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

Chisos Mountains

Big Bend National Park

Ancillary Map Information Document

Produced to accompany the Geologic Resources Inventory Digital Geologic Data for Big Bend National Park

cmtn_geology.pdf

Version: March 2012

Geologic Resources Inventory Map Document for Big Bend National Park

Table of Contents

Geologic Resources Inventory Map Document 1
About the NPS Geologic Resources Inventory Program 2
Map Unit List 4
Map Unit Descriptions 6
Qya - Alluvium, undivided (Quaternary) 6
Qya1 - Younger alluvium (Quaternary) 6
Qrf - Rock fall deposits (Quaternary) 6
Qc - Colluvium and colluvial fans (Quaternary) 6
Qe - Eolian sand (Quaternary) 6
Qya2 - Older alluvium (Quaternary) 6
Qs - Spring deposits (Quaternary) 6
Landslide deposits 6
Qlb - Landslide deposits, basalt source (Quaternary) 6
Qlc - Landslide deposits, Chisos Formation source (Quaternary) 6
Qlg - Landslide deposits, granitic source (Quaternary) 6
Qlj - Landslide deposits, Javelina Formation source (Quaternary) 7
Qlu - Landslide deposits, undifferentiated source (Quaternary) 7
Qlss - Landslide deposits, sandstone source (Quaternary) 7
Qlt - Landslide deposits, trachyte source (Quaternary) 7
Qlp - Landslide deposits, Pine Canyon Member of South Rim Formation source (Quaternary) 7
Qia - Intermediate age alluvial deposits, undivided (Quaternary) 7
Qia1 - Younger intermediate age alluvium (Quaternary) 7
Qia2 - Older intermediate age alluvium (Quaternary) 7
Qoa - Old alluvium (Quaternary) 7
QTa - Extremely old alluvium (Quaternary and Tertiary) 7
Tgbs - Gabbro sill (Tertiary) 7
Tbre - Breccia (Tertiary) 8
Trf - Rhyolite flow (Tertiary) 8
Tqeb - Explosion breccia of Sierra Quemada (Tertiary) 8
Tt - Trachyte flows of Punta de la Sierra (Tertiary) 8
Tld - Leucocratic dike (Tertiary) 8
Tid - Intermediate dike (Tertiary) 8
South Rim Formation 8
Tsl - South Rim Formation, Lost Mine Member (Tertiary) 8
Tsb - South Rim Formation, Boot Rock member (Tertiary) 8
Tsp - South Rim Formation, Pine Canyon Rhyolite Member (Tertiary) 8
Tseq - South Rim Formation, rocks equivalent to South Rim Formation (Tertiary) 8
Twa - South Rim Formation, altered parts of Ward Mountain pluton (Tertiary) 9
Timi - South Rim Formation, intermediate to mafic intrusion (Tertiary) 9
Trp - South Rim Formation, rhyolite porphyry dikes and sills (Tertiary) 9
Tdd - South Rim Formation, Dominguez Mountain dike swarms (Tertiary) 9
Tqd - South Rim Formation, Sierra Quemada dike complex (Tertiary) 9
Tqrd - South Rim Formation, rhyolite dikes of Sierra Quemada (Tertiary) 9
Tfs - South Rim Formation, felsic sill (Tertiary) 9
Tw - South Rim Formation, Ward Mountain pluton (Tertiary) 9

Tgps - South Rim Formation, granite plutons and stocks (Tertiary) 9
Tmi - South Rim Formation, mafic intrusions of Pine Canyon caldera and Dominguez Mountain (Tertiary) 9
Tnm - South Rim Formation, intrusions of Nugent Mountain (Tertiary) 10
Tpl - South Rim Formation, Panther laccolith (Tertiary) 10
Trsl - South Rim Formation, Rough Spring laccolith (Tertiary) 10
Tqi - South Rim Formation, rhyolite intrusions of Sierra Quemada (Tertiary) 10
Ttc - South Rim Formation, tuff and conglomerate (Tertiary) 10
Tbs - South Rim Formation, undifferentiated basalt sills (Tertiary) 10
Tmd - South Rim Formation, mafic dikes and sills (Tertiary) 10
Tdm - South Rim Formation, Dominguez Mountain core flows (Tertiary) 10
Tdbf - South Rim Formation, Dominguez Mountain basalt(?) flows (Tertiary) 10
Chisos Formation 10
Tcbr - Chisos Formation, breccia facies (Tertiary) 10
Tcwu - Chisos Formation, upper white tuff facies (Tertiary) 10
Tvt - Chisos Formation, vitric tuff (Tertiary) 11
Tcbm - Chisos Formation, Bee Mountain Basalt Member and equivalent flows (Tertiary) 11
Tcw - Chisos Formation, white tuff facies (Tertiary) 11
Tcksu - Chisos Formation, upper siltstone facies (Tertiary) 11
Traf - Chisos Formation, rhyolite ash flow (Tertiary) 11
Tctsy - Chisos Formation, yellow-orange tuffaceous sandstone facies (Tertiary) 11
Tcts - Chisos Formation, tuffaceous sandstone facies (Tertiary) 11
Tcs - Chisos Formation, undifferentiated sandstone facies (Tertiary) 11
Tcas - Chisos Formation, Ash Spring Basalt Member (Tertiary) 11
Tcac - Chisos Formation, Alamo Creek Basalt Member and equivalent flows (Tertiary) 11
Tcstr - Chisos Formation, sandstone, tuff, and rhyolite facies (Tertiary) 11
Tcnr - Chisos Formation, nodular rhyolite facies (Tertiary) 12
Tcksl - Chisos Formation, lower siltstone facies (Tertiary) 12
Tbf - Chisos Formation, basalt flows, undifferentiated (Tertiary) 12
Tcla - Chisos Formation, lacustrine facies (Tertiary) 12
Tcrt - Chisos Formation, rhyolite tuff facies (Tertiary) 12
Tms - Mafic sills (Tertiary) 12
Tis - Intermediate sill (Tertiary) 12
TKbp - Black Peaks Formation (Tertiary and Cretaceous) 12
Kj - Javelina Formation (Cretaceous) 12
Ka - Aguja Formation (Cretaceous) 12
Kas - Aguja Formation, metamorphosed sandstone and quartzite facies near Tortuga dome (Cretaceous) 12
Kah - Aguja Formation, hornfels facies (Cretaceous) 13
Kp - Pen Formation (Cretaceous) 13
Kb - Boquillas Formation (Cretaceous) 13
GRI Source Map Citation 14
Geologic Map of the Chisos Mountains, Big Bend National Park 14
Radiometric Age Determinations 14
Correlation of Map Units 15
Location Map 15
Map Explanation 16
Support and Data Sources 17
GRI Digital Data Credits 18

Geologic Resources Inventory Map Document

Chisos Mountains

Big Bend National Park, Texas

Document to Accompany Digital Geologic-GIS Data

cmtn_geology.pdf

Version: March 2012

This document has been developed to accompany the digital geologic-GIS data developed by the Geologic Resources Inventory (GRI) program for Big Bend National Park, Texas (BIBE).

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.

For information about the status of GRI digital geologic-GIS data for a park contact:

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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.

Map Unit List

The geologic units present in the digital geologic-GIS data produced for Big Bend National Park, Texas (BIBE) are listed below. Units are listed with their assigned unit symbol and unit name (e.g., Qya - Alluvium, undivided). Units are listed from youngest to oldest. No description for water is provided. Information about each geologic unit is also presented in the Geologic Unit Information (CMTNUNIT) table included with the GRI geology-GIS data.

Cenozoic Era

Quaternary Period

Qya - Alluvium, undivided (Quaternary)
Qya1 - Younger alluvium (Quaternary)
Qrf - Rock fall deposits (Quaternary)
Qc - Colluvium and colluvial fans (Quaternary)
Qe - Eolian sand (Quaternary)
Qya2 - Older alluvium (Quaternary)
Qs - Spring deposits (Quaternary)
Landslide deposits
  Qlb - Landslide deposits, basalt source (Quaternary)
  Qlc - Landslide deposits, Chisos Formation source (Quaternary)
  Qlg - Landslide deposits, granitic source (Quaternary)
  Qlj - Landslide deposits, Javelina Formation source (Quaternary)
  Qlu - Landslide deposits, undifferentiated source (Quaternary)
  Qlss - Landslide deposits, sandstone source (Quaternary)
  Qlt - Landslide deposits, trachyte source (Quaternary)
  Qlp - Landslide deposits, Pine Canyon Member of South Rim Formation source (Quaternary)
Qia - Intermediate age alluvial deposits, undivided (Quaternary)
Qia1 - Younger intermediate age alluvium (Quaternary)
Qia2 - Older intermediate age alluvium (Quaternary)
Qoa - Old alluvium (Quaternary)

Quaternary and Tertiary Periods

QTa - Extremely old alluvium (Quaternary and Tertiary)

Tertiary Period

Tgbs - Gabbro sill (Tertiary)
Tbre - Breccia (Tertiary)
Trf - Rhyolite flow (Tertiary)
Tqeb - Explosion breccia of Sierra Quemada (Tertiary)
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  Tseq - South Rim Formation, rocks equivalent to South Rim Formation (Tertiary)
  Twa - South Rim Formation, altered parts of Ward Mountain pluton (Tertiary)
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  Tdd - South Rim Formation, Dominguez Mountain dike swarms (Tertiary)
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Tfs - South Rim Formation, felsic sill (Tertiary)
Tw - South Rim Formation, Ward Mountain pluton (Tertiary)
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Tmi - South Rim Formation, mafic intrusions of Pine Canyon caldera and Dominguez Mtn. (Tertiary)
Tnm - South Rim Formation, intrusions of Nugent Mountain (Tertiary)
Tpl - South Rim Formation, Panther laccolith (Tertiary)
Trsl - South Rim Formation, Rough Spring laccolith (Tertiary)
Tqi - South Rim Formation, rhyolite intrusions of Sierra Quemada (Tertiary)
Ttc - South Rim Formation, tuff and conglomerate (Tertiary)
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Tis - Intermediate sill (Tertiary)

Cenozoic and Mesozoic Eras

Tertiary and Cretaceous Periods

TKbp - Black Peaks Formation (Tertiary and Cretaceous)

Mesozoic Era

Cretaceous

Kj - Javelina Formation (Cretaceous)
Ka - Aguja Formation (Cretaceous)
Kas - Aguja Formation, metamorphosed sandstone and quartzite facies near Tortuga dome (Cretaceous)
Kah - Aguja Formation, hornfels facies (Cretaceous)
Kp - Pen Formation (Cretaceous)
Kb - Boquillas Formation (Cretaceous)

Map Unit Descriptions

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

Qya - Alluvium, undivided (Quaternary)

Alluvial fan, pediment, and stream deposits. *GRI Source Map ID 3140* (SIM 3140).

Qya1 - Younger alluvium (Quaternary)

On or within several meters of valley floor. *GRI Source Map ID 3140* (SIM 3140).

Qrf - Rock fall deposits (Quaternary)

Generally unsorted, angular, cobble- to boulder-sized rock fragments forming talus on steep slopes. *GRI Source Map ID 3140* (SIM 3140).

Qc - Colluvium and colluvial fans (Quaternary)

Mixture of gravel, sand, silt, and clay. *GRI Source Map ID 3140* (SIM 3140).

Qe - Eolian sand (Quaternary)

Unconsolidated, moderately to well-sorted, silty fine- to medium-grained sand. *GRI Source Map ID 3140* (SIM 3140).

Qya2 - Older alluvium (Quaternary)

Generally elevated 3 m or more above the valley floor. *GRI Source Map ID 3140* (SIM 3140).

Qs - Spring deposits (Quaternary)

Spring-generated calcium carbonate mixed with fine sand and silt; locally nodular or laminated. *GRI Source Map ID 3140* (SIM 3140).

Landslide deposits

Qlb - Landslide deposits, basalt source (Quaternary)

Slumps, flows, and slides of Alamo Creek Basalt. *GRI Source Map ID 3140* (SIM 3140).

Qlc - Landslide deposits, Chisos Formation source (Quaternary)

Slumps, flows, and slides of white tuffaceous facies. *GRI Source Map ID 3140* (SIM 3140).

Qlg - Landslide deposits, granitic source (Quaternary)

Slumps, flows, and slides of nearby felsic granite sill. *GRI Source Map ID 3140* (SIM 3140).

Qlj - Landslide deposits, Javelina Formation source (Quaternary)

Slumps, flows, and slides of claystone of Javelina Formation. *GRI Source Map ID 3140* (SIM 3140).

Qlu - Landslide deposits, undifferentiated source (Quaternary)

Slumps, flows, and slides of undifferentiated source. *GRI Source Map ID 3140* (SIM 3140).

Qlss - Landslide deposits, sandstone source (Quaternary)

Slumps, flows, and slides of sandstone. *GRI Source Map ID 3140* (SIM 3140).

Qlt - Landslide deposits, trachyte source (Quaternary)

Slumps, flows, and slides of trachyte. *GRI Source Map ID 3140* (SIM 3140).

Qlp - Landslide deposits, Pine Canyon Member of South Rim Formation source (Quaternary)

Slumps, flows, and slides of Pine Canyon Rhyolite Member. *GRI Source Map ID 3140* (SIM 3140).

Qia - Intermediate age alluvial deposits, undivided (Quaternary)

Alluvial fan, pediment, and stream deposits. *GRI Source Map ID 3140* (SIM 3140).

Qia1 - Younger intermediate age alluvium (Quaternary)

Typically has a stage-I to -II soil-carbonate horizon 1 to 1.5 m thick. *GRI Source Map ID 3140* (SIM 3140).

Qia2 - Older intermediate age alluvium (Quaternary)

Typically has a weakly to moderately cemented, stage-III to -IV soil-carbonate horizon 1 m or more thick. *GRI Source Map ID 3140* (SIM 3140).

Qoa - Old alluvium (Quaternary)

Alluvial fan, pediment, and stream deposits, moderately to well consolidated. *GRI Source Map ID 3140* (SIM 3140).

QTa - Extremely old alluvium (Quaternary and Tertiary)

Gravel, sand, and silt predominantly of alluvial fan origin. *GRI Source Map ID 3140* (SIM 3140).

Tgbs - Gabbro sill (Tertiary)

Gabbro sill intruding metamorphosed Cretaceous rocks in waterworks area along Fresno Creek. *GRI Source Map ID 3140* (SIM 3140).

Tbre - Breccia (Tertiary)

Volcaniclastic breccia exposed at tops of several small hills near central-west map border south of Blue Creek Canyon. *GRI Source Map ID 3140* (SIM 3140).

Trf - Rhyolite flow (Tertiary)

Young rhyolite flows. *GRI Source Map ID 3140* (SIM 3140).

Tqeb - Explosion breccia of Sierra Quemada (Tertiary)

Extremely lithic-rich, rhyolitic explosion breccia scattered within perimeter of ring dikes of central Sierra Quemada. *GRI Source Map ID 3140* (SIM 3140).

Tt - Trachyte flows of Punta de la Sierra (Tertiary)

Trachytic flows. *GRI Source Map ID 3140* (SIM 3140).

Tld - Leucocratic dike (Tertiary)

Light colored, mostly rhyolite and rhyodacite porphyry. *GRI Source Map ID 3140* (SIM 3140).

Tid - Intermediate dike (Tertiary)

Dark colored, mostly andesite and dacite. *GRI Source Map ID 3140* (SIM 3140).

South Rim Formation

Tsl - South Rim Formation, Lost Mine Member (Tertiary)

Quartz trachyte ash-flow tuffs and local lava flows. *GRI Source Map ID 3140* (SIM 3140).

Tsb - South Rim Formation, Boot Rock member (Tertiary)

Composed of two ash-flow tuff facies, caldera fill, and outflow. *GRI Source Map ID 3140* (SIM 3140).

Tsp - South Rim Formation, Pine Canyon Rhyolite Member (Tertiary)

Consists of multiple cooling units of peralkaline rhyolitic ash-flow tuff. *GRI Source Map ID 3140* (SIM 3140).

Tseq - South Rim Formation, rocks equivalent to South Rim Formation (Tertiary)

Other rhyolite flows and ignimbrites equivalent to South Rim flows or trachyte flows of Punta de La Sierra, but not continuous with any of those units. *GRI Source Map ID 3140* (SIM 3140).

Twa - South Rim Formation, altered parts of Ward Mountain pluton (Tertiary)

Altered zone at top of Ward Mountain pluton; not studied. *GRI Source Map ID 3140* (SIM 3140).

Timi - South Rim Formation, intermediate to mafic intrusion (Tertiary)

Chiefly diorite, possibly gabbro. *GRI Source Map ID 3140* (SIM 3140).

Trp - South Rim Formation, rhyolite porphyry dikes and sills (Tertiary)

Various porphyritic dikes and sills, mostly rhyolite or rhyodacite in composition. *GRI Source Map ID 3140* (SIM 3140).

Tdd - South Rim Formation, Dominguez Mountain dike swarms (Tertiary)

Mostly light-colored rhyolite to dacite porphyry. *GRI Source Map ID 3140* (SIM 3140).

Tqd - South Rim Formation, Sierra Quemada dike complex (Tertiary)

Thick dike-like intrusions that form outer rim of volcanic center. *GRI Source Map ID 3140* (SIM 3140).

Tqrd - South Rim Formation, rhyolite dikes of Sierra Quemada (Tertiary)

Rhyolite dikes in Sierra Quemada. *GRI Source Map ID 3140* (SIM 3140).

Tfs - South Rim Formation, felsic sill (Tertiary)

Gray feldspar-rich, porphyritic riebeckite microgranite with weathered alkalai-feldspar phenocrysts set in a groundmass of weathered laths of alkalai feldspar and anhedral quartz. *GRI Source Map ID 3140* (SIM 3140).

Tw - South Rim Formation, Ward Mountain pluton (Tertiary)

Rhyolite pluton, mostly flow-banded rhyolite and fine-grained granite and quartz syenite. *GRI Source Map ID 3140* (SIM 3140).

Tgps - South Rim Formation, granite plutons and stocks (Tertiary)

Various granite to monzogranite plutons and stocks scattered throughout map. *GRI Source Map ID 3140* (SIM 3140).

Tmi - South Rim Formation, mafic intrusions of Pine Canyon caldera and Dominguez Mountain (Tertiary)

Several small mafic stocks; also a large ring-shaped intrusive body. *GRI Source Map ID 3140* (SIM 3140).

Tnm - South Rim Formation, intrusions of Nugent Mountain (Tertiary)

Several small intrusions of porphyritic alkalic rhyolite or microgranite and alkalic granophyre. *GRI Source Map ID 3140* (SIM 3140).

Tpl - South Rim Formation, Panther laccolith (Tertiary)

Large laccolith of porphyritic sodic rhyolite north of Pine Canyon caldera. *GRI Source Map ID 3140* (SIM 3140).

Trsl - South Rim Formation, Rough Spring laccolith (Tertiary)

Light-gray to dark-gray quartz microsyenite that is also referred to as Government Spring laccolith. *GRI Source Map ID 3140* (SIM 3140).

Tqi - South Rim Formation, rhyolite intrusions of Sierra Quemada (Tertiary)

Small rhyolite stocks in central part of volcanic center at Sierra Quemada. *GRI Source Map ID 3140* (SIM 3140).

Ttc - South Rim Formation, tuff and conglomerate (Tertiary)

Air-fall tuff and conglomerate at base of eruptive sequence. *GRI Source Map ID 3140* (SIM 3140).

Tbs - South Rim Formation, undifferentiated basalt sills (Tertiary)

Two exposures of possibly same sill are included in this unit. *GRI Source Map ID 3140* (SIM 3140).

Tmd - South Rim Formation, mafic dikes and sills (Tertiary)

Dark colored, probably basaltic in composition. *GRI Source Map ID 3140* (SIM 3140).

Tdm - South Rim Formation, Dominguez Mountain core flows (Tertiary)

Dark-colored bedded flows in core of Dominguez Mountain. *GRI Source Map ID 3140* (SIM 3140).

Tdbf - South Rim Formation, Dominguez Mountain basalt(?) flows (Tertiary)

Black lava flows on lower east flank of Dominguez Mountain. *GRI Source Map ID 3140* (SIM 3140).

Chisos Formation

Tcbr - Chisos Formation, breccia facies (Tertiary)

Breccia and conglomerate. *GRI Source Map ID 3140* (SIM 3140).

Tcwu - Chisos Formation, upper white tuff facies (Tertiary)

Tuff, sandstone, and rhyolite. *GRI Source Map ID 3140* (SIM 3140).

Tvt - Chisos Formation, vitric tuff (Tertiary)

Thin vitric tuff. *GRI Source Map ID 3140* (SIM 3140).

Tcbm - Chisos Formation, Bee Mountain Basalt Member and equivalent flows (Tertiary)

Dark-colored basalt flows that are conspicuously scoriaceous. *GRI Source Map ID 3140* (SIM 3140).

Tcw - Chisos Formation, white tuff facies (Tertiary)

Tuff and tuffaceous sandstone. *GRI Source Map ID 3140* (SIM 3140).

Tcksu - Chisos Formation, upper siltstone facies (Tertiary)

Greenish, purplish, and gray siltstone. *GRI Source Map ID 3140* (SIM 3140).

Traf - Chisos Formation, rhyolite ash flow (Tertiary)

Thin, discontinuous rhyolite ash flow interbedded with white tuff facies. *GRI Source Map ID 3140* (SIM 3140).

Tctsy - Chisos Formation, yellow-orange tuffaceous sandstone facies (Tertiary)

Tuffaceous(?) sandstone. *GRI Source Map ID 3140* (SIM 3140).

Tcts - Chisos Formation, tuffaceous sandstone facies (Tertiary)

A small exposure of tuffaceous sandstone. *GRI Source Map ID 3140* (SIM 3140).

Tcs - Chisos Formation, undifferentiated sandstone facies (Tertiary)

Thin, discontinuous sandstone layers intercalated with white tuff facies. *GRI Source Map ID 3140* (SIM 3140).

Tcas - Chisos Formation, Ash Spring Basalt Member (Tertiary)

Dark-colored, fine-grained basalt. *GRI Source Map ID 3140* (SIM 3140).

Tcac - Chisos Formation, Alamo Creek Basalt Member and equivalent flows (Tertiary)

Dark-colored basalt. *GRI Source Map ID 3140* (SIM 3140).

Tcstr - Chisos Formation, sandstone, tuff, and rhyolite facies (Tertiary)

Thick unit of well-bedded brown-colored sandstone with accessory tuffaceous sandstone. *GRI Source Map ID 3140* (SIM 3140).

Tcnr - Chisos Formation, nodular rhyolite facies (Tertiary)

White rhyolite flows with nodular concretions of quartz ubiquitous. *GRI Source Map ID 3140* (SIM 3140).

Tcksl - Chisos Formation, lower siltstone facies (Tertiary)

Interbedded greenish, purplish, and gray siltstone. *GRI Source Map ID 3140* (SIM 3140).

Tbf - Chisos Formation, basalt flows, undifferentiated (Tertiary)

Basaltic lavas undifferentiated. *GRI Source Map ID 3140* (SIM 3140).

Tcla - Chisos Formation, lacustrine facies (Tertiary)

Silt and clay. *GRI Source Map ID 3140* (SIM 3140).

Tcrt - Chisos Formation, rhyolite tuff facies (Tertiary)

Rhyolite and tuff. *GRI Source Map ID 3140* (SIM 3140).

Tms - Mafic sills (Tertiary)

Dark-colored sills. *GRI Source Map ID 3140* (SIM 3140).

Tis - Intermediate sill (Tertiary)

dark-colored basaltic(?) sill. *GRI Source Map ID 3140* (SIM 3140).

TKbp - Black Peaks Formation (Tertiary and Cretaceous)

Chiefly cross-bedded sandstone, includes some interbedded claystone. *GRI Source Map ID 3140* (SIM 3140).

Kj - Javelina Formation (Cretaceous)

Claystone containing thin lens-shaped interbeds of buff cross-bedded sandstone. *GRI Source Map ID 3140* (SIM 3140).

Ka - Aguja Formation (Cretaceous)

Claystone that includes thick layers of buff-colored sandstone. *GRI Source Map ID 3140* (SIM 3140).

Kas - Aguja Formation, metamorphosed sandstone and quartzite facies near Tortuga dome (Cretaceous)

arkosic metasandstone and quartzite. *GRI Source Map ID 3140* (SIM 3140).

Kah - Aguja Formation, hornfels facies (Cretaceous)

Light-gray claystone has been changed into dark red-brown hornfels and sandstone into quartzite. *GRI Source Map ID 3140* (SIM 3140).

Kp - Pen Formation (Cretaceous)

Primarily claystone that includes thin parallel interbeds of fine-grained sandstone. *GRI Source Map ID 3140* (SIM 3140).

Kb - Boquillas Formation (Cretaceous)

Thin-bedded limestone, chalk, and marl. *GRI Source Map ID 3140* (SIM 3140).

GRI Source Map Citation

The GRI digital geologic-GIS map for Big Bend National Park, Texas (BIBE) was compiled from the following source:

Bohannon, R.G., 2011, Geologic Map of the Chisos Mountains, Big Bend National Park, Texas, U.S. Geological Survey Scientific Investigations Map 3140, 1:50,000 scale. (*GRI Source Map ID 3140*)

This U.S Geological Survey source publication is available on-line at: http://pubs.usgs.gov/sim/3140/.

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

Geologic Map of the Chisos Mountains, Big Bend National Park

Radiometric Age Determinations

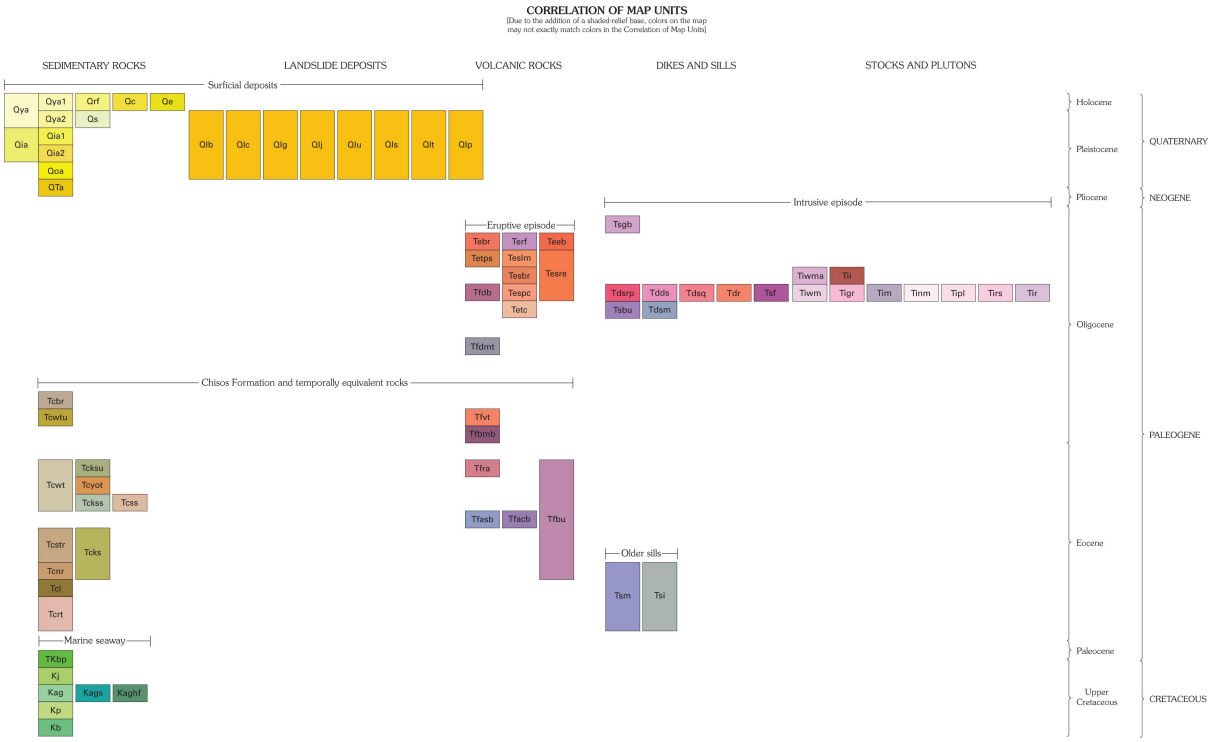
Table 1. Radiometric age determinations of select rocks in the Chisos Mountains.

[Ar/Ar refers to $^{40}Ar/^{39}Ar$ method of isotopic dating and SHRMP refers to senstive high resolution ion microprobe technique for uranium-lead dating of zircon. MapX is Universal Transverse Mercator NAD 27 horizontal position in meters, and MapY is vertical position. Data supplied by Dan Miggins, USGS written commun., 2008.]

Number	Unit	Age (Ma)	Method	Sample	MapX	MapY
1	Terf	32.11 ± 0.11	Ar/Ar	17DM-5-1-03	664884	3236530
2	Tdsrp	32.12 ± 0.10	Ar/Ar	16DM-5-1-03	669644	3236517
3	Tesbr	32.11 ± 0.23	Ar/Ar	32DM-5-4-03	669318	3238420
4	Tesbr	32.23 ± 0.07	Ar/Ar	131DM-2-11-05	668923	3239649
5	Tesbr	32.21 ±0.05	Ar/Ar	132DM-2-11-05	668945	3239603
6	Tesbr	31.93 ± 0.13	Ar/Ar	TPC-407	664672	3235973
7	Tesbr	32.43 ± 0.29	Ar/Ar	TPC-414	664708	3236872
8	Terf	32.03 ± 0.10	Ar/Ar	TPC-315	666268	3238853
9	Teeb	29.5 ± 0.07	Ar/Ar	4BS11.3.05	662742	3230020
10	Tdsq	29	Ar/Ar	2BS22.1.05	662419	3232023
11	Tsbu	31	Ar/Ar	4BS22.1.05	663815	3231737
12	Tetc	32.1 ± 0.3	Ar/Ar	144DM-3-12-05	658849	3233872
13	Tdsrp	41.6 ± 0.4	SHRMP	75DM	677043	3243161
14	Tsf	32.3 ± 0.3	SHRMP	EC43 (G-11)	671934	3231401
15	Kags	81.7 ± 1.0	SHRMP	04LS07	667265	3230394
16	Kags	76.8 ± 0.7	SHRMP	04LS06a	667008	3231129
17	Tcyot	41.4 ± 0.5	SHRMP	6DM	659903	3233103
18	Terf	32.3 ± 0.4	SHRMP	16DM-5-1-03	664713	3236435
19	Tdsrp	32.6 ± 0.6	SHRMP	33DM-5-4-30	675552	3237371
20	Tinm	31.5 ± 0.3	SHRMP	128DM	676885	3237714
21	Tiwm	32.4 ± 0.3	SHRMP	138DM	662955	3239942
22	Tiwm	32.7 ± 0.3	SHRMP	139DM	662388	3240360
23	Teeb	32.3 ± 0.7	SHRMP	3BS	662689	3229967
24	Tfvt	32.1 ± 0.3	Ar/Ar	144DM-3-12-05	658880	3233689
25	Tsgb	26-30	SHRMP	04LS09	668244	3229679
26	Tfasb	40.38-43.39	Ar/Ar	2BS27.203	658352	3236702
27	Tfbmb	33.74 ± 0.12	Ar/Ar	153DM-3-18-05	659168	3231740

Extracted from the pdf pamphlet for SIM 3140. This table, as well as additional information pertaining the the table can be found with the U.S Geological Survey source publication, available on-line, at: http://pubs.usgs.gov/sim/3140/

Correlation of Map Units



Extracted from: (SIM 3140).

Location Map

Extracted from: (SIM 3140).

Map Explanation

MAP EXPLANATION

Contact

Dike, leucocratic—Light colored, mostly rhyolite and rhyodacite porphyry

Dike, intermediate—Dark colored, mostly andesite and dacite

Fault—Dashed where approximately located; dotted where concealed

Mass movement sole and related faults—Dotted where concealed

Anticline

Syncline

Strike and dip of bedding

50 **Inclined**

Horizontal

Road, paved—Suitable for all vehicles

Road, service—Official use only

Trails

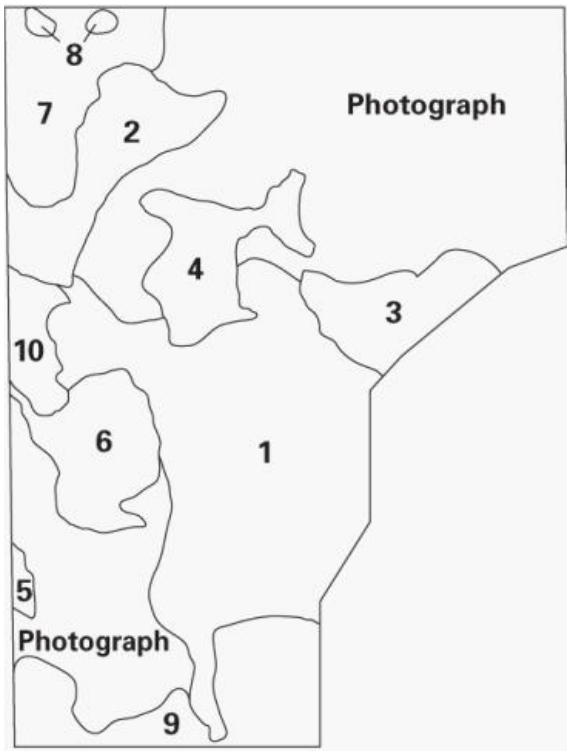
Dirt road—High clearance recommended

19 **Sample for age determination**—Showing sample number keyed to results reported in rock descriptions

Extracted from: (SIM 3140).

Support and Data Sources

SUPPORT AND DATA SOURCES



This map was produced under the partial auspices of the U.S. National Park Service (NPS). Cartography for roads and trails was provided by Geographic Information Specialists (GIS) at the NPS Park Headquarters. The geologic data come from a variety of sources and the map represents the work of several geologists from the U.S. Geological Survey (USGS), University of Texas at El Paso (UTEP), University of Texas at Austin (UTA) and Texas Tech University (TTU). All of the geology is primarily based on the author's interpretation of ortho-rectified USGS color-infared photogrammetry. This facilitated a uniform locational accuracy of geologic features to within 2 m through¬out the mapped area. Large parts of the map also benefited from field studies conducted by numerous geologists (see figure below). All of the surficial deposits (rocks of Quaternary age) have been studied to various degrees by Margaret Berry and Van Williams (both USGS). Dan Miggins (USGS and UTEP) provided age and petrographic data for specific sites over much of the area. Areas 1 and 2 - the author (USGS), areas 3, 4, and 5 - Kenzie Turner and the author (both USGS), area 6- Robert Scott, Lawrence Snee, and Kenzie Turner (all USGS), area 7 -Tom Lehman (UTA and TTU), area 8 - Robert Scott (USGS), area 9 - Ric Page (USGS), and area 10 - Dan Barker (retired) and Robert Scott (USGS). Other parts of the map (photograph) have not been field checked.

Extracted from: (SIM 3140).

GRI Digital Data Credits

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

The information contained here was compiled to accompany the digital geologic-GIS map(s) and other digital data for Big Bend National Park, Texas (BIBE) developed by Andrea Croskrey (NPS GRD).

GRI review and finalization by Stephanie O'Meara.

GRI program coordination and scoping provided by Bruce Heise and Tim Connors (NPS GRD, Lakewood, Colorado).