MF (200)

DEPARTMENT OF THE INTERIOR
UNITED STATES GEOLOGICAL SURVEY

PREPARED IN COOPERATION WITH THE
U. S. ATOMIC ENERGY COMMISSION

MINERAL INVESTIGATIONS
FIELD STUDIES MAP MF-243

MAP SYMBOLS

Contact
Long dashed where approximately located, short dashed where indefinitely located, dotted where concealed, queried where doubtful

High-angle fault
Long dashed where approximately located, short dashed where indefinitely located, dotted where concealed, queried where probable. U, upthrown side; D, downthrown side; Arrows indicate relative strike-slip movement

Thrust fault
Saw-teeth on upper plate

Anticline
Showing direction of plunge of axis; dashed where approximately located

Syncline
Showing direction of plunge of axis; dashed where approximately located

Strike and dip of beds

Quarry

Shaft
Short bar indicates inclined; circle indicates caved or flooded

Adit
Short bar indicates caved

Trench

Prospect

ANOMALOUS RADIOACTIVITY

Radioactivity anomaly in or adjacent to metalliferous quartz veins

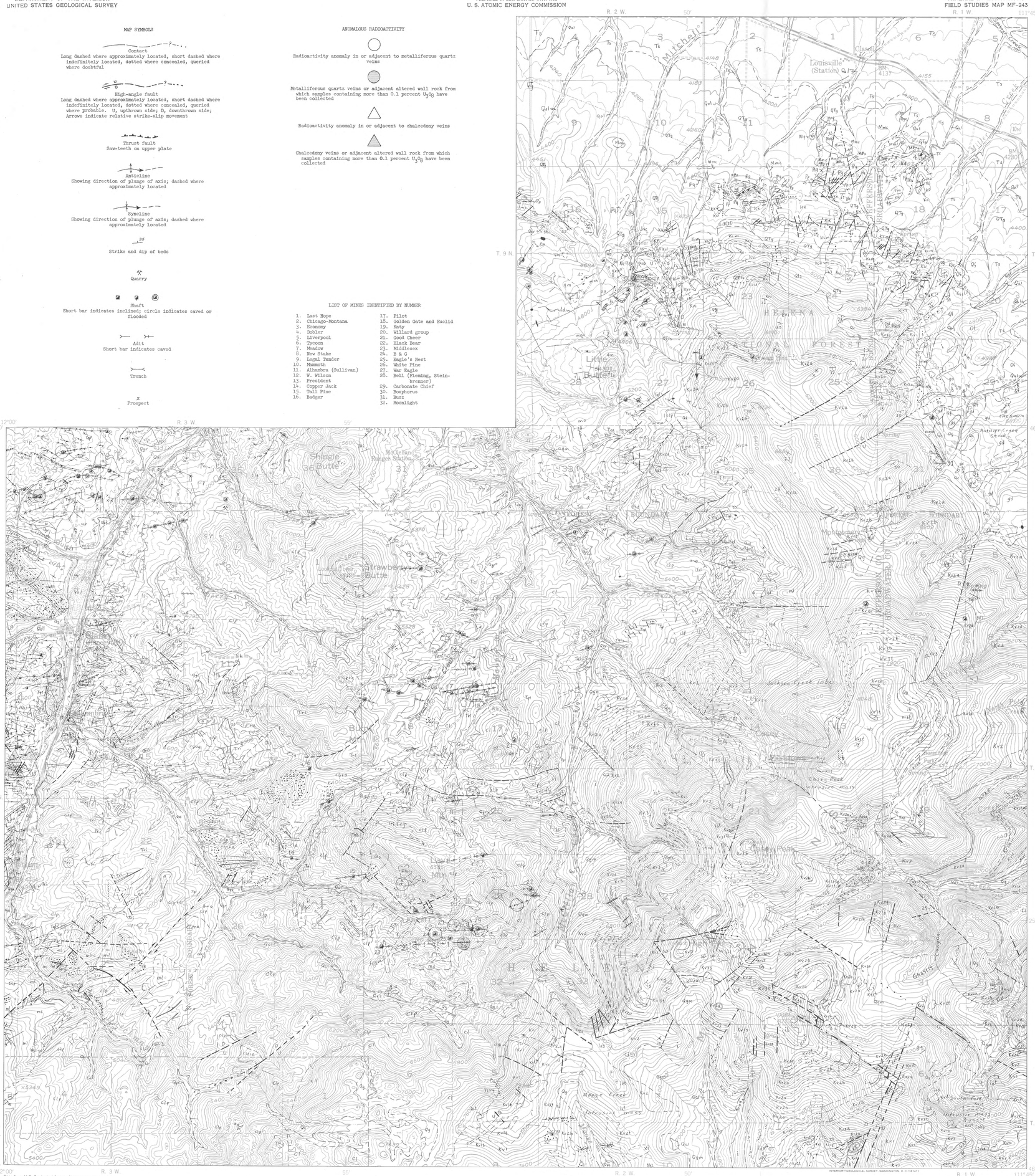
Metalliferous quartz veins or adjacent altered wall rock from which samples containing more than 0.1 percent U_3O_8 have been collected

Radioactivity anomaly in or adjacent to chalcedony veins

Chalcedony veins or adjacent altered wall rock from which samples containing more than 0.1 percent U_3O_8 have been collected

LIST OF MINES IDENTIFIED BY NUMBER

1. Last Hope
2. Chicago-Montana
3. Economy
4. Dobler
5. Liverpool
6. Tycoon
7. Meadow
8. New Stake
9. Legal Tender
10. Mammoth
11. Alhambra (Sullivan)
12. W. Wilson
13. President
14. Copper Jack
15. Tall Pine
16. Badger
17. Pilot
18. Golden Gate and Euclid
19. Katy
20. Willard group
21. Good Cheer
22. Black Bear
23. Middlesex
24. B & G
25. Eagle's Nest
26. White Pine
27. War Eagle
28. Bell (Fleming, Steinbrenner)
29. Carbonate Chief
30. Bosphorus
31. Buzz
32. Moonlight



Base from U.S. Geological Survey Clancy and East Helena 15 minute topographic quadrangles, 1950

PRELIMINARY GEOLOGIC MAP OF THE NORTHERN ELKHORN MOUNTAINS, JEFFERSON AND BROADWATER COUNTIES, MONTANA

By
Harry W. Smedes

SCALE 1:24 000

1 0 1 MILE

CONTOUR INTERVAL 40 FEET
DATUM IS MEAN SEA LEVEL

1962

Geology by Harry W. Smedes, 1953-55; assisted by Paul E. Myers, 1953

INTERIOR—GEOLOGICAL SURVEY, WASHINGTON, D. C.—61411

MINERAL INVESTIGATIONS
FIELD STUDIES MAP MF-243

E X P L A N A T I O N

QUATERNARY — Recent and Pleistocene

- Qal — Alluvium
- Qf — Alluvial fan
- Qc — Colluvium
- Qls — Landslide debris
- Qtr — Travertine at Alhambra Hot Springs

Qgr — Gravel
Largely glacial outwash, conspicuous as high terraces along major streams

Qg, Qgm, Qgo — Glacial deposits
Qg, glacial deposits, undivided.
Qgm, moraine.
Qgo, outwash

QUATERNARY OR TERTIARY

- Qtg — Gravel
  Alluvial fans, probably mudflows, and bouldery rock veneer
- Qtls — Landslide debris

ANGULAR UNCONFORMITY

Ts — Poorly consolidated beds of ash, gravel, sand, silt, clay, and tuff; Lake beds of Knopf (1913) and Lorenz and Swenson (1951)

Tri, Trb, Trp, Trt — Rhyolite
Tri, platy flow-banded intrusive rocks.
Trb, intrusive breccia plug and dike at west end of Lava Mountain.
Trp, massive rhyolite porphyry at east end of Lava Mountain.
Trt, tuff, welded tuff, breccia, and tuffaceous sandstone, undivided

Tql — Quartz latite
In dikes and plugs; includes a few small bodies of andesitic and basaltic intrusive rocks; dacite of Knopf (1913)

ld — Porphyry dikes including lamprophyre
Probably range in age from early-batholithic to post-batholithic

a — Aplite, alaskite, pegmatite, and alkalic granite, undivided
All dikes shown without symbol on map belong to this group. Mapped dikes are shown by lines. clp + a and mly + a indicate areas in which individual bodies were not mapped separately, the map unit includes flat sheets on gentle slopes, swarms of dikes, and complex digitate margins of larger masses

lgd — Leucogranodiorite
Between Jackson and Crystal Creeks

Upper Cretaceous or Paleocene — Rocks of the Boulder batholith

c, cl, clp, ml, mlp, md, fl, flb — Butte quartz monzonite and related rocks
Coarse, medium, and fine-grained quartz monzonite and minor amounts of granodiorite.
c, undivided.
cl, coarse-grained, light-gray, very sparsely porphyritic to non-porphyritic.
clp, same as cl but with conspicuous phenocrysts of K-feldspar.
ml, medium-grained, light-gray, non-porphyritic.
mlp, same as ml but with conspicuous phenocrysts of K-feldspar.
md, medium-grained, dark-gray, non-porphyritic.
fl, fine-grained, light-gray, porphyritic in various degrees.
flb, similar to fl but with an aplitic groundmass

gd, qm — Granodiorite and quartz monzonite
Coarse- and medium-grained, light and medium colored rocks.
gd, granodiorite of the Antelope Creek stock.
qm, sagite quartz monzonite of Little Butte, and other plug-like intrusive bodies

aqm, mo, mmo, sd, sg, mnh — Coarse- to fine-grained, dark-colored rocks
Composite intrusive mass in the north-central part of the area, and as a few small dikes and plugs. Relations between units not known. Rock units were not mapped separately; rock types are designated by appropriate symbols at the sample locations
aqm, sagite quartz monzonite.
mo, monzonite.
mmo, mela monzonite.
sd, syenodiorite.
sg, syenogabbro.
mnh, mela norite and hyperite

ANGULAR UNCONFORMITY

Elkhorn Mountains volcanics — Upper Cretaceous

Kv3, Kv3b, Kv3s, Kv3a — Upper member
Characterized by thin-bedded water-laid volcanic sedimentary rocks and by absence of ash flow tuff and lava.
Kv3, undivided.
Kv3b, volcanic breccia, tuff breccia, mud flow breccia, and conglomerate.
Kv3s, tuff, lapilli tuff, and minor amounts of sandstone.
Kv3a, bedded volcanic sedimentary rocks.
Over 2000 ft thick

Kv2, Kv2b, Kv2t, Kv2l, Kv2s, Kv2f — Middle member
Quartz latite welded ash flow tuff and andesitic pyroclastic debris and lava.
Kv2, undivided.
Kv2b, volcanic breccia, tuff breccia, mud flow breccia, and conglomerate.
Kv2t, tuff and lapilli tuff.
Kv2l, lapilli tuff and tuff breccia.
Kv2s, ash flow tuff, mostly welded.
Kv2f, lava flow
3300 to 7500 ft thick

Kv1, Kv1b, Kv1l, Kv1a — Lower member
Andesitic and basaltic pyroclastic and flow rocks, and sparse thin quartz latitic ash flow tuff.
Kv1, undivided.
Kv1b, volcanic breccia, tuff breccia, mud flow breccia, and conglomerate.
Kv1t, tuff and lapilli tuff.
Kv1a, non-welded to partly welded ash flow tuff.
About 2500 ft thick

i, ia, iaa, iha, iaha, ib, iab, iabb, it, iat, iht, iaht — Porphyritic basaltic and andesitic intrusive rocks
Mainly contemporaneous with but probably in part younger than the Elkhorn Mountains volcanics. Relations between units not known. Rock units were not mapped separately; rock types are designated by appropriate symbols at the sample locations.
i, undivided; mapped dikes shown by lines; scatter-patterns of thin lines superimposed on other rocks of the Elkhorn Mountains volcanics indicates areas in which individual dikes, sill, etc., could not be mapped separately.
ia, andesite, undivided.
iaa, augite andesite.
iha, hornblende andesite.
iaha, augite-hornblende andesite.
ib, basalt, undivided.
iab, augite basalt.
iabb, augite-hornblende basalt.
it, trachybasalt, undivided
iat, augite trachybasalt.
iht, hornblende trachybasalt.
iaht, augite-hornblende trachybasalt

CRETACEOUS OR TERTIARY

UNCONFORMITY
(Angular locally)

Slim Sam formation

Ksu — Upper unit
Medium- to coarse-grained tuffaceous sandstone and andesitic tuff, siltstone, mudstone, and shale; dusky yellow green, grayish blue and green, dark to medium gray, medium olive gray, and moderate brown.
450 to 1100 ft thick

LOCAL UNCONFORMITY

Ksl — Lower unit
Feldspathic sandstone and siltstone, and laminated siliceous mudstone and shale; pale yellow green, light olive gray, and medium light gray to dark gray; sandstone beds have low chert content but otherwise resemble those of the middle unit of the Colorado formation.
150 to 1150 ft thick

CRETACEOUS — Lower and Upper Cretaceous — Colorado formation

Kcu — Upper unit
Dark gray to black shale, siltstone, and minor amounts of mudstone and sandstone.
About 100 ft thick

Kcm — Middle unit
Cherty and feldspathic (tuffaceous) sandstone and siltstone, and light gray delicately laminated, very siliceous mudstone.
About 500 ft thick

Kcl — Lower unit
Dark gray siliceous sandstone, siltstone, and mudstone; sandstone is locally feldspathic (tuffaceous).
About 215 ft thick

UNCONFORMITY FOR CRETACEOUS

Kk — Kootenai formation
Upper part composed of olive gray, yellowish brown, yellowish gray, yellowish green, and yellowish brown siltstone, fine-grained sandstone, and limestone; partly cross-bedded; two beds of fresh-water limestone occur near top. Basal 70 ft composed of grayish orange, yellowish brown, and very light to medium gray, fine- to medium-grained cherty sandstone.
About 540 ft thick

TERTIARY — Upper Jurassic

Jm — Morrison formation
Olive brown, purple, and varicolored siltstone, shale, and fine-grained sandstone; sandstone in lower part commonly calcareous, cherty, and cross-bedded.
About 270 ft thick

Jms — Morrison and Swift formations, undivided
About 320 ft thick

Js — Swift formation
Poorly bedded yellowish cherty clastic limestone.
About 50 ft thick

JURASSIC

EROSIONAL UNCONFORMITY

Pp — Phosphoria formation
Comprises three units. Upper unit is about 25 ft of fine-grained grayish orange, to yellowish brown phosphatic quartzite; middle unit is about 40 ft of very-fine to medium-grained grayish orange, dusky yellow, and olive gray quartzite and chert; lower unit is about 25 ft of olive gray cherty limestone and light gray quartzite mottled with pale red chert.
About 90 ft thick

PERMIAN

Pq — Quadrant formation
Comprises four units. Upper unit is about 115 ft of spotted vitreous quartzite with local shaly partings and limestone lenses; next unit is about 30 ft of spotted sandstone and calcareous siltstone with some beds of quartzite and dark gray shaly limestone; next unit is about 50 ft of very fine-grained limestone in beds, lenses, and pods within quartzite beds; lower unit is about 200 ft of medium- to light gray vitreous quartzite with spotted texture.
About 400 ft thick

PENNSYLVANIAN

PMa — Amsden formation
Poorly exposed thin bedded pale grayish red siltstone and minor amounts of medium gray siltstone; pale red purple dolomite near middle of formation.
About 180 ft thick

MISSISSIPPIAN AND PENNSYLVANIAN

Madison group

Mmc — Mission Canyon limestone
Thick-bedded to massive white to pale grayish yellow crystalline limestone; breccias of probable solution-collapse origin occur locally in the upper part.
About 790 ft thick

Mlp — Lodgepole limestone
Comprises two units. Upper unit is about 235 ft of medium- and thick-bedded medium gray to very light gray limestone; lower unit is about 580 ft of thin-bedded gray limestone with dark gray dolomitic siltstone in lower part.
About 815 ft thick

MISSISSIPPIAN

CARBONIFEROUS

METAMORPHIC ROCKS

All pre-batholithic rocks in the area are thermally metamorphosed. High-grade hornfels and granulitic rocks of the pyroxene hornfels facies occur in the inner contact zone along the margins of the Boulder batholith and related satellitic bodies. Away from those margins the metamorphic grade diminishes and the high-grade rocks grade into hornfels, quartzite, marble, and greenstone of the low-grade albite-epidote-hornfels facies.

- Xenoliths
- ta — Tactite and contaminated igneous rock
- Strongly sheared rocks
  Subsequently mineralogically recrystallized to schist, schistose amphibolite, and granular metamorphic rocks
- Metalliferous quartz vein
- Chalcedony vein and vein zone, with various amounts of quartz
  These make up the "reefs" familiar to the local miners and prospectors
- Silicified rock
  Silica probably deposited in part by meteoric water
- Hydrothermally altered rock
  Largely sericitized or kaolinized

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