Base map produced by the United States Geological Survey
Lima Peaks 1:24,000 scale quadrangle map
Control by: USGS and USC&GS
Compiled from aerial photographs taken 1964
Field checked: 1965
Projection: Polyconic
Universal Transverse Mercator Zone 12
UTM grid declination: 1°06' West
1965 Magnetic North Declination: 18° East
Vertical Datum: National Geodetic Vertical Datum of 1929
Horizontal Datum: 1927 North American Datum

SCALE 1:24,000

CONTOUR INTERVAL 40 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929

Maps may be obtained from:
Publications Office
Montana Bureau of Mines and Geology
1300 West Park Street
Butte, Montana 59701-8997
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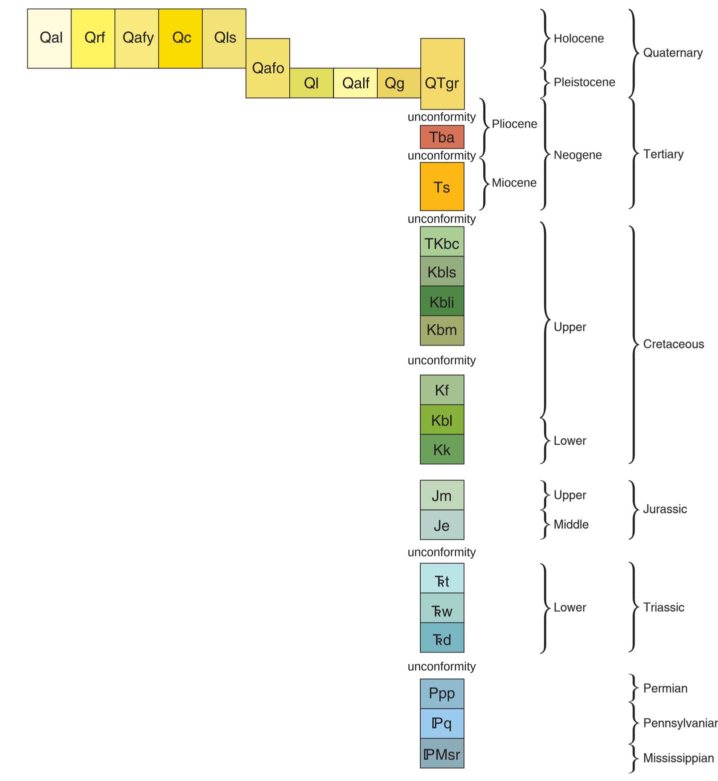
CORRELATION DIAGRAM



MAP SYMBOLS

- Contact: dashed where approximately located
- Normal fault: dashed where approximately located; dotted where concealed, bar and ball on downthrown side; arrow indicates measured dip on fault surface
- Strike slip fault, right lateral: dashed where approximately located; arrows indicate right lateral slip
- Strike slip fault, left lateral: dashed where approximately located; arrows indicate left lateral slip
- Thrust fault: dashed where approximately located; dotted where concealed; teeth on upper plate
- Anticline: dashed where approximately located; dotted where concealed
- Syncline: dashed where approximately located; dotted where concealed
- Overturned anticline: showing dip direction of limbs
- Overturned syncline: showing dip direction of limbs
- Horizontal bedding
- Strike and dip of inclined beds
- Inclined bedding – approximate
- Strike and dip of vertical bedding
- Vertical bedding – approximate
- Overturned bedding; showing strike and dip
- Vertical lineations
- Vertical cleavage
- Location of measured sections of Blackleaf Formation and part of Frontier Formation by T.S. Dyman (1985)
- Large exotic limestone blocks of Mississippian Madison Group (see text for interpretation).

INTRODUCTION

The Lima Peaks quadrangle is located in southwestern Beaverhead County in southwestern-most Montana, near the southern terminus of the Beaverhead Mountains (fig. 1). Rocks and deposits of Mississippian through Quaternary age are present along the eastern margin of the Cretaceous to early Tertiary Sevier fold-and-thrust belt. This area is structurally complex because rocks of the thrust belt structurally interacted with the southwestern terminus of the northeast-trending, older, Laramide Blacktail–Snowcrest uplift (Perry and others, 1988; Skipp, 1988; Lonn and others, 2006).

Scholten and others (1955) published the first detailed geologic map of a large area that included this quadrangle. The authors provided detailed descriptions of the stratigraphy and presented structural interpretations that predated the development of modern plate tectonics and thrust belt theory. Their interpretations included foreland-dipping decollements and gravity sliding. Ryder and Scholten (1973, updated 1985) published a locally more detailed map of the area that emphasized the conglomerates of the Beaverhead Group. The first structural interpretations of the area that included hinterland-dipping thrust faults and decollements were presented in the 1980s by several authors including Hammons (1981); Perry and others (1981); Perry and others (1983); Perry and others (1988); and Skipp (1988). These authors also recognized the "thin-skinned" nature of the Tendoy thrust fault. Dougherty (1997) detailed deposition of the Beaverhead Group conglomerates in a foreland basin environment.

Several large blocks of Mississippian limestone (indicated by a pattern on the map), described by Ryder and Scholten (1973/1985), and Perry and others (1988) as "slide blocks," are now interpreted as large limestone blocks carried along at or near the bases of footwall thrusts as they formed. Thus, they were preserved at or near the leading edges of eroded thrust imbricates in the footwall of the Lima thrust (Susanne Janecke in Lonn and others, 2006). The current, more detailed map shows a limestone block in Birch Creek, now within a landslide, near the leading buried edge of a footwall imbrication. Synclinal folding and subsequent normal faulting modified and redistributed other blocks within the footwall. Still others are sedimentary and not related to any recognized structure.

The three authors completed most field mapping for the Lima Peaks map in the 1980s, 1990s, and 2000s. Juanita MacKenzie assisted Skipp in the field in 1980–1982, June Skinner assisted in 1992, and Jean LaDue in 1981, 1982, 1997–1998, and 2000-2002. Mike Wells and Steve Richards assisted Perry during the 1980s, and he worked in consultation with R.T. Ryder and J.C. Haley during that same time. Susanne Janecke worked in the area sporadically from 1997 through 2004.

Descriptions of Cretaceous rocks are based on measured sections of Blackleaf Formation and the lower part of the Frontier Formation (Dyman, 1985) located in the southeastern corner of the Lima Peaks quadrangle. Descriptions of the Cretaceous rocks also include seminal published works by Dyman, Perry, Tysdal, and others in 1997 and 2008. Older geologic maps of the area immediately surrounding this quadrangle include those of Scholten and others (1955), Ryder and Scholten (1973), and an open-file geologic map of the Edie Ranch 15' quadrangle (Skipp and others, 1979). The Lima Peaks quadrangle is one of 36 7.5' quadrangles within a preliminary geologic map compilation of the Lima 30' x 60' quadrangle (Lonn and others, 2006). Significant parts of that map were compiled from maps by co-authors Skipp, Ruppel, and Janecke.

Skipp compiled the geology of the Lima Peaks quadrangle in 2016. Janecke acknowledges support from the National Science Foundation, American Chemical Society, and the EDMAP and Minerals programs of the U.S. Geological Survey. The map benefited greatly from reviews by Mitchell W. Reynolds and Erin Marsh, U.S. Geological Survey; and Colleen Elliott and Petr Yakovlev, Montana Bureau of Mines and Geology.

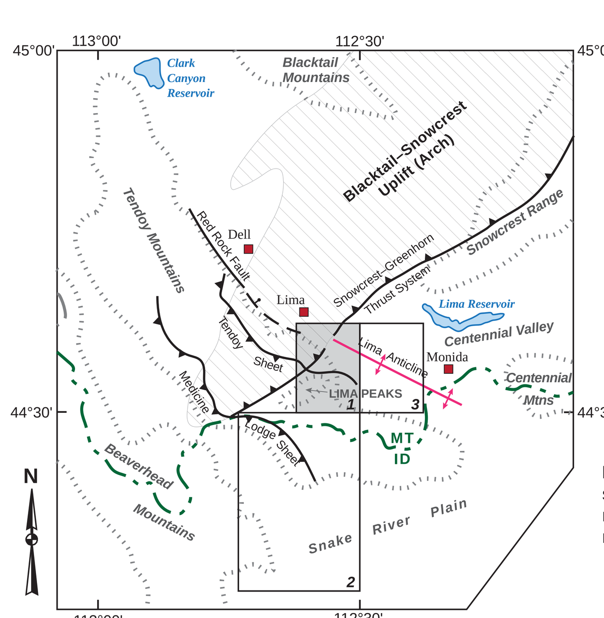
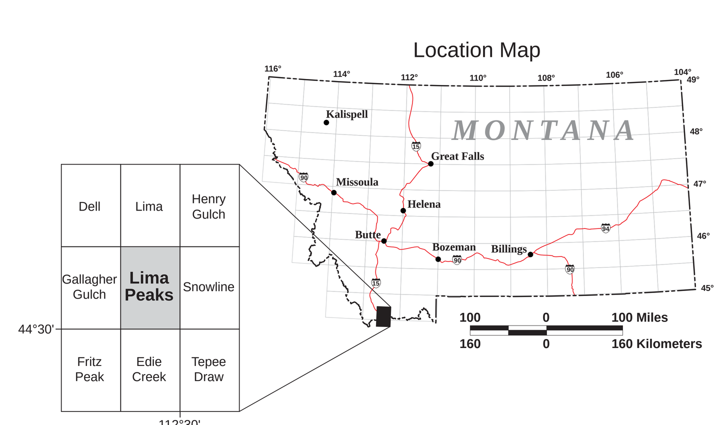


Figure 1. Index map of Lima, Montana region showing prominent physiographic features, place names, and generalized tectonic features; map modified from Perry and others (1988, fig. 1).

1. Lima Peaks 7.5' quadrangle, Beaverhead County, Montana
2. Edie Ranch 15' quadrangle, Beaverhead County, Montana and Lemhi County, Idaho (geologic map by Skipp, Prostka, and Schleicher, 1979)
3. Snowline 7.5' quadrangle, Beaverhead County, Montana



GIS production: Yiwen Li and Paul Thale, MBMG. Map layout: Susan Smith, MBMG.

DESCRIPTION OF MAP UNITS

Quaternary Deposits

Qal **Alluvium (Holocene)**—Unconsolidated, poorly sorted deposits of clay, sand, and gravel deposited by modern streams.

Qrf **Rockfall deposit (Holocene)**—Unconsolidated, locally derived deposit of angular debris preserved below source scar.

Qafy **Alluvial fan deposit, younger than Qafo (Holocene)**—Fan-shaped to locally dissected deposits of unconsolidated gravel, sand, and silt.

Qc **Colluvium (Holocene)**—Unconsolidated slope wash, talus, and minor rock falls; locally includes minor fan gravels, alluvium, and an unsorted deposit of angular road construction debris on the north side of Junction Creek along Highway I-15. Also may include reworked glacial deposits in sec. 2, T. 15 S., R. 8 W., south of the Tendoy thrust.

Qls **Landslide (Holocene)**—Unconsolidated deposit of locally derived, chiefly angular, poorly sorted debris. Several large landslides on east side of Birch Creek are sourced along a large north–south-trending normal fault parallel to, and less than a mile east, of the creek. Locally includes remobilized glacial deposits north of the Lima thrust.

Qafo **Alluvial fan deposit, older than Qafy (Holocene to Pleistocene)**—Chiefly unconsolidated, locally faulted and dissected, fan-shaped deposits of gravel, sand, silt, and clay in Dutch Hollow.

Ql **Lacustrine deposit (Pleistocene)**—Fine-grained lake sediment.

Qalf **Alluvium and/or alluvial fan deposit, older than Qal and Qafy (Pleistocene)**—Dissected and faulted deposits of subrounded gravel, sand, and silt that lie above or partially bury glacial outwash deposits. Locally cut by unit Qafo.

Qg **Glacial deposits (Pleistocene)**—Glacial till (in moraines) and outwash deposits. Unconsolidated and loosely consolidated, unsorted to poorly sorted, quartzite pebble to boulder gravel in a matrix of silt, sand, and clay in cirques and on sloping surfaces north and south of Lima Peaks.

Quaternary and Tertiary Deposits

QTgr **Gravel (Quaternary and/or Tertiary)**—Thin deposits of unconsolidated, coarse-grained, rounded quartzite boulder gravel that locally overlie Tertiary basalts in northern part of the quadrangle.

Tertiary Deposits

Tba **Basalt (Pliocene)**—Dark colored, flat-lying, locally scoriaceous flow or flows that cap mesas in northern part of quadrangle. K/Ar age of 4.9 +/- 0.5 Ma determined on correlated basalt cap in the Snowline quadrangle, just east of the Lima Peaks quadrangle (fig. 1) (Fritz and others, 2007; Lonn and others, 2006). Thickness about 12 m.

Ts **Gravel, sandstone, siltstone, and mudstone (Pliocene and/or Miocene)**—Thin unconsolidated gravels consisting of rounded to subrounded, light colored quartzite, and dark gray chert boulders and cobbles. Locally overlie thick, flat-lying, bedded to crudely bedded, yellow, yellowish gray, and gray sandstone and siltstone—some salt-and-pepper and claystone in the vicinity of Dutch Hollow and farther east (Tgr of Lonn and others, 2006). Base not exposed; thickness unknown.

Cretaceous Deposits

Beaverhead Group

TKbc **Quartzite clast conglomerate (Tertiary? and Upper Cretaceous)**—Quartzite clast conglomerate derived from the Little Sheep Creek Conglomerate. Crops out in footwall of thrust imbrication beneath Tendoy thrust in sec. 30, T. 14 S., R. 8 W., in northwestern corner of quadrangle, where it is involved in a post-depositional synclinal faulted fold complex. Unit extends westward beneath large imbrication in footwall of Tendoy thrust (Lonn and others, 2000). May be overlain by Red Butte Conglomerate of Haley and Perry (1991). Thickness unknown.

Kbls **Little Sheep Creek Conglomerate (Upper Cretaceous)**—Poorly consolidated quartzite roundstone conglomerate of highly polished and rounded pale gray to gray-green quartzite and siltite cobbles derived chiefly from Middle Proterozoic Lemhi Group. Lesser amounts of nearly white vitreous quartzite clasts are probably derived from Ordovician Kinnikinic Quartzite. A few granodiorite clasts are probably derived from the Beaverhead Mountains pluton (Perry and others, 1988, p. 288). Fine-grained sandstone and pebble conglomerates in lower part are exposed west of Alder Creek. Large exotic limestone blocks of Mississippian Madison Group (Perry and Sando, 1983) are distributed along the north–south-trending normal fault in the western part of the quadrangle and in a large landslide near the leading edge of a footwall imbricate below the Tendoy thrust. This unit is interpreted to stratigraphically underlie the quartzite clast conglomerate and to have been thrust over the Red Butte Conglomerate in the central Beaverhead Mountains. It is not in stratigraphic contact with the Red Butte as shown in Lonn and others (2006). Thickness is difficult to determine due to internal imbrication, but may exceed 1,000 m.

Kbli **Lima Conglomerate (Upper Cretaceous)**—Predominantly limestone pebble to cobble conglomerate derived from Blacktail–Snowcrest basement uplift prior to emplacement of Tendoy thrust plate (Nichols and others, 1985). Includes several large isolated blocks of Mississippian Madison Group, indicated by pattern on map. Formation exhibits inverted clast stratigraphy with oldest clasts (Archean schist and marble) near top and youngest clasts of Permian, Triassic, and Lower Cretaceous limestone near base. Limestone clasts are subangular to subrounded. Mixed clast zone at top. Upper 30 m of formation yielded mid-Campanian pollen (Sample D5696, Nichols and others, 1985). Thickness about 1,220 m in Alder and Truax Creeks area north of Lima Peaks (fig. 1) where exposed in footwall of Tendoy thrust.

Kbm **Monida Sandstone (Upper Cretaceous)**—Medium- to coarse-grained, quartz and calcite sandstone near top of formation composed of quartz and calcite grains; fine to pebbly with dark gray mudstone stringers from which sample D6597 yielded Late Cretaceous pollen no older than Coniacian (Nichols and others, 1985). Locally contains lenses of limestone clasts. Present in the footwall of the Tendoy thrust and possibly in the hanging wall south and east of thrust. Oldest formation of Beaverhead Group. Contact with the underlying Frontier Formation north of the Tendoy thrust not exposed, but similar attitudes suggest a largely conformable relationship. The unit is reportedly conformable and/or gradational with the Frontier Formation south of thrust (Dyman and others, 1995). Conformable contact east of quadrangle. Thickness locally about 1,430 m east of Truax Creek.

Kf **Frontier Formation (Upper Cretaceous)**—Non-marine greenish gray mudstone and siltstone and interbedded brown-weathering, salt-and-pepper sandstone with a locally thick zone of rounded quartzite clasts. The lower 100 m is characterized by lithic sandstone and subordinate olive to dark gray carbonaceous mudstone and shale. Sample D6586-D from carbonaceous mudstone at the base of the Frontier in the adjacent Snowline quadrangle (fig. 1) (LP-131-1 of Dyman and Nichols, 1988, table 1) yielded Cenomanian palynomorphs. The highest green volcanic porcelanite bed from the same area contains sanidine, which yielded an $^{40}Ar/^{39}Ar$ age of 85.81 Ma +/- 0.22 Ma (Dyman and others, 1997). Another sanidine $^{40}Ar/^{39}Ar$ age, from near the middle of the formation, yielded an unweighted mean of 86.25 +/- 0.38 Ma, indicating a basal Santonian age (Dyman and others, 2008). A largely covered and undated estimated thickness above the highest porcelanite includes conglomeratic beds with limestone and quartzite clasts. Many limestone clasts contain distinctive gastropods derived from the Kootenai Formation in addition to greenish gray siltstone and sandstone. The Frontier is thus Cenomanian to at least Santonian in age and is overlain unconformably by the Monida Sandstone of the Beaverhead Group north of the the Tendoy thrust and by a largely covered interval south of the thrust that may contain unrecognized beds of Monida Sandstone. Total thickness is probably more than 2,500 m south of Lima Peaks.

Kbl **Blackleaf Formation (Upper and Lower Cretaceous)**—Consists of a lower clastic facies (unit 1), about 67 m thick; overlain by lower mudstone shale facies (unit 2), about 17 m thick; an upper clastic facies (unit 3), about 70 m thick; and a volcaniclastic lithofacies, "pastel beds" (unit 4), about 278 m thick (Dyman, 1985; Dyman and Nichols, 1988). Units 1 and 3 are composed predominantly of quartz- and chert-rich sandstone; unit 2 of mudstone, shale, and minor siltstone and sandstone; and unit 4 of volcanic sandstone, mudstone, bentonite, porcelanite, and siltstone (Dyman and Nichols, 1988). Unit 4 is equivalent to the Vaughn Member and units 1 and 3 are equivalent to the Flood and Taft Hill Members of the Blackleaf Formation of Cobban and others (1976). Total thickness of Blackleaf is 465 m south of Lima Peaks (Dyman and Nichols, 1988, fig. 6). Although these units were described in measured sections located in the southwestern part of this quadrangle, the formation is mapped as a single unit here.

Kk **Kootenai Formation (Lower Cretaceous)**—A basal conglomerate or sandstone is overlain successively by a thin shale, the first sandstone, a lower fine-grained unit, the second sandstone, a middle fine-grained unit, a lower calcareous unit, an upper fine-grained unit, and an upper calcareous unit (DeCelles, 1986). The uppermost unit is a characteristic gastropod-bearing limestone. The upper and lower fine-grained units contain abundant redbeds in the Lima Peaks area. No precisely measured surface section is present in area, although Sadler (1980, p. 175) estimates thickness as 275 m immediately west of the Lima Peaks quadrangle. The American Stratigraphic Company lithologic log of the Farmers Union 9-31 Lima State Drillhole (sec. 31, T. 14 S., R. 07 W.; AMSTRAT #M2764) provides a thickness of about 168 m (10,176–10,625 ft). A cross section through this drillhole (Perry and others, 1983, fig. 8) suggests indicated well-log thickness is close to true thickness.

Jurassic Deposits

Jm **Morrison Formation (Upper Jurassic)**—Mudstone, siltstone, shale, and sandstone. Presence indicated by reddish brown soil in swale between limestone of Rierdon Formation and basal chert pebble conglomerate or sandstone of the Kootenai Formation. Moritz (1951, p. 1811–1812) described 119 m on the east side of Sheep Creek in sec. 29, T. 15 S., R. 8 W., but there is not a complete section of Morrison in section 29. Estimated map thickness is about 100 m. Lower and upper contacts covered; upper contact probably unconformable.

Je **Ellis Group, including Gypsum Spring tongue of Twin Peak Formation (Middle Jurassic)**—Ellis Group consists of the Rierdon Formation at the top and Sawtooth Formation below. Rierdon Formation upper limestone is very pale orange and yellowish gray, very thin-bedded to fissile, argillaceous micrite containing lenses of oolitic limestone and very thin-bedded fossiliferous micritic limestone that exhibits no sedimentary structures. The oolitic limestone is yellowish gray and moderate yellowish brown, medium- to coarse-grained, well sorted, and forms consistent low ridges. The base of the Rierdon Formation is placed at the lowest oolitic limestone ridge. The thickness of the Rierdon is 31–32 m (Moritz, 1951; Sadler, 1980). The Sawtooth Formation, about 40 m thick, consists of an upper argillaceous limestone and a basal shaly limestone, but is poorly exposed and forms a swale between the Gypsum Spring tongue and the Rierdon Formation. The Gypsum Spring tongue consists of interbedded siltstone, limestone, limestone conglomerates, sandstone, and one thin bed of dolomite. Limestone conglomerates in the upper part are varicolored, argillaceous, silty, chiefly thin-bedded, and contain crystalline, sparry calcite pellets and grapestones, oolites, and edgewise limestone rip-up clasts in an oolitic micrite matrix with rare rounded white chert pebbles (Sadler, 1980, p. 143). Rare fossil fragments include the brachiopod *Lingula* sp. Siltstone is orange and brown and thin- to wavy-bedded. Sandstone in the lower part is light yellow red, quartzose, thin bedded, and contains ripples and edgewise siltstone intraclasts. Dolomite is very light gray and weathers pale greenish gray. The entire unit is 73 m thick just west of the Lima Peaks quadrangle (Sadler, 1980). The upper and lower contacts are covered. Typical outcrops consist of limestone ledges below shales of the Morrison Formation. Red siltstones indicate that the unit may possibly correlate in part with the Triassic Ankareh Formation identified in the subsurface east of this area (Perry, 1986).

Triassic Deposits

Ꞓt **Thaynes Formation (Lower Triassic)**—Interbedded limestone, silty limestone, calcareous siltstone, and sandstone. Upper third is pale yellowish brown bioclastic limestone locally containing nodules of black chert. Limestone is very thin bedded, weathers light gray and grayish orange, and interbedded with thin beds of laminated silty limestone and calcareous siltstone. Limestone forms thin, resistant, step-like outcrops. Weathered-out fossil debris includes circular crinoid columnals, star-shaped crinoid columnals (Pentacrinus), pelecypod shell fragments, and echinoid plates and spines. Middle third is pale yellowish brown and light grayish orange siltstone and very fine-grained sandstone, thin bedded, locally laminated, chert-bearing, and weathers to moderate yellowish brown, very pale orange or light grayish orange. Lower third is pinkish gray, pale yellowish brown or pale grayish orange, bioclastic, thin bedded, partly crinkly bedded, locally hematitic limestone that weathers moderate to dark yellowish brown and yellowish gray. Fossils include pelecypod shells, gastropods, brachiopods including *Lingula*, *Pugnoides*, and *Rhynchonella* (Scholten and others, 1955), and crinoid and echinoid debris (description modified from Sadler, 1980). Gradational contact with underlying Woodside Formation. Estimated thickness is 165 m near center sec. 12, T. 15 S., R. 8. W. A thickness of 207 m is reported south of Mt. Garfield (Scholten and others, 1955, p. 367; Sadler, 1980, p. 111).

Ꞓw **Woodside Formation (Lower Triassic)**—Siltstone and minor fine-grained sandstone, limestone, silty limestone, and dolomite. The siltstone is white, very light gray, yellowish gray, grayish yellowish orange, grayish yellow green, pale to moderate brown, and moderate reddish brown, fissile, very thin bedded, and laminated. Weathered colors are greenish gray, moderate yellowish brown, and reddish brown. The formation is 40 m thick at Little Sheep Creek, 2.5 to 5 km west of the quadrangle (description modified from Sadler, 1980). The formation is poorly exposed, commonly forming a reddish soil zone or recessive unit between limestones and siltstones of Dinwoody Formation below, and Thaynes Formation above. Upper and lower contacts are gradational. Thickness ranges from 14 m to 30 m. Scholten and others (1955, p. 367) report a thickness of about 32 m in an area south of Mt. Garfield, along Little Sheep Creek, just west of the Lima Peaks quadrangle.

Ꞓd **Dinwoody Formation (Lower Triassic)**—Silty limestone and calcareous siltstone. Upper silty limestone member consists of interbedded and calcareous siltstone and limestone. Calcareous siltstone is light gray and yellowish gray, very thin- to thin-bedded, thinly laminated and festoon trough cross-laminated in places, and weathers pale to moderate yellowish brown. Limestone is white, light gray, and pale yellowish brown, silty, very thin- to thick-bedded but mostly thin bedded, crenulated bedded, finely crystalline or bioclastic, and is commonly recrystallized; weathers light gray, light olive gray, and pale to moderate yellowish brown. Bioclastic material is chiefly pelecypod shell fragments, phosphatic brachiopod *Lingula*, echinoid plates and spines, and rare gastropod fragments. Crenulated bedding forms from parallel-aligned pelecypod-fragment coquinas. Abundant megafossils—including brachiopods, molluscs, and ammonoids—are present in surrounding areas (Scholten and others, 1955, p. 357; Moritz, 1951). Upper member forms low ledges surrounded by brown soil. Sadler (1980) reports 226 m in Little Sheep Creek west of Lima Peaks quadrangle. Lower calcareous siltstone member consists of about 30 m of dark yellowish brown and grayish orange shaly siltstone that weathers to pale to moderate yellowish brown slopes. Siltstone is interbedded with a few low limestone ledges. Contact with underlying Phosphoria Formation is disconformable. Description modified from Sadler (1980). Estimated thickness in Lima Peaks quadrangle 200–300 m.

Permian Deposits

Ppp **Phosphoria and Park City Formations, undivided (Permian)**—Dolostone, chert, phosphatic mudstone, phosphorite, and minor limestone and sandstone. Formations are divisible into the members, not mapped separately in the Lima Peaks quadrangle, although fragments of each were recognized in float. Members in descending order: (1) Tosi Chert Member of the Phosphoria Formation, which consists of grayish brown, argillaceous and silty, thin bedded chert and minor grayish brown dolostone lenses. (2) Retort Phosphatic Shale Member of the Phosphoria Formation, which consists of mudstone—some of which is phosphatic—and phosphorite. Phosphorite is brownish gray and moderate yellowish brown, pelletal, thin- to thick-bedded, and is interbedded with minor phosphatic carbonate facies. (3) The Franson tongue of the Park City Formation consists of limestone, siltstone, dolostone, and minor pale-brown sandstone. Limestone is ledge-forming and contains brachiopods and pelecypods (Yochelson, 1968). (4) Rex Chert Member of the Phosphoria Formation consists of chert, salt-and-pepper sandstone, cherty dolomite, phosphorite, and mudstone. Chert is brownish gray to pale brown, thin- to thick-bedded, and forms ridges. Sandstone is yellowish orange to brownish gray, but is not reported in eastern part of the Lima Peaks quadrangle. Phosphorite is moderate yellowish brown to dark gray, locally sandy, pelletal, and thin-bedded. Dolomite is light yellowish brown, fossiliferous (orbiculoid brachiopods and fish remains). (5) Grandeur tongue of the Park City Formation consists of dolomite, sandstone, and mudstone. Dolomite is yellowish gray to pale brown, aphanitic, locally contains white chert nodules, and is sparsely fossiliferous. Interbedded sandstone is very pale orange, variably dolomitic, and thin bedded. Basal contact with Quadrant Formation is covered. Contacts between members are gradational. Thickness of formation varies from about 100 m to about 152 m in measured sections immediately west and east, respectively, of the Lima Peaks quadrangle (Cressman and Swanson, 1964).

Pennsylvanian and Mississippian Deposits

IPq **Quadrant Sandstone (Pennsylvanian)**—Upper member: Dominantly sandstone with minor dolostone. Sandstone is very pale orange to very light gray, weathers brownish gray, is commonly quartzose, locally calcareous, predominantly medium- to fine-grained, well sorted, well rounded, and friable to silica-cemented; commonly characterized by very large cross beds, most of eolian origin. Horizontally laminated and bioturbated intervals are less common. Dolostone is very pale orange to light gray, locally sandy or limy, and brecciated in places. Upper member weathers brownish gray and commonly is fractured and contains numerous slickensided surfaces. Upper member thickness is 275 m. Upper contact conformable with overlying Phosphoria Formation (modified from Saperstone, 1986a, b; and Saperstone and Ethridge, 1984). Lower member: Interbedded dolostone and sandstone. Dolostone is very pale orange to light gray, locally silty and sandy, micritic to coarsely crystalline, locally calcareous, containing crinoid and brachiopod bioclasts and yielding a fetid odor. Interbedded sandstone is very pale orange to very light gray, quartzose, fine grained, well sorted, subrounded to rounded, dolomitic and/or calcareous, horizontally laminated to crossbedded. Iron staining common among laminae and in mottling. Lower member thickness is about 60 m. Formation forms steep talus-covered slopes of Lima Peaks and Garfield Mountain. Contact with underlying Conover Ranch Formation not exposed. Formation estimated to be about 335 m thick on north flank of Garfield Mountain.

IPMsr **Snowcrest Range Group: Conover Ranch Formation and Lombard Limestone, undivided (Lower Pennsylvanian to Upper Mississippian)**—Conover Ranch is dark gray, black, light tan, and reddish brown limestone, calcareous shale, sandstone, siltstone, and minor gypsum. Upper part consists of dark gray silty limestone, mudstone, and wackestone; coarse-grained wackestone largely composed of brachiopod fossil fragments; contains shaly partings that weather light tan; calcareous shale is silty and thin bedded. Partly covered upper part about 60 m thick. Lower part consists of two lenticular ledges, 10–15 m thick, of light tan sandstone, non-calcareous, fine-grained, cross bedded, medium- to thick-bedded, in a mostly covered interval of gray to reddish brown soils probably representing siltstone and shales. Lower part about 315 m thick. Formation about 375 m thick. Conformably overlain by Quadrant Sandstone (Saperstone, 1986a; Scholten, 1955; Sloss and Moritz, 1951). Disconformably overlies Lombard Limestone (Upper Mississippian) which is black to medium and dark gray limestone and calcareous shale. Upper part consists of poorly exposed gray fissile calcareous siltstone, argillaceous calcareous mudstone, and black calcareous mudstone about 90 m thick. Middle part is cliff-forming, medium gray limestone, wackestone to packstone, fossiliferous, containing crinoidal grainstones, articulated brachiopods and molluscs, bryozoans, and large solitary horn corals, including *Syphonophyllia* sp.; modular black chert is present at top. Middle part is about 40 m thick. Lower unit is gradational with middle part and consists of interbedded medium- to thin-bedded wackestone, silty lime mudstone, and calcareous shale that form steep slopes; base not exposed; about 165 m thick. Total formation thickness about 295 m in adjacent areas (description modified from McDowell, 1992).

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MBMG Open-File Report 692

Geologic Map of the Lima Peaks 7.5' Quadrangle, Beaverhead County, Montana

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2017

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