

U.S. Department of the Interior
National Park Service
Natural Resource Stewardship and Science Directorate
Geologic Resources Division



Grant-Kohrs Ranch National Historic Site

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Grant-Kohrs Ranch National Historic Site

grko_geology.pdf

Version: 7/23/2013

Geologic Resources Inventory Map Document for Grant-Kohrs Ranch National Historic Site

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Geologic Resources Inventory Map Document



Grant-Kohrs Ranch National Historic Site, Montana

Document to Accompany Digital Geologic-GIS Data

[grko_geology.pdf](#)

Version: 7/23/2013

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Grant-Kohrs Ranch National Historic Site, Montana (GRKO).

Attempts have been made to reproduce all aspects of the original source products, including the geologic units and their descriptions, geologic cross sections, the geologic report, references and all other pertinent images and information contained in the original publication.

National Park Service (NPS) Geologic Resources Inventory (GRI) Program staff have assembled the digital geologic-GIS data that accompanies this document.

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About the NPS Geologic Resources Inventory Program

Background

Recognizing the interrelationships between the physical (geology, air, and water) and biological (plants and animals) components of the Earth is vital to understanding, managing, and protecting natural resources. The Geologic Resources Inventory (GRI) helps make this connection by providing information on the role of geology and geologic resource management in parks.

Geologic resources for management consideration include both the processes that act upon the Earth and the features formed as a result of these processes. Geologic processes include: erosion and sedimentation; seismic, volcanic, and geothermal activity; glaciation, rockfalls, landslides, and shoreline change. Geologic features include mountains, canyons, natural arches and bridges, minerals, rocks, fossils, cave and karst systems, beaches, dunes, glaciers, volcanoes, and faults.

The Geologic Resources Inventory aims to raise awareness of geology and the role it plays in the environment, and to provide natural resource managers and staff, park planners, interpreters, researchers, and other NPS personnel with information that can help them make informed management decisions.

The GRI team, working closely with the Colorado State University (CSU) Department of Geosciences and a variety of other partners, provides more than 270 parks with a geologic scoping meeting, digital geologic-GIS map data, and a park-specific geologic report.

Products

Scoping Meetings: These park-specific meetings bring together local geologic experts and park staff to inventory and review available geologic data and discuss geologic resource management issues. A summary document is prepared for each meeting that identifies a plan to provide digital map data for the park.

Digital Geologic Maps: Digital geologic maps reproduce all aspects of traditional paper maps, including notes, legend, and cross sections. Bedrock, surficial, and special purpose maps such as coastal or geologic hazard maps may be used by the GRI to create digital Geographic Information Systems (GIS) data and meet park needs. These digital GIS data allow geologic information to be easily viewed and analyzed in conjunction with a wide range of other resource management information data.

For detailed information regarding GIS parameters such as data attribute field definitions, attribute field codes, value definitions, and rules that govern relationships found in the data, refer to the NPS Geology-GIS Data Model document available at: <http://science.nature.nps.gov/im/inventory/geology/GeologyGISDataModel.cfm>

Geologic Reports: Park-specific geologic reports identify geologic resource management issues as well as features and processes that are important to park ecosystems. In addition, these reports present a brief geologic history of the park and address specific properties of geologic units present in the park.

For a complete listing of Geologic Resource Inventory products and direct links to the download site visit the GRI publications webpage http://www.nature.nps.gov/geology/inventory/gre_publications.cfm

GRI geologic-GIS data is also available online at the NPS Data Store Search Application: <http://irma.nps.gov/App/Reference/Search>. To find GRI data for a specific park or parks select the appropriate park

(s), enter "GRI" as a Search Text term, and then select the Search Button.

For more information about the Geologic Resources Inventory Program visit the GRI webpage: <http://www.nature.nps.gov/geology/inventory>, or contact:

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The Geologic Resources Inventory (GRI) program is funded by the National Park Service (NPS) Inventory and Monitoring (I&M) Division.

GRI Digital Maps and Source Map Citation

The GRI digital geologic-GIS map for Grant-Kohrs Ranch National Historic Site, Montana (GRKO):

GRI Digital Geologic Map of Grant-Kohrs Ranch National Historic Site and Vicinity, Montana (GRI MapCode GRKO)

Montana Bureau of Mines and Geology source map.

Berg, Richard B., 2004, Geologic Map of the Deer Lodge and Conleys Lake 7 ½' Quadrangles, Powell County, Southwestern Montana, Montana Bureau of Mines and Geology, Open File Report 509, 1:24,000 scale. ([Open File Report 509](#)). (GRI Source Map ID 4950)

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Grant-Kohrs Ranch National Historic Site, Montana (GRKO) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qal - Alluvium). Units are listed from youngest to oldest. Information about each geologic unit is also presented in the Geologic Unit Information (UNIT) table included with the GRI geology-GIS data.

Cenozoic Era

Quaternary Period

[sg](#) - Sand and gravel (pit)
[Qal](#) - Alluvium
[Qat](#) - Alluvial terrace deposit
[Qat1](#) - Alluvial terrace deposit, youngest
[Qat2](#) - Alluvial terrace deposit, second youngest
[Qat3](#) - Alluvial terrace deposit, third youngest
[Qac](#) - Alluvium and colluvium
[Qls](#) - Landslide deposit
[Qaf](#) - Alluvial fan deposit
[Qat4](#) - Alluvial terrace deposit, fourth youngest
[Qat5](#) - Alluvial terrace deposit, fifth youngest
[Qgo](#) - Glacial outwash deposit
[Qgt](#) - Glacial till
[Qgto](#) - Glacial till older
[Qpg](#) - Pediment gravel deposit
[Qgob](#) - Glacial outwash of Bull Lake Glaciation
[Qgtb](#) - Glacial till of Bull Lake Glaciation

Tertiary Period

[Ts](#) - Sedimentary rocks, undivided
[Tsa](#) - Ash bed
[Tmii](#) - Mafic to intermediate intrusive bodies
[Trt](#) - Rhyolite tuff, tuffaceous sediments, and fossiliferous limestone

Mesozoic Era

Cretaceous Period

[Kgs](#) - Golden Spike Formation (sedimentary beds)
[KgsI](#) - Lava flow unit (informal) of the Golden Spike Formation
[Kba](#) - Basalt flows and flow breccias
[Kbpx](#) - Basalt flows and flow breccias, large-pyroxene basalt
[Kbpl](#) - Basalt flows and flow breccias, plagioclase basalt
[Kem](#) - Elkhorn Mountain Volcanics
[Kemt](#) - Welded ash-flow tuff
[Kemf](#) - Andesitic lava flows, fine-grained
[Kemtbb](#) - Tuff and tuff breccia
[Kemfb](#) - Andesite flows, flow breccia and tuff breccia
[Kcc](#) - Carter Creek Formation
[Kk](#) - Kootenai Formation

Jurassic Period

[Jsw](#) - Swift Formation

Mesozoic and Paleozoic Eras

[MPzs](#) - Mesozoic and Paleozoic sedimentary beds

Precambrian

Proterozoic Eon

[Ybe](#) - Belt Supergroup undivided

Map Unit Descriptions

Descriptions of all geologic map units, generally listed from youngest to oldest, are presented below.

sg - Sand and gravel (pit) (Holocene)

Sand and gravel. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qal - Alluvium (Holocene)

Gravel, sand, silt, and clay, along active channels of rivers, creeks, and intermittent streams. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat - Alluvial terrace deposit (Holocene)

Used only in [cross section](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat1 - Alluvial terrace deposit, youngest (Holocene)

Deposits on irregularly shaped, unpaired terraces 3-6 ft above the modern floodplain that consist of 3-6 ft of well -to poorly- sorted rock clasts derived from Tertiary and older strata ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat2 - Alluvial terrace deposit, second youngest (Holocene)

Deposits on irregularly shaped, unpaired terraces 6-16 ft above the modern floodplain that consist of 3-6 ft of poorly- sorted clasts similar to those in youngest alluvial terrace deposits ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat3 - Alluvial terrace deposit, third youngest (Holocene)

Deposits on irregularly shaped unpaired terraces 20-30 ft above the modern floodplain that consist of 3-6 ft of poorly- sorted clasts similar to those in the younger alluvial terrace deposits ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qac - Alluvium and colluvium (Holocene and Pleistocene)

Colluvium and alluvium are combined where it is not practical to distinguish between them. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qls - Landslide deposit (Holocene and Pleistocene)

Occur on some of the steeper slopes developed on the poorly consolidated Tertiary sedimentary rocks. Unconsolidated mixture of fine-grained sedimentary rock and soil characterized by hummocky topography. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qaf - Alluvial fan deposit (Holocene and Pleistocene)

With the exception of the large alluvial fan along Taylor and La Marche creeks on the west side of the Deer Lodge Valley, alluvial fans are small deposits of gravel, sand, silt, and clay formed where tributaries enter the Clark Fork River flood plain and along some of the major streams. Alluvial fans are well developed on the east side of the Clark Fork River flood plain, but not along the west side of this river. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat4 - Alluvial terrace deposit, fourth youngest (Holocene and Pleistocene)

Preserved on paired terraces above the modern drainages and are moderately- to well- stratified, and moderately to well sorted ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qat5 - Alluvial terrace deposit, fifth youngest (Holocene and Pleistocene)

Occur mainly on paired terraces and are more highly stratified and better sorted than glacial outwash deposits. Also contain more fine-grained material than glacial outwash deposits (Derkey and others, 2004). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qgo - Glacial outwash deposit (Holocene and Pleistocene)

Poorly sorted deposits of well-rounded material that ranges in size from boulder to sand. There are extensive outwash deposits on both the east and west sides of the Deer Lodge Valley. Outwash deposits on the east side of the valley consist mainly of basalt and porphyritic volcanic rock boulders, cobbles, and pebbles. On the west side of the valley outwash deposits consist of 80-95 percent granite clasts with the remainder quartzite. On the west side of the Deer Lodge Valley the percent of quartzite increases with distance from the mountain front. Near the Clark Fork River outwash contains an estimated 50 percent quartzite and 50 percent granite. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qgt - Glacial till (Holocene and Pleistocene)

Glacial till forms prominent deposits at the mouth of Racetrack Creek, Tin Cup Joe Creek, and also along Rock Creek. Till deposits consist almost entirely of granitic material that ranges in size from pebble to boulder. Granite boulders in these deposits do not show evidence of weathering. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qgto - Glacial till older (Holocene and Pleistocene)

Scattered granite boulders on the slopes along the front of the Flint Creek Range between Robinson and La Marche creeks are interpreted to be remnants of older glacial till. Similar deposits are found on both sides of Mullan Gulch just north of this area. [Mutch \(1961\)](#) mapped larger areas of older glacial till in the mountains west of the Conleys Lake 7 ½' quadrangle. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qpg - Pediment gravel deposit (Holocene and Pleistocene)

Poorly sorted and poorly stratified gravels that range in thickness from 1-20 ft. Subrounded cobbles and pebbles in a sandy matrix with local development of caliche. Pediment gravels on the east side of the Deer Lodge Valley consist mainly of basalt and porphyritic volcanic rock fragments with rare granite and quartzite. Pediment gravels on the west side of the Deer Lodge Valley, where examined on the surface, consist of an estimated 90 percent metasedimentary rocks derived from the [Belt Supergroup](#) (mainly

quartzite) with the remainder granite. In those rare instances where a complete section of the pediment gravel is exposed, crumbly, strongly weathered granite cobbles and boulders are present in the lower part of the gravel deposit. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qgob - Glacial outwash of Bull Lake Glaciation (Holocene and Pleistocene)

Poorly exposed, poorly stratified, unconsolidated, poorly sorted, generally reddish-brown deposits containing subangular to rounded cobble- to boulder-size clasts in a clayey to silty sand matrix ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Qgtb - Glacial till of Bull Lake Glaciation (Holocene and Pleistocene)

Poorly exposed, nonstratified, unconsolidated, poorly sorted, generally reddish-brown deposits containing subangular to rounded cobble-to boulder-size, matrix-supported clasts in a clayey to silty sand matrix. Clasts are primarily derived from volcanic rocks and most clasts are deeply weathered ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Ts - Sedimentary rocks, undivided (Eocene to Pliocene)

Predominately massive sandy to silty mudstone with blocky fracture and grayish orange (10YR 7/4) to very pale orange (10 YR 8/2) color. Biotite flakes recognizable in most exposures, muscovite less common, and glass shards recognizable in some beds. Sand, granule, and pebble conglomerate beds up to 6 ft thick, containing granite and quartzite clasts, are generally poorly sorted. Several bentonite beds can be recognized by typical crumbly weathering of bentonitic clay.

Light gray (N 9) [ash beds](#) are exposed at several localities and easily recognizable because these beds appear white in contrast to the grayish orange color of underlying and overlying beds. At some localities the ash beds are relatively erosion resistant and form small ledges. Thickness ranges from 3 to 6 ft. One ash bed is traceable for 2 miles from the SE $\frac{1}{4}$ sec. 34, T.7 N., R. 10 W., to the NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 7 N., R. 10 W., a short distance north of Tin Cup Joe Creek on the Conleys Lake 7 $\frac{1}{2}$ ' quadrangle. Another ash bed is exposed over part of the distance and is 18 ft above the lower bed. Ash from this and other exposures of what may be the same bed has an index of refraction of approximately 1.498 and consist of shards in the medium sand size range and sparse diatoms.

Tertiary sedimentary beds overlie the Eocene Lowland Creek Volcanics in the subsurface in the Deer Lodge Valley ([McLeod, 1987](#)). These Tertiary beds are considered to range in age from Eocene to Pliocene ([Rasmussen and Prothero, 2003](#); [Konizeski and others, 1961](#)). Generally poor exposures in this valley have hampered detailed study of Tertiary sedimentary beds. However on the basis of a detailed paleontological study ([Rasmussen, 1977](#)) the Arikareean Cabbage Patch Beds in the northern part of the Deer Lodge Basin were correlated with a similar beds in the Flint Creek Basin, in the vicinity of Drummond, in the Blackfoot Basin, the Divide Basin, and the Three Forks area. Cabbage Patch Beds are exposed between Mullan Gulch and Dry Gulch in the northern part of the Conleys Lake 7 $\frac{1}{2}$ ' quadrangle. Because of similar lithology and abundance of volcanic ash, the Cabbage Patch Beds are interpreted to continue south of the Conleys Lake 7 $\frac{1}{2}$ ' quadrangle. *GRI Source Map ID 4950* ([Open File Report 509](#)).

Tsa - Ash bed (Eocene to Pliocene)

Light gray (N 9) ash beds are exposed at several localities and easily recognizable because these beds appear white in contrast to the grayish orange color of underlying and overlying beds. At some localities the ash beds are relatively erosion resistant and form small ledges. Thickness ranges from 3 to 6 ft. One

ash bed is traceable for 2 miles from the SE $\frac{1}{4}$ sec. 34, T.7 N., R. 10 W., to the NE $\frac{1}{4}$ NE $\frac{1}{4}$ sec. 1, T. 7 N., R. 10 W., a short distance north of Tin Cup Joe Creek on the Conleys Lake 7 $\frac{1}{2}$ ' quadrangle. Another ash bed is exposed over part of the distance and is 18 ft above the lower bed. Ash from this and other exposures of what may be the same bed has an index of refraction of approximately 1.498 and consist of shards in the medium sand size range and sparse diatoms. (Within [Ts – Sedimentary rocks, undivided](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Tmii - Mafic to intermediate intrusive bodies (Eocene to Pliocene)

Dark-gray alkali dikes intrude the [Carter Creek Formation](#) in the northwestern part of the Deer Lodge 7 $\frac{1}{2}$ ' quadrangle ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Trt - Rhyolite tuff, tuffaceous sediments, and fossiliferous limestone (Eocene to Pliocene)

White to buff, tuffaceous rocks with sparse coarser-grained, well-indurated tuff-breccia lenses containing darker volcanic fragments. Fossiliferous limestone interbedded with siliceous tuff crops out near the northwestern corner of the Deer Lodge 7 $\frac{1}{2}$ ' quadrangle ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kgs - Golden Spike Formation (sedimentary beds) (Upper Cretaceous)

Lava flows of andesitic composition with intervening sandstone, conglomerate, and volcanoclastic beds with minor limestone and rare black shale. The non-volcanic sandstone consists mainly of quartz, lithic fragments, biotite, and muscovite whereas the volcanoclastic beds consist mainly of plagioclase feldspar, volcanic glass, and volcanic rock fragments in a fine-grained matrix (Mackie, 1986). Lava flows from prominent outcrop, and the sandstone beds are generally very poorly exposed. Brownish gray (5YR 4/1) limestone occurs in float and rare outcrops above a lava flow in secs. 35 and 36, T. N., R. 10 W., and also on the north side of Cottonwood draw in the SE $\frac{1}{4}$, NE $\frac{1}{4}$ sec. 12, T. 8 N., R. 10 W., where a pisolitic limestone bed about 4 ft thick overlies an andesite flow. Just below this limestone bed the andesite shows evidence of weathering- local bleaching accompanied with the development of hematite. There is a small exposure of black shale northwest of the power line road in the NW $\frac{1}{4}$ SW $\frac{1}{4}$ sec. 36, T. 9 N., R. 10 W. See also: [KgsI](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

KgsI - Lava flow unit (informal) of the Golden Spike Formation (Cretaceous)

Andesite flows are intermittently exposed in the low hills near the northern boundary of the Conleys Lake 7 $\frac{1}{2}$ ' quadrangle. Plagioclase phenocrysts (most from 3 mm to 1 cm) range from sparse to abundant and at some localities define flow foliation. Smaller pyroxene phenocrysts are less prominent. Flow banding, prominent in some exposures particularly those just north of Mullan Gulch, is highly variable in attitude. Several individual flows can be recognized in some of the larger exposures where tops of flows are marked by flow breccias. See also: [Kgs](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kba - Basalt flows and flow breccias (Cretaceous)

Because of poor exposure, basalt was mapped as a single lithologic, but probably not stratigraphic, unit in the Deer Lodge 7 $\frac{1}{2}$ ' quadrangle, but subdivided to the south ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

** "subdivided" unit descriptions exist, see KbpX and Kbpl.

Kbpx - Basalt flows and flow breccias, large-pyroxene basalt (Cretaceous)

Dark green porphyritic basalt contains augite phenocrysts as large as 1 cm. The dark-green matrix has a distinct hackly fracture (Derkey and others, 2004). *GRI Source Map ID 4950* ([Open File Report 509](#)).

** Subdivision of the Kba unit into Kbpx and Kbpl units (mentioned in the Kba unit description as "subdivided to the south ([Derkey and others, 2004](#))") isn't reflected on the source map or in the GRI digital geologic-GIS data, yet unit descriptions were present for both units on the source map.

Kbpl - Basalt flows and flow breccias, plagioclase basalt (Cretaceous)

Dark green porphyritic basalt contains augite phenocrysts as large as 1 cm. The dark-green matrix has a distinct hackly fracture (Derkey and others, 2004). *GRI Source Map ID 4950* ([Open File Report 509](#)).

** Subdivision of the Kba unit into Kbpx and Kbpl units (mentioned in the Kba unit description as "subdivided to the south ([Derkey and others, 2004](#))") isn't reflected on the source map or in the GRI digital geologic-GIS data, yet unit descriptions were present for both units on the source map.

Kem - Elkhorn Mountains Volcanics (Cretaceous)

Used only in [cross section](#). Includes units: [Kemt](#), [Kemf](#), [Kemtb](#), and [Kemfb](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kemt - Welded ash-flow tuff (Cretaceous)

Brown to red-brown to red-gray to dark-gray, crystal-poor (<5 percent), containing abundant lithic fragments of the underlying andesite units. Variable colors are due to intensity of degree of welding ([Derkey and others, 2004](#)). See also: [Kem](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kemf - Andesitic lava flows, fine-grained (Cretaceous)

Medium- to dark-brown and dark-green, fine-grained, nearly aphyric lava flows (Derkey and others, 2004). See also: [Kem](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kemtb - Tuff and tuff breccia (Cretaceous)

Dark-gray to green groundmass in a crystal lithic tuff that is easily distinguished by its 1- to 2-mm equidimensional, white plagioclase phenocrysts. Locally contains abundant lithic fragments up to 7 cm in diameter ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kemfb - Andesite flows, flow breccia and tuff breccia (Cretaceous)

Dark-gray to purplish-gray containing locally distributed white plagioclase phenocrysts that are typically flattened and irregular in shape and resemble rolled oats resulting in the field name "oatmeal andesite" (Derkey and others, 2004). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kcc - Carter Creek Formation (Cretaceous)

Local exposures in small fault slices within the northern part of the Deer Lodge 7 ½' quadrangle. Consist of coarse-grained, salt-and-pepper, cross-bedded sandstone, white to pale-green tuffaceous beds, and beds of fine-grained, gray to brownish-gray limestone lenses up to 20 inches thick containing no visible fossils. Thickness is more than 500 ft ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Kk - Kootenai Formation (Cretaceous)

Consists of four recognizable lithic units that from bottom to top are lower calcareous member, upper clastic member, gastropod limestone member, and upper quartzite ([Derkey and others, 2004, cited personal communication from A.B. French, 1989](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Jsw - Swift Formation (Jurassic)

Medium-to light-gray, tan and pink chert-clast-rich sandstone that contains scattered chert pebble conglomerate lenses and beds with pebbles as large as 3 cm in diameter. Contains secondary quartz veins that locally make up over 50 percent of the rock, particularly near faults ([Derkey and others, 2004](#)). *GRI Source Map ID 4950* ([Open File Report 509](#)).

MPzs - Mesozoic and Paleozoic sedimentary beds (Mesozoic and Paleozoic)

Shown only in [cross section](#). *GRI Source Map ID 4950* ([Open File Report 509](#)).

Ybe - Belt Supergroup undivided (Proterozoic)

Siltite, argillaceous quartzite, and quartzite are found in float along the range- front fault north of Robinson Gulch. These metasedimentary rocks are interpreted to belong to the Belt Supergroup. *GRI Source Map ID 4950* ([Open File Report 509](#)).

The geologic cross sections present in the GRI digital geologic-GIS data produced for Grant-Kohrs Ranch National Historic Site, Montana (GRKO) are presented below. Cross section graphics were scanned at a high resolution and can be viewed in more detail by zooming in (when viewing the digital format of this document).

B **B'**

Cross section B-B'

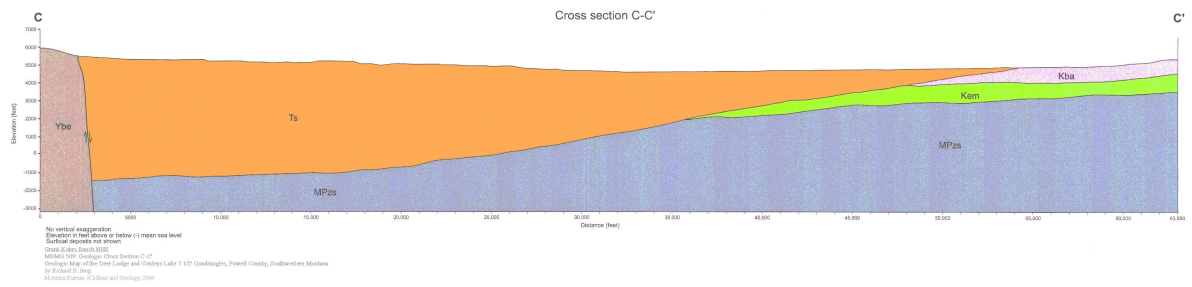
Elevation (feet)

Distance (feet)

10x vertical exaggeration
Elevation in feet above mean sea level

[Grant-Kohrs Ranch NHS](#)
MBMG 509: Cross Section B-B'
Geologic Map of the Deer Lodge and Conleys Make 7 1/2' Quadrangles, Powell County, Southwestern Montana
by Richard B. Berg
Montana Bureau of Mines and Geology, 2004

2013 NPS Geologic Resources Inventory Program

C-C'

GRI Source Map ID 4950 ([Open File Report 509](#)).

GRI Source Map Citation

The GRI digital geologic-GIS map for Grant-Kohrs Ranch National Historic Site, Montana (GRKO) was compiled from the following source:

Berg, Richard B., 2004, Geologic Map of the Deer Lodge and Conleys Lake 7 ½' Quadrangles, Powell County, Southwestern Montana. Montana Bureau of Mines and Geology Open File Report 509, 1:24,000 scale. ([Open File Report 509](#)). (*GRI Source Map ID 4950*)

Additional information pertaining to each source map is also presented in the Source Map Information (GRKOMAP) table included with the GRI geology-GIS data.

Open File Report 509

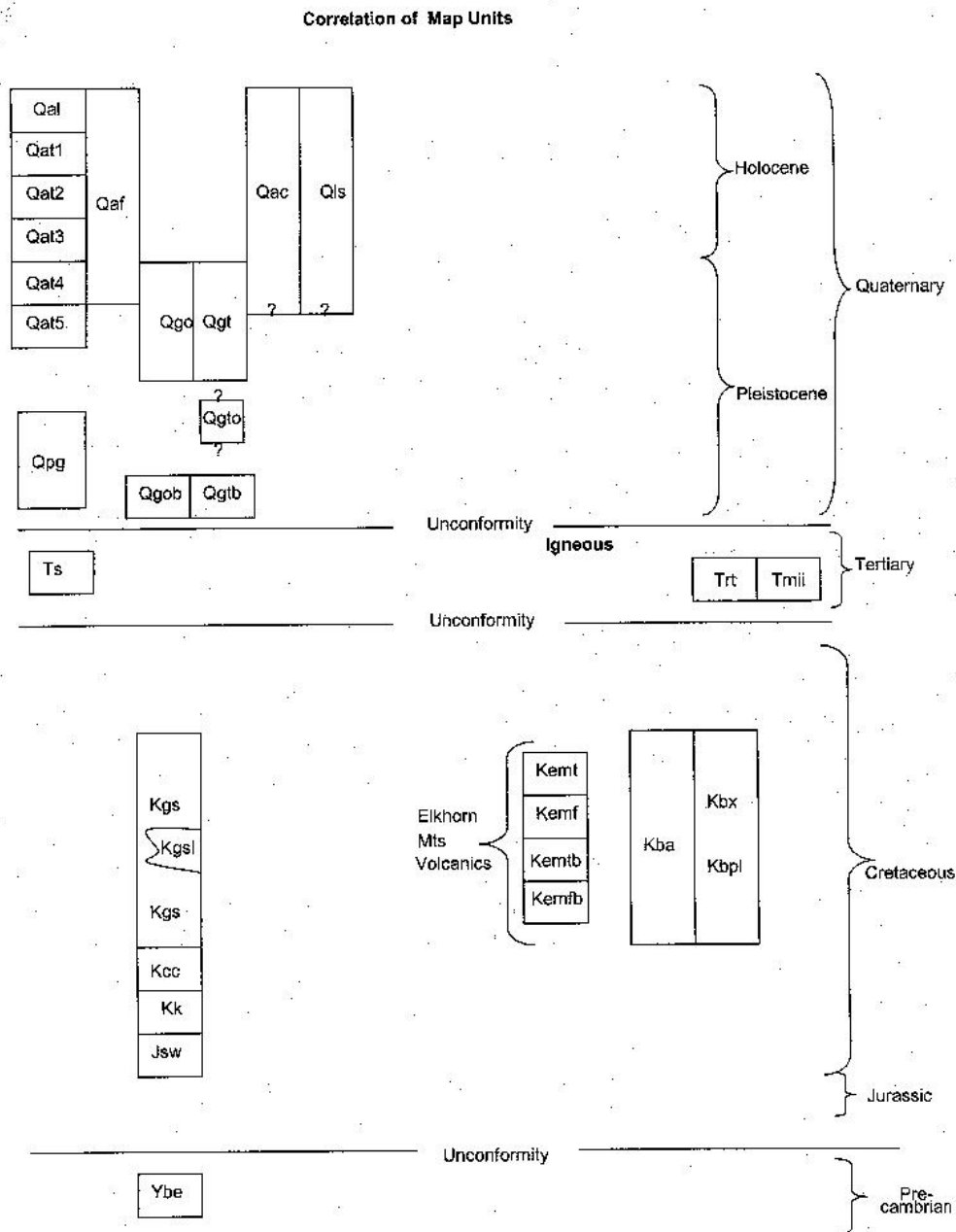
Geology

The broad Deer Lodge Valley is a half graben bounded on the west by range-front faults, but lacking major faults on the east side. With the exception of a small remnant of metasedimentary rocks of the Proterozoic [Belt Supergroup](#) on the west side of the Deer Lodge Valley, all rocks exposed in these two quadrangles are Mesozoic or Cenozoic. The [Swift Formation](#) (Jurassic age) and Cretaceous sedimentary formations are exposed in the northern part of the Deer Lodge quadrangle. The Cretaceous [Golden Spike Formation](#), exposed in the low hills in the northern part of the Conleys Lake quadrangle, consists of lava flows of andesitic composition interlayered with sandstone. On the east side of the Deer Lodge Valley a variety of volcanic rocks of the [Elkhorn Mountains Volcanics](#) and also other basaltic volcanics, all of Cretaceous age, are exposed over large areas.

A thick sequence of Tertiary sediments occupies the central part of the broad Deer Lodge Valley ([Location Map](#)). A well drilled about 7 miles south of the Grant Kohrs Ranch National Historic Site penetrated 10,052 ft of Tertiary sediments before encountering Eocene volcanic rocks. In spite of this great thickness of Tertiary sediments, Arikareean Cabbage Patch beds are thought to be the only beds exposed in this part of the Valley. Exposed Tertiary sediments consist of lake beds, fluvial deposits, and an ash bed traceable for 2 miles. Extensive pediments on both sides of the valley are covered with deposits of gravel derived from mountains flanking the Deer Lodge Valley. Deposits of glacial till are found in the northwestern part of the Conleys Lake quadrangle and also in the southeast corner of the Deer Lodge quadrangle. Large outwash deposits are prominent on both the east and west sides of the valley.

Extracted from: ([Open File Report 509](#)).

Correlation of Map Units



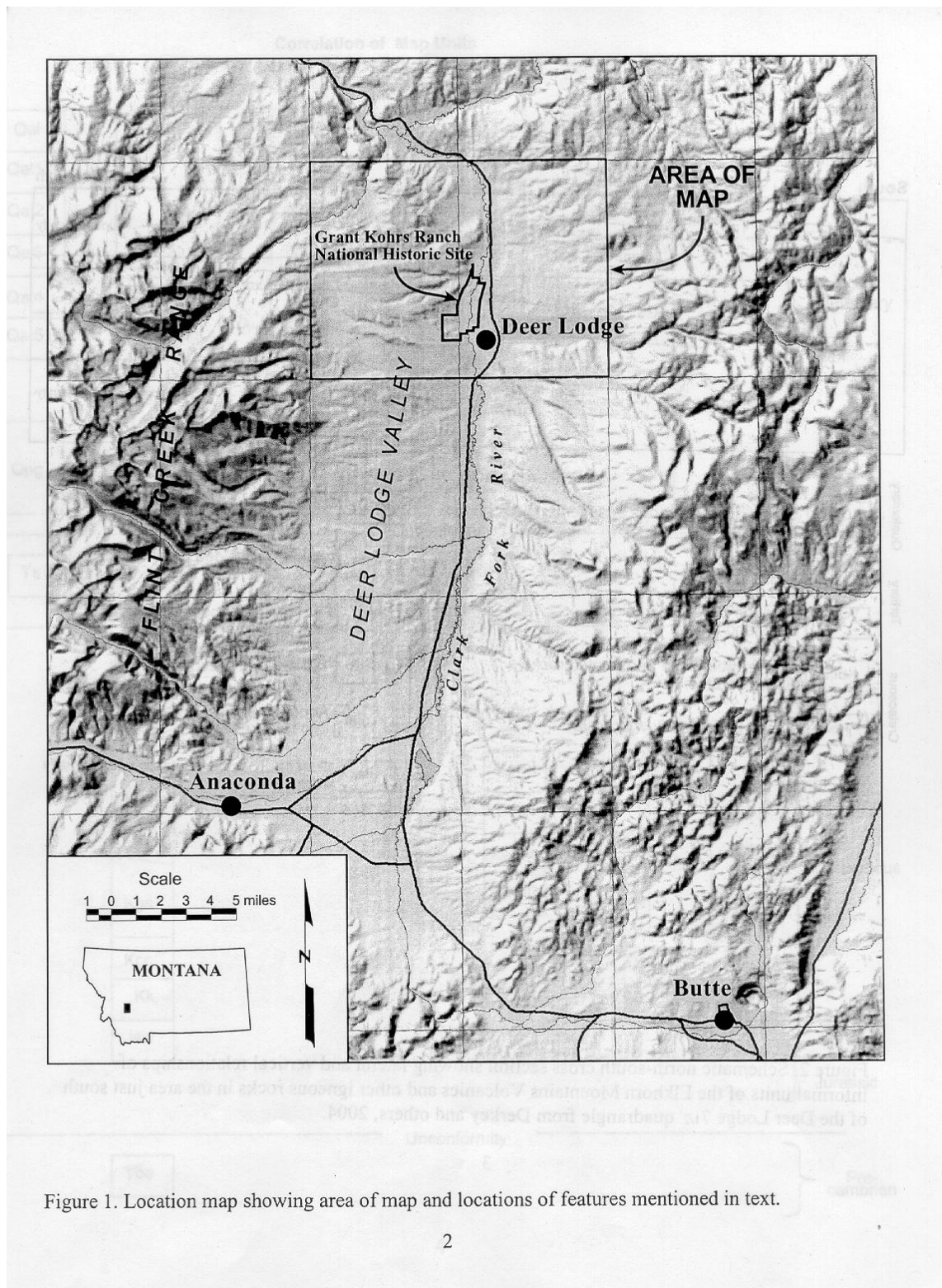
Extracted from: ([Open File Report 509](#)).

Index Map



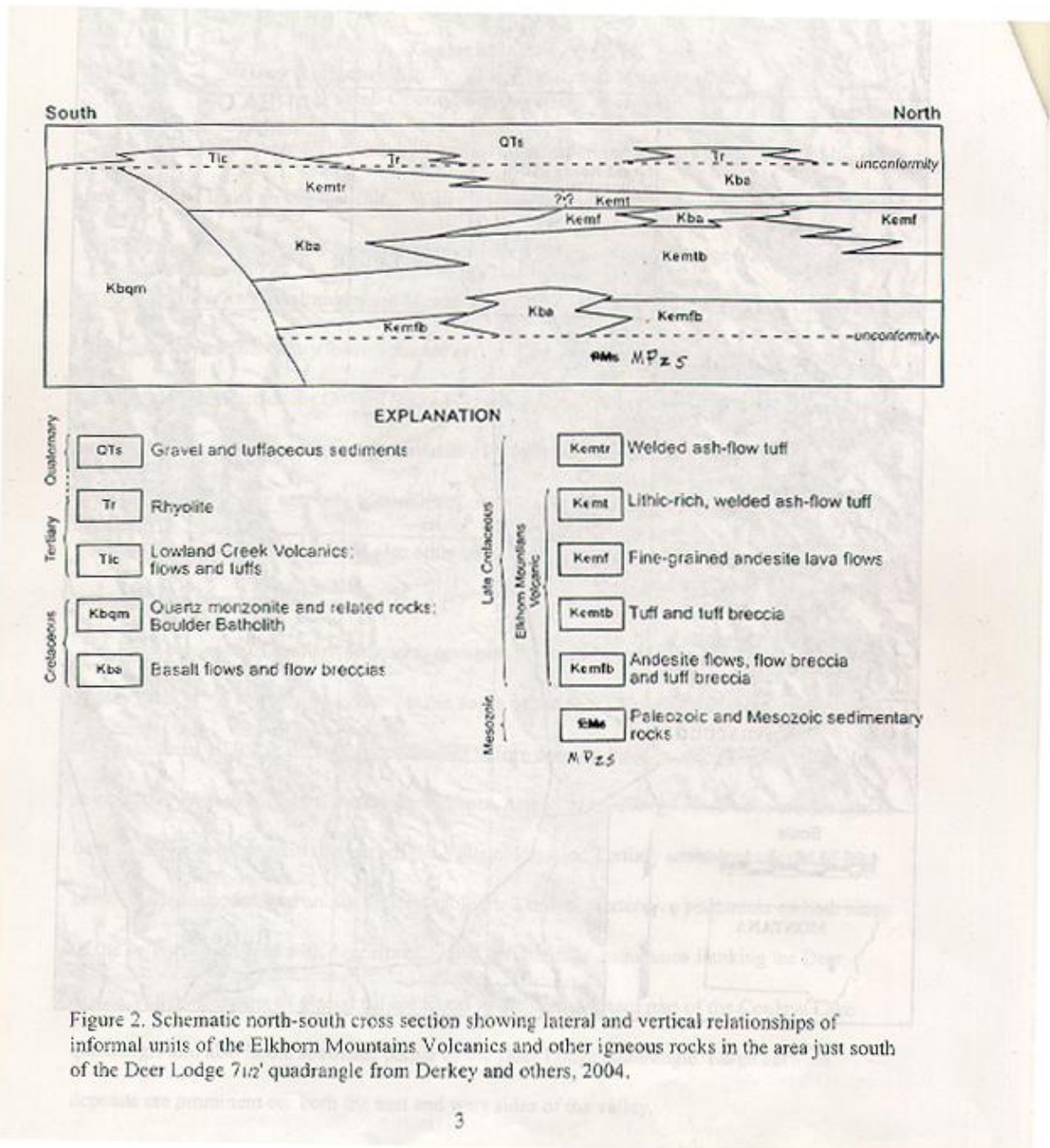
Extracted from: ([Open File Report 509](#)).

Location Map



Extracted from: ([Open File Report 509](#)).

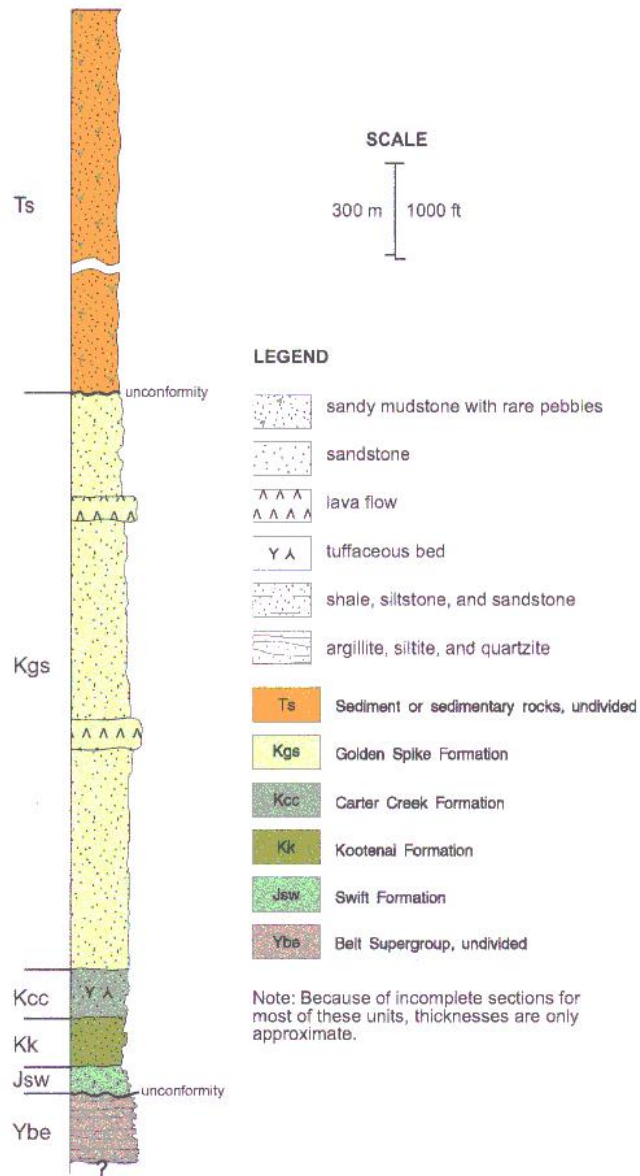
North-South Cross Section



Extracted from: ([Open File Report 509](#)).

Stratigraphic Column

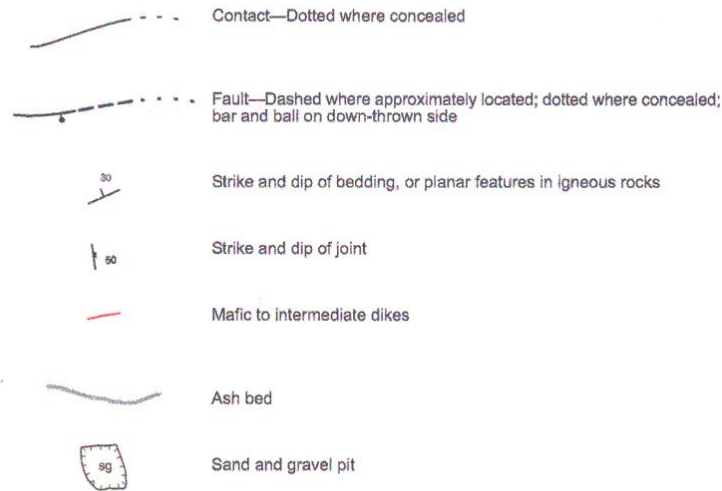
Stratigraphic Column for the Northern Deer Lodge Valley



Extracted from: ([Open File Report 509](#)).

Legend

MAP SYMBOLS



Extracted from: ([Open File Report 509](#)).

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This document was developed and completed by Derek Witt and Stephanie O'Meara (Colorado State University) using formatted text and graphic files produced from an earlier version of this document by Georgia Hybels and Anne Poole (NPS, GRD) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory (GRI) Program. Quality control of this document by Stephanie O'Meara (Colorado State University).

The information contained here was compiled to accompany the digital geologic-GIS map and other digital data for Grant-Kohrs Ranch National Historic Site, Montana (GRKO). This digital map was migrated to a file geodatabase format implementing the NPS GRI Geologic-GIS Data Model v. 2.1 by Derek Witt and Stephanie O'Meara using a previous GRI version of the digital map digitized and completed by Anne Poole and Georgia Hybels.

GRI finalization by Stephanie O'Meara (Colorado State University).

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