

DESCRIPTION OF MAP UNITS

Cenozoic

Note: Colluvium (Holocene)—a matrix-supported diamict consisting of angular to subangular pebble and cobble sized clasts derived from local bedrock in a matrix of silt and sand—is found throughout the study area in areas of moderate and steep slope

- Qal** Alluvium (Holocene): Sand, minor pebble to cobble gravel, silt, and wetland deposits in the floodplains of modern streams and drainages. Many small deposits in narrow valleys were not mapped. Up to 3 meters thick
- Qt** Quaternary talus: Angular boulder, cobble and pebble-sized blocks that form coalescing aprons at the base of steep cliffs
- Ql** Landslide deposit (Pleistocene?): Sediments of Ts deformed by mass movement. Recognized by hummocky surface and bounded by pronounced head scarp. Preservation of hummocks suggests late Quaternary age

Tertiary-Eocene

- Tr** Tertiary Rhyolite Porphyry: light to medium pink, flow-banded lithic, vitric, crystal (sanadine, quartz) rhyolite tuff
- Ts** Tertiary sedimentary rocks: Poorly consolidated, light tan to reddish brown, thin bedded moderately well-sorted, very fine to medium grained lithic (rhyolite) arenite intercalated with reddish brown siltstone and clay. May contain minor pediment gravels near surface. Poorly exposed, primarily exposed in landslide scarps

Mesozoic

Cretaceous Intrusive Rocks

- Kap** Andesite porphyry: Dark-green to dark-gray, aphanitic to plagioclase-phyric; forms rubblely outcrops along ridges, preferentially intrudes fine grained units, forms small stocks and dikes
- Kgd** Intrusive rocks of the Boulder Batholith, undivided; Medium to coarse grained, equigranular to biotite, hornblende granodiorite to quartz monzonite

Cretaceous Sedimentary Rocks

- Kc** Colorado Group: Recessive, orange, brown and red thinly bedded, thin laminated fine-grained sandstone, siltstone and shale.
- Kk** Kootenai Formation: Light-gray to brown, medium-bedded, moderately sorted, chert-lithic arenite; commonly displays large low-angle cross-stratification (150-350 ft (~50-100 m), 100m

Jurassic Sedimentary Rocks

- Jem** Morrison Formation and Ellis Group, undivided; recessive succession characterized by a lower portion of thin-bedded, calcite-cemented, lithic arenite, sandy siltstone, siltstone, and shale yielding orange, red, tan, and dark-gray, sandy siltstone regolith and an upper portion of thin to medium-bedded, locally contains up to 7 cm long lemnites, orange to red quartz arenite, thin-bedded siltstone, shale, and sandy micrite (125-225 ft (~40-70 m), 120m

Paleozoic

Permian sedimentary rocks

- Pp** Phosphoria: Dk-lt gray, semi resistant chert rich, oolitic in part, thinly bedded phosphatic wackestone

Pennsylvanian sedimentary rocks

- Pq** Quadrant Formation: Cliff-forming unit of buff-yellow and pink, medium-thick bedded, silica-cemented, cross-stratified, quartz arenite. Locally contains chert nodules and thin calcareous silt laminations. Contains basal unit of dolomitic, cross-stratified quartz arenite to sandy dolomite. (150-350 ft (~50-100 m), 120m
- Pa** Amsden Formation: Recessive unit of light-gray to tan, thinly laminated, thin-bedded quartz arenite, siltstone, shale, and silty micrite that produces distinctive reddish-brown regolith (100-165 ft (~30-50m), 50m

Mississippian sedimentary rocks

- Madison Group:
- Mmc** Mission Canyon Formation: Thick to massively bedded, medium- to dark-gray, fossiliferous (rugose corals, sponges, and bioclastic hash) wackestone, packstone and locally rudstone. Displays characteristic scalloped surface and locally abundant thin, dark-gray chert nodules, local medium-thick bedded trough cross bedded crinoids. Coarsely crystalline in part. Massive character commonly makes determination of bedding orientation difficult. (575-825 ft (~175-250 m), 425m
  - Mlp** Lodgepole Formation: Characteristically very well bedded, thin- to medium-bedded micrite to packstone with tan silty interbeds. Displays abundant sedimentary structures including scour marks, graded bedding, parallel laminations, cross lamination, and ripple marks. Forms blocky outcrops. Becomes thicker bedded and increasingly fossiliferous (crinoids, brachiopods, rugose corals, bioclastic hash) toward gradational contact with overlying strata (500-650 ft (~150-200 m), 200m

Mississippian-Devonian sedimentary rocks

- Dtf** Three Forks Formation: Recessive unit of gray to green, thin-bedded, calcareous, micaceous shale, siltstone, silty micrite, and lesser fine-grained quartz arenite. Subdivided into three members consisting of a middle resistant, platy, thinly laminated siltstone, silty micrite and fine-grained sandstone overlain and underlain by recessive siltstone and shale units. Characterized by reddish-orange to green, platy regolith (165-250 ft (~50-75 m), 200m
- Dj** Jefferson Formation: Dark-gray to blue-gray, medium- to thick-bedded, locally massive, intercalated dolomite (duotone) and subordinate limestone. Consists of a resistant basal medium-bedded, dark-gray, fossiliferous (crinoids, brachiopods, corals) sandy dolomitic wackestone with strong fetid odor overlain by a recessive black, calcareous shale. Upper section is a cliff-forming, slightly fetid, locally fossiliferous sandy dolomitic wackestone with thin sandstone laminations. Unit is distinctly sucrosic and weathers to a light-gray scalloped surface (500-650 ft (~150-200 m), 550m

Cambrian sedimentary rocks

- Cdc** Dry Creek Formation: Orange, red, brown, and yellow, thin-bedded, thinly laminated siltstone and shale with subordinate very fine grained quartz arenite. Contains abundant parallel laminae, cross-laminae, and climbing ripple laminae. Weathers recessively and forms valleys and saddles characterized by reddish, platy regolith (60-150 ft (20-50 m) 200m.
- Cpi** Pilgrim Formation: Lower portion characterized by a grey to light grey thin convolute bedded, mottled micrite interbedded with orange weathering fine grained quartz arenite. Grades into a dark grey, med-thin bedded, bioturbated dolo-wackestone overlain by a resistant, fetid, heavily bioturbated with calcite vugs, dolomitic wackestone (~500 ft (~150m), 340m
- Cp** Park Formation: Recessive unit of green-grey, thinly laminated, locally calcareous micaceous shale that produces distinct green regolith (~150-165 ft. (50m), 70m
- Cm** Meagher Formation: Medium grey, fossiliferous wackestone to micrite containing very thin wavy sandy interbeds which grades into a thinly bedded, light tan to dark grey, locally mottled, sandy micrite to packstone. Upper portion is light grey to grey, thin-medium bedded, locally cross-stratified oolitic packstone (120-140 ft (~40m), 340m
- Cw** Welsey Formation: Recessive unit of tan, parallel laminated, thinly bedded micaceous sandy shale/siltstone to very fine quartz arenite. Characterized by tan micaceous regolith (200-220 ft (~65m), 200m
- Cf** Flathead Formation: Poorly exposed, only visible in float, light tan to pink, moderately sorted, medium to thick bedded, parallel and cross-stratified, silicified cemented subfeldspathic arenite to quartz pebble conglomerate that fines upward into thin to medium bedded, trough to planar cross-stratified quartz arenite (50-100 ft (~15-30m), 100m

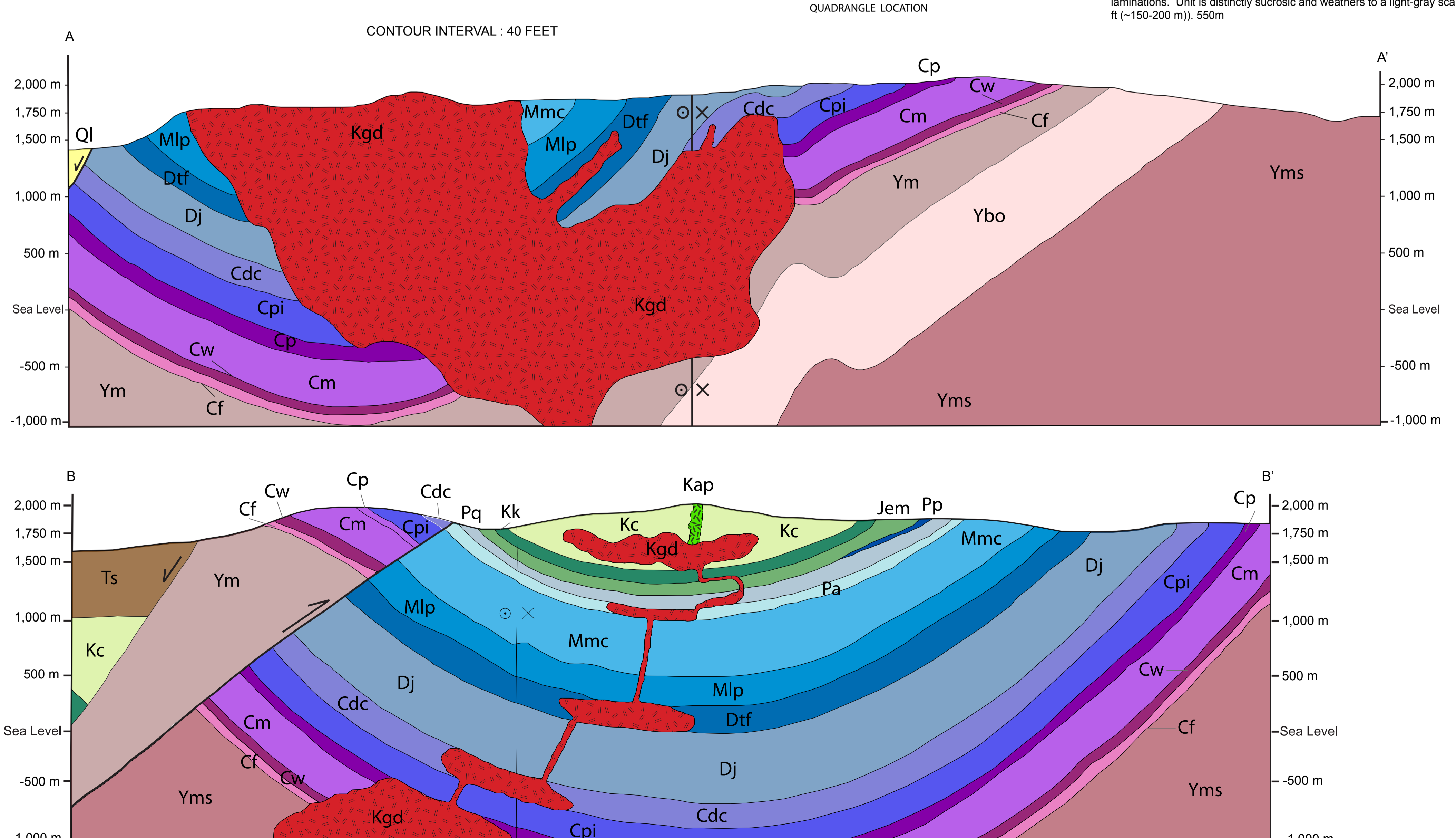
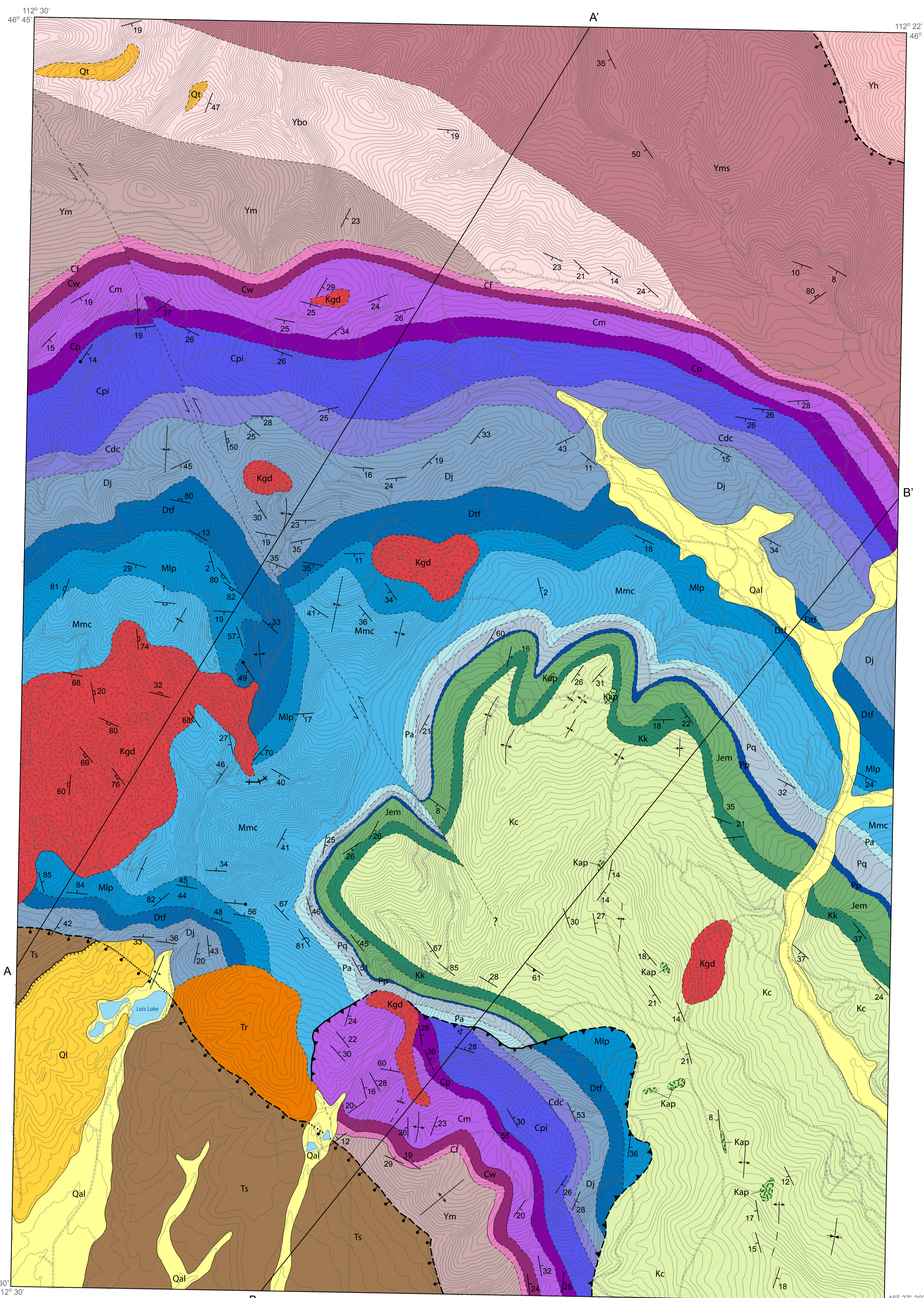
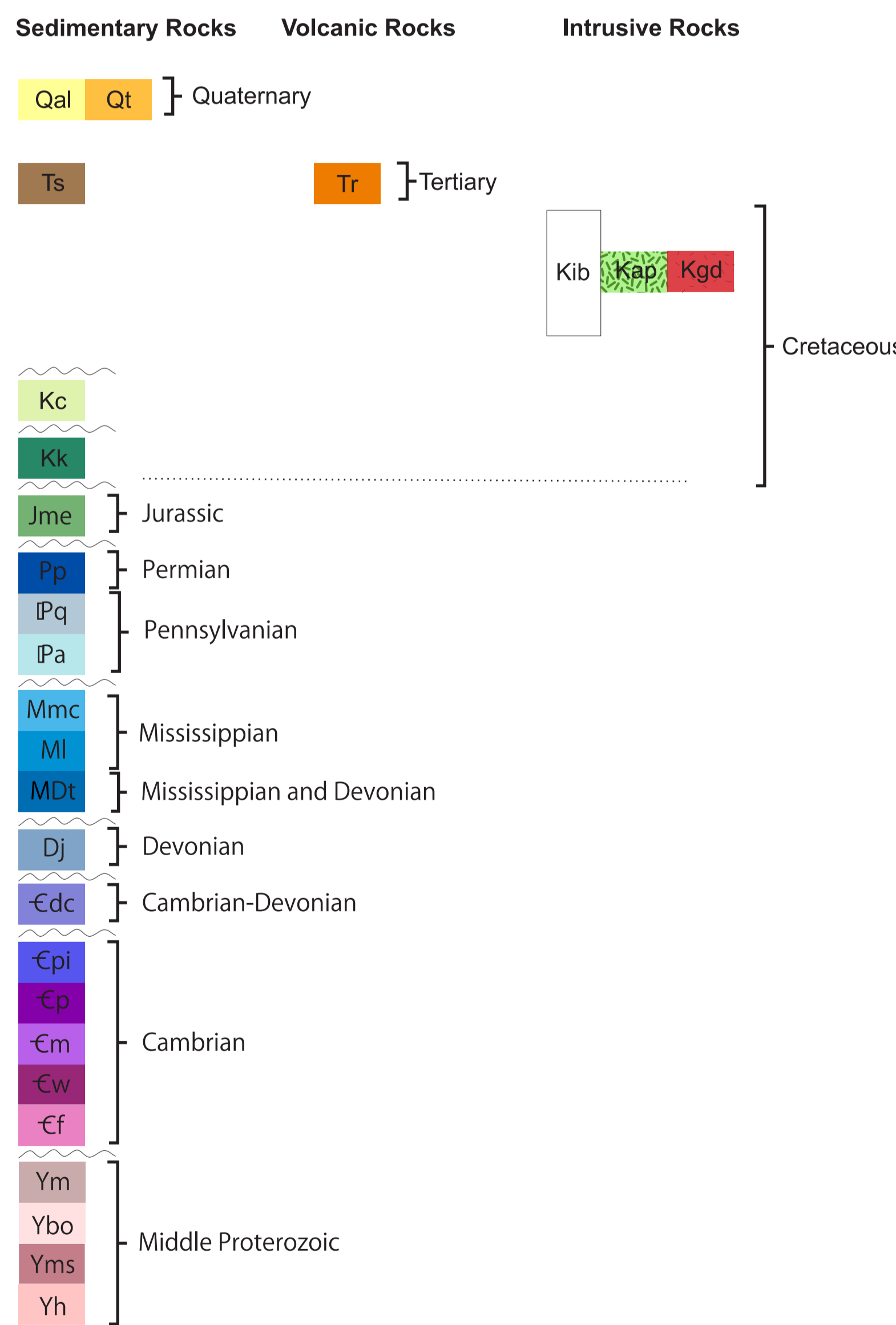
Proterozoic sedimentary rocks

- Middle Proterozoic Belt Supergroup:
- Characterized by red, green, and tan, thin bedded siltstone and shale interbedded with tan, fine to medium grained, thin to medium bedded, quartz arenite to micaceous subfeldspathic arenite and green-grey, fine grained calcareous arenite (>5000' ft (>1500' m), 1500m)
- Ym** McNamara Formation: Medium-brick red, very recessive, thinly bedded, contains low angle cross stratification, climbing ripple cross stratification, abundant rip up clasts, medium grained, moderately to well sorted, interbedded with red argillaceous shale, arkosic arenite
  - Ybo** Bonner Formation: Distinctly cliff forming, med pinkish-red to whitish tan, thickly bedded, locally contains red mud rip-ups, med-coarse grained, with arkos and quartz pebbles, moderately to poorly sorted, subangular-angular, trough cross stratified, feldspathic arenite
  - Yms** Mount Shields Formation: Med-red to lt-tan, parallel and trough cross laminated, fine-med grained, thin-med bedded subfeldspathic arenite with interbedded red argillite
  - Yh** Helena Formation: Lt-med blue, microlaminated, recessive, locally contains ripple marks and mud rip-ups, interbedded siltstone and dolomitic

MAP SYMBOLS

- |  |                     |  |                          |
|--|---------------------|--|--------------------------|
|  | Bedding, inclined   |  | Contacts                 |
|  | Bedding up          |  | Known                    |
|  | Bedding overturned  |  | Approximate              |
|  | Foliation; cleavage |  | Covered                  |
|  | Joint               |  | Known Thrust Fault       |
|  | Breccia             |  | Approximate Thrust Fault |
|  | Dike                |  | Approximate Normal Fault |
|  | Road                |  | Covered Normal Fault     |
|  | Lake                |  | Landslide Head Scarp     |
|  |                     |  | Anticline                |
|  |                     |  | Syncline                 |

CORRELATION OF MAP UNITS



Montana Bureau of Mines and Geology  
EDMAP 8  
**Geologic Map of the Esmeralda Hill 7.5' Quadrangle, Lewis and Clark County and Powell County, Montana**  
Balgord, E.A., Mahoney, J.B., Potter, J.J., Pignotta, G.S., Wittkop, C., King, N.E., Ihinger, P.D., Harde, B.G., and Kadulski, B.  
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2010

