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

Bent's Old Fort National Historic Site

GRI Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory (GRI) Digital Geologic Data for Bent's Old Fort National Historic Site

beol_geology.pdf

Version: 1/7/2019

Geologic Resources Inventory Map Document for Bent's Old Fort National Historic Site

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Geologic Resources Inventory Map Document

Bent's Old Fort National Historic Site, Colorado

Document to Accompany Digital Geologic-GIS Data

beol_geology.pdf

Version: 1/7/2019

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Bent's Old Fort National Historic Site, Colorado (BEOL).

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.

This document contains the following information:

1) **About the NPS Geologic Resources Inventory Program** – A brief summary of the Geologic Resources Inventory (GRI) Program and its products. Included are web links to the GRI GIS data model, and to the GRI products page where digital geologic-GIS datasets, scoping reports and geology reports are available for download. In addition, web links to the NPS Data Store and GRI program home page, as well as contact information for the GRI coordinator, are also present.

2) **GRI Digital Maps and Source Map Citations** – A listing of all GRI digital geologic-GIS maps produced for this project along with sources used in their completion. In addition, a brief explanation of how each source map was used is provided.

3) **Map Unit List** – A listing of all geologic map units present on maps for this project, generally listed from youngest to oldest.

4) **Map Unit Descriptions** – Descriptions for all geologic map units. If a unit is present on multiple source maps the unit is listed with its source geologic unit symbol, unit name and unit age followed by the unit's description for each source map.

5) **Ancillary Source Map Information** – Additional source map information presented by source map. For each source map this may include a stratigraphic column, index map, map legend and/or map notes.

6) **GRI Digital Data Credits** – GRI digital geologic-GIS data and ancillary map information document production credits.

For information about using GRI digital geologic-GIS data contact:

Stephanie O'Meara
Geologist/GIS Specialist/Data Manager
Colorado State University Research Associate, Cooperator to the National Park Service
Fort Collins, CO 80523
phone: (970) 491-6655
e-mail: stephanie.omeara@colostate.edu

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://go.nps.gov/gri_products

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: https://www.nps.gov/subjects/geology/gri.htm, or contact:

Jason Kenworthy
Inventory Program Coordinator
National Park Service Geologic Resources Division
P.O. Box 25287
Denver, CO 80225-0287
phone: (303) 987-6923
fax: (303) 987-6792
email: Jason_Kenworthy@nps.gov

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 Citations

The GRI digital geologic-GIS maps for Bent's Old Fort National Historic Site, Colorado (BEOL). The source map used for each map is also indicated, as is how the source was used.

Digital Geologic-GIS Map of Bent's Old Fort National Historic Site and Vicinity, Colorado (*GRI MapCode BEOL*)

> Sharps, J.A., 1976, Geologic Map of the Lamar Quadrangle, Colorado and Kansas: U.S. Geological Survey, Miscellaneous Investigations Series Map I-944, scale 1:250,000 (Lamar 1 degree x 2 degree Quadrangle). (*GRI Source Map ID 14*).

The GRI used only a partial extent of the source map, the Hadley 7.5' quadrangle extent. Prominent map components present on the source map (e.g., unit colors, figures, unit descriptions and references) were also incorporated into this GRI digital geologic-GIS dataset and related product documents.

Digital Surficial Geologic-GIS Map of Bent's Old Fort National Historic Site and Vicinity, Colorado (*GRI MapCode BOFS*)

> Linn, Sarah, 1999, Surficial Geologic Map of Bent's Old Fort National Historic Site and Vicinity, Colorado: Colorado State University, unpublished map, scale 1:24,000 (Surficial Map of Bent's Old Fort National Historic Site). (*GRI Source Map ID 936*).

The full extent of the source map was used and all geologic features present on the map were captured. In addition, prominent map components present on the source map (e.g., unit colors, unit descriptions) were also incorporated into this GRI digital geologic-GIS dataset and related product documents.

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

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Bent's Old Fort National Historic Site, Colorado (BEOL) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qob - Overbank fines). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the GRI Geologic Unit Information (BEOLUNIT) table included with the GRI geologic-GIS data.

Cenozoic Era

Quaternary Period
Qob - Overbank fines
Qss - Saturated soil
Qt - Terrace deposits
Qal - Alluvium
Qsw - Slopewash
Qe - Eolian sand
Qlo - Loess
Qb - Broadway Alluvium
Qs - Slocum Alluvium
Qv - Verdos Alluvium

Mesozoic Era

Cretaceous Period
Knf - Niobrara Formation, Fort Hays Limestone Member
Kc - Carlile Shale
Kg - Greenhorn Limestone

Map Unit Descriptions

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

Qob - Overbank fines (Holocene)

No additional unit description provided. Unit present on source map: Surficial Map of Bent's Old Fort National Historic Site.

Qss - Saturated soil (Holocene)

ss - Saturated soil (Holocene)
No additional unit description provided. Unit present on source map: Surficial Map of Bent's Old Fort National Historic Site.

Qt - Terrace deposits (Holocene)

No additional unit description provided. Unit present on source map: Surficial Map of Bent's Old Fort National Historic Site.

Qal - Alluvium (Holocene)

Qal - Alluvium (Holocene)
No additional unit description provided. Unit present on source map: Surficial Map of Bent's Old Fort National Historic Site.

Qa - Alluvium (Holocene)
Silt, sand, and gravel of modern flood plains and streams, dark-yellowish-gray to yellowishtan, crossbedded, unconsolidated. Equivalent to Piney Creek Alluvium and post-Piney Creek alluvium. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qsw - Slopewash (Holocene)

Material deposited on slopes by sheetwash and ephemeral rills; mostly sandy silt but may include any material upslope from site of deposit
such as gravcl or chips of limestone or shale. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qe - Eolian sand (Holocene and Pleistocene)

Yellowish-brown very fine to medium silty quartz sand; generally more silty toward top. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qlo - Loess (Holocene and Pleistocene)

Gravel, sand, and silt; in terraces which are 20-50 feet (6-15 m) above the Arkansas River in western part of quadrangle and 15-40 feet (4-12 m) above in eastern part. Pebbles have a very thin cali
che coating. Unconsolidated. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qb - Broadway Alluvium (Pleistocene)

Gravel, sand, and silt; in terraces which are 20-50 feet (6-15 m) above the Arkansas River in western part of quadrangle and 15-40 feet (4-12 m) above in eastern part. Pebbles have a very thin cali
che coating. Unconsolidated. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qs - Slocum Alluvium (Pleistocene)

Cobbly and bouldery gravel containing silty sand; in terraces which are 80-100 feet (24-30 m) above the Arkansas River in western part of quadrangle and 65-100 feet (20-30 m) in eastern part. Caliche rind on pebbles and cobbles is 3-12 mm thick. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Qv - Verdos Alluvium (Pleistocene)

Cobbly gravel and silty sand; in terraces which are 130-180 feet (40-55 m) above the Arkansas River in western part of quadrangle and 120-180 feet (37-55 m) in eastern part. Caliche rind on pebbles and cobbles is 3-12 mm thick. In places basal part is cemented by caliche. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Knf - Niobrara Formation, Fort Hays Limestone Member (Upper Cretaceous)

Hard yellowish-gray massive bedded limestone. Forms ledges and bluffs north of Arkansas River from La Junta to McClave. About 75-100 feet (23-30 m) thick. Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Kc - Carlile Shale (Upper Cretaceous)

Consists of four members. Total thickness 125-200 feet (38-60 m).

Juana Lopez Member - Hard rust-brown calcarenite bed. Thickness 0-3 feet (0-1 m).

Codell Sandstone Member - Soft yellowish-gray to light-gray silty sandstone and sandy shale. Thickness 0-30 feet (0-9 m).

Blue Hill Shale Member - Black fissile shale containing a zone of large yellow septarian limestone concretions. Thickness 50-60 feet (15-18 m).

Fairport Chalky Shale Member - Calcareous shale, black at top. grading to yellowish gray at base; more calcareous toward base. Thin interbeds of chalk in lower 30 feet (9 m). Thickness about 1 10 feet (33 m).

Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Kg - Greenhorn Limestone (Upper Cretaceous)

Consists of three members, all of which contain thin beds of bentonite. Thickness about 135 feet (41 m).

Bridge Creek Limestone Member - Interbedded thin beds of limestone and calcareous shale. About

70 feet (21 m) thick.

Hartland Shale Member - Calcareous shale. About 25 feet (8 m) thick.

Lincoln Limestone Member - Mostly calcareous shale, but contains many thin hard gray limestone beds. About 35 feet (11 m) thick.

Description from source map: Lamar 1 degree x 2 degree Quadrangle.

Ancillary Source Map Information

The following sections present ancillary source map information associated with source(s used for this project. In addition, a section of a U.S. Geological Survey professional paper pertaining to the Arkansas River near Bent's Old Fort National Historic Site, Professional Paper 700-B, is also included for its relevance to the geology of and surrounding the historical site. No ancillary information other than unit descriptions was associated with the Linn, 1999 source map.

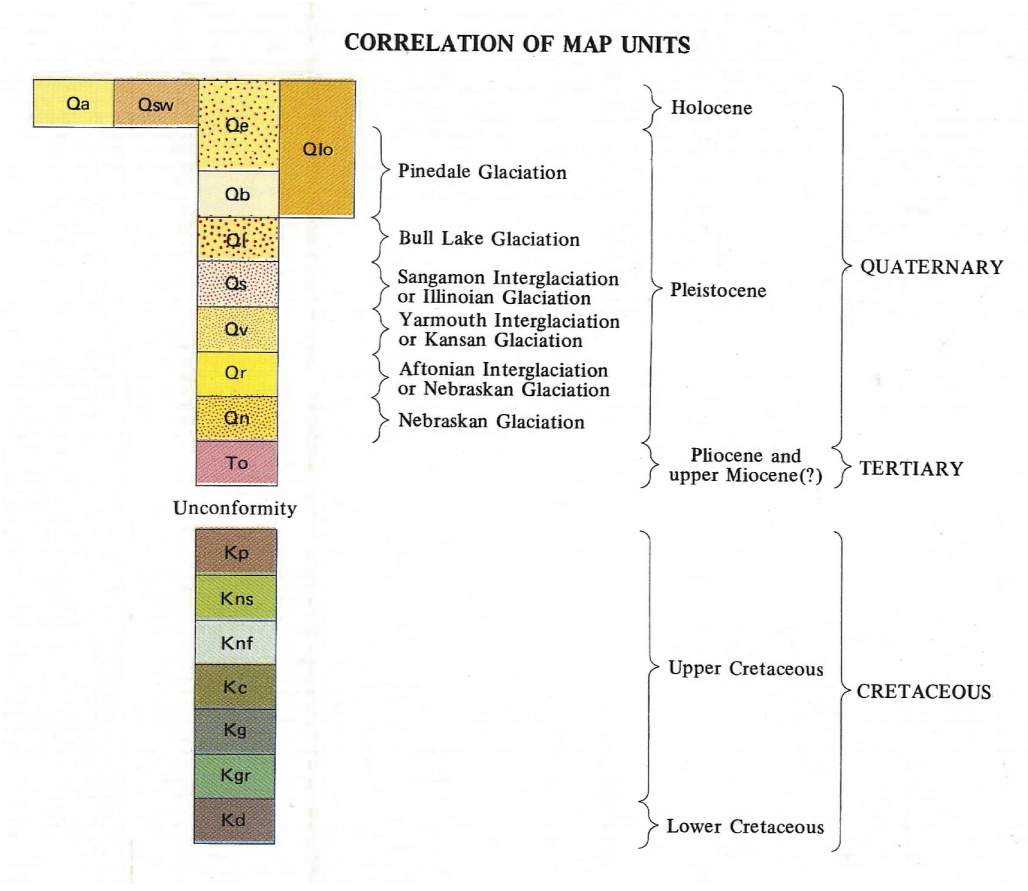
USGS I-944

The formal citation for this source.

Sharps, J.A., 1976, Geologic Map of the Lamar Quadrangle, Colorado and Kansas: U.S. Geological Survey, Miscellaneous Investigations Series Map I-944, scale 1:250,000 (*GRI Source Map ID 14*).

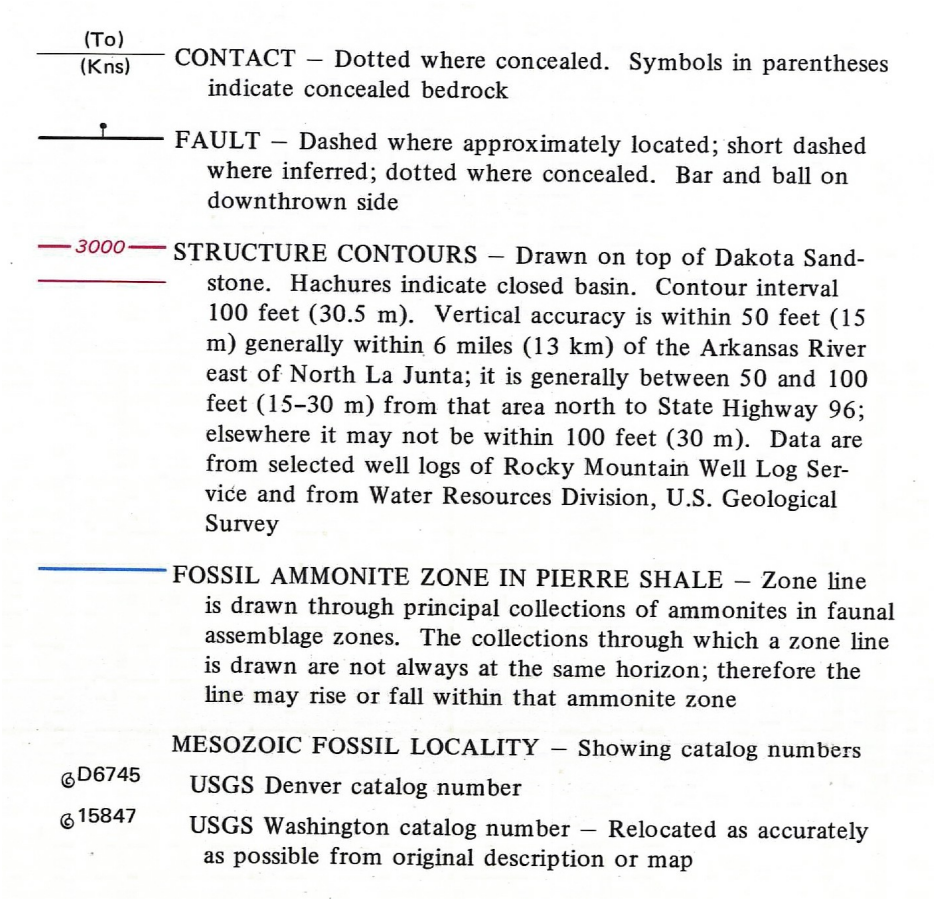
Prominent graphics and text associated with this source.

Correlation of Map Units



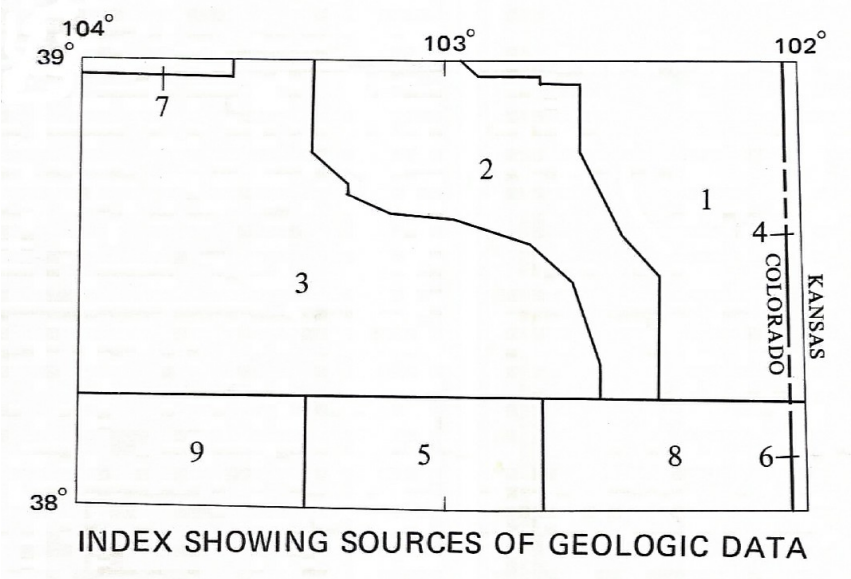
Note that several units, units Qr, Qn, To, Kns, Kgr and Kd, although present on the correlation figure above, are not present in the GRI digital geologic-GIS data for Bent's Old Fort National Historic Site as the GRI data/map is only a partial extent of the full source map extent. Graphic from source map: Lamar 1 degree x 2 degree Quadrangle.

Map Legend



Note that only contacts were captured in the GRI digital geologic-GIS data as only a limited extent of the source map was used. Other geologic feature, although present on the source map extent, were not present in the map extent used for the GRI digital geologic-GIS data. Graphic from source map: Lamar 1 degree x 2 degree Quadrangle.

Index Showing Sources of Geologic Data



Numbers indicated correspond to numbers listed under Geologic Sources below. Graphic from source map: Lamar 1 degree x 2 degree Quadrangle.

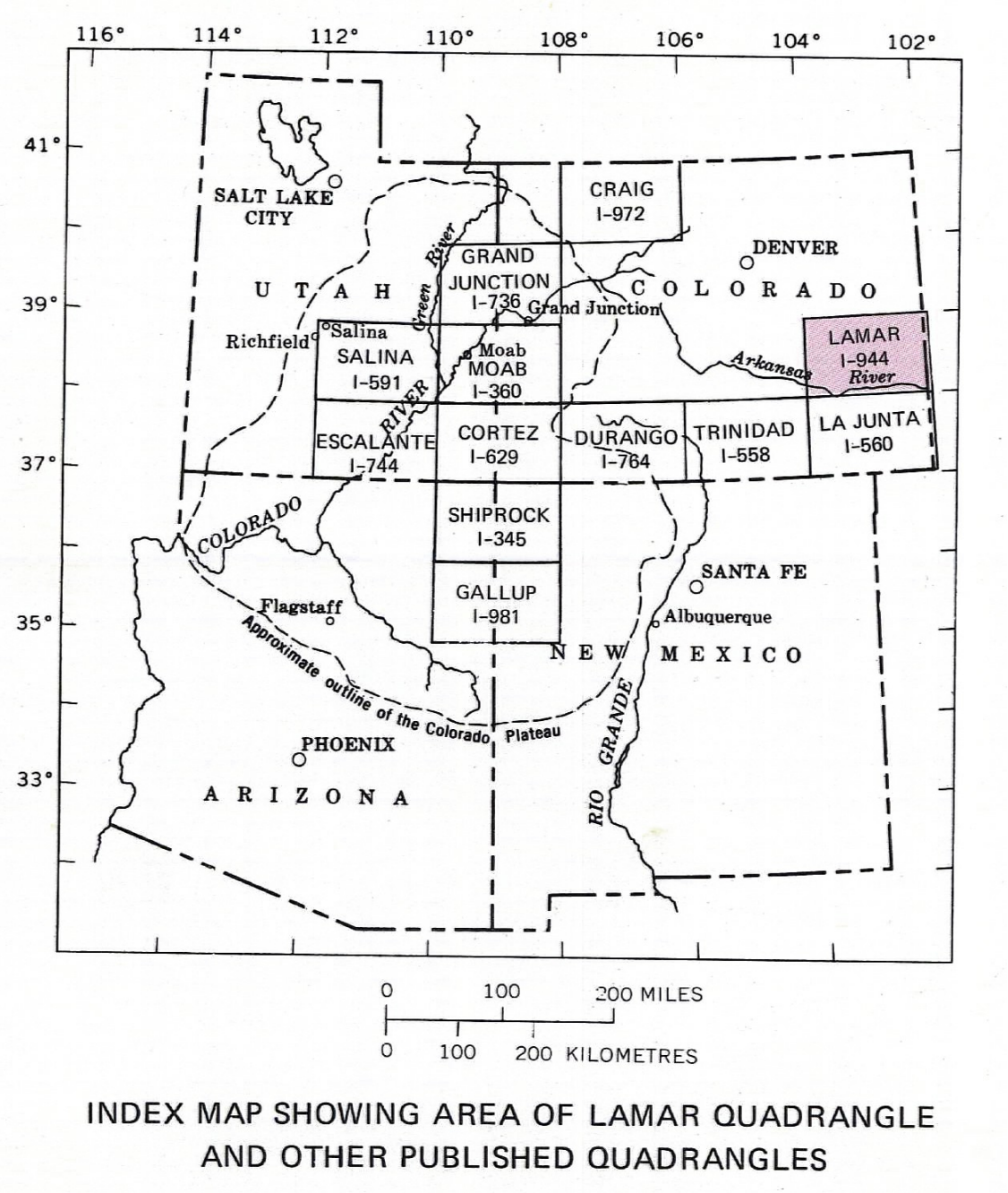
Geologic Sources

All previous mapping modified in part by reconnaissance mapping by J. A. Sharps.

1. Boettcher, A. J., 1964, Geology and ground-water resources in eastern Cheyenne and Kiowa Counties, Colorado, with a section on Chemical quality of the ground water, by C. A. Horr: U.S. Geol. Survey Water-Supply Paper 1779-N, 32 p.
2. Coffin, D. L., 1967, Geology and ground-water resources of the Big Sandy Creek valley, Lincoln, Cheyenne, and Kiowa Counties, Colo- rado, with a section on Chemical Quality of the ground water, by C. A. Horr: U.S. Geol. Survey Water-Supply Paper 1843, 49 p.
3. Dane, C. H., Pierce, W. G., and Reeside, J. B., Jr., 1937, The Stratigraphy of the Upper Cretaceous rocks north of the Arkansas River in eastern Colorado: U.S. Geol. Survey Prof. Paper 186-K, p. 207-232.
4. Elias, M. K., 1931, The geology of Wallace County, Kansas: Kansas State Geol. Survey Bull. 18, 254 p.
5. Irwin, J. H., U.S. Geol. Survey unpublished mapping.
6. McLaughlin, T. G., 1943, Geology and Ground-Water Resources of Hamilton and Kearny Counties, Kansas, with analyses by E. O. Holmes: Kansas State Geol. Survey Bull. 49, 220 p.
7. ___1946, Geology and ground-water resources of parts of Lincoln, Elbert, and El Paso Counties, Colorado, with special reference to Big Sandy Creek valley above Limon: Colorado Water Conserv. Board, Ground Water Ser. Bull. 1, 139 p
8. Voegeli, P. T., Sr., and Hershey, L. A., 1965, Geology and ground water resources of Prowers County, Colorado: U.S. Geol. Survey Water-Supply Paper 1772, 101 p.
9. Weist, W. G, Jr., 1965, Geology and occurrence of ground-water in Otero County and the southern part of Crowley County, Colorado, with sections on Hydrology of the Arkansas River valley in the project area, by W. G. Weist, Jr. and E. D. Jenkins; Hydrologic properties of the water-bearing materials, by E. D. Jenkins; and Quality of the ground water, by C. A. Horr: U.S. Geol. Survey Water-Supply Paper 1799, 90 p.

Text from from source map: Lamar 1 degree x 2 degree Quadrangle.

Index Map Showing Area of Lamar Quadrangle and other Published Quadrangles



INDEX MAP SHOWING AREA OF LAMAR QUADRANGLE AND OTHER PUBLISHED QUADRANGLES

Graphic from source map: Lamar 1 degree x 2 degree Quadrangle.

References

Dane, C. H., Pierce, W. G., and Reeside, J. B., Jr., 1937, The Stratigraphy of the Upper Cretaceous rocks north of the Arkansas River in eastern Colorado: U.S. Geol. Survey Prof. Paper 186-K, p. 207-232.

Darton, N. H., 1906, Geology and underground waters of the Arkansas Valley in eastern Colorado: U.S. Geol. Survey Prof. Paper 52, 90 p.

Elias, M. K., 1931, The geology of Wallace County, Kansas: Kansas State Geol. Survey Bull. 18, 254 p.

Text from from source map: Lamar 1 degree x 2 degree Quadrangle.

USGS Professional Paper 700-B

Included in this document is a section of a U.S. Geological Survey professional paper pertaining to the Arkansas River near Bent's Old Fort National Historic Site.

> Swenson, Frank A, 1970, Meandering of the Arkansas River Since 1833 near Bent's Old Fort, Colorado, *in* Geological Survey Research 1970, Chapter B: U.S. Geological Survey, Professional Paper 700-B, pages B210-B213.
>
> The article/paper is presented below.

Abstract

Bent's Old Fort, constructed on the Santa Fe Trail in 1833 in southeastern Colorado, has been established as a National Historical Monument- The U.S. National Park Service is interested in determining the relative position of the fort, at the time it was occupied, to the meandering Arkansas River. Available data indicate there has been relatively little shift in the meanders of the river at this location.

Introduction

Before 1846 the Arkansas River formed the international boundary between Mexico and the United States. The Santa Fe Trail, leading from the Missouri River at Independence, Mo, to Santa Fe, was an important commercial artery. The trail led across the dry plains of Kansas to the Great Bend of the Arkansas River and then westward along the north bank. Near present Dodge City, Kans., the Santa, Fe Trail forked. One branch continued across Mexican territory to the southwest, but the main branch continued on the north side of the Arkansas River toward the west.

In 1833 William and Charles Bent, with their partner Ceran St. Vrain, established a trading post and fort on the north bank of the Arkansas River where the trail crossed the river and headed up Timpas Creek toward Raton Pass to the southwest. The remains of this fort, now preserved as Bent's Old Fort National Historical Site, is in Otero County 8 miles east of La Junta in southeastern Colorado.

At the request, and with the informal cooperation, of the U.S. National Park Service, an investigation was made to determine, if possible, the relative location of the meandering Arkansas River during the time Bent's Old Fort was occupied from 1833 until it was abandoned and destroyed in 1849.

Location of Bent's Old Fort

Bent's Old port was built of adobe on the edge of a low terrace projecting southeastward into the flood plain of the Arkansas River. An early visitor described the fort as lying 300 yards from the river. Other descriptions indicated that the ford across the river was east of the fort. This meager information is all that has been found regarding the Arkansas River at the time the fort was occupied, from 1833 until 1849. No maps or other pertinent data are available that date back to the time the fort was occupied.

Character of the Arkansas River

The Arkansas River, in the reach under consideration, is a broadly meandering stream. It flows approximately 6 miles to cover a linear distance of 3 miles. These meanders are developed on a flood plain that, in general, is uniformly less than 3/4 mile wide. The flood plain is entirely developed in unconsolidated materials and underlain by 30 to 40 feet of fill. The river gradient is about 5 feet per mile, and the sediment load carried is moderately heavy, consisting largely of silt and sand in this reach of river. The flow of the Arkansas River has ranged from no flow to 200,000 cubic feet per second during the period of stream-gaging record at La Junta, 8 miles upstream. Large diversions of water are made for irrigation, which accounts in part for the wide range in discharge of the stream. Rapid snowmelt in the mountains or cloudbursts within the basin also cause heavy flooding within the area. The maximum flood recorded was on June 4, 192l, and it resulted from a cloudburst during the period of heavy snowmelt.

Migration of Meanders

Few specific data are available regarding the rate of lateral migration of meanders in a stream. When sudden channel shifts transfer territory from one country to another, as happened on the Rio Grande at El Paso, Tex., or from one State to another, as has happened along the Missouri River between Iowa and Nebraska, much publicity results. The presence of many oxbow lakes in various degrees of filling along many of our streams tends to indicate that lateral shifts of channel and migration of meanders are exceedingly common. Wolman and Leopold (1957) present a table compiling data on lateral migration of rivers across valleys. Some of the data on which this table is based are admittedly crude, but the hide range in rates of lateral movement is of interest. Some of tire streams show no appreciable movement in periods of up to 50 or 60 years; others are believed to have shifted laterally hundreds of feet a year over long periods.

It would appear that the Arkansas River in eastern Colorado, with its flood plain developed on erodible, unconsolidated material, could be expected to have appreciable lateral shifts and downstream migration of meanders. The fact that it carries a. moderate load of sand and smaller sized material, and ranges widely in discharge, would serve to increase meandering of the stream. The presence of meander scallops on the edges of the terraces bordering the flood plain and more or less filled oxbow lakes tends also to confirm such movement in the past.

Past Courses of the Arkansas River Near Bent’s Old Fort

Early descriptions state that the Arkansas River was about 300 yards from the fort between 1833 and 1849, but they do not say if it was this close on the south or east. The location of the ford on the Santa Fe Trail indicates that the river ran east of the fort. No maps or charts showing the relative position of the fort and the Arkansas River are known.

The first survey of the area was made during July and August 1869, when the U.S. General Land Office laid out the section lines south of the river. In the course of this survey a meander line was run which was intended to depict the ordinary high-water line and the sinuosities of the river. This was accomplished by starting at a known point where the section line intersected the river and chaining from

this point on a stated bearing to another station located on the ordinary high-water line. A total of 14 such points, shown on figure 1A, were so located. The notes from this survey were taken into the office, plotted, and the course of the river, as depicted in figure 1A, was sketched on the plat.

During March 1882 a similar General Land Office survey was made to lay out the sections north of the Arkansas River. No meander line along the north bank of the river was run, but wherever section lines crossed the river, points were located on both banks, presumably at. the ordinary high-water line. Here again the survey notes were taken into the office, the data were plotted, and the coarse of the river was depicted as shown on figure 1B. This plotting, would indicate a rather straight stream, entirely out of character with the river as we know it today.

When the points established by the 1869 and 1882 surveys are blotted together, there is much better control on the course of the river. The fact that there is very close agreement at all locations where the points from the separate surveys fall on section lines tends to indicate that both surveys were remarkably accurate. Some shifts of the river during the 13-year interval might be expected, and also there is the personal factor -selecting a point to establish the expected ordinary high-water mark of the stream. With the cumulative control provided by the points from the separate surveys, the writer has made an interpretation of the course of the Arkansas river as of the I869 survey. This interpretation (fig. 1C) shows a meandering stream very mach like the present Arkansas River. The stream, as plotted, is about 1,000 feet from Bent's Old Fort which closely approximates the 300 yards reported. The crossover of the flow of water from one meander to the other would occur east of the fort, and this would be the logical location of the ford where the Santa Fe Trail crossed the Arkansas River. Thus, it would seem that the location of the Arkansas River in relation to the fort, at the time the fort was in use. between 1833 and 1849, has been roughly established.

The earliest aerial photographs available for this reach of the Arkansas River were taken November 20, 1936. There is a long time period between the 1869-1882 surveys and 1936, but there appears to have been little significant lateral migration of the meanders or shifting of the Arkansas River during the intervening 67 years (fig. 2). The largest shift of the channel was south of the fort where the river moved about 900 feet north of the meander point established in 1869. Immediately east of the. fort there appears to have been no lateral migration of the upstream limb of the meander. This might. be considered unusual as the current from the fairly straight upstream reach of the stream impinges against, the bank at. this point. The reason that lateral migration has not taken place to any great extent is that the point of impact is at the edge of the flood plain and the streambank is high, extending down from the surface of the stream terrace directly to the water surface.

Near the apex of the meander in section 14 and along the downstream limp, between 1869 and 1936, a lateral shift of the meander totaling more than 500 feet in places has occurred. There has been major shifting of the course of the river along the meander in section 13 also, except where the meander impinges on the edge of the flood plain.

Between November 1936 and July 1947 (fig. 3) there was very little shifting of the course of the Arkansas River in the large meanders in sections 13 and 14. Upstream, however, in sections 22 and 23, major changes in the stream tools place. The rather straight course of 1869-82, more or less maintained through 1936, became very sinuous by 1947. Another major change also took place daring this short period-the Arkansas River became a braided stream. Islands were few and of small size in 1936, but they became numerous and of large size by 1947, and this tendency has remained as shown by the 1964 (fig. 4) map. Since 1936 there has been a large increase in the amount of water diverted from the river for irrigation, and this removal of water daring low flows of the summer is believed to be responsible for the development of the more braided character of the Arkansas River.

Conclusion and References

Despite the fact that the Arkansas River, in the reach near Bent's Old Fort, has well developed meanders and the river is flowing on easily erodible material, there has been relatively little shift of the stream since 1869. Little progressive migration of meanders downstream has occurred.

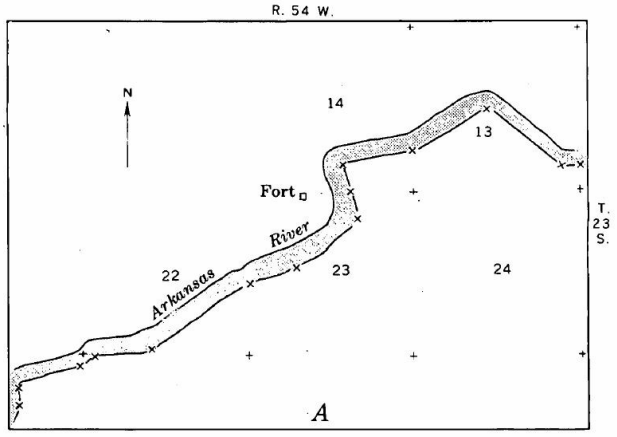
Wolman, M. C., and Leopold, L. B., 1957, River flood plains -Some observations on their formation: U.S. Geological Survey, Professional Paper 282-C, p. 87-109.

Figures

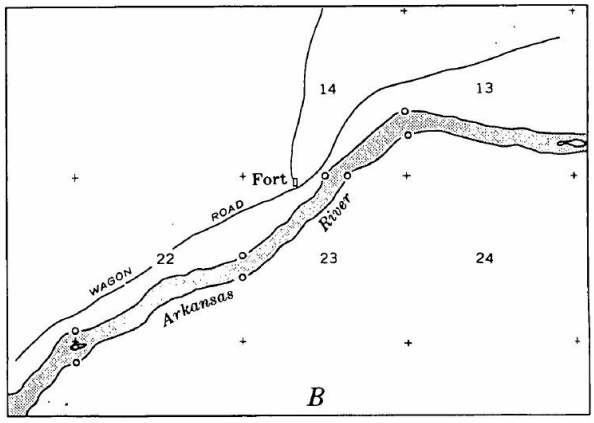
Figures mentioned in the above article/paper text are presented below.

Figure 1: Meanders of the Arkansas River near Bent's Old Fort

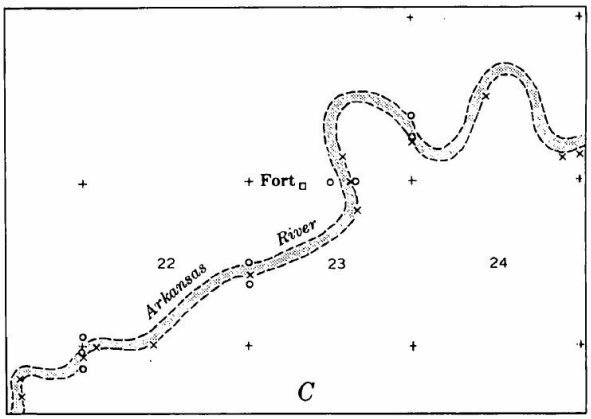
A, General Land Office plat of July-August1869 survey south of river in T. 23 S., R. 54 W.



B, General Land Office plat of March 1882 survey north of river.



C, composite of points from A and B with an interpretation (sketched in) of the course of the river as it probably actually existed at the time (1869).



Graphics from source: Meandering of the Arkansas River Since 1833 near Bent's Old Fort, Colorado.

Figure 2: Arkansas River course and flood plain (patterned), November 1936

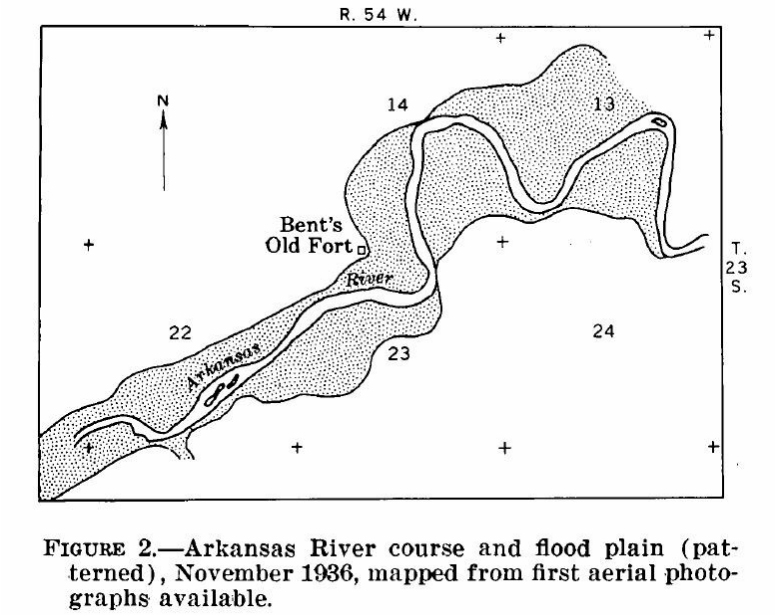


FIGURE 2.—Arkansas River course and flood plain (patterned), November 1936, mapped from first aerial photographs available.

Graphic from source: Meandering of the Arkansas River Since 1833 near Bent's Old Fort, Colorado.

Figure 3: Arkansas River course and flood plain (patterned), July 1947

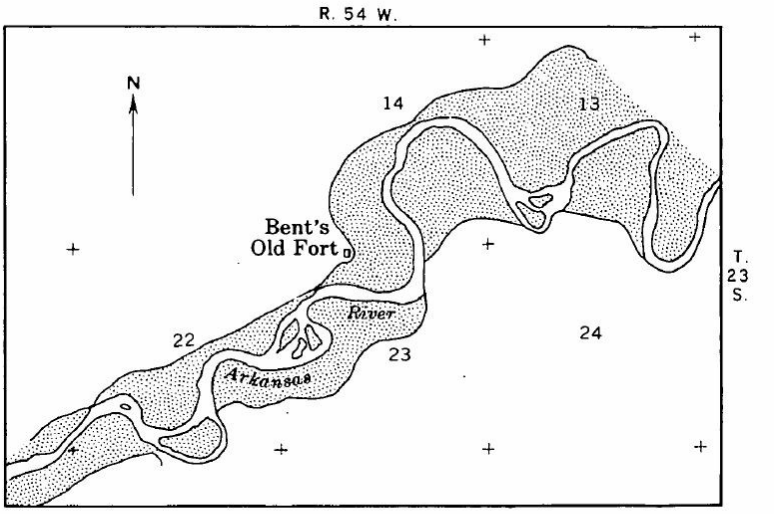


FIGURE 3.—Arkansas River course and flood plain (patterned), July 1947, mapped from aerial photographs. Note increase in number and size of islands since 1936 (fig. 2).

Graphic from source: Meandering of the Arkansas River Since 1833 near Bent's Old Fort, Colorado.

Figure 4: Arkansas River course and flood plain (patterned), June 1964

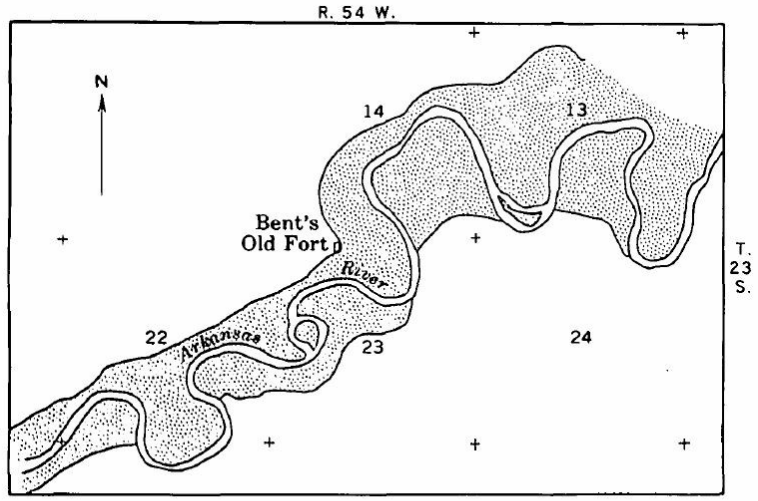


FIGURE 4.—Arkansas River course and flood plain (patterned), June 1964, mapped from aerial photographs.

Graphic from source: Meandering of the Arkansas River Since 1833 near Bent's Old Fort, Colorado.

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This document was developed and completed by Stephanie O'Meara (Colorado State University) for the NPS Geologic Resources Division (GRD) Geologic Resources Inventory(GRI) Program. Quality control of this document by James Winter (Colorado State University).

The information in this document was compiled from GRI source maps, and is intended to accompany the digital geologic-GIS maps and other digital data for Bent's Old Fort National Historic Site, Colorado (BEOL) developed by Stephanie O'Meara (see the GRI Digital Maps and Source Map Citations section of this document for all sources used by the GRI in the completion of this document and related GRI digital geologic-GIS maps). An earlier version of the GRI digital surficial geologic-GIS data, as well as this document, was produced by Stephanie O'Meara, Trista Thornberry (Colorado State University) and Eileen Ernenwein (NPS GRD).

GRI finalization by Stephanie O'Meara.

Initial GRI program coordination and scoping provided by Joe Gregson (NPS I&M, Fort Collins, Colorado).