U.S. GEOLOGICAL SURVEY
GEORGE OTIS SMITH, DIRECTOR

AREAL GEOLOGY

MONTANA
PHILIPSBURG QUADRANGLE

LEGEND
(continued)

IGNEOUS ROCKS
Sequence not fully known
(Areas of igneous rocks are shown by patterns of triangles and rhombs.)

- **Tva** — Volcanic ash *(white and buff unconsolidated silty material)*
- **Ta** — Andesitic extrusive rocks *(chiefly tuffs of coarse to medium texture; lavas near western margin of quadrangle)*
- **Tpg** — Porphyritic muscovite-biotite granite
- **Tpbg** — Porphyritic biotite granite
- **Tagd** — Acidic granodiorite *(rich in quartz; contains hornblende locally; fingers out into granodiorite porphyry)*
- **Tg** — Nonporphyritic muscovite-biotite granite
- **Tbg** — Nonporphyritic biotite granite *(contains a little muscovite; 1. plagioclase is oligoclase; 2. plagioclase is albite and fluorite is present; 3. plagioclase is abundant and chiefly andesine)*
- **Tgd** — Medium and basic granodiorite *(hornblende and biotite usually nearly equal in quantity; includes some diorite and some decomposed porphyritic dike rocks)*
- **Tbd** — Basic diorite *(dark rocks of fine to medium grain, with more or less idiomorphic hornblende)*
- **Tad** — Acidic diorite *(quartz-mica diorite, coarse grained, largely anhedral, with allotriomorphic hornblende)*

TERTIARY

- **bs** — Basic sills *(diabase, partly altered to epidiorite, in Algonkian sediments, and other altered basic rocks in Cretaceous sediments)*

TERTIARY ?

Fault

Concealed fault *(covered by surficial deposits)*

Downthrown side of drop fault
Overthrust side of thrust fault
Strike and dip of stratified rocks
Strike and overturned dip
Strike of vertical strata
Horizontal strata
Strike and dip of cleavage
Strike of vertical cleavage

Location and names of mines are shown on the topographic map

LEGEND

SEDIMENTARY ROCKS
(Areas of subaqueous deposits are shown by patterns of parallel lines, subaerial deposits by patterns of dots and circles; metamorphism is indicated by hachures combined with the line patterns.)

QUATERNARY

Recent
- **Qal** — Alluvium *(water-laid deposits on valley bottoms and low terraces)*

Pleistocene
- **Qm** — Moraines *(earlier and later moraines not distinguished)*

QUATERNARY AND TERTIARY

Pliocene and Pleistocene
- **QTg** — Later terrace gravels *(gravels capping high terraces)*

UNCONFORMITY

TERTIARY

Eocene to Miocene?
- **Teg** — Earlier gravels *(somewhat consolidated and deformed; probably of two or more epochs)*

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CRETACEOUS

Upper Cretaceous
- **Kc** — Colorado formation *(black shale overlain by gray sandstone with subordinate shale; possibly includes Montana formation in part)*

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Lower Cretaceous
- **Kk** — Kootenai formation *(chiefly red and green shale and sandstone; some limestone; basal conglomerate in most places)*

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JURASSIC
- **Je** — Ellis formation *(chiefly buff-weathering calcareous shales and sandstones and impure limestone; conglomerate near middle.)*

UNCONFORMITY

CARBONIFEROUS

Pennsylvanian
- **Cq** — Quadrant formation *(upper part mainly quartzite; lower part mainly reddish magnesian limestone and deep-red shale)*

UNCONFORMITY ?

Mississippian
- **Cm** — Madison limestone *(upper part thick-bedded, white and gray; lower part dark-gray and flaggy; chert abundant; fossils conspicuous)*

DEVONIAN
- **Dj** — Jefferson limestone *(white to black magnesian limestone with little chert; fossils usually inconspicuous)*

SILURIAN ?
- **Sm** — Maywood formation *(red, gray, and drab shales, and flaggy magnesian limestone; calcareous sandstone near base)*

UNCONFORMITY ?

CAMBRIAN
- **Crl** — Red Lion formation *(mainly limestone with closely spaced thin siliceous laminae; calcareous shale at base)*
- **Ch** — Hasmark formation *(white magnesian limestone in upper part; dark calcareous shale locally wanting in middle; pale-gray magnesian limestone in lower part)*
- **Csh** — Silver Hill formation *(upper part calcareous shale and limestone with siliceous laminae; lower part dark-green, slightly calcareous shale.)*
- **Cf** — Flathead quartzite *(light-colored vitreous quartzite)*

UNCONFORMITY

ALGONKIAN

Belt series
- **As** — Spokane formation *(mud-cracked and ripple-marked sandstone and shale, prevailingly red where unmetamorphosed.)*
- **Anl** — Newland formation including Greyson(?) shale *(calcareous shales and impure limestones characterized by buff tints on weathered surfaces)*
- **Ar** — Ravalli formation *(chiefly gray quartzitic sandstone with much dark shale in upper part)*
- **Ap** — Prichard formation *(schists and gneisses, prevailingly dark blue-gray, rusty on weathered surfaces; derived from clay shales)*
- **An** — Neihart quartzite *(pure thick-bedded light-colored quartzite)*

Legend is continued on the left margin

E. M. Douglas, Geographer.
H. L. Baldwin, Jr., in charge of section.
Topography by J. E. Blackburn, J. Gussenhoven, L. Morrison, and J. E. Tichenor.
Triangulation by H. L. Baldwin, Jr.
Surveyed in 1905.

Geology by F. C. Calkins, assisted by D. F. Macdonald, W. E. Wrather, and J. T. Pardee.
Surveyed in 1906-08.

APPROXIMATE MEAN DECLINATION 1905.

Scale 1/125000
1 ½ 0 1 2 3 4 5 Miles
1 ½ 0 1 2 3 4 5 Kilometers

Contour interval 100 feet.
Datum is mean sea level.
A later level adjustment shows the elevations on this sheet to be 4½ feet too high.

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