

**GEOLOGIC MAP OF THE
HAMILTON 30' x 60' QUADRANGLE,
WESTERN MONTANA**

Compiled and mapped by Jeffrey D. Lonn and Richard Berg

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**PRELIMINARY GEOLOGIC MAP OF THE HAMILTON
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Description of Map Units

- Qls LANDSLIDE DEPOSITS (HOLOCENE)
 Unsorted and unstratified mixtures of locally derived material transported down adjacent steep slopes and characterized by irregular hummocky surfaces. Occurs most often as earthflow movement on slopes underlain by Tertiary sedimentary (Tgc) and volcanic (Tv) rocks with high clay content.
- Qal ALLUVIAL DEPOSITS OF THE PRESENT FLOOD PLAIN (HOLOCENE)
 Fresh, well-sorted, well-rounded gravel and sand with a minor amount of silt and clay. Beneath modern flood plains and streams. Well logs show an average thickness of 40 feet (McMurtrey and others, 1972).
- Qc COLLUVIAL DEPOSITS (HOLOCENE)
- Qaf ALLUVIAL FAN DEPOSIT (HOLOCENE AND PLEISTOCENE)
 Well- to poorly sorted, well-rounded to subangular locally derived cobbles and boulders in a matrix of sand and gravel deposited in alluvial fan and glacial outwash environments. Includes deposits of several ages and topographic levels.
- Qat RIVER TERRACE DEPOSIT (LATE PLEISTOCENE?)
 Not exposed in outcrop, but the surfaces consist of unweathered, well-rounded, mostly granitic cobbles. These surfaces stand 15-25 feet above the present flood plain. Well logs indicate a thickness of 60-70 feet of sand, gravel, and cobbles. At least two terraces have been recognized (Uthman, 1988), but they are cannot be distinguished everywhere.
- Qgt GLACIAL TILL (PLEISTOCENE)
 Unsorted mostly unstratified, clay, silt, sand, gravel, and boulders up to 25 feet in diameter deposited by glaciers in moraines. Moraines record at least three glaciations (Weber, 1972). Mass movement and Lake Missoula shoreline processes have modified some of these deposits.
- Taf ALLUVIAL FAN DEPOSIT (LATE MIOCENE TO PLIOCENE)
 Brown, unconsolidated to weakly lithified, poorly sorted, moderately stratified, sub-angular to rounded boulders, cobbles, and sandy silt deposited in alluvial fan environments. Includes abundant brown, massive micaceous silt beds. Found as interfluvial remnants perched 200 feet or more above the present Bitterroot flood plain, and capping pediments or strath terraces formed on older units. Clasts are locally derived, and are often coated with brown iron oxide or caliche. Bedding typically dips more steeply than the surface of this unit, indicating an erosional surface. Lag deposits of small, sub-

angular boulders are common on these pediment surfaces. Unit is probably correlative with the Sixmile Creek Formation of southwestern Montana.

Tgc GRAVEL AND CLAY (LATE EOCENE TO MIDDLE MIOCENE?)

Unit includes two facies, undivided on the map. Possibly correlative with the Renova Formation of southwestern Montana. Deep drill holes show that unconsolidated sedimentary rocks similar to Tgc are up to 2400 feet thick in places (Norbeck, 1980).

Fluvial Gravel of the Ancestral Bitterroot River Channel (“ABR Facies”) – Predominantly light gray to white, unconsolidated, well-sorted, well-rounded, well-stratified sand pebbles, and cobbles. Clast lithologies are representative of rocks from the entire drainage basin and include granitic rocks, Bitterroot mylonite, Belt quartzite, Belt carbonate, high-grade metamorphic rocks, extrusive volcanic rocks, and black and red chert. Informally called the “ancestral Bitterroot River (ABR) facies” (Lonn and Sears, 1998). Contains interbedded light tan clay and silt that predominate in the blue clay facies with which the ABR facies interfingers. The ABR facies hosts most of the developed sand and gravel deposits in the Bitterroot Valley and is also a productive aquifer.

Clay, Silt, and Tephra of the Ancestral Bitterroot River Channel (“Blue Clay Facies”) – Informally called the “blue clay facies” (Lonn and Sears, 1998) after drill log descriptions. Mostly light gray clay and silt in beds 6 inches to 5 feet thick, with abundant interbedded tephra. Contains lenses of well-sorted, cross-stratified, fluvial gravel like that described for the ABR facies. Some brown, ledge-forming massive silty layers with root casts and burrows are present and interpreted to be paleosols. Fossil assemblages indicate an Oligocene to late Miocene age (Konizeski, 1958). Landslides commonly develop where this unit underlies steep slopes, especially where irrigated. Swelling clays are also common.

Tv VOLCANIC ROCK, UNDIFFERENTIATED (EOCENE?)

Includes flows, welded tuff, tuff, and various volcanoclastic rocks. Composition is generally rhyolitic to quartz latitic (Clark, 1979). Also includes some dikes in the southeastern part of the map area.

Tra RHYOLITE AND ANDESITE (EOCENE)

Dikes, sills, and other shallow porphyritic intrusive bodies of mainly rhyolite. These are mostly thin (less than 100 feet thick) dikes that are reddish, topographically resistant features containing phenocrysts of quartz, sanadine, plagioclase, biotite, and hornblende in an aphanitic groundmass. Flow banding is common.

Tg GRANODIORITE, GRANITE, AND SYENITE (EOCENE OR PALEOCENE)

Undivided, small epizonal plutons of medium- to coarse-grained nonfoliated rock.

Tgw GRANODIORITE OF THE WILLOW CREEK STOCK (EOCENE OR PALEOCENE)

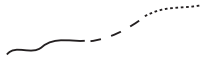
Pink to white, fine- to medium-grained, nonfoliated granodiorite. Contains 1-2% potassium feldspar megacrysts up to several centimeters long and 10% biotite and muscovite (Presley, 1971).

- Tgs GRANODIORITE OF THE SKALKAHO STOCK (EOCENE OR PALEOCENE)
White, fine-grained equigranular, nonfoliated granodiorite containing 5% biotite and a trace of muscovite. Mineralogically, it is similar to the nearby Willow Creek stock and may be related (LaTour, 1974).
- Tm MYLONITE ZONE (MID-EOCENE)
A 600- to 1500-foot thick east dipping zone in which Precambrian metasedimentary rocks, Cretaceous, and Tertiary plutons have been intensely deformed to produce a well-foliated rock which is locally ultramylonitic (Toth, 1983).
- TKp GRANODIORITE AND MONZOGRANITE OF THE PARADISE PLUTON (PALEOCENE AND OR UPPER CRETACEOUS)
Medium-grained equigranular to porphyritic (with pink K-spar phenocrysts six millimeters long) monzogranite and granodiorite (Toth, 1983). Contains 5-20% hornblende and biotite.
- TKg FOLIATED GRANODIORITE AND MONZOGRANITE (PALEOCENE TO UPPER CRETACEOUS)
A granitic complex of muscovite-biotite granodiorite and monzogranite, and local but related quartz diorite, quartz monzodiorite, and syenogranite that makes up much of the Idaho batholith. Mainly light gray, slightly porphyritic (feldspar phenocrysts) biotite granodiorite with 2-5% biotite which defines a weak, but obvious primary flow foliation (Toth, 1983).
- TKag AUGEN GNEISS (PALEOCENE AND OR UPPER CRETACEOUS)
In the southeast corner of the map, foliated biotite granodiorite of the Idaho batholith (TKg) has been deformed into an augen gneiss. The contact is gradational.
- Ymi MISSOULA GROUP QUARTZITE, ARGILLITE, AND SILTITE, UNDIVIDED (MIDDLE PROTEROZOIC)
Dominated by gray, flat-laminated, fine- to medium-grained quartzite. Some is pink and feldspar-rich. Sequences from one foot to several hundred feet thick of finer-grained sediment types are present, including red and green argillite, red to purple siltite, and some carbonate-rich facies. This unit overlies the middle Belt carbonate unit, but poor stratigraphic knowledge in this area and lack of exposure make assignment of formation names difficult. Some areas display metamorphism up to amphibolite grade.
- Yc MIDDLE BELT CARBONATE (MIDDLE PROTEROZOIC)
Metamorphosed gray limestone, dolomitic siltstone, white quartzite, and black argillite of the Helena and Wallace Formations of the Belt Supergroup. Some degree of recrystallization has occurred everywhere, but primary sedimentary features are often preserved. The layering is defined by original sedimentary beds, and minerals display only weak preferred orientation. The more highly metamorphosed areas contain green layers of mainly diopside and actinolite, and scapolite forms large white porphyroblasts. LaTour (1974) distinguished greenschist facies and amphibolite facies metamorphism within this unit on the basis of the presence or absence of diopside, but because the diopside is fine-

grained, this is not possible in hand specimen. Within this unit, there are some sequences of gray, medium-grained, flat-laminated quartzite in beds 1-2 feet thick.

- Yq BELT SUPERGROUP QUARTZITE ALONG SKALKAHO CREEK (MIDDLE PROTEROZOIC)
Gray, medium-grained, biotite-rich, flat laminated quartzite. Thin, interbedded, fine-grained clastic layers have been metamorphosed into biotite-muscovite-quartz-feldspar schist, with foliation parallel to original bedding. This unit appears to conformably underlie the middle Belt carbonate unit and is therefore part of the Ravalli Group, perhaps correlative with the Revett Formation.
- Ybm GNEISSIC METASEDIMENTARY ROCKS, UNDIVIDED, OF BELT SUPERGROUP (MIDDLE PROTEROZOIC) Mostly migmatitic quartzofeldspathic gneiss with lesser amounts of calc-silicate gneiss, pelitic schist, and amphibolite. These are probably higher grade metamorphic equivalents of the Belt Supergroup rocks described above (Ymi, Yc, and Yq). Age of amphibolite grade metamorphism is uncertain.
- Ycg CALC-SILICATE GNEISS (MIDDLE PROTEROZOIC)
Banded gray to green gneiss consisting of light green layers of diopside, quartz, and actinolite alternating with light gray layers of quartz, feldspar, and biotite. Scapolite is common as large (up to 0.5 cm) white porphyroblasts. This unit is a higher grade metamorphic equivalent of Yc and may be gradational with Yc. It is also present but unmapped with Yc, where Yc has been metamorphosed and highly injected near contacts with Tertiary igneous intrusive rocks.
- Yqf METASEDIMENTARY QUARTZOFELDSPATHIC GNEISS (MIDDLE PROTEROZOIC)
Banded reddish-brown-weathering rock composed of quartz-feldspar-biotite-rich layers, quartz-rich layers, and migmatite. Platy minerals are not always aligned, but they are concentrated in distinct layers. Primary sedimentary features have been obliterated. Layers of biotite-muscovite-rich pelitic schist with rare sillimanite are present but uncommon. This unit is assumed to be a higher grade metamorphic equivalent of the Belt Supergroup rocks described above (Ymi and Yq). Age of amphibolite grade metamorphism is unknown.
- Yam AMPHIBOLITE AND HORNBLLENDE GNEISS (MIDDLE PROTEROZOIC)
Elongate bodies of medium-grained amphibolite and hornblende gneiss containing green to black hornblende and varying amounts of white plagioclase. Some biotite is visible.
- Yog ORTHOGNEISS (PROTEROZOIC)
Reddish-brown gneissic rock consisting of medium- to coarse-grained plagioclase, potassium feldspar, quartz, and biotite. Elongate quartz pods and weakly aligned biotite define schistosity (Clark, 1979).
- Yan ANORTHOSITE (PROTEROZOIC?)
Massive, hypidiomorphic-granular anorthosite containing small flakes of biotite (some altered to chlorite), muscovite, and minor clinozoisite (Chase, 1973).

Map Symbols



Contact; dashed where approximately located, dotted where concealed.



Line between mapped areas of undivided and divided metamorphic rocks.



Strike and dip of bedding



Strike and dip of foliation



Vertical foliation



Fault; sense of movement and dip of fault plane unknown. Dashed where approximate, dotted where concealed.



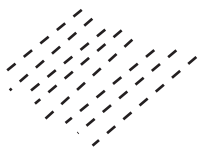
Normal fault; ball and bar on downthrown side. Dashed where approximate, dotted where concealed.



Thrust Fault; teeth on upper plate

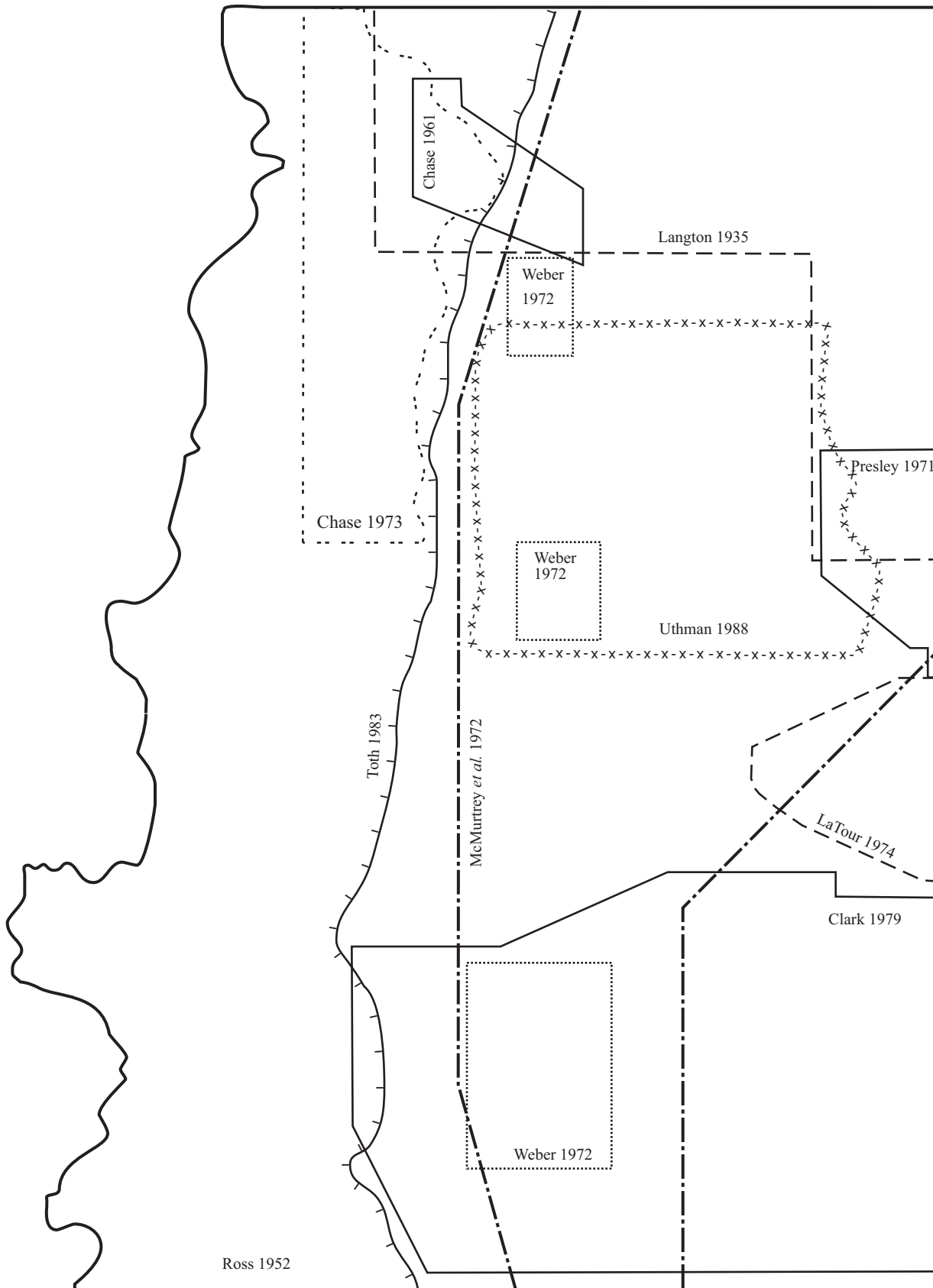


Rhyolite and andesite in dikes or sills. Thin reddish, topographically resistant, rhyolitic to andesitic, porphyritic dikes. Flow banding is common.



Pediment surface of mid-Miocene (Sears, 1996) and Pliocene (Fields et al., 1985) age, irregularly mantled with thin pediment gravel or lag deposits of subangular boulders. Pediment surfaces appear to cut all Tertiary and older units regardless of resistance

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Hamilton 30' x 60' Quadrangle, Montana



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