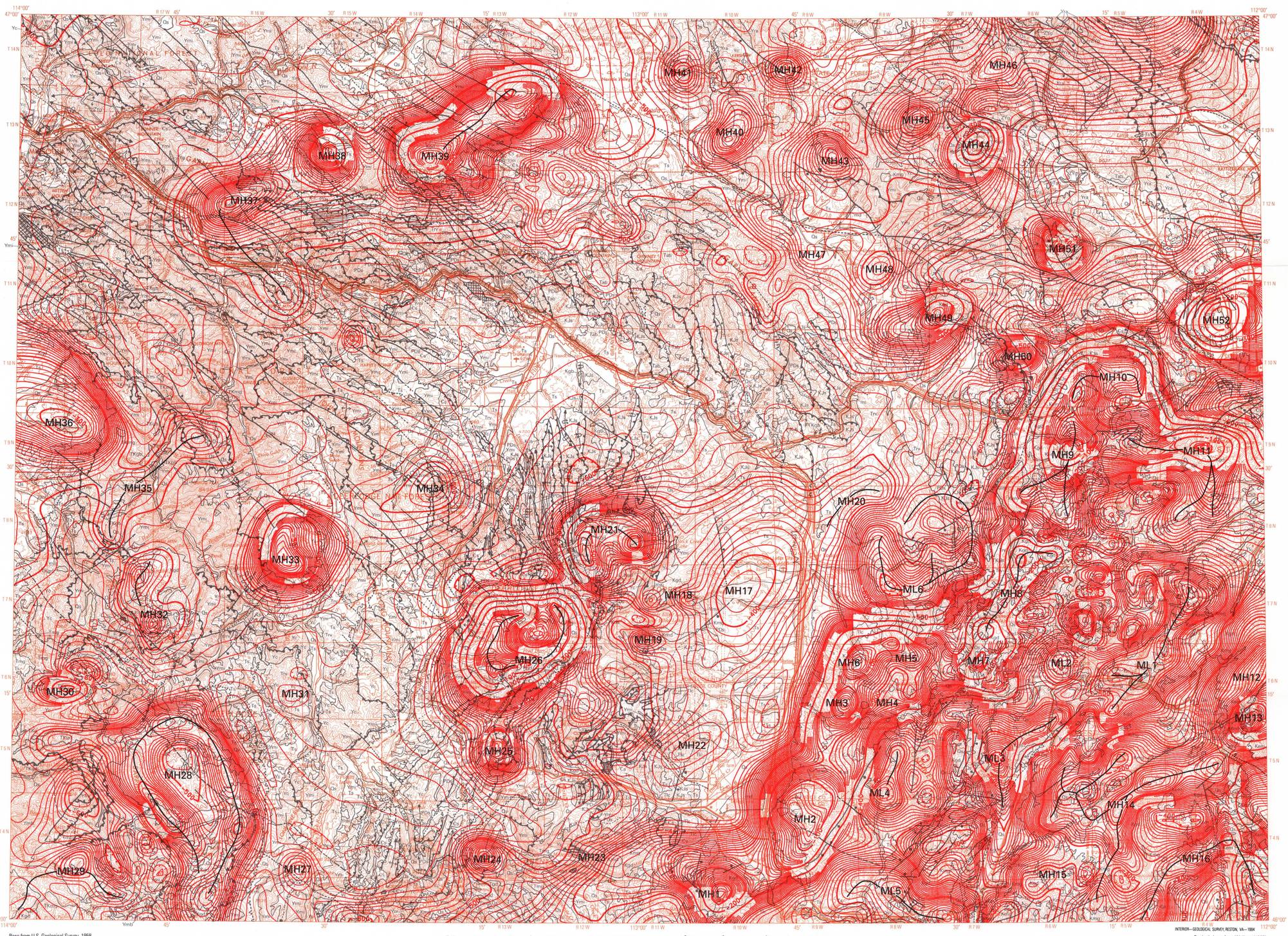
U.S. DEPARTMENT OF THE INTERIOR
U.S. GEOLOGICAL SURVEY

MISCELLANEOUS INVESTIGATIONS SERIES
MAP I–2050–I (SHEET 2 OF 2)
Pamphlet accompanies map

Map B. Map showing complete Bouguer gravity anomalies and generalized geology



Map C. Map showing aeromagnetic anomalies and generalized geology

Base from U.S. Geological Survey, 1958
Revised 1977

Geologic base from Wallace (1987)

SCALE 1:250 000

CONTOUR INTERVAL 200 FEET
SUPPLEMENTARY CONTOUR INTERVAL 100 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

EXPLANATION

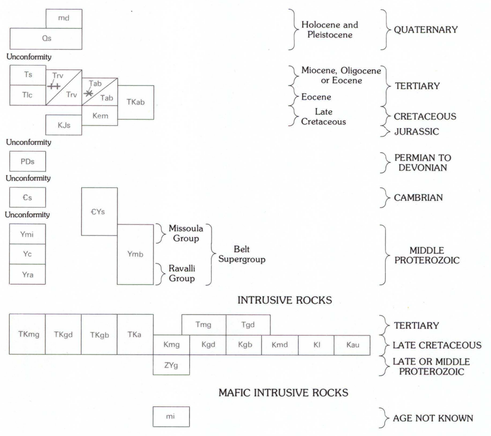
–190– **Gravity anomaly contour**—Interval 2 mGal; hachures indicate lower values

× **Gravity station**

–GH13– **Gravity anomaly referenced in text pamphlet**—Showing trend line(s) for selected anomalies

CORRELATION OF MAP UNITS

SEDIMENTARY AND VOLCANIC ROCKS



DESCRIPTION OF MAP UNITS

MAN-MADE DEPOSITS

md **Placer and mill tailings, mine dumps, and slag piles (Holocene)**

SEDIMENTARY AND VOLCANIC ROCKS

Qs **Surficial deposits (Holocene and Pleistocene)**—Alluvium, fan and terrace gravel, colluvium, gravel deposits on pediment surfaces, and landslide and travertine deposits (Holocene and Pleistocene); till, glacial lake, and outwash deposits (Pleistocene)

Ts **Sedimentary deposits and rocks (Tertiary)**—Fan and gravel deposits (Pliocene) on pediment surfaces (Pliocene?) and conglomerate, sandstone, mudstone, and volcanic ash beds (Miocene, Oligocene, or Eocene?)

Trv **Rhyolitic volcanic rocks (Miocene, Oligocene, and Eocene)**—In most of quadrangle, consists mainly of rhyolitic, quartz latitic, and latitic volcanic rocks (Oligocene and Miocene). Includes rhyolitic and dacitic plugs and dikes (lower Tertiary). In Bearmouth area, rhyolitic rocks interbedded with lesser amounts of basaltic, andesitic, and latitic volcanic rocks and dikes (Eocene). In southern Sapphire Mountains, rocks are mainly rhyolitic and latitic volcanic rocks and lesser amounts of andesitic flows and dikes (Eocene?)

Tab **Andesitic and basaltic volcanic rocks (Oligocene and Eocene)**—In most of quadrangle, consists of andesitic, basaltic, and latitic volcanic rocks (Eocene) and basaltic and andesitic volcanic rocks (Oligocene or Eocene). In eastern Garnet Range, consists of basaltic, andesitic, and latitic volcanic rocks and dikes (Oligocene? and Eocene)

Tlc **Lowland Creek Volcanics (Eocene)**—Rhyolite and dacite flows, welded tuff, and air-fall tuff

TKab **Andesitic and basaltic volcanic rocks (Early Tertiary or Late Cretaceous)**—Mainly basaltic and andesitic flows, flow breccia, and air-fall tuff east and northeast of Deer Lodge

Kem **Elkhorn Mountains Volcanics (Late Cretaceous)**—Andesitic, quartz latitic, and basaltic air-fall tuff, breccia, welded tuff, and flows

KJs **Sedimentary rocks (Cretaceous and Jurassic)**—In northeast corner of quadrangle, consists of Two Medicine Formation, Virgelle Sandstone, Telegraph Creek Formation, Marias River Shale (Upper Cretaceous), and Blackleaf Formation (Lower Cretaceous). In area west, northwest, and north of Deer Lodge, consists of Golden Spike Formation and Carten Creek (originally spelled "Carter Creek" by Gwinn (1961) and now changed to "Carten Creek" to conform to U.S. Board on Geographic Names), Jens, and Coberly Formations of Gwinn (1961) (Upper Cretaceous); Blackleaf and Kootenai Formations (Lower Cretaceous); Morrison Formation (Upper Jurassic); and Ellis Group (Upper and Middle Jurassic)

PDs **Sedimentary rocks (Permian, Pennsylvanian, Mississippian, and Devonian)**—Consists of Shedhorn Sandstone, Phosphoria and Park City Formations (Permian), Quadrant Quartzite (Middle Pennsylvanian), Snowcrest Range Group (Lower Pennsylvanian and Upper Mississippian), Madison Group and related rocks (Upper and Lower Mississippian), Three Forks Formation (Lower Mississippian and Upper Devonian), and Jefferson (Upper Devonian) and Maywood Formations (Upper and Middle Devonian). In the Butte quadrangle, the formations of the Snowcrest Range Group (Conover Ranch, Lombard, and Kibbey Formations) are too thin to map as separate formations (Wardlaw, oral commun., 1986). Three Forks Formation occurs only in northeastern part of quadrangle

Cs **Sedimentary rocks (Cambrian)**—Includes Red Lion Formation (Upper Cambrian) and Hasmark Formation (Upper and Middle Cambrian). Also includes the underlying Park Shale, Meagher Limestone, and Wolsey Shale (Middle Cambrian) in northeast part of quadrangle, all of which are laterally equivalent to the Silver Hill Formation (Middle Cambrian) in west, southwest, and northwest parts of quadrangle. Flathead Quartzite at base (Middle Cambrian) present in entire quadrangle

CYs **Sedimentary rocks (Cambrian and Middle Proterozoic)**—Consists of lower Paleozoic and upper Middle Proterozoic rock units that are structurally superposed or are too thin to show at this scale. Red Lion (Upper Cambrian) and Hasmark (Upper and Middle Cambrian) Formations, Silver Hill Formation (Middle Cambrian), or Flathead Quartzite (Middle Cambrian) may be present overlying any of these Middle Proterozoic units: Pilcher Quartzite, Garnet Range, or McNamara Formations (Middle Proterozoic)

BELT SUPERGROUP (MIDDLE PROTEROZOIC)

Ymi **Missoula Group**—Consists of Pilcher Quartzite, Garnet Range and McNamara Formations; Bonner Quartzite; and Mount Shields, Shepard, and Snowslip Formations

Yc **Middle Belt carbonate rocks**—Mainly consists of upper and middle members of the Wallace Formation west of long 113°30′ W. and the laterally equivalent Helena Formation east of long 113°30′ W.

Yra **Ravalli Group**—Consists of Empire, Spokane, and Greyson Formations

Ymb **Metamorphosed rocks of the Belt Supergroup**—Consists of quartzite, biotite-muscovite schist, quartzofeldspathic gneiss, calc-silicate gneiss, and migmatite. Metamorphosed during Late Cretaceous or early Tertiary time

INTRUSIVE ROCKS

Tmg **Granitic rocks (Tertiary)**—Mainly muscovite-biotite granite and monzogranite

Tgd **Granodioritic rocks (Tertiary)**—Mainly quartz monzodiorite and granodiorite

TKmg **Granitic rocks (Tertiary and Late Cretaceous)**—Consists of foliated and nonfoliated biotite-muscovite monzogranite, leucomonzogranite, and granodiorite

TKgd **Granodioritic rocks (Tertiary and Late Cretaceous)**—Mainly foliated and nonfoliated biotite granodiorite, hornblende-biotite granodiorite, tonalite, and quartz diorite

TKgb **Gabbroic rocks (Tertiary and Late Cretaceous)**—Consists of gabbro, microgabbro, and diorite

TKa **Alkalic rocks (Tertiary or Late Cretaceous)**—Pyroxenite, leucosyenite, and hornblende syenite

Kmg **Granitic rocks (Late Cretaceous)**—Mainly granite porphyry, biotite monzogranite porphyry, biotite monzogranite, biotite-muscovite monzogranite, biotite-muscovite granodiorite, quartz monzonite, microleucomonzogranite, leucomonzonite, aplite, alaskite, and pegmatite

Kgd **Granodioritic rocks (Late Cretaceous)**—Consists of foliated and nonfoliated biotite-hornblende granodiorite, biotite-hornblende granodiorite porphyry, biotite-hornblende monzogranite, and tonalite

Kgb **Gabbroic rocks (Late Cretaceous)**—Diorite, diorite porphyry, gabbro, microgabbro, and diabase

Kmd **Monzodioritic rocks (Late(?) Cretaceous)**—Mainly hornblende quartz diorite, granodiorite, tonalite, quartz monzodiorite, diorite, quartz diorite, leucogranodiorite, and augite-hornblende monzonite

Kl **Latite (Late Cretaceous)**—Sill in northeastern corner of map

Kau **Augen gneiss (Late Cretaceous)**—Part of the Idaho batholith in southwestern corner of map

ZYg **Gabbroic rocks (Late or Middle Proterozoic)**—Gabbro, microgabbro, and diorite dikes and sills

MAFIC INTRUSIVE ROCKS OF UNCERTAIN AGE

mi **Diorite and diorite porphyry, diabase, gabbro, microgabbro, and diorite**

Contact—Long-dashed where inferred or approximately located; short-dashed where concealed by younger deposits

Normal fault—Ball and bar on apparent downthrown block. Long-dashed where inferred or approximately located; short-dashed where concealed by younger deposits

Strike-slip or oblique-slip fault—Arrows show inferred direction of relative lateral movement. Ball and bar show apparent direction of dip-slip offset. Long-dashed where inferred or approximately located; short-dashed where concealed by younger deposits

Thrust fault—Sawteeth on upper plate. Short-dashed and open sawteeth where concealed by younger deposits

Anticline—Shows trace of axial plane, direction of plunge, and dip directions of limbs. Short-dashed where concealed by younger deposits

Syncline—Shows trace of axial plane, direction of plunge, and dip directions of limbs. Short-dashed where concealed by younger deposits

Overturned anticline—Shows trace of axial plane, direction of plunge, and dip directions of limbs. Short-dashed where concealed by younger deposits

Overturned syncline—Shows trace of axial plane, direction of plunge, and dip directions of limbs. Short-dashed where concealed by younger deposits

Zone of imbricate thrust faults
In Mississippian, Devonian, and Cambrian strata
In Wallace and Helena Formations and Missoula Group strata
In Mississippian, Pennsylvanian, Permian, Jurassic, and Cretaceous strata
In Cambrian and Middle Proterozoic strata

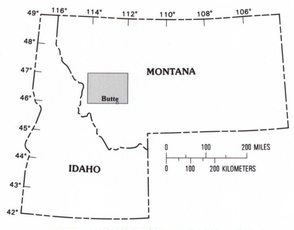
Silicified shear zone—In Mississippian and Devonian strata

EXPLANATION

[Contours simulate anomalies at an altitude of 3.2 km above mean sea level]

–500– **Magnetic anomaly contour**—Contour interval 10 nT; hachures indicate lower values

–MH16– **Aeromagnetic anomaly referenced in text pamphlet**—Showing trend line(s) for selected anomalies



INDEX MAP SHOWING LOCATION OF THE BUTTE 1° × 2° QUADRANGLE

MAPS SHOWING GRAVITY AND AEROMAGNETIC ANOMALIES IN THE BUTTE 1° × 2° QUADRANGLE, MONTANA

By
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1994