn Mountains volcanics — *Mostly greenish gray andesitic breccia, partly of mudflow origin; some tuff units and a lava flow, Kvf, on Lone Mountain*

Ks — Slim Sam formation — *Very fine- to coarse-grained sandy crystal-lithic tuff with thin interbeds of black shale in lower part. 0 to 600 ft thick*

Lower and Upper Cretaceous

Kcu, Kcm, Kcl — Colorado formation — *Upper black shale unit, Kcu, is very dark gray to black fissile shale with some very fine grained sandstone and siltstone; Niobrara age. 0 to 380 ft thick. Middle siliceous unit, Kcm, is siltstone, sandstone, and siliceous mudstone; Early Niobrara to Mowry age. 0 to 900 ft thick. Lower black shale unit, Kcl, is a dark-gray fissile shale with a basal very fine grained orthoquartzite; Newsastle to Fall River age. 0 to 325 ft thick*

PROBABLE EROSIONAL UNCONFORMITY

Lower Cretaceous

Kk — Kootenai formation — *"Salt-and pepper" sandstone, locally conglomeratic; greenish-gray and grayish-red silty claystone and siltstone, dark-gray fossiliferous limestone. 0 to 530 ft thick*

PROBABLE EROSIONAL UNCONFORMITY

Upper Jurassic — JURASSIC

Ju — Morrison and Swift formations, undifferentiated — *Morrison formation: red, brown, olive, and gray nonmarine shale, mudstone, siltstone, limestone, and fine-grained sandstone. About 540 ft thick. Swift formation: thin yellowish-brown calcareous marine sandstone and conglomerate*

EROSIONAL UNCONFORMITY

PERMIAN

Pp — Phosphoria formation — *Yellow to gray chert and yellowish-brown very fine- to medium-grained quartzite containing phosphatic fragments. Locally contains a few thin beds of phosphate rock. About 50 ft thick*

PP — Phosphoria and Quadrant formations, undifferentiated

PENNSYLVANIAN — CARBONIFEROUS

Pq — Quadrant formation — *Interbedded yellowish-brown quartzite and gray, locally cherty dolomite. About 325 ft thick*

PMa — Amsden formation — *Reddish calcareous siltstone with a conspicuous medial unit of limestone and dolomite. About 260 ft thick*

MISSISSIPPIAN

Madison group

Mmc — Mission Canyon limestone — *Medium- to light-gray fine- to coarse-grained thick and indistinctly bedded limestone. About 1100 ft thick*

Ml — Lodgepole limestone — *Gray thin- to medium-bedded fossiliferous limestone. About 600 ft thick*

Upper Devonian and Mississippian

MDt — Three Forks shale — *Gray, very fissile shale overlain by yellowish-gray calcareous siltstone containing subordinate beds of light-gray silty limestone. About 360 ft thick*

Upper Devonian — DEVONIAN

Dj — Jefferson dolomite — *Medium- to dark-gray fetid dolomite that weathers to brownish gray; includes a few light-gray weathering limestone beds. About 500 ft thick*

Upper Cambrian and Upper Devonian

D€ — Maywood and Red Lion formations, undifferentiated — *The Maywood formation of Devonian age consists of light-colored limestone and dolomite in part containing siltstone chips and partings. The Red Lion formation of Cambrian age consists of reddish siltstone with some thin dolomite beds. An erosional unconformity separates the two formations. Total thickness: 10 to 110 ft*

Upper Cambrian — CAMBRIAN

€pi — Pilgrim dolomite — *Mottled dark- and light-gray limestone, very light gray dolomite, and mottled light-gray and olive-gray dolomitic limestone. 350 to 420 ft thick*

Middle Cambrian

€pa — Park shale — *Olive-green fissile shale with a waxy luster. 200 to 300 ft thick*

€m — Meagher limestone — *Mottled and banded limestone; light to dark gray yellowish orange to yellowish gray. 360 to 500 ft thick*

€w — Wolsey shale — *Greenish-gray shale and mudstone, commonly silty; contains thin beds of limestone and limy siltstone, and near the base, a few beds of quartzite. Glauconite common. About 380 ft thick*

€f — Flathead quartzite — *White to grayish-red cross-laminated beds of orthoquartzite with a very few thin units of shale or siltstone. 25 to 120 ft thick*

UNCONFORMITY

Upper Precambrian — PRECAMBRIAN

Belt series

p€es — Empire shale and Spokane shale, undifferentiated — *Mainly grayish red argillite and siltstone with a middle part of dark-purple and light-greenish-gray argillite and siltstone. In the northern part of the Limestone Hills a thin upper unit of laminated dark-gray siltstone and argillite is Empire shale. 0 to about 5000 ft thick*

p€g — Greyson shale — *Greenish-gray shale, silty shale, and argillite; yellowish-gray siltstone; light-gray fine-grained sandstone; and in upper part a few beds of granular and algal limestone. Grades into Spokane shale. Maximum exposed thickness is about 3000 ft*

INTRUSIVE ROCKS

Upper Cretaceous or Paleocene — CRETACEOUS OR TERTIARY

mo — Monzonite — *Fine- to medium-grained augite and hornblende monzonite of Lone Mountain stock; locally porphyritic near margin*

Upper Cretaceous — CRETACEOUS

dp — Porphyry, undifferentiated — *Intrusive equivalents of Elkhorn Mountains volcanics; mainly diorite porphyry, but includes a few thin sills and dikes of hornblende lamprophyre and augite lamprophyre, and perhaps some bodies of granodiorite porphyry and monzonite porphyry*

gdp — Granodiorite porphyry — *Mostly fine grained; grades toward quartz diorite porphyry, diorite porphyry, and monzonite porphyry; mainly as sills*

hdp — Hornblende diorite porphyry — *Mostly fine grained; grades into monzonite and granodiorite porphyry; some varieties contain a little augite*

adp — Augite diorite porphyry — *Mostly fine grained; most bodies contain some hornblende*

Precambrian(?) or Upper Cretaceous(?) — PRECAMBRIAN(?) OR CRETACEOUS(?)

di — Diabase

Contact, showing dip

Gradational contact

Fault, showing dip — *U, upthrown side; D, downthrown side. Arrows indicate relative lateral movement*

Thrust fault — *T on side of upper plate*

Anticline — *Showing crestline and plunge of axis*

Syncline — *Showing position of trough and plunge of axis*

Overturned anticline

Overturned syncline

Note: Length of dashes indicate relative degree of accuracy; long dash most accurate. Dotted where concealed, queried where doubtful

Strike and dip of beds

Strike and dip of overturned beds

Strike of vertical beds

Horizontal beds

Vein, showing dip

Vertical shaft

Caved shaft

Mine or quarry

Adit

Prospect pit

GEOLOGIC MAP AND SECTIONS

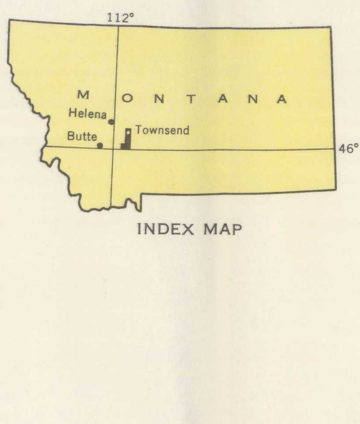
OF PART OF THE

TOWNSEND VALLEY, BROADWATER AND JEFFERSON COUNTIES, MONTANA

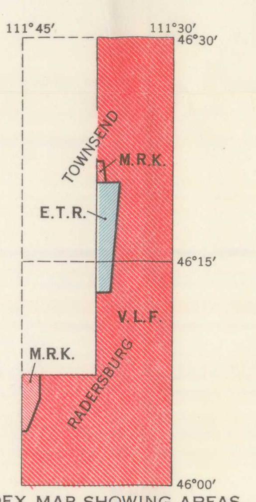
Scale 1:48,000

5000 0 20,000 Feet

Contour interval 40 feet
Datum is mean sea level



INDEX MAP



INDEX MAP SHOWING AREAS OF RESPONSIBILITY

Canyon Ferry Reservoir flooded after topographic and geologic mapping

Base from U. S. Geological Survey maps of Townsend and Radersburg quadrangles, Montana

Geology mapped by V. L. Freeman, E. T. Ruppel, and M. R. Klepper, 1949, 1952, and 1953

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.
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