Big Bend National Park Field trip Guide

University of Houston

Department of Earth and Atmospheric Sciences

March 9th – March 15th 2013

Big Bend Field trip for Field Methods class (GEOL 3460), spring 2012

Instructor: Dr. Paul Mann

Our trip to Big Bend is critical to your training in field geology. We want to remind you of two important policies that apply to this trip and that you would need to agree to when you sign the official UH form “Release and indemnification form”. This form has you agree that you will follow all UH policies regarding your conduct on field trips.

1) **Safety is paramount.** A student participant who willfully or negligently endangers the safety and welfare of himself/herself or another will be required to leave the field trip and return to Houston at their own expense.

2) **All field trips in the UH Earth and Atmospheric Sciences Department are alcohol and drug-free.** This means that participants who go on this field trip and sign the mandatory UH release and indemnification form agree not to consume alcoholic beverages of any kind or to use illegal substances for the duration of the field trip, including during the evenings and in the vans while traveling to and from Big Bend park.To avoid problems, do not bring alcoholic beverages and/or illegal substances on this trip. Violators will be required to terminate the field course and return to Houston at their own expense.

NOTE: Big Bend Park is located in a politically sensitive and heavily patrolled international border region with Mexico. We will be stopped by US immigration and border patrol officers while on this trip. Everyone who is part of the trip, traveling in the vans, and is **NOT** a US citizen would need to bring with them on the trip their: F-1 visa, I-20 form, and valid passport. US resident aliens would need to bring their their US resident alien green card. US citizens would need a valid drivers license or passport. Not having this information with you on your person, could delay your van and all of its occupants for hours while US immigration officials confirm your identity and visa status.

Field Methods

Big Bend National Park

Field Mapping Project

March 9-15th, 2013

The purpose of this trip is to construct a geologic map and a measured stratigraphic column that is useful in addressing two questions:

1) What was the depositional environment of the sedimentary rocks exposed in the study area?
2) What is the nature of magmatism? (composition, age, and type of intrusive bodies)
3) What type of folds are exposed in the study area and when did they form?
4) What is the sequence of events *(geologic history)* archived in the Dagger Flat area?

Before we leave Big Bend you are expected to turn in a: (1) colored, inked version of your geologic map, and (2) your notebook (containing your stratigraphic column and answers to the questions listed above).

Stratigraphic Column

You will measure and describe a representative stratigraphic section in the field area. Using your Jacob staff, you will measure thicknesses and make lithologic descriptions for every 1.5 meter interval. Descriptions should follow the guidelines outlined in Coe.

Geological Map

The following geologic features must be shown on your geologic map:

1. Contacts between rock units (Quaternary alluvium (Qal), Quaternary older alluvium (Qoal), Quaternary landslides (Qls), Tertiary igneous rocks (Tig), Cretaceous Boquillas Formation (Kbo), Cretaceous Buda Formation (Kbu), Cretaceous Del Rio Formation (Kdr), Cretaceous Santa Elena Formation (Kse) .
2. Attitude (strike and dip) of rock units.
3. Trend and plunge of small-scale folds.
4. Attitude of fractures and small-scale faults

Use the symbols outlined in Compton (Appendix 7) to depict the features listed above.

**You should strive for 3 bedding attitudes per square inch, 20 fractures (in total). The quantity of fold and fault measurements will be determined on the first day of mapping.*

The geologic map must contain a legend which explains the geologic symbols present on the map and a brief description of the rock units.

- Qal – Yellow
- Qsl - Golden Yellow
- Qf - Yellow Orange
- Tig – Red
- Kbo – Green
- kbu – Pink
- kdr – orange
- Kse – blue
- Ksp – brown
- Kdc – grey
- Ktc - aqua green

Field Final

On the 5th day of our trip you will take an independent field mapping exam. The location will be disclosed to you that morning. During the exam you will be asked to make a complete geologic map of the area in 4 hours. The map will be turned in before we head back to camp.

Daily Itinerary

Daily Itinerary

March 9th – Arrive at Stillwell Ranch around 6pm. You can pick up fast food in Fort Stockton for dinner or cook at camp.

March 10th – Eat Breakfast. Be prepared to leave camp by 8:15am. All day will be spent in the field. Lunch in the field. Vans will leave the field at 6pm..

March 11th –Eat Breakfast. Be prepared to leave camp by 8:15am. Lunch in the field. Vans will leave the field at 5:30pm.

March 12th –same routine as previous day.

March 13th –same routine as previous day.

March 14th –Field final day. You will have 4 hours to complete mapping of the designated area. After the exam we will take a driving tour into central Big Bend, stopping for gas and snacks, a visit to the National Park Visitor Center, and make a couple scenic stops.

March 15th – Drive home (10 hours). ETA to Houston is 7pm.

Geologic Report

You will use your geologic map to address the following two questions:

1) What is the sequence of events *(geologic history)* with respect to sedimentation, faulting and magmatism?
2) What type of faults are present, which way did they move, and how far? *(i.e., the name, the trend of the striations, and net slip).*

Guidelines and due date for this report are forthcoming.

Travel Instructions from Houston to Big Bend National Park –

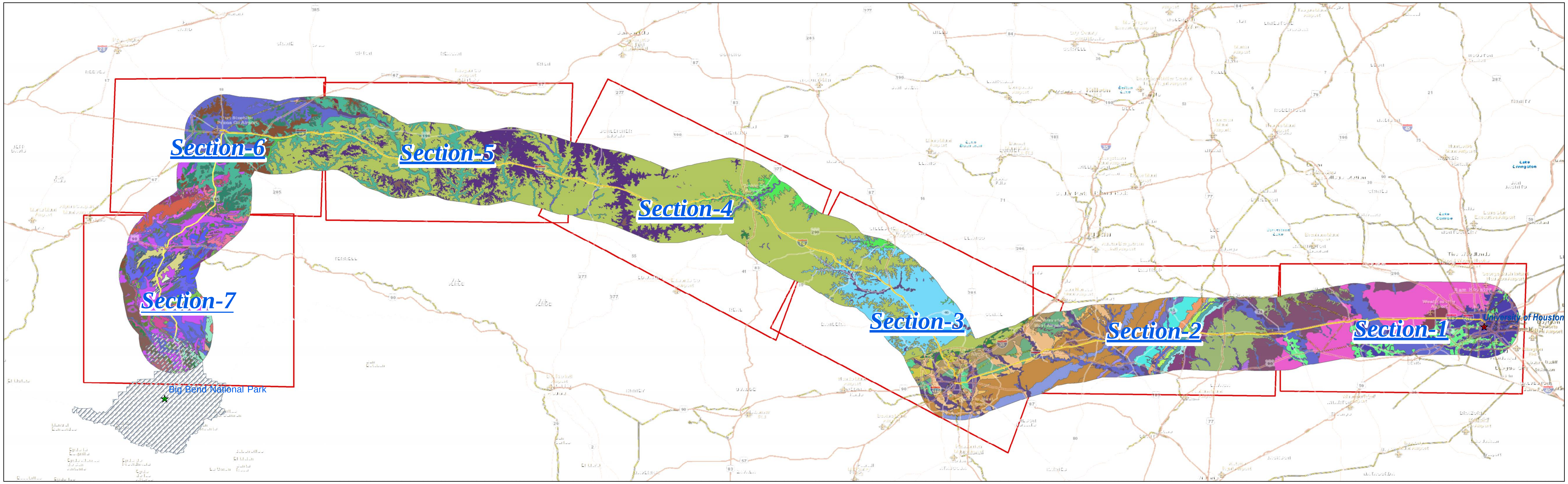
BUCKLE UP!

- Depart Houston at 6am. Houston to Exit for Kerrville (Highway 16) ~259 miles from Houston. Meet at the Chevron station on the southside of the Interstate 10. *Fill up your tank*. (4 hours)

- Kerrville to Fort Stockton. Meet at the Food Basket on Dickenson Blvd (the main drag – business route) ~252 miles from Kerrville (3.5 hours). Address is 1300 W. Dickenson Blvd. *Fill up your tank before you go to the grocery store*.

- Fort Stockton to Stillwell Ranch (~100 miles). Take highway 385 south from Fort Stockton. Head toward Marathon (~55 miles from Fort Stockton). Continue toward Big Bend on highway 385. Make left on Ranch Rd. 2627 to Stillwell Ranch. This turn is ~40 miles past Marathon.

Mann’s Cell Phone Number 512-809-2843



Legend

Geological Features

- ■ Unknown Feature

Unit Name

- ■
- ■ Aguja Formation
- ■ Anacacho Limestone
- ■ Antlers Sand
- ■ Austin Chalk
- ■ Beaumont Formation, areas predominantly clay
- ■ Beaumont Formation, areas predominantly sand
- ■ Bissett Conglomerate
- ■ Black Gap area volcanic rocks
- ■ Black Peaks Member of Tornillo Formation
- ■ Bouquillas Formation
- ■ Buda Limestone
- ■ Buda Limestone and Del Rio Clay, undivided
- ■ Caballos Novaculite and Maravillas Chert, undivided
- ■ Cadell Formation
- ■ Capitan Formation
- ■ Carizzo Sand
- ■ Catahoula Formation
- ■ Cathederal Mountain Formation
- ■ Cook Mountain Formation
- ■ Devils Graveyard volcanic rocks
- ■ Dimple Formation
- ■ Duff Formation, Cottonwood Springs Basalt, Potato Hill Andesite,
- ■ Eagle Ford Formation
- ■ Edwards Limestone
- ■ Finlay Limestone
- ■ Fleming Formation
- ■ Fredericksberg Group and Maxon Sandstone, undivided
- ■ Fredericksburg Group
- ■ Gaptank Formation
- ■ Gatuna Formation
- ■ Glen Rose Limestone
- ■ Goliad Formation
- ■ Gorman Formation
- ■ Hannold Hill Member of Tornillo Formation
- ■ Haymond Formation
- ■ Hensell Sand
- ■ Javelina Member of Tornillo Formation
- ■ Lenox Hills and Neal Ranch Formations, undivided
- ■ Leona Formation
- ■ Lissie Formation
- ■ Manning Formation
- ■ Maxon Sandstone and Glen Rose Limestone, undivided
- ■ Midway Group, undivided
- ■ Navarro Group and Marlbrook Marl, undivided
- ■ Oakville Sandstone
- ■ Oligocene intrusive rocks
- ■ Pecan Gap Chalk
- ■ Pen Formation
- ■ Permian rocks, undivided Quaternary
- ■ deposit, undivided Quaternary-Tertiary
- ■ deposits, undivided
- ■ Riley Formation showing Lion Mountain Sandstone...
- ■ Santa Elena Limestone
- ■ Skinner Ranch and Hess Formations, undivided
- ■ Smithwick Formation
- ■ Sue Peaks Formation, Del Carmen Limestone...
- ■ Terrace deposits
- ■ Tertiary intrusive rocks, undivided
- ■ Tesnus Formation
- ■ Tessey Limestone
- ■ Uvalde Gravel
- ■ Washita Group
- ■ Washita and Fredericksburg Groups, undivided
- ■ Weches Formation
- ■ Wellborn Formation
- ■ Whitsett Formation
- ■ Willis Formation
- ■ Woods Hollow Shale, Fort Pena Formation, Alsate Shale, Marathon Limestone
- ■ Word Formation
- ■ Yegua Formation
- ■ alluvial fan deposits
- ■ alluvium
- ■ caliche deposits
- ■ fill and spoil
- ■ gypsite deposits
- ■ land slide deposits
- ■ older alluvial deposits
- ■ playa deposits
- ■ sand sheet deposits
- ■ water
- — Faults

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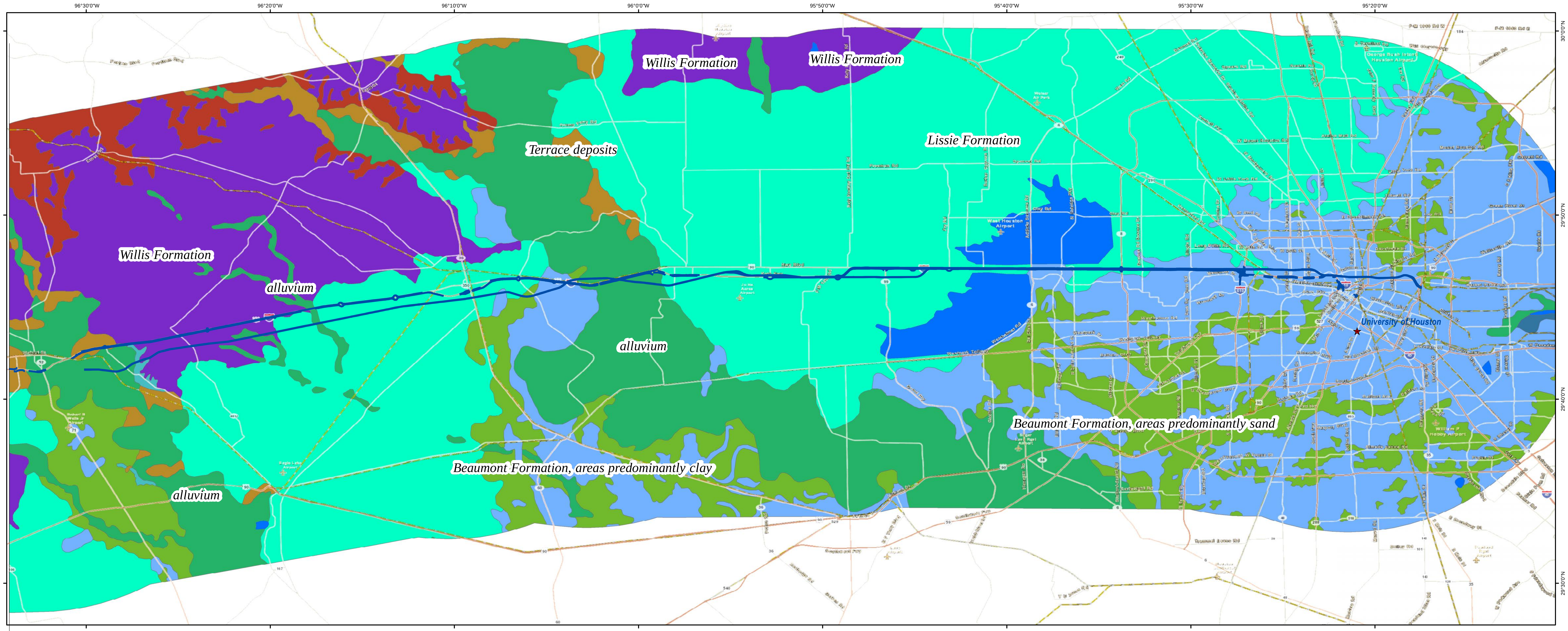
Simplifed Geological Map Houston
Big Bend National Park

Map showing Geological Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective.
Data from USGS were used to develop the map.
USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S

0 25 50 100 150 200
Miles



Legend

— Faults

GEOLOGICAL FORMATIONS

UNIT NAME & AGE

🟦 NAME: Beaumont Formation, areas predominantly clay --- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene-Late

🟩 NAME: Beaumont Formation, areas predominantly sand --- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene-Late

🟥 NAME: Fleming Formation --- AGE: Phanerozoic | Cenozoic | Tertiary | Miocene

🟦 NAME: Goliad Formation --- AGE: Phanerozoic | Cenozoic | Tertiary | Miocene

🟩 NAME: Lissie Formation --- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene-Middle

🟫 NAME:Terrace deposits --- AGE Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene

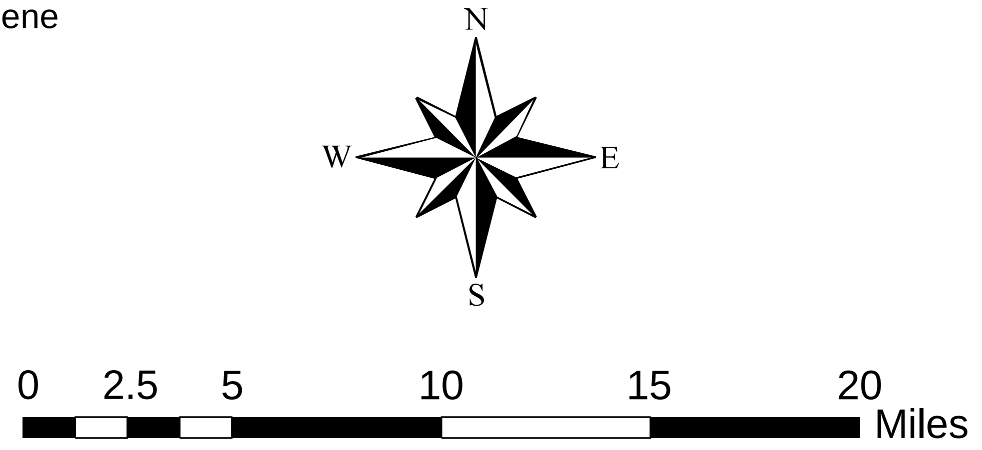
🟪 NAME:Willis Formation --- AGE: Phanerozoic | Cenozoic | Tertiary | Pliocene

🟩 NAME: alluvium --- AGE: Phanerozoic | Cenozoic | Quaternary | Holocene

🟦 NAME: fill and spoil --- AGE: Phanerozoic | Cenozoic | Quaternary | Holocene

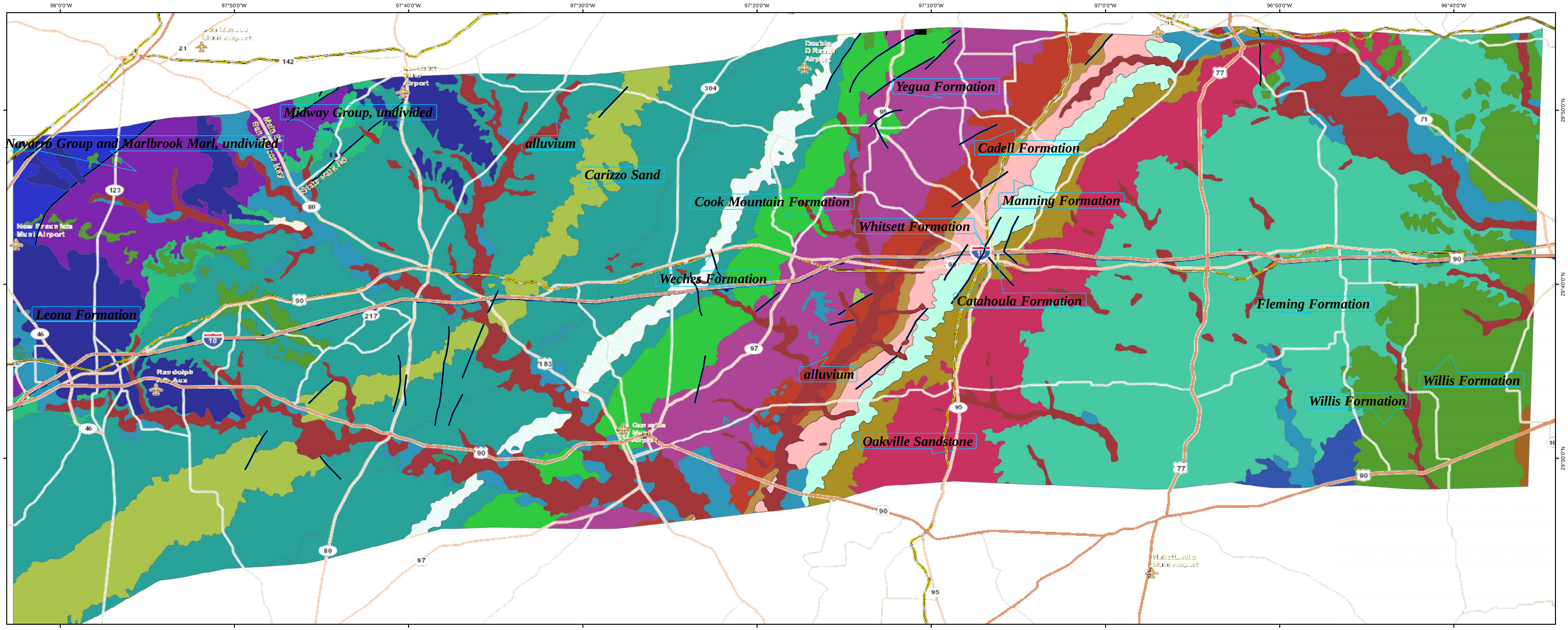
🟦 water

Simplifed Geological Map
Houston - Big Bend National Park Route
Section-1-



Map showing Geological Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective. Data from USGS were used to develop the map.

USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S



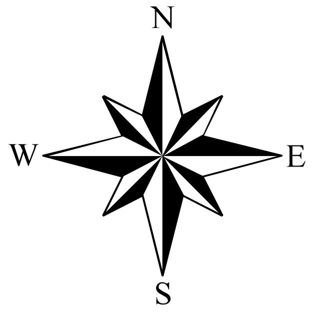
Legend

— Faults

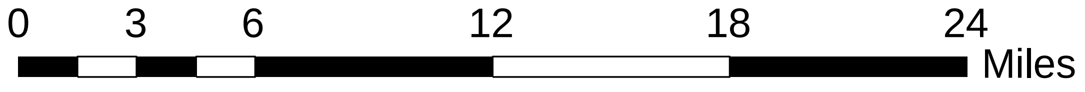
GEOLOGICAL FEATURES

UNIT NAME & AGE

🟩	NAME: --- AGE:
🟪	NAME:Austin Chalk --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟥	NAME:Cadell Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟩	NAME:Carizzo Sand --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟫	NAME:Catahoula Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Oligocene
🟩	NAME:Cook Mountain Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟦	NAME:Eagle Ford Formation --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
▨	NAME:Edwards Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
🟩	NAME:Fleming Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Miocene
🟦	NAME:Goliad Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Miocene
🟦	NAME:Leona Formation --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene
🟫	NAME:Lissie Formation --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene-Middle
🟥	NAME:Manning Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟩	NAME:Midway Group, undivided --- AGE:Phanerozoic | Cenozoic | Tertiary | Paleocene
🟪	NAME:Navarro Group and Marlbrook Marl, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟥	NAME:Oakville Sandstone --- AGE:Phanerozoic | Cenozoic | Tertiary | Miocene
🟦	NAME:Pecan Gap Chalk --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟦	NAME:Terrace deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
▨	NAME:Weches Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟫	NAME:Wellborn Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
🟩	NAME:Whitsett Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene Oligocene
🟩	NAME:Willis Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Pliocene
🟪	NAME:Yegua Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene-Middle
🟥	NAME:alluvium --- AGE:Phanerozoic | Cenozoic | Quaternary | Holocene
🟩	NAME:water --- AGE:None



Simplifed Geological Map
Houston - Big Bend National Park Route
Section-2-



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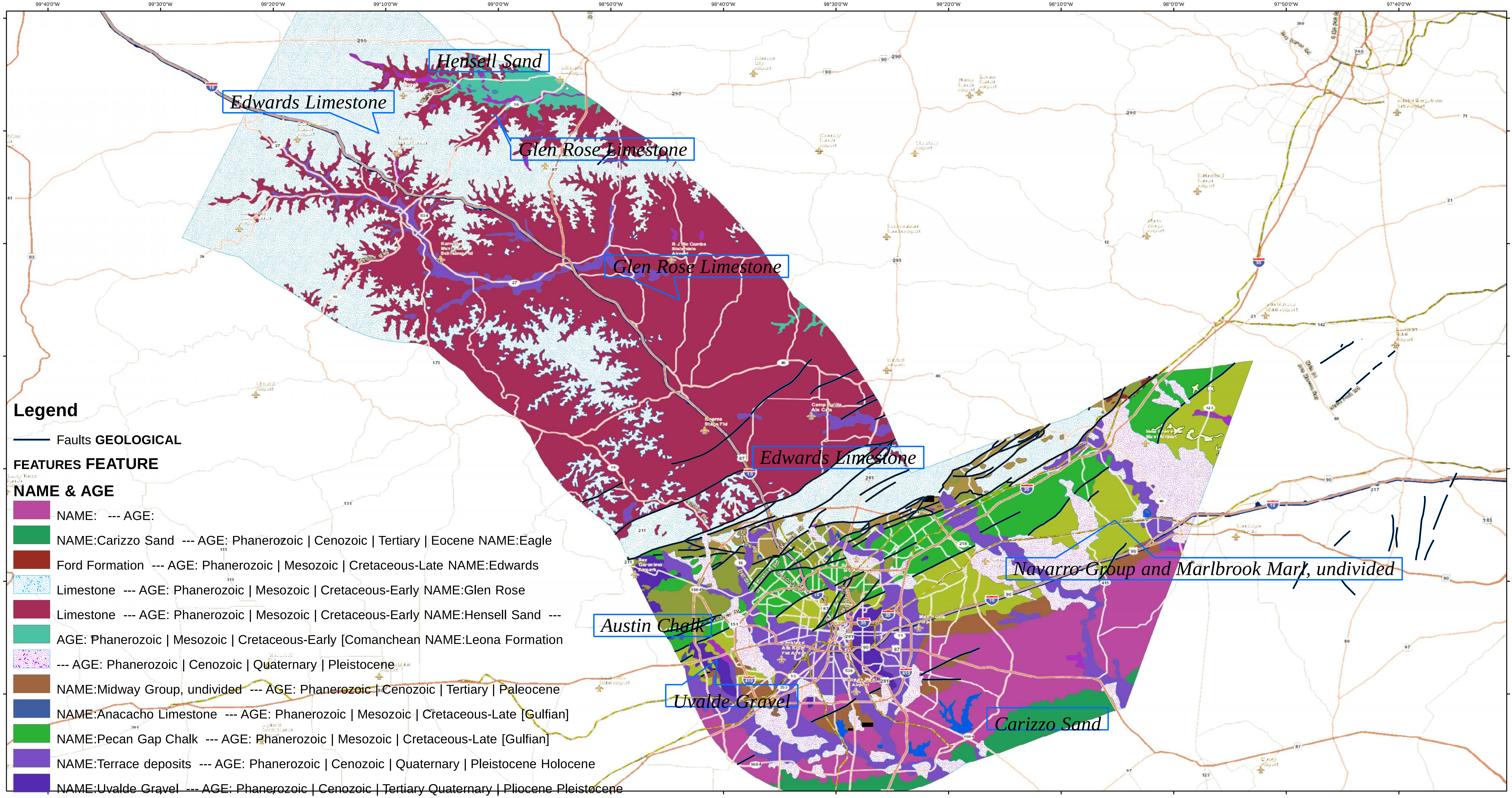

Legend

— Faults **GEOLOGICAL**

FEATURES **FEATURE**

NAME & AGE

🟪 NAME: --- AGE:
🟩 NAME:Carizzo Sand --- AGE: Phanerozoic | Cenozoic | Tertiary | Eocene NAME:Eagle
🟥 Ford Formation --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late NAME:Edwards
▨ Limestone --- AGE: Phanerozoic | Mesozoic | Cretaceous-Early NAME:Glen Rose
🟥 Limestone --- AGE: Phanerozoic | Mesozoic | Cretaceous-Early NAME:Hensell Sand ---
🟩 AGE: Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean NAME:Leona Formation
▨ --- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene
🟫 NAME:Midway Group, undivided --- AGE: Phanerozoic | Cenozoic | Tertiary | Paleocene
🟦 NAME:Anacacho Limestone --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟩 NAME:Pecan Gap Chalk --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟪 NAME:Terrace deposits --- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
🟪 NAME:Uvalde Gravel --- AGE: Phanerozoic | Cenozoic | Tertiary Quaternary | Pliocene Pleistocene
🟨 NAME:Willis Formation --- AGE: Phanerozoic | Cenozoic | Tertiary | Pliocene
🟪 NAME:alluvium --- AGE: Phanerozoic | Cenozoic | Quaternary | Holocene NAME:Austin Chalk
🟩 --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian] NAME:caliche deposits --- AGE:
⬜ Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
▨ NAME:Buda Limestone and Del Rio Clay, undivided --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late
🟦 NAME:water --- AGE: None
🟨 NAME:Navarro Group and Marlbrook Marl, undivided --- AGE: Phanerozoic | Mesozoic | Cretaceous-Late [Gulfian]
🟦 NAME:Riley Formation showing Lion Mountain Sandstone and Cap Mountain Limestone Members, undivided --- AGE: Phanerozoic | Paleozoic | Cambrian-Middle

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Simplifed Geological Map
Houston - Big Bend National Park Route
Section-3-

0 5 10 20 30 40
Miles

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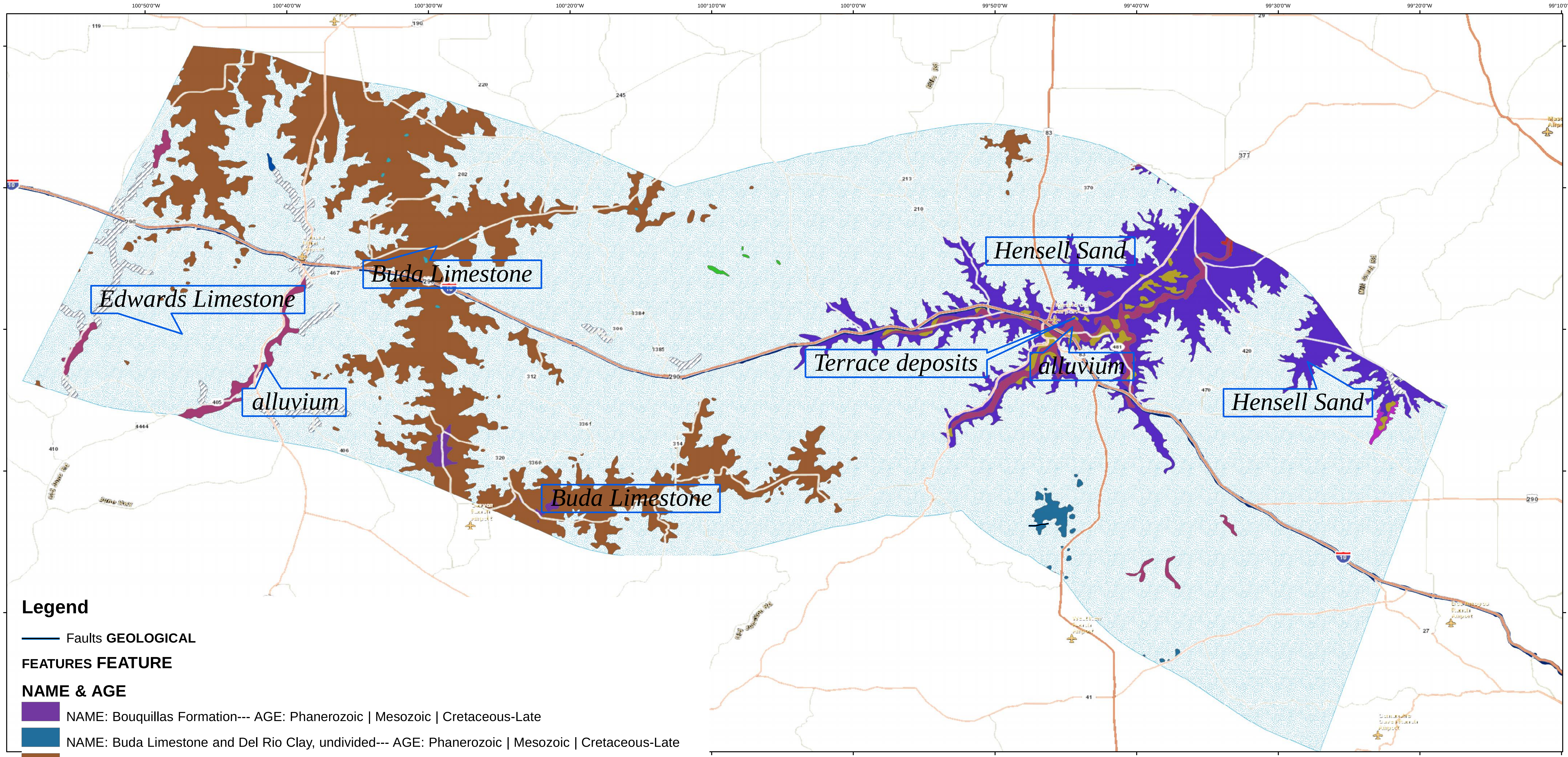
Map showing Geological Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective. Data from USGS were used to develop the map.
USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S



Legend

Faults **GEOLOGICAL**

FEATURES FEATURE

NAME & AGE

- 🟪 NAME: Bouquillas Formation--- AGE: Phanerozoic | Mesozoic | Cretaceous-Late
- 🟦 NAME: Buda Limestone and Del Rio Clay, undivided--- AGE: Phanerozoic | Mesozoic | Cretaceous-Late
- 🟫 NAME: Buda Limestone--- AGE: Phanerozoic | Mesozoic | Cretaceous-Early
- ▨ NAME: Edwards Limestone--- AGE: Phanerozoic | Mesozoic | Cretaceous-Early
- 🟪 NAME: Glen Rose Limestone--- AGE: Phanerozoic | Mesozoic | Cretaceous-Early
- 🟩 NAME: Gorman Formation--- AGE: Phanerozoic | Paleozoic| Ordovician-Early
- 🟪 NAME: Hensell Sand--- AGE: Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean
- 🟩 NAME: Permian rocks, undivided--- AGE: Phanerozoic | Paleozoic | Permian
- ▨ NAME: Quaternary deposit, undivided--- AGE: Phanerozoic | Cenozoic | Quaternary
- 🟥 NAME: Smithwick Formation--- AGE: Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Middle [Atoka]
- 🟨 NAME: Terrace deposits--- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟥 NAME: alluvium--- AGE: Phanerozoic | Cenozoic | Quaternary | Holocene
- 🟦 NAME: playa deposits--- AGE: Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟦 NAME: water--- AGE: None

0 4 8 16 24 32 Miles

N W E S

Simplifed Geological Map
Houston - Big Bend National Park Route
Section-4-

Map showing Geological Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective. Data from USGS were used to develop the map.
USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S

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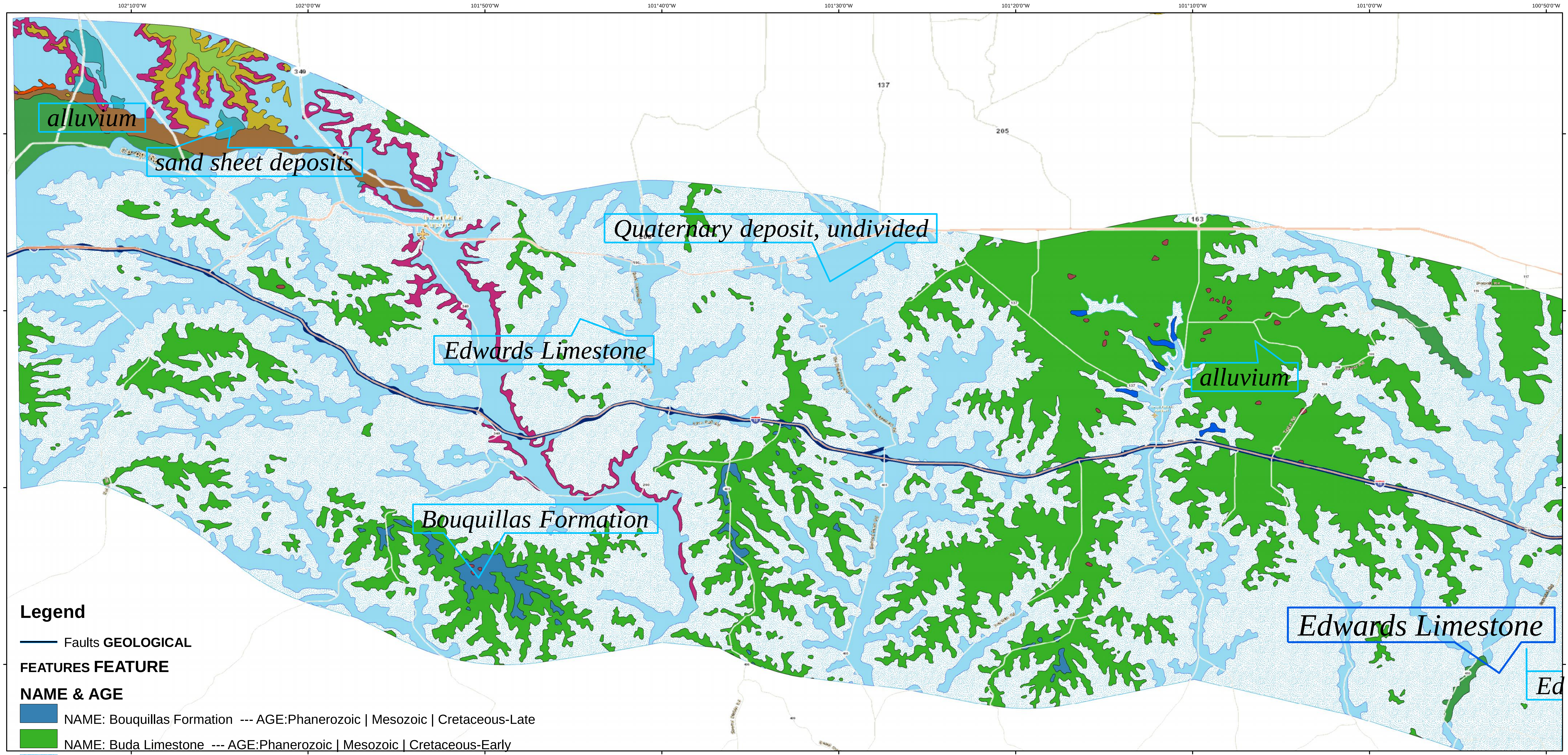

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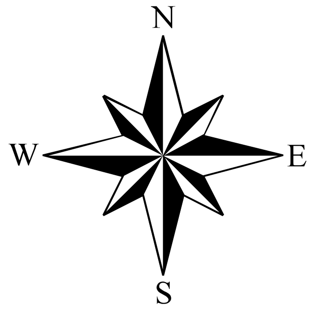
Faults **GEOLOGICAL**

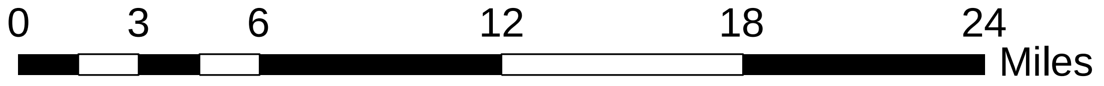
FEATURES FEATURE

NAME & AGE

- 🟦 NAME: Bouquillas Formation --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
- 🟩 NAME: Buda Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
- ▨ NAME: Edwards Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
- 🟪 NAME: Finlay Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean Albian]
- 🟨 NAME: Fredericksburg Group --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
- 🟧 NAME: Gatuna Formation --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene-Middle(?)
- 🟥 NAME: Maxon Sandstone and Glen Rose Limestone, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
- 🟦 NAME: Quaternary deposit, undivided --- AGE:Phanerozoic | Cenozoic | Quaternary
- 🟫 NAME: Terrace deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟩 NAME: Washita Group --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean] Cretaceous-Late
- 🟩 NAME: alluvium --- AGE:Phanerozoic | Cenozoic | Quaternary | Holocene
- 🟥 NAME: playa deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟦 NAME: sand sheet deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Holocene
- 🟦 NAME: water --- AGE:None



Simplifed Geological Map
Houston - Big Bend National Park Route
Section-5-



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Map showing Geological Features between Houston City
and Big Bend National Park. The purpose of this
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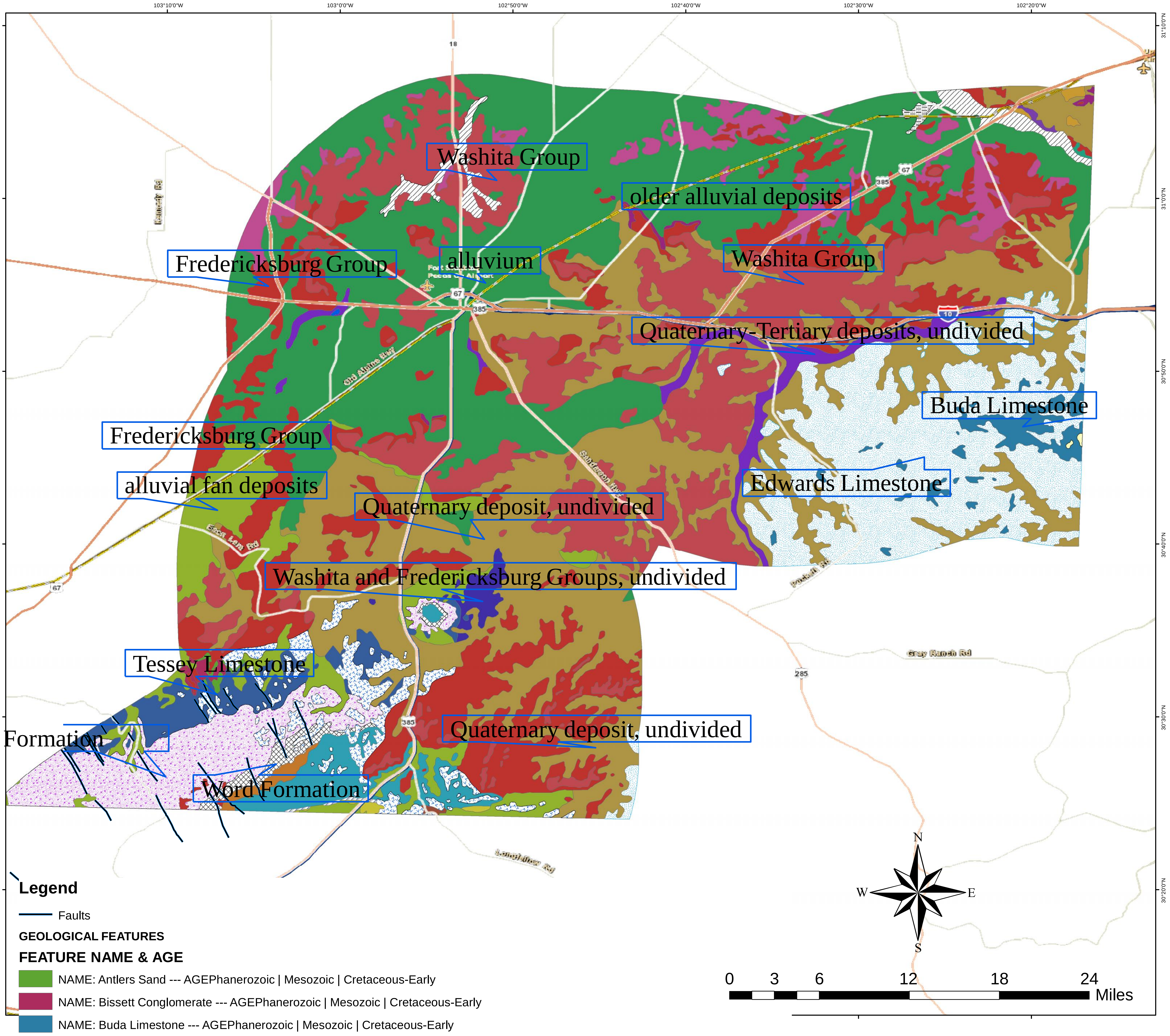
USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S



Legend

— Faults

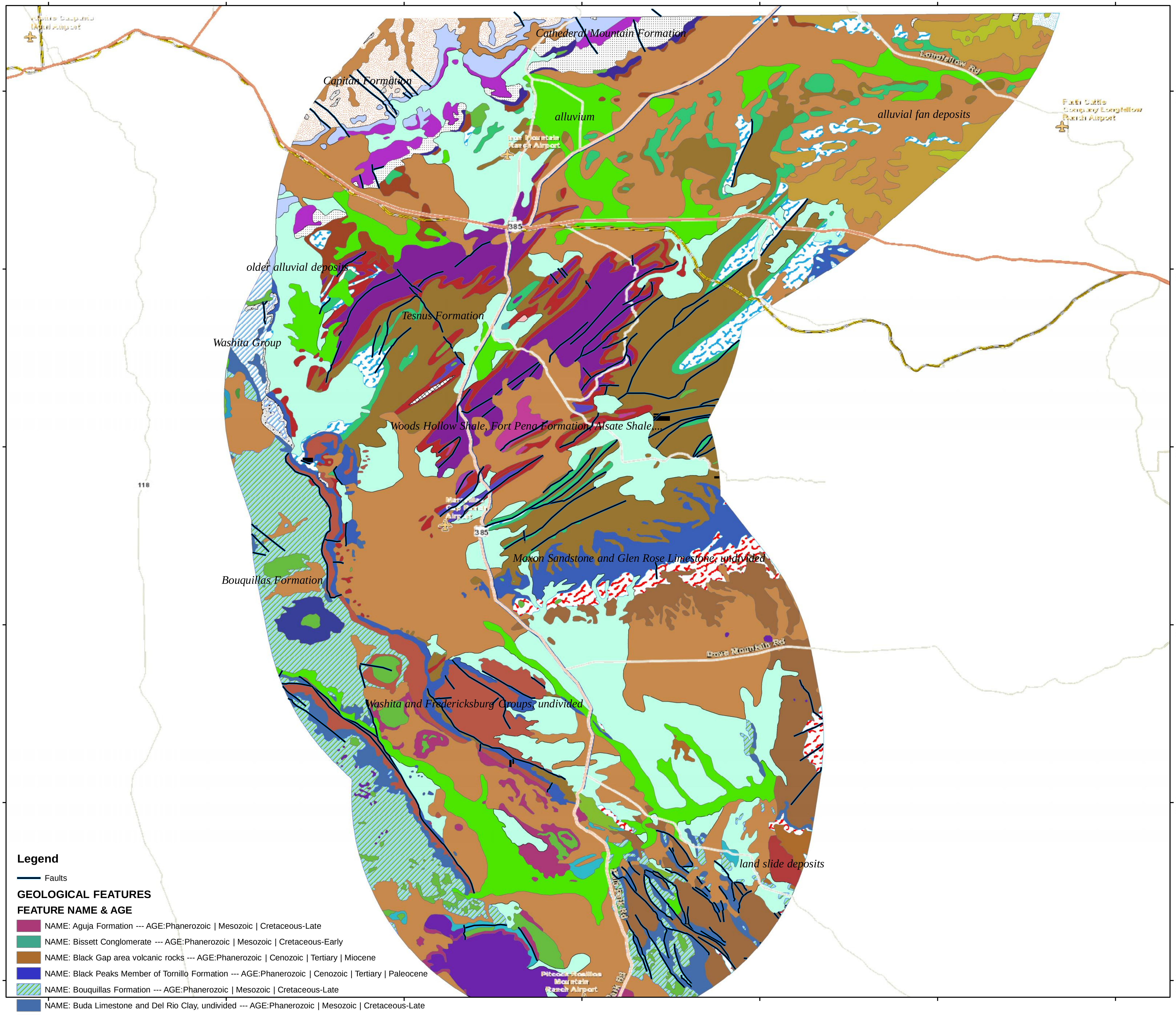
GEOLOGICAL FEATURES

FEATURE NAME & AGE

- 🟩 NAME: Antlers Sand --- AGEPhanerozoic | Mesozoic | Cretaceous-Early
- 🟥 NAME: Bissett Conglomerate --- AGEPhanerozoic | Mesozoic | Cretaceous-Early
- 🟦 NAME: Buda Limestone --- AGEPhanerozoic | Mesozoic | Cretaceous-Early
- ▨ NAME: Capitan Formation --- AGEPhanerozoic | Paleozoic | Permian [Guadalupe]
- 🟧 NAME: Cathederal Mountain Formation --- AGEPhanerozoic | Paleozoic | Permian [Leonard]
- ▨ NAME: Edwards Limestone --- AGEPhanerozoic | Mesozoic | Cretaceous-Early
- 🟩 NAME: Finlay Limestone --- AGEPhanerozoic | Mesozoic | Cretaceous-Early [Comanchean Albian]
- ▨ NAME: Fredericksberg Group and Maxon Sandstone, undivided --- AGEPhanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
- 🟥 NAME: Fredericksburg Group --- AGEPhanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
- 🟨 NAME: Gaptank Formation --- AGEPhanerozoic | Paleozoic | Carboniferous Pennsylvanian-Early Pennsylvanian-Middle Pennsylvanian-Late
- 🟪 NAME: Gatuna Formation --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene-Middle(?)
- 🟫 NAME: Haymond Formation --- AGEPhanerozoic | Paleozoic | Carboniferous Pennsylvanian-Early
- ▨ NAME: Lenox Hills and Neal Ranch Formations, undivided --- AGEPhanerozoic | Paleozoic | Permian [Wolfcamp]
- 🟪 NAME: Maxon Sandstone and Glen Rose Limestone, undivided --- AGEPhanerozoic | Mesozoic | Cretaceous-Early
- 🟫 NAME: Quaternary deposit, undivided --- AGEPhanerozoic | Cenozoic | Quaternary
- 🟪 NAME: Quaternary-Tertiary deposits, undivided --- AGEPhanerozoic | Cenozoic | Tertiary Quaternary | Pliocene Pleistocene
- 🟦 NAME: Skinner Ranch and Hess Formations, undivided --- AGEPhanerozoic | Paleozoic | Permian [Wolfcamp]
- ▨ NAME: Terrace deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟦 NAME: Tessey Limestone --- AGEPhanerozoic | Paleozoic | Permian [Ochoa]
- 🟥 NAME: Washita Group --- AGEPhanerozoic | Mesozoic | Cretaceous-Early [Comanchean] Cretaceous-Late
- 🟦 NAME: Washita and Fredericksburg Groups, undivided --- AGEPhanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
- ▨ NAME: Word Formation --- AGEPhanerozoic | Paleozoic | Permian [Guadalupe]
- 🟩 NAME: alluvial fan deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟩 NAME: alluvium --- AGEPhanerozoic | Cenozoic | Quaternary | Holocene
- ▨ NAME: gypsite deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟪 NAME: older alluvial deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene
- 🟨 NAME: playa deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
- 🟧 NAME: sand sheet deposits --- AGEPhanerozoic | Cenozoic | Quaternary | Holocene
- 🟦 NAME: water --- AGENone

Simplifed Geological Map
Houston - Big Bend National Park Route
Section-6-

logical Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective. Data from USGS were used to develop the map. USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S



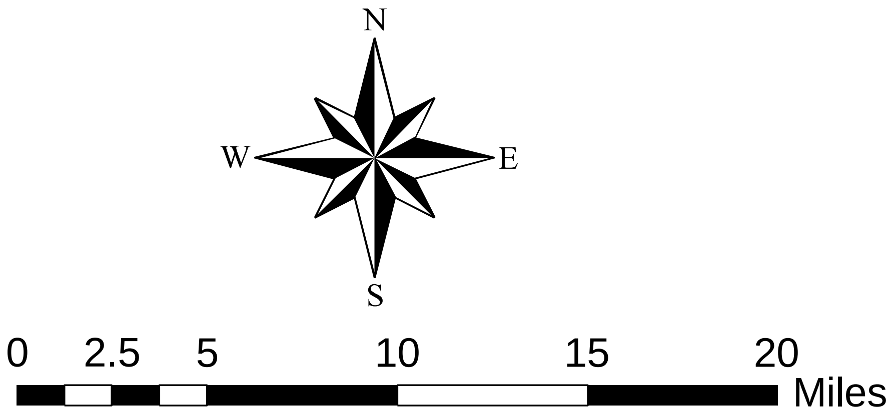
Legend

— Faults

GEOLOGICAL FEATURES

FEATURE NAME & AGE

■ NAME: Aguja Formation --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
■ NAME: Bissett Conglomerate --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
■ NAME: Black Gap area volcanic rocks --- AGE:Phanerozoic | Cenozoic | Tertiary | Miocene
■ NAME: Black Peaks Member of Tornillo Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Paleocene
▨ NAME: Bouquillas Formation --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
■ NAME: Buda Limestone and Del Rio Clay, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
■ NAME: Caballos Novaculite and Maravillas Chert, undivided --- AGE:Phanerozoic | Paleozoic | Ordovician-Late Devonian Carboniferous Mississippian
▨ NAME: Capitan Formation --- AGE:Phanerozoic | Paleozoic | Permian [Guadalupe]
■ NAME: Cathederal Mountain Formation --- AGE:Phanerozoic | Paleozoic | Permian [Leonard]
■ NAME: Devils Graveyard volcanic rocks --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene Oligocene
■ NAME: Dimple Formation --- AGE:Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Early
■ NAME: Duff Formation , Cottonwood Springs Basalt,.. --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene-Late Oligocene-Early
■ NAME: Duff Formation, Cottonwood Springs Basalt, Potato Hill Andesite... --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene-Late Oligocene-Early
▨ NAME: Edwards Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
■ NAME: Fredericksberg Group and Maxon Sandstone, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
▨ NAME: Fredericksburg Group --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
■ NAME: Gaptank Formation --- AGE:Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Early Pennsylvanian-Middle Pennsylvanian-Late
■ NAME: Glen Rose Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
■ NAME: Hannold Hill Member of Tornillo Formation --- AGE:Phanerozoic | Cenozoic | Tertiary | Eocene
▨ NAME: Haymond Formation --- AGE:Phanerozoic | Paleozoic | Carboniferous Pennsylvanian-Early
▨ NAME: Javelina Member of Tornillo Formation --- AGE:Phanerozoic | Mesozoic Cenozoic | Cretaceous-Late Tertiary | Paleocene
■ NAME: Lenox Hills and Neal Ranch Formations, undivided --- AGE:Phanerozoic | Paleozoic | Permian [Wolfcamp]
■ NAME: Maxon Sandstone and Glen Rose Limestone, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
■ NAME: Oligocene intrusive rocks --- AGE:Phanerozoic | Cenozoic | Tertiary | Oligocene
■ NAME: Pen Formation --- AGE:Phanerozoic | Mesozoic | Cretaceous-Late
■ NAME: Quaternary deposit, undivided --- AGE:Phanerozoic | Cenozoic | Quaternary
■ NAME: Santa Elena Limestone --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
▨ NAME: Skinner Ranch and Hess Formations, undivided --- AGE:Phanerozoic | Paleozoic | Permian [Wolfcamp]
▨ NAME: Sue Peaks Formation, Del Carmen Limestone, and Telephone Canyon Formation, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early
■ NAME: Tertiary intrusive rocks, undivided --- AGE:Phanerozoic | Cenozoic | Tertiary
■ NAME: Tesnus Formation --- AGE:Phanerozoic | Paleozoic | Carboniferous Mississippian-Late Pennsylvanian-Early
▨ NAME: Washita Group --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean] Cretaceous-Late
■ NAME: Washita and Fredericksburg Groups, undivided --- AGE:Phanerozoic | Mesozoic | Cretaceous-Early [Comanchean]
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate ... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale, .. --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale, ... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale, Marathon Limestone, and Dagger Flat Sandstone, undivided --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale,... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
▨ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale,.... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation, Alsate Shale.... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Woods Hollow Shale, Fort Pena Formation... --- AGE:Phanerozoic | Paleozoic| Cambrian Ordovician
■ NAME: Word Formation --- AGE:Phanerozoic | Paleozoic | Permian [Guadalupe]
■ NAME: alluvial fan deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
■ NAME: alluvium --- AGE:Phanerozoic | Cenozoic | Quaternary | Holocene
■ NAME: land slide deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene Holocene
■ NAME: older alluvial deposits --- AGE:Phanerozoic | Cenozoic | Quaternary | Pleistocene



Simplifed Geological Map
Houston - Big Bend National Park Route
Section-7-

Map showing Geological Features between Houston City and Big Bend National Park. The purpose of this map is to enable UH students to discover geology of Texas from a broader prospective. Data from USGS were used to develop the map.

USGS- The State of Texas: U.S. Geological Survey Open-File Report 2005-1351, U.S

University of Houston - CBTH Project
http://cbth.uh.edu/

U.S. Department of the Interior
U.S. Geological Survey

Scientific Investigations Map 3142
Prepared in cooperation with the National Park Service
(Pamphlet accompanies map)

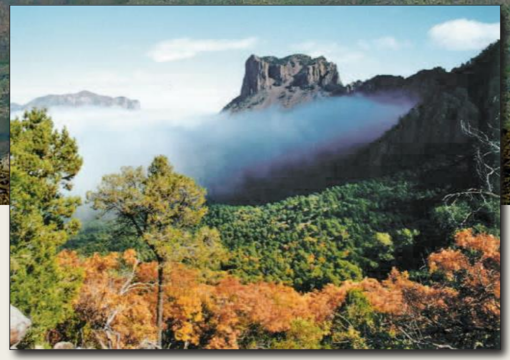
2011

Geologic Map of Big Bend National Park, Texas

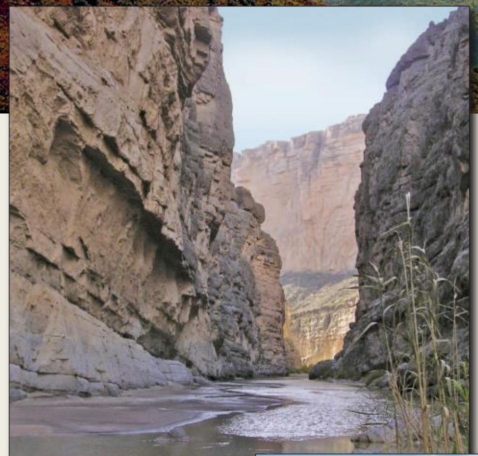
By Kenzie J. Turner,[1] Margaret E. Berry,[1] William R. Page,[1] Thomas M. Lehman,[2] Robert G. Bohannon,[1] Robert B. Scott,[3] Daniel P. Miggins,[1] James R. Budahn,[1] Roger W. Cooper,[4] Benjamin J. Drenth,[1] Eric D. Anderson,[1] and Van S. Williams[1]

[1]U.S. Geological Survey, Denver, Colorado
[2]Texas Tech University, Lubbock, Texas
[3]U.S. Geological Survey, Corvallis, Oregon
[4]Lamar University, Beaumont, Texas

(Above) Mule Ear Peaks. Mule Ear Peaks are one of the most distinctive geologic landforms in the park, and are composed of the Chisos Formation and overlying Burro Mesa Formation.



Casa Grande. Casa Grande is one of the highest peaks (7,325 ft elevation) in the Chisos Mountains, and in Texas. The peak's name, meaning "Big House" in Spanish, comes from its massive, steep-sided profile, which towers above the Basin. Casa Grande is an extra-caldera vent, or volcanic dome, of the Pine Canyon caldera, which erupted rocks of the South Rim Formation.



(Above) The Rio Grande near the mouth of Santa Elena Canyon. As the international boundary between the U.S. and Mexico (Mexico is on the left side of the river and the U.S. is on the right), the Rio Grande is the lifeblood of the region and is a fragile, riparian ecosystem with unique plant and animal communities, and a critical shared water resource of bi-national communities along this desolate course.

(Right) Chisos Formation. Spires of orange-weathering tuffaceous sandstone of the Chisos Formation, near Blue Creek Ranch.

View of El Pico in the Sierra del Carmen. Although El Pico is located across the Rio Grande from Big Bend, in Coahuila, Mexico, the Sierra del Carmen extends northward into Big Bend National Park, where the range forms towering limestone cliffs, originally deposited in ancient seas during Cretaceous time. The high mountain range is a series of uplifted, east-tilted fault blocks, which mark the easternmost range of the western North American cordillera.

Scenic Landscapes

Big Bend National Park offers some of the most diverse and scenic landscapes of all national parks, and is renowned for its spectacular geology. The Chisos Mountains are the centerpiece of the park with its rugged volcanic peaks in an evergreen and oak woodland setting. The lowlands surrounding the Chisos Mountains are part of the Chihuahuan Desert, where each Spring the desert floor blooms with bursts of brightly colored wildflowers, cacti, and other plants. The Rio Grande contrasts sharply with the desert, and forms a green ribbon of life winding through the rocky landscape. Mesa de Anguila and Sierra del Carmen are uplifted mesas and mountains bounding the west and east sides of the park, respectively, where they form steep, majestic cliffs and deep, intervening canyons.

CONVERSION FACTORS		
Multiply	**By**	**To obtain**
inches (in.)	2.54	centimeters (cm)
feet (ft)	0.3048	meters (m)
miles (mi)	1.609	kilometers (km)

APPROXIMATE MEAN DECLINATION, 2010

Base from U.S. Geological Survey
Chisos Mountains, Texas–Chihuahua–Coahuila, 1985;
Boquillas, Texas–Coahuila, 1984; and
Santiago Mountains, Texas, 1985

Projection Universal Transverse Mercator

1927 North American Datum

Ecosystems

The geology of Big Bend is intricately linked to plant and animal ecosystems, and the geologic formations greatly influence the distribution of the wide variety of plant and animal communities in the park. The extraordinary bio-diversity in Big Bend reflects the wide variety of natural mountain, desert, and river landscapes in the park, and is also due to the great variability in climate and elevation of those different landscapes. Big Bend has more species of birds than any other national park, and the Chihuahuan Desert has the greatest diversity of plants of any desert on earth.

***Yucca Faxoniana*.** This towering variety is also known as giant or Spanish dagger, beaked yucca, or soaptree yucca. Native Americans ate flowers, petals, and young stalks of the plant, and used the leaves for rope mats, sandals, and baskets.

(Right) Collared lizards. Collared lizards are some of the largest lizards in the park, and are a critical part of the Big Bend ecosystem because they are the food source for many birds in the park, and they help control the population of insects.

(Left) Black bears. Black bears were common in the park in the early 1900s, but none were observed after Big Bend became a park in 1944. They returned to the park from Mexico in the 1980s, and remain there today mostly in the Chisos Mountains; their recolonization is rare and enigmatic. They are well adapted to the Chisos Mountains, mainly because of their food source of acorns, juniper berries, pinon nuts, all available in this woodland environment.

(Right) Century plant. The century plant is the largest agave in the park, and is the food source for the endangered Mexican long-nosed bat, which pollinates the bright-colored yellow flowers.

Blooming prickly pear. Big Bend boasts more species of cacti than any other park, and the wide variety is attributed to the diverse settings of the park.

(Above) Gulf Fritillary. Over 160 species of butterflies occur in Big Bend National Park, and the Gulf Fritillary, also known as Passion Butterfly, is one of the more common varieties in the park.

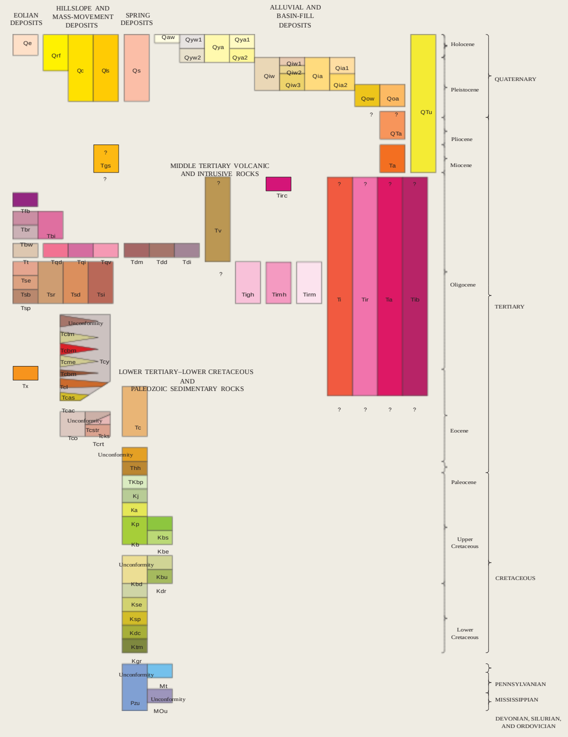
(Right) Mexican Jay. Big Bend National Park is one of the best localities in the U.S. for bird watching, and more species have been recorded there than any other National Park. Some of the more rare species include the Mexican Jay, Mexican mallard, Lucifer hummingbird, and Colima warbler.

Face off. A coyote **(left)** and a black-tailed jackrabbit **(above)** face off. Coyotes are well adapted in Big Bend, and are found in almost all environments in the park. The black-tailed jackrabbit is actually a hare, and is prey for mountain lions, coyotes, fox, bobcats, and hawks and eagles.

Texas Brown tarantula. The Texas Brown tarantula is a common variety of spider found in Big Bend National Park. Texas Browns can grow in excess of a four-inch leg span, and weigh more than 3 ounces as adults.

Geology

CORRELATION OF MAP UNITS



LIST OF MAP UNITS

SURFICIAL DEPOSITS

	Eolian deposits
Qe	Eolian sand (Holocene)
	Hillslope and mass-movement deposits
Qrf	Rock fall deposits (Holocene and late Pleistocene)
Qc	Colluvium and colluvial-fan deposits (Holocene and Pleistocene)
Qls	Landslide deposits (Holocene and Pleistocene)
	Spring deposits
Qs	Spring deposits (Holocene and Pleistocene)
	Alluvial and basin-fill deposits
Qaw	Active tributary wash and river deposits (latest Holocene)
Qyw1	Younger of the young axial river deposits (Holocene)
Qyw2	Older of the young axial river deposits (Holocene to late Pleistocene)
Qya	Young alluvial deposits, undivided (Holocene to late Pleistocene)
Qya1	Younger of the young alluvial deposits (Holocene)
Qya2	Older of the young alluvial deposits (Holocene to late Pleistocene)
Qiw	Intermediate axial river deposits, undivided (late and middle Pleistocene)
Qiw1	Youngest intermediate axial river deposits (late Pleistocene)
Qiw2	Older intermediate axial river deposits (late to middle Pleistocene)
Qiw3	Oldest intermediate axial river deposits (middle Pleistocene)
Qia	Intermediate alluvial deposits, undivided (late and middle Pleistocene)
Qia1	Younger of the intermediate alluvial deposits (late to middle Pleistocene)
Qia2	Older of the intermediate alluvial deposits (middle Pleistocene)
Qow	Old axial river deposits (middle to early? Pleistocene)
Qoa	Old alluvial deposits, undivided (middle to early? Pleistocene)
QTa	Very old alluvium (early Pleistocene and Pliocene)
Ta	Basin-fill deposits (Miocene)
	Tertiary mass-movement deposits
Tgs	Gravity slide blocks (Miocene?)
	Undivided surficial deposits
QTu	Quaternary to Tertiary deposits, undivided (Holocene to Miocene) (cross-section only)

MIDDLE TERTIARY VOLCANIC AND INTRUSIVE ROCKS

Tv	Volcanic rocks, undivided (Oligocene)
Tirc	Intrusive complex at Rattlesnake Mountain (Oligocene)
Ti	Intrusive rocks, undivided (Oligocene to Eocene)
Tir	Rhyolitic and other felsic composition intrusive rocks, undivided (Oligocene to Eocene)
Tia	Andesitic and other intermediate composition intrusive rocks, undivided (Oligocene to Eocene)
Tib	Basaltic and other mafic composition intrusive rocks, undivided (Oligocene to Eocene)
Tfb	Basaltic flow (Oligocene)
	Burro Mesa Formation (Oligocene)
Tbr	Rhyolite member
Tbw	Wasp Spring member
Tbi	Intrusive rocks, undivided
Tt	Trachytic lava, undivided (Oligocene)
	Sierra Quemada related rocks (Oligocene)
Tqd	Sierra Quemada ring dike
Tqi	Sierra Quemada intrusive rocks, undivided
Tqv	Sierra Quemada vent breccia
	Dominguez Mountain related rocks (Oligocene)
Tdm	Dominguez Mountain mafic lava flows
Tdd	Dominguez Mountain dike swarm
Tdi	Dominguez Mountain intrusive rocks, undivided
	South Rim Formation (Oligocene)
Tse	Emory Peak rhyolite member
Tsb	Boot Rock member
Tsp	Pine Canyon rhyolite member
Tsr	Outflow deposits, undivided
Tsd	Ring dike
Tsi	Intrusive rocks, undivided
Tigh	Fayalite syenite of Grapevine Hills (Oligocene)
Timh	Fayalite syenite of McKinney Hills (Oligocene)
Tirm	Syenite of Rosillos Mountains (Oligocene)
	Chisos Formation (Oligocene and Eocene)
Tcy	Younger part, undivided (Oligocene and Eocene)
Tctm	Tule Mountain Trachyandesite Member (Oligocene)
Tcbm	Bee Mountain Basalt Member (Oligocene)
Tcme	Mule Ear Spring Tuff Member (Oligocene)
Tcl	Undifferentiated lava flow (Eocene)
Tcas	Ash Spring Basalt Member (Eocene)
Tcac	Alamo Creek Basalt Member (Eocene)
Tco	Older part, undivided (Eocene) (cross-section only)
Tcstr	Sandstone, tuff, and rhyolite unit
Tcks	Siltstone unit
Tcrt	Rhyolite tuff unit
Tx	Christmas Mountains related volcanic rocks (Eocene)

LOWER TERTIARY TO LOWER CRETACEOUS SEDIMENTARY ROCKS

Tc	Canoe Formation (Eocene)
Thh	Hannold Hill Formation (Eocene)
TKbp	Black Peaks Formation (Paleocene to Upper Cretaceous)
Kj	Javelina Formation (Upper Cretaceous)
Ka	Aguja Formation (Upper Cretaceous)
Kp	Pen Formation (Upper Cretaceous)
Kb	Boquillas Formation, undivided (Upper Cretaceous)
Kbs	San Vicente Member
Kbe	Ernst Member
Kbd	Buda Limestone and Del Rio Clay, undivided (Upper Cretaceous) (cross-section only)
Kbu	Buda Limestone (Upper Cretaceous)
Kdr	Del Rio Clay (Upper Cretaceous)
Kse	Santa Elena Limestone (Lower Cretaceous)
Ksp	Sue Peaks Formation (Lower Cretaceous)
Kdc	Del Carmen Limestone (Lower Cretaceous)
Ktm	Telephone Canyon Formation and Maxon Sandstone, undivided (Lower Cretaceous)
Kgr	Glen Rose Limestone (Lower Cretaceous)

PALEOZOIC ROCKS

Pzu	Paleozoic rocks, undivided (Lower Pennsylvanian through Ordovician)
Mt	Tesnus Formation (Lower Pennsylvanian and Upper Mississippian)
MOu	Mississippian to Ordovician rocks, undivided

MAP EXPLANATION

Contact

Faults

Normal—Dashed where approximately located, dotted where concealed. Bar and ball on downthrown side

Buried—Inferred from geophysical data

Reverse—Dotted where concealed. Showing relative motion; U on upthrown side, D on downthrown side; Rosillos Mountains only

Oblique-slip, right-lateral offset—Dotted where concealed. Bar and ball on downthrown side; paired arrows indicate relative right-lateral strike-slip movement

Oblique-slip, left-lateral offset—Dotted where concealed. Bar and ball on downthrown side; paired arrows indicate relative left-lateral strike-slip movement

Thrust—Dashed where approximately located, dotted where concealed. Sawteeth on upper plate

Dike

Anticline—Dashed where approximately located, dotted where concealed

Syncline—Dashed where approximately located, dotted where concealed

Strike and dip of bedding

Inclined

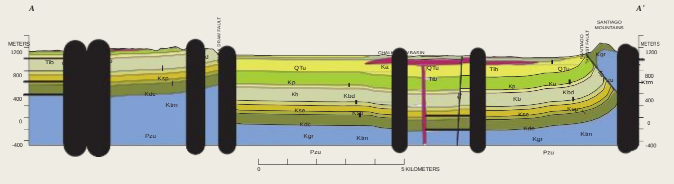
Horizontal

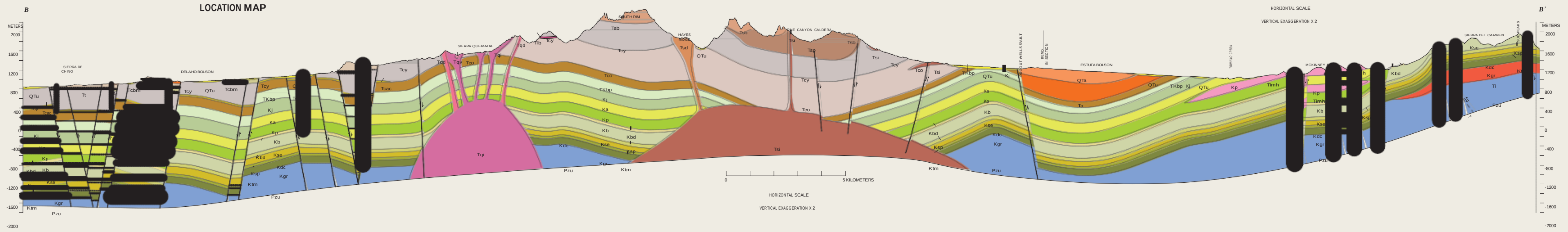
Vertical

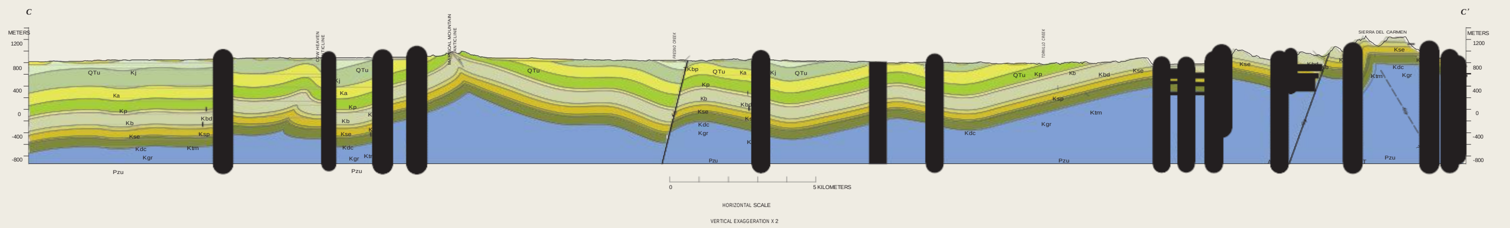
Overturned

Geochronology sample location and map sample number (Appendix)

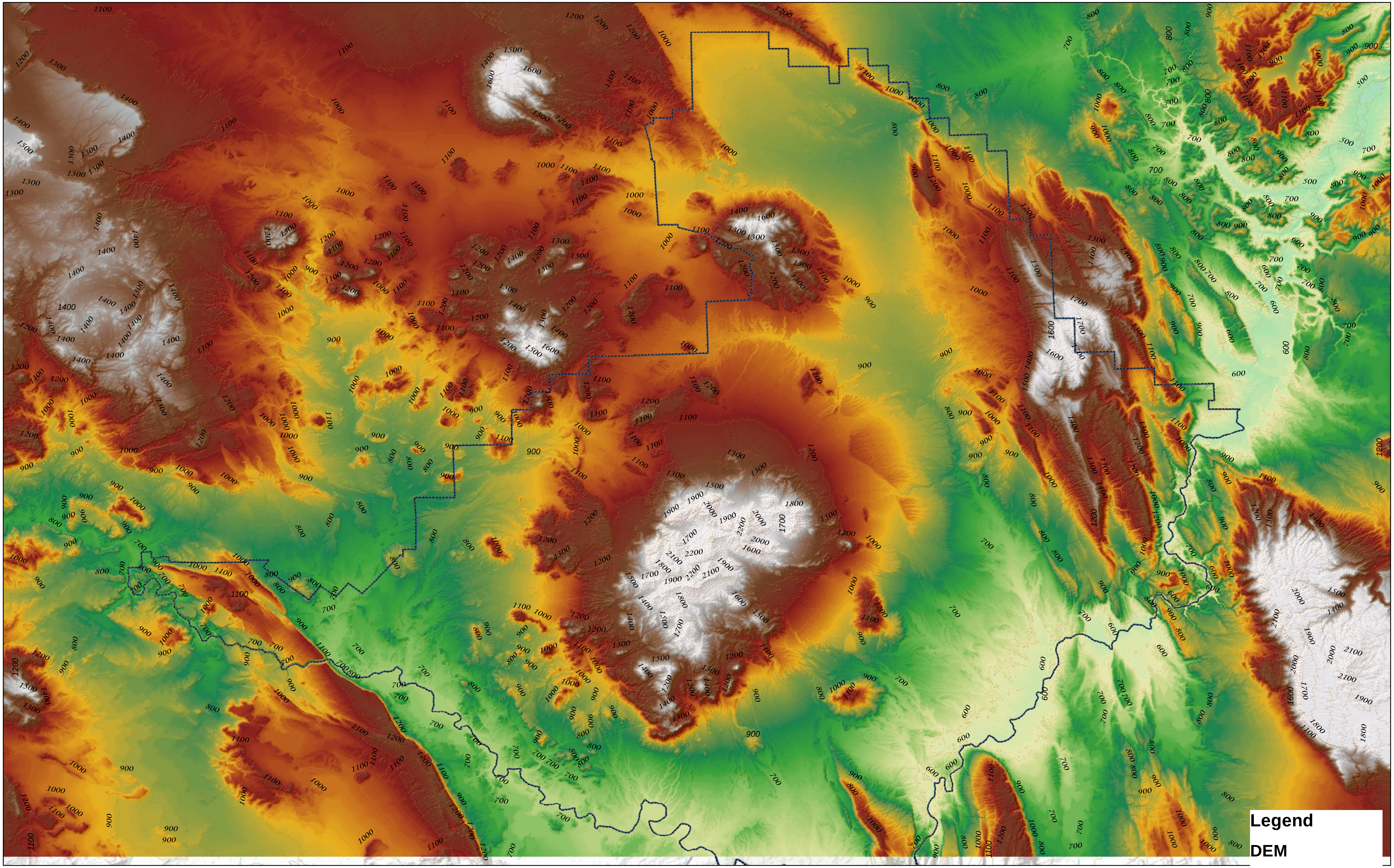
LOCATION MAP







Photograph Credits



Legend

DEM

meter above S.L.

High : 2719

Low : 372.294

▭ bigbendpark

Big Bend National Park Topographical Map

1:225,000

0 5 10 20 Kilometers

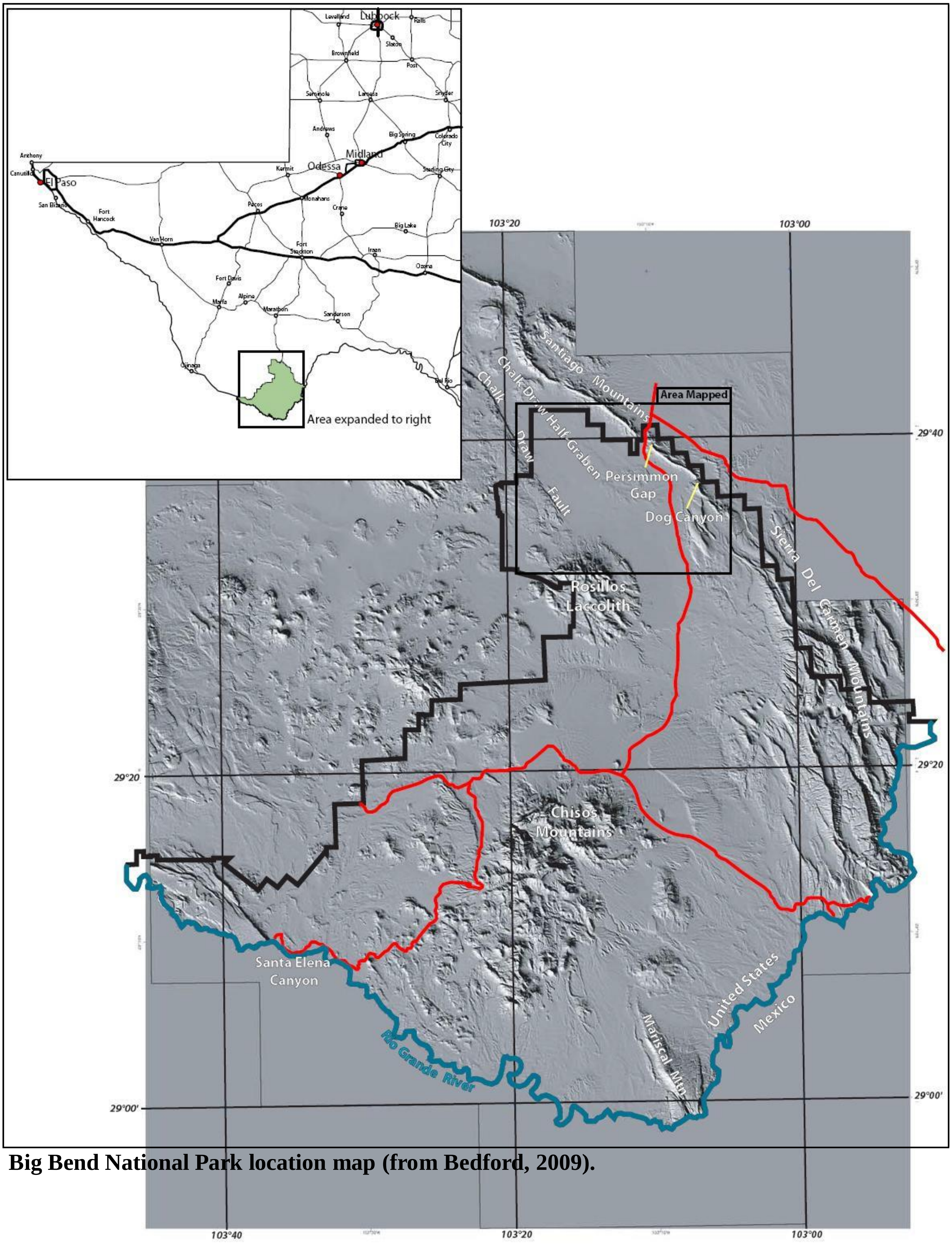
N

University of Houston
Department of Earth and Atmospheric Sciences
CBTH Project
http://cbth.uh.edu/

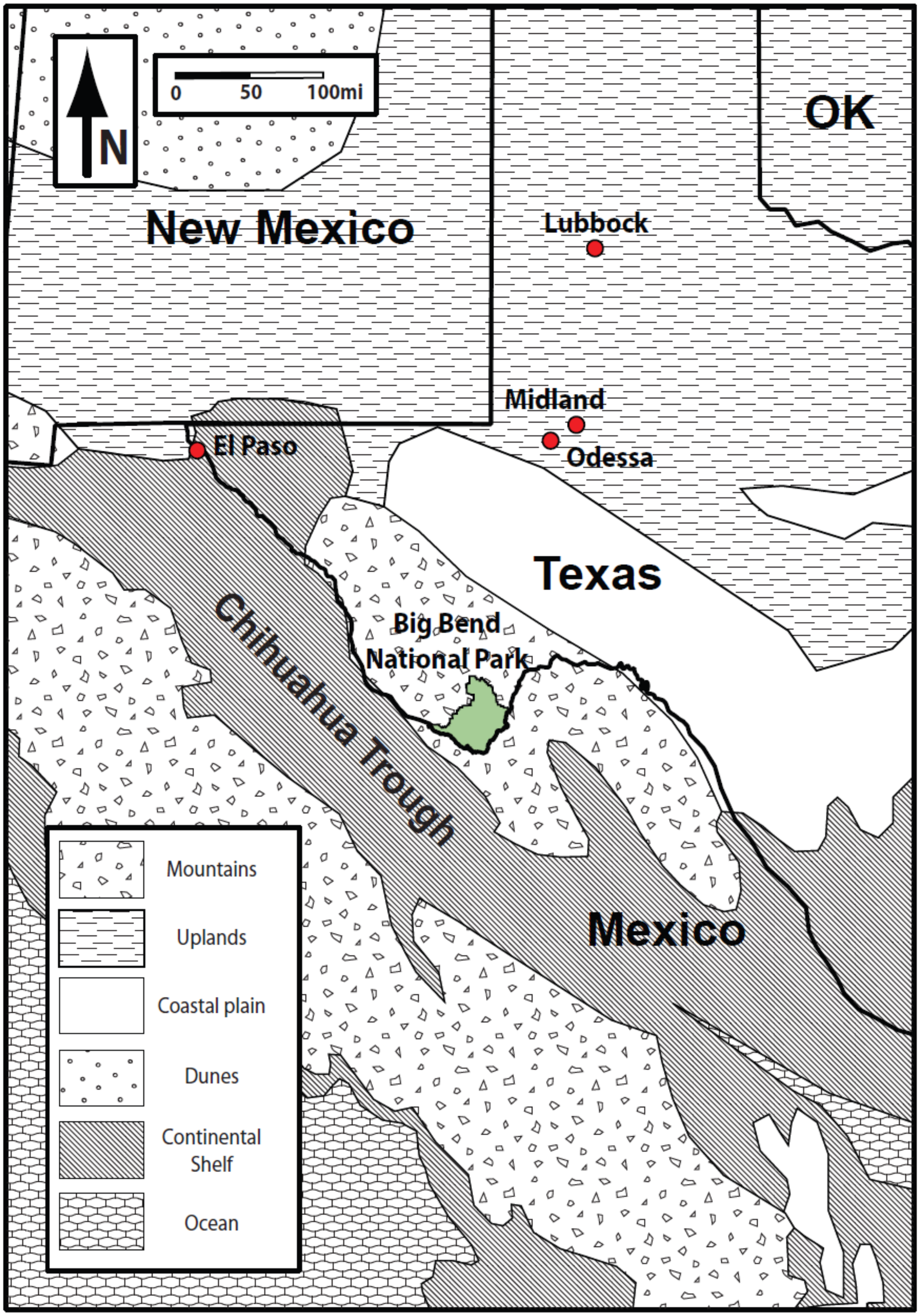
Projection:
GCS_WGS_1984
Datum: D_WGS_1984

Data Source: USGS
http://pubs.usgs.gov/sim/3142

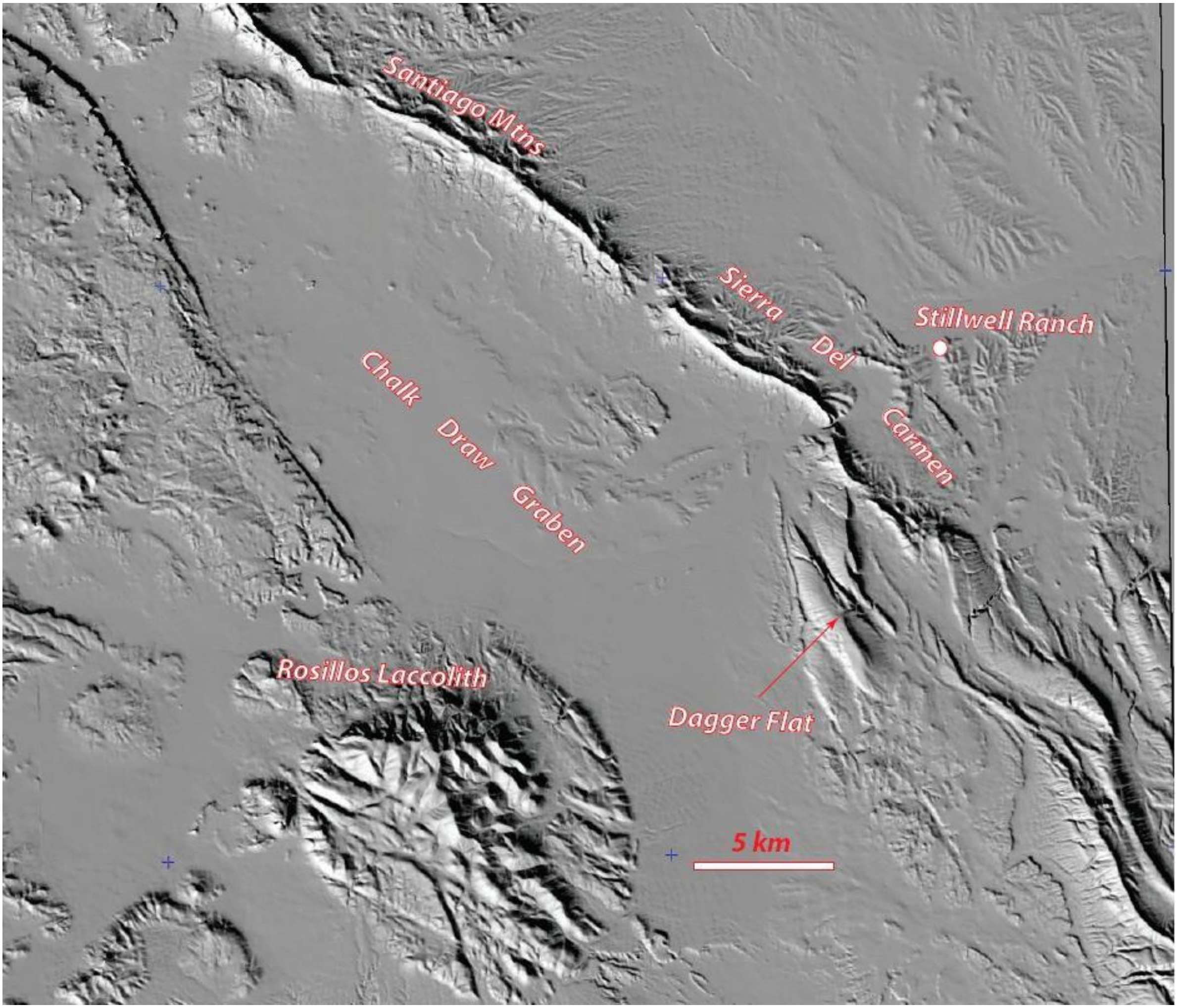
Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution



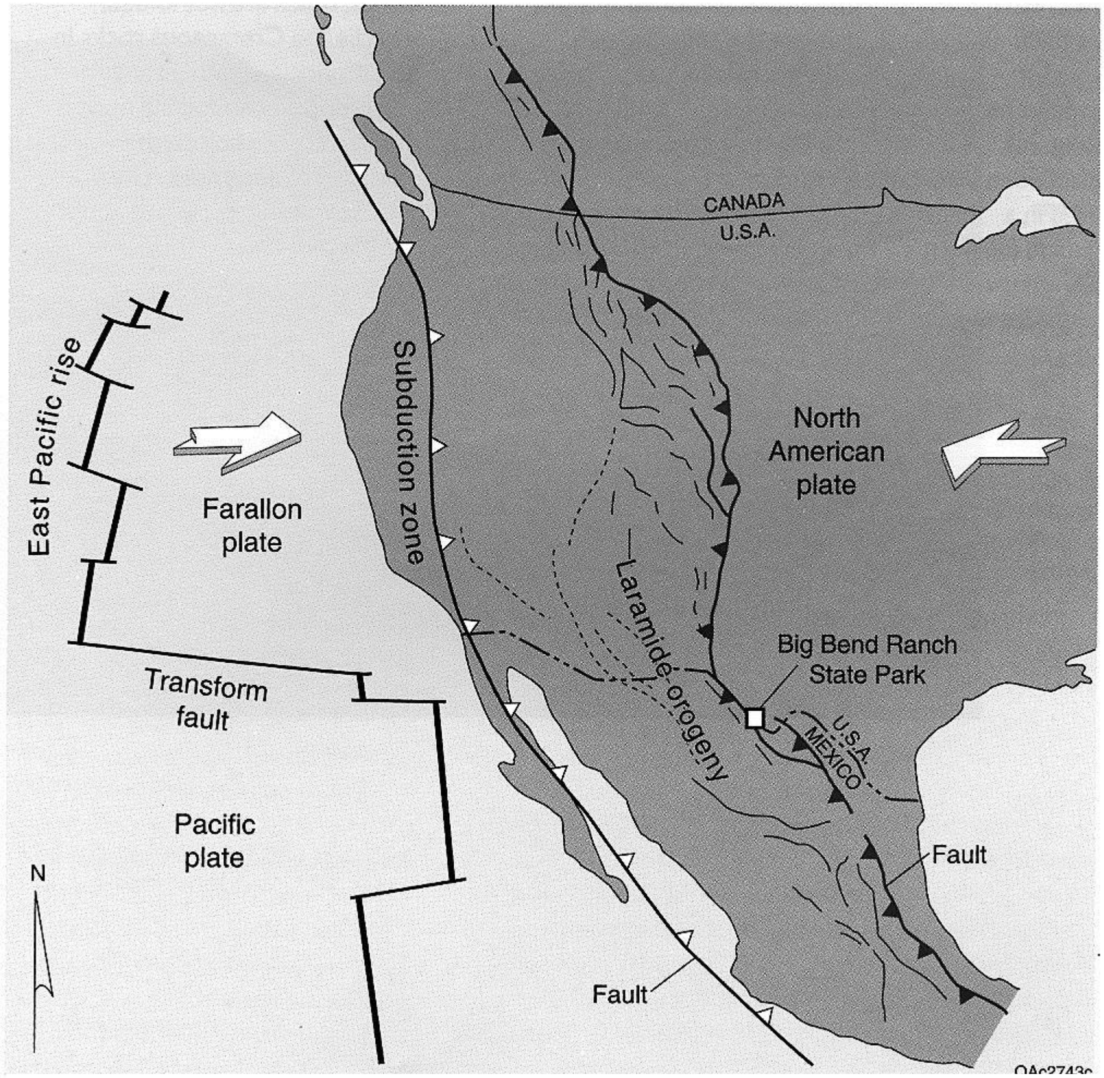
Big Bend National Park location map (from Bedford, 2009).



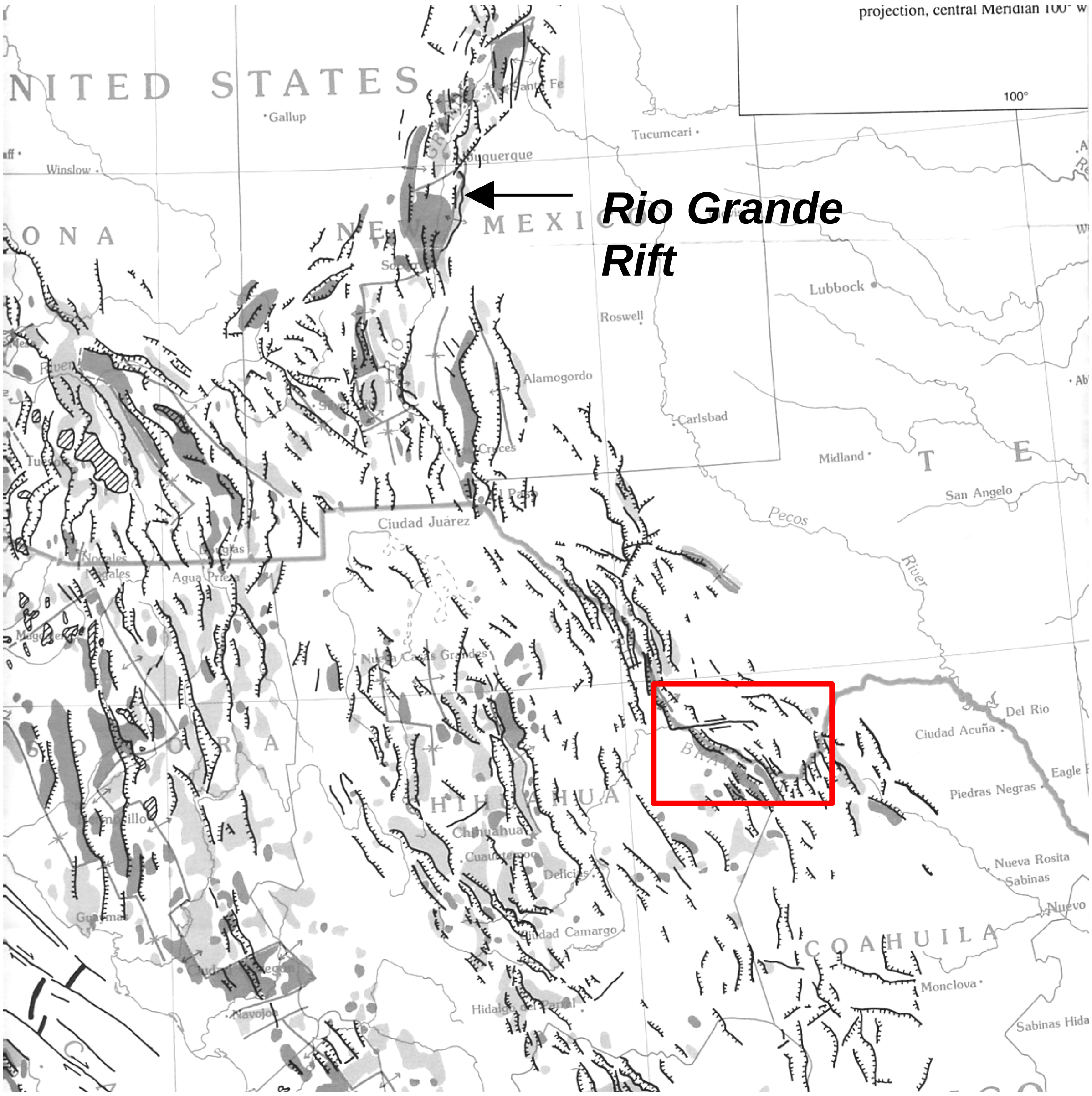
Modified from the Late Jurassic 150 Ma paleogeographic map by Dr. Ron Blakey. Note the location of the Chihuahua Trough.



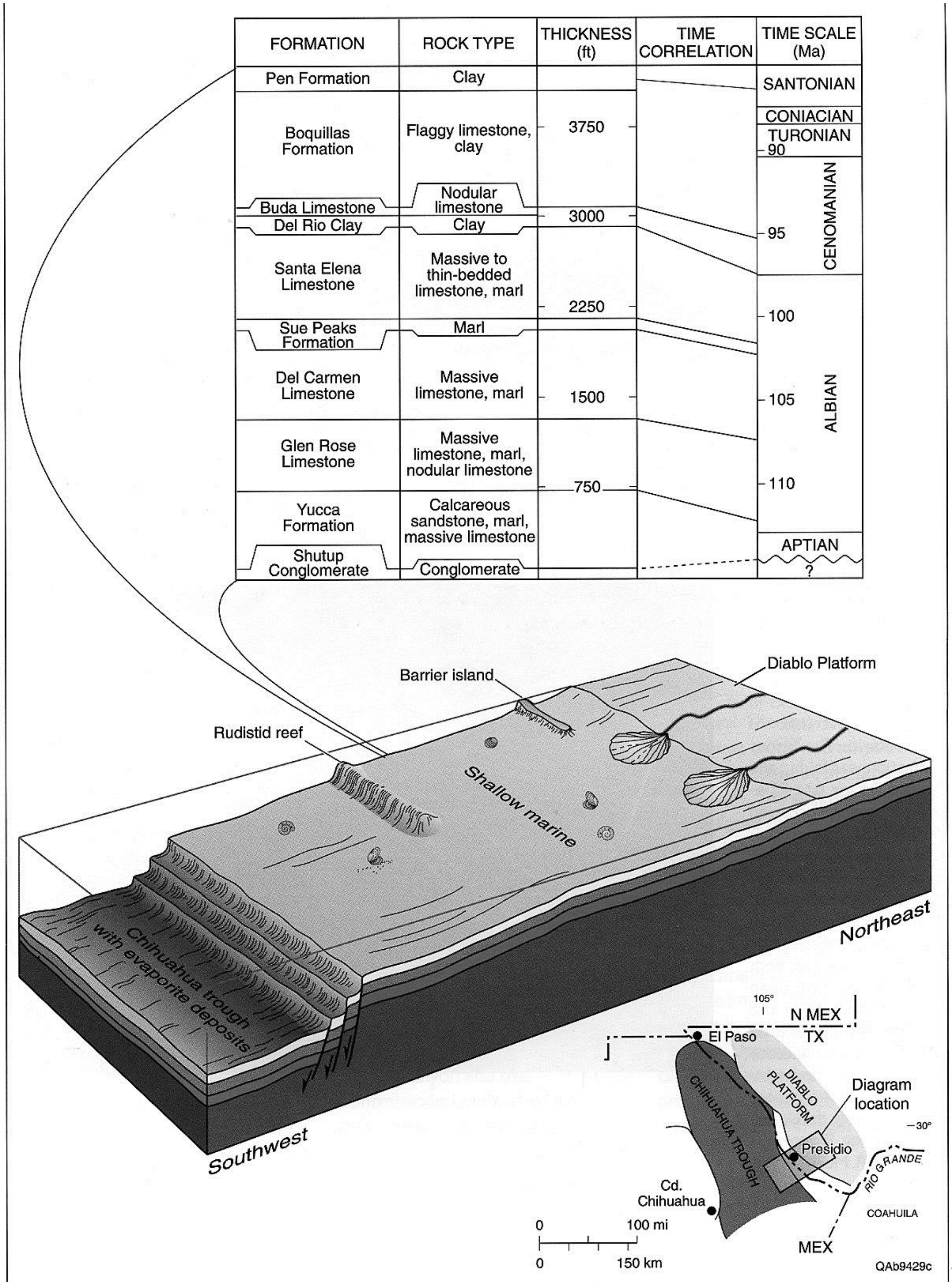
Hillshade relief map showing major physiographic and geologic features in northern Big Bend.



Map of Late Cretaceous-early Tertiary Laramide fold-thrust belt extending from Canada to southern Mexico. It resulted from subduction of the Farallon plate beneath the western portion of the North American plate.

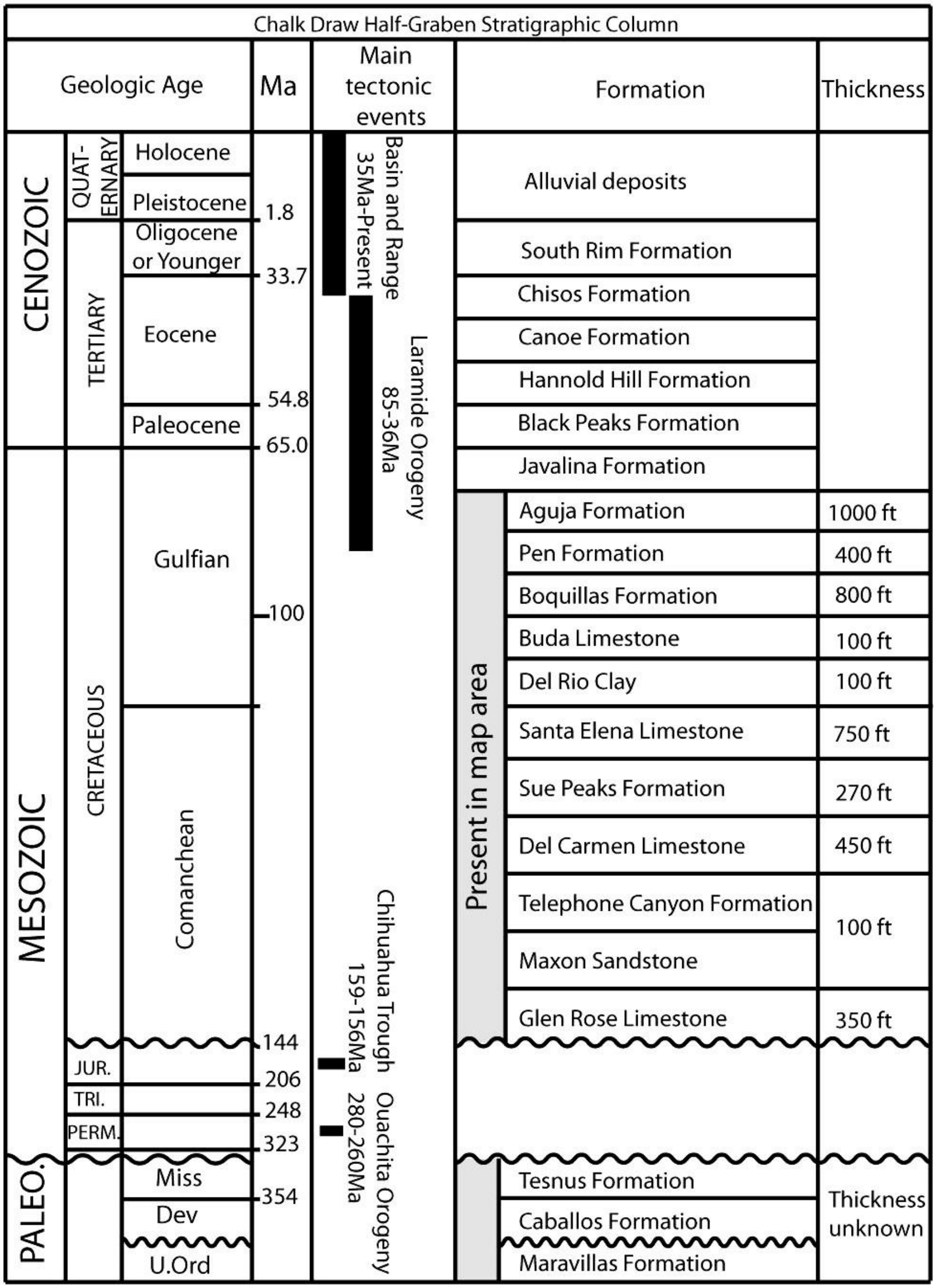


Map of Cenozoic extension in the western United States and Northern Mexico (modified after Faulds and Varga, 1998). Red box shows location of Big Bend National Park. Extensional fault systems shown on this map post-date Laramide compressional deformation.



FORMATION	ROCK TYPE	THICKNESS (ft)
Pen Formation	Clay	
Boquillas Formation	Flaggy limestone, clay	3750
Buda Limestone	Nodular limestone	
Del Rio Clay	Clay	3000
Santa Elena Limestone	Massive to thin-bedded limestone, marl	2250
Sue Peaks Formation	Marl	
Del Carmen Limestone	Massive limestone, marl	1500
Glen Rose Limestone	Massive limestone, marl, nodular limestone	750
Yucca Formation	Calcareous sandstone, marl, massive limestone	
Shutup Conglomerate	Conglomerate	

Block diagram and stratigraphic chart showing that Cretaceous sedimentary rocks were deposited in a shallow ocean at the edge of the Chihuahua trough, a deep basin that formed when South America rifted from North America.



Formation	Thickness
Alluvial deposits	
South Rim Formation	
Chisos Formation	
Canoe Formation	
Hannold Hill Formation	
Black Peaks Formation	
Javalina Formation	
Aguja Formation	1000 ft
Pen Formation	400 ft
Boquillas Formation	800 ft
Buda Limestone	100 ft
Del Rio Clay	100 ft
Santa Elena Limestone	750 ft
Sue Peaks Formation	270 ft
Del Carmen Limestone	450 ft
Telephone Canyon Formation	100 ft
Maxon Sandstone	
Glen Rose Limestone	350 ft
Tesnus Formation	Thickness unknown
Caballos Formation	
Maravillas Formation	

Stratigraphic column illustrating units exposed in map area as well as major tectonic events. Formation names and thicknesses derived from Maxwell, R.A., Lonsdale, J.T., Hazzard, R.T., and Wilson, J.A., 1967.

Figure (9)Overview Figure Showing Field Trip Planned Sites

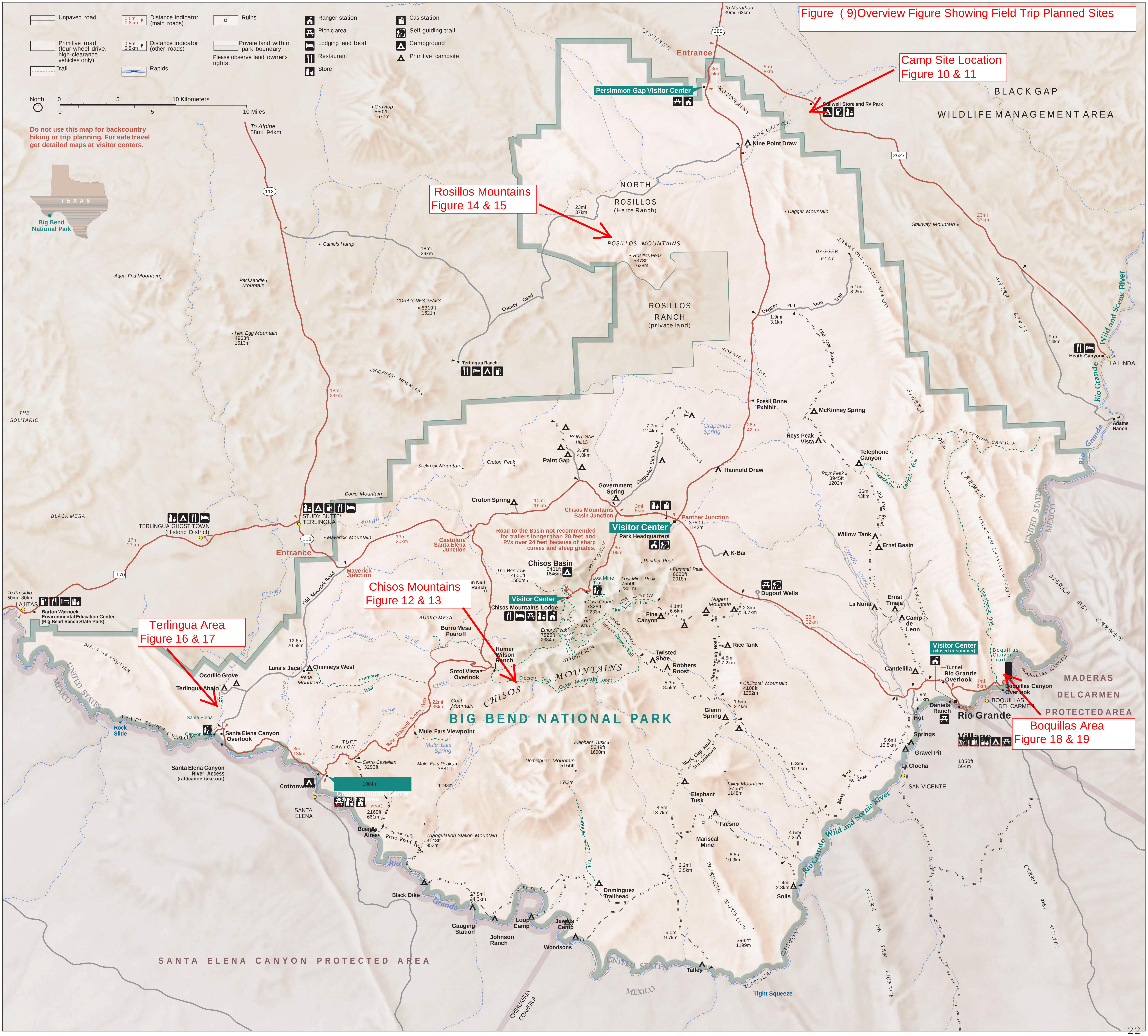


Figure 10

Big Bend National Park Orthoimagery
NorthEast of Dagger Flat

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Projedion:
GCS V113S 1984
Datum: D_WGS_1984

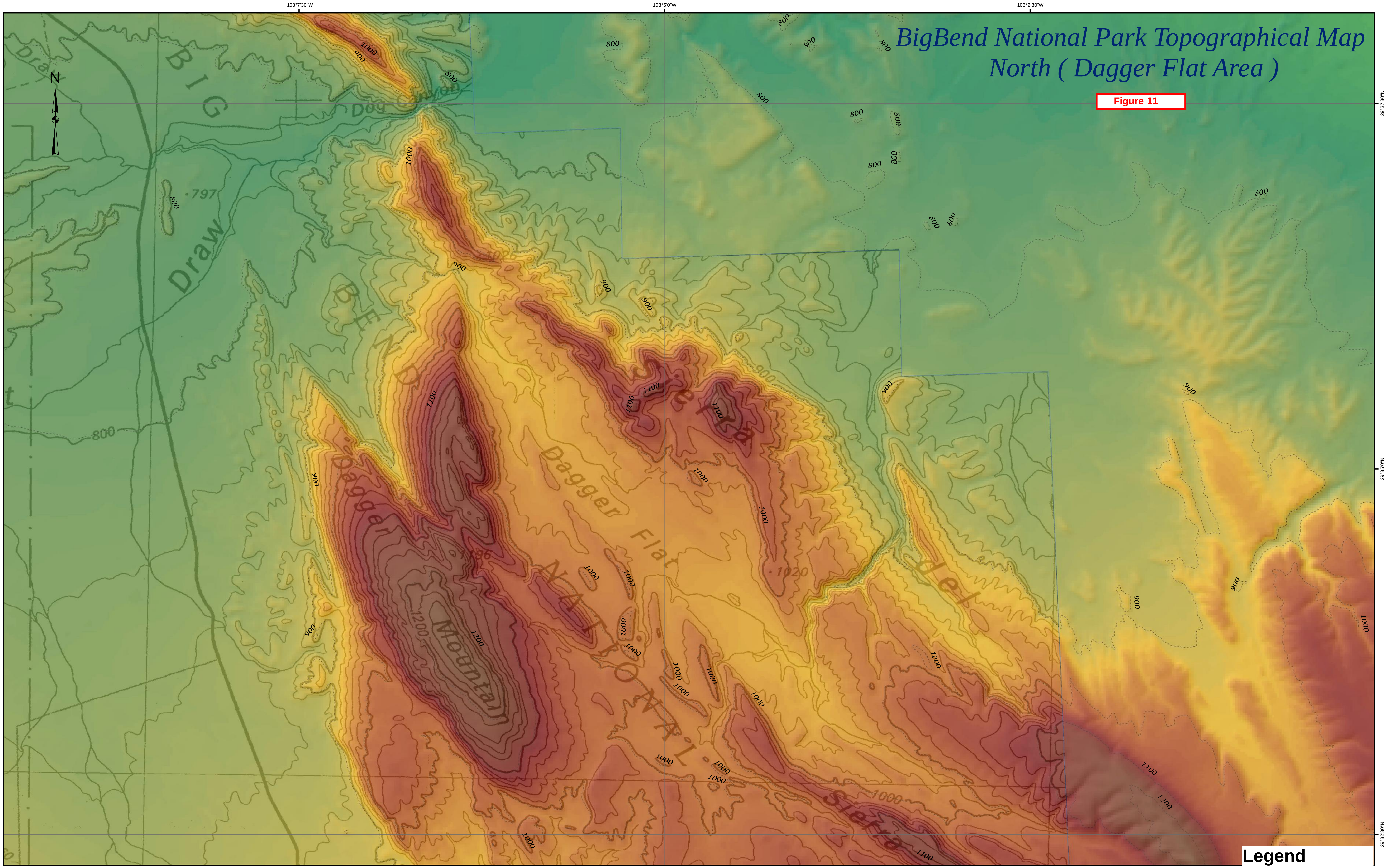
Data Source.USGS
httpJ/pub>.u>g>.govi>rn/3142

1:25,000
0 0.5 1 2
Kilometers
GeologicalFeatures of the Big Bend NationalPark
are shown over a OEM (30 meter Resolution

N

BigBend National Park Topographical Map North (Dagger Flat Area)

Figure 11



Legend

DEM

meter above S.L.

High : 2719

Low : 372.294

1:30,000

0 1 2 4 Kilometers

Projection:
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Datum: D_WGS_1984

Data Source: USGS
http://pubs.usgs.gov/sim/3142

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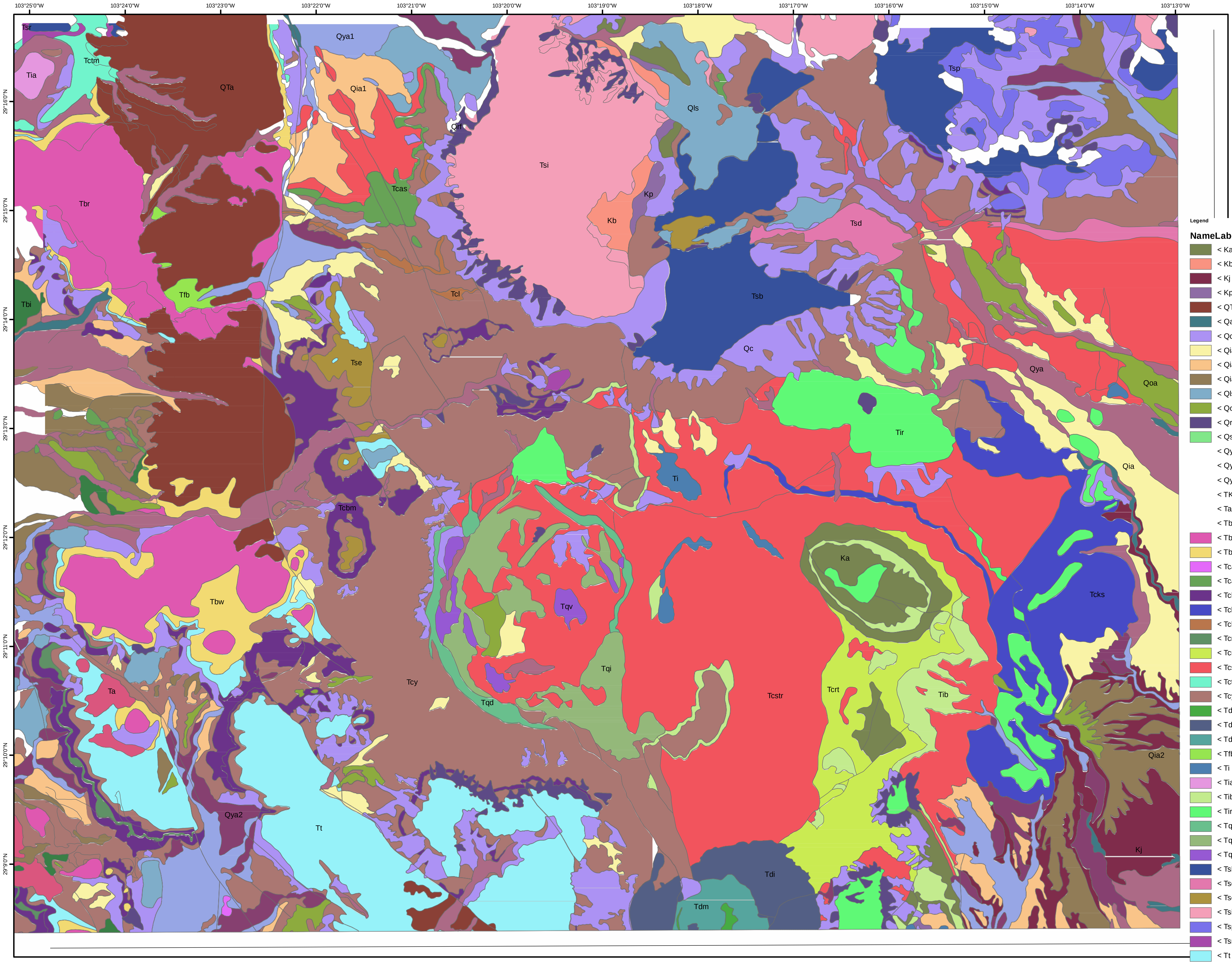
Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution

Big Bend National Park Geological Map (Chisos Mountains)

Figure 12



Legend

NameLabel

< Ka >Aguja Formation (Upper Cretaceous)
< Kb >Boquillas Formation, undivided (Upper Cretaceous)
< Kj >Javelina Formation (Upper Cretaceous)
< Kp >Pen Formation (Upper Cretaceous)
< QTa >Very old alluvium (early Pleistocene and Pliocene)
< Qaw >Active tributary wash and river deposits (latest Holocene)
< Qc >Colluvium and colluvial-fan deposits (Holocene and Pleistocene)
< Qia >Intermediate alluvial deposits, undivided (late and middle Pleistocene)
< Qia1 >Younger of the intermediate alluvial deposits (late to middle Pleistocene)
< Qia2 >Older of the intermediate alluvial deposits (middle Pleistocene)
< Qls >Landslide deposits (Holocene and Pleistocene)
< Qoa >Old alluvial deposits, undivided (middle to early? Pleistocene)
< Qrf >Rock fall deposits (Holocene and late Pleistocene)
< Qs >Spring deposits (Holocene and Pleistocene)
< Qya >Young alluvial deposits, undivided (Holocene to late Pleistocene)
< Qya1 >Younger of the young alluvial deposits (Holocene)
< Qya2 >Older of the young alluvial deposits (Holocene to late Pleistocene)
< TKbp >Black Peaks Formation (Paleocene to Upper Cretaceous)
< Ta >Basin fill deposits (Miocene)
< Tbi >Intrusive rocks, undivided, Burro Mesa Formation (Oligocene)
< Tbr >Rhyolite member, Burro Mesa Formation (Oligocene)
< Tbw >Wasp Spring member, Burro Mesa Formation (Oligocene)
< Tcac >Alamo Creek Basalt Member, Younger part of Chisos Formation (Eocene)
< Tcas >Ash Spring Basalt Member, Younger part of Chisos Formation (Eocene)
< Tcbm >Bee Mountain Basalt Member, Younger part of Chisos Formation (Oligocene)
< Tcks >Siltstone unit, Older part of Chisos Formation (Eocene)
< Tcl >Undifferentiated lava flows, Younger part of Chisos Formation (Eocene)
< Tcme >Mule Ear Spring Tuff Member, Younger part of Chisos Formation (Oligocene)
< Tcrt >Rhyolite tuff unit, Older part of Chisos Formation (Eocene)
< Tcstr >Sandstone, tuff, and rhyolite unit, Older part of Chisos Formation (Eocene)
< Tctm >Tule Mountain Trachyandesite Member, Younger part of Chisos Formation (Oligocene)
< Tcy >Younger part, undivided, Chisos Formation (Oligocene and Eocene)
< Tdd >Dominguez Mountain dike swarm (Oligocene)
< Tdi >Dominguez Mountain intrusive rocks, undivided (Oligocene)
< Tdm >Dominguez Mountain mafic lava flows (Oligocene)
< Tfb >Basaltic flow (Oligocene)
< Ti >Intrusive rocks, undivided (Oligocene to Eocene)
< Tia >Andesitic and other intermediate composition intrusive rocks, undivided (Oligocene to Eocene)
< Tib >Basaltic and other mafic composition intrusive rocks, undivided (Oligocene to Eocene)
< Tir >Rhyolitic and other felsic composition intrusive rocks, undivided (Oligocene to Eocene)
< Tqd >Sierra Quemada ring dike (Oligocene)
< Tqi >Sierra Quemada intrusive rocks, undivided (Oligocene)
< Tqv >Sierra Quemada vent breccia (Oligocene)
< Tsb >Boot Rock member, South Rim Formation (Oligocene)
< Tsd >Ring dike, South Rim Formation (Oligocene)
< Tse >Emory Peak rhyolite member, South Rim Formation (Oligocene)
< Tsi >Intrusive rocks, undivided, South Rim Formation (Oligocene)
< Tsp >Pine Canyon rhyolite member, South Rim Formation (Oligocene)
< Tsr >Outflow deposits, undivided, South Rim Formation (Oligocene)
< Tt >Trachytic lava, undivided (Oligocene)

N

Projection Information :
NAD_1927_UTM_Zone_13N
Projection: Transverse_Mercator
GCS_North_American_1927
Datum: D_North_American_1927

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Kilometers

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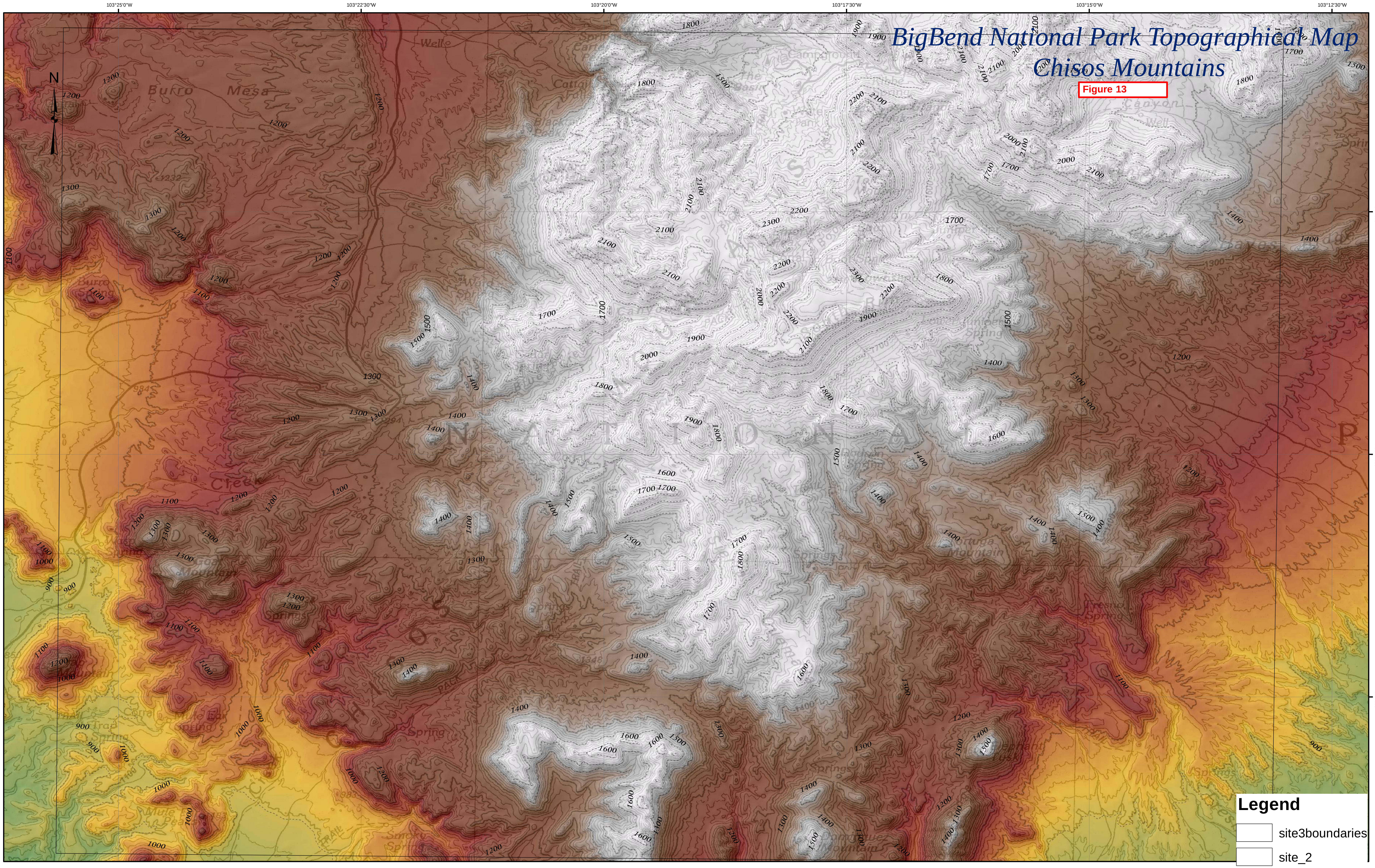

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0 0.5 1 2 Kilometers

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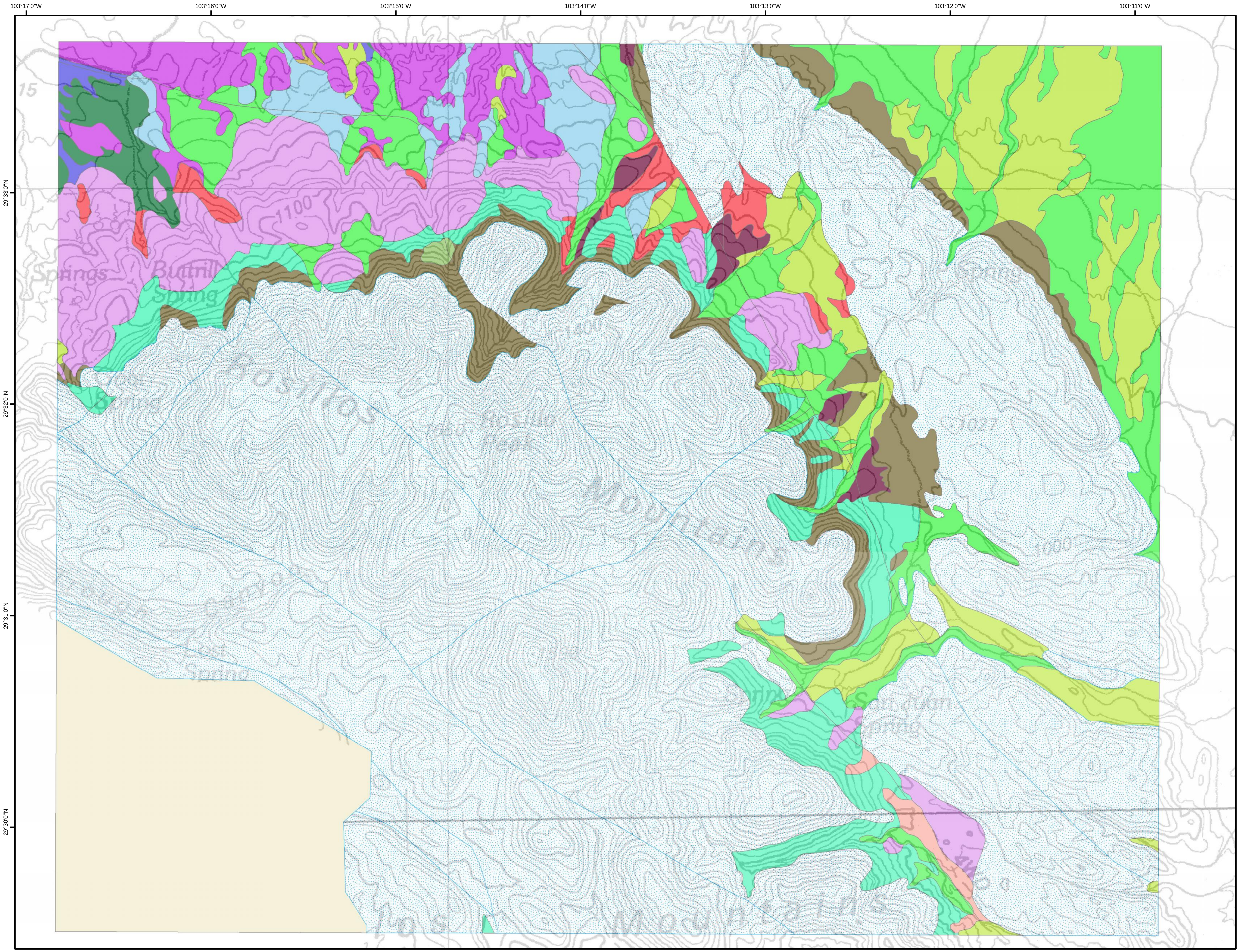
CBTH Project
http://cbth.uh.edu/

Projection:
GCS_WGS_1984
Datum: D_WGS_1984

Data Source: USGS
http://pubs.usgs.gov/sim/3142

Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution



Big Bend National Park

Geological Map

(Rosillos Mountains)

Figure 14

N

1:25,000

0 0.5 1 2 3

Kilometers

Projection Information :
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Projection: Transverse_Mercator
GCS_North_American_1927
Datum: D_North_American_1927

Legend

Geological Features

Feature Symbol & Name

🟫 < Ka >Aguja Formation (Upper Cretaceous)
🟪 < Kb >Boquillas Formation, undivided (Upper Cretaceous)
🟦 < Kbu >Buda Limestone (Upper Cretaceous)
🟥 < Kp >Pen Formation (Upper Cretaceous)
🟩 < Qc >Colluvium and colluvial-fan deposits (Holocene and Pleistocene)
🟨 < Qia1 >Younger of the intermediate alluvial deposits (late to middle Pleistocene)
🟦 < Qia2 >Older of the intermediate alluvial deposits (middle Pleistocene)
🟪 < Qls >Landslide deposits (Holocene and Pleistocene)
🟥 < Qoa >Old alluvial deposits, undivided (middle to early? Pleistocene)
🟩 < Qya >Young alluvial deposits, undivided (Holocene to late Pleistocene)
🟦 < Qya1 >Younger of the young alluvial deposits (Holocene)
🟩 < Qya2 >Older of the young alluvial deposits (Holocene to late Pleistocene)
🟧 < TKbp >Black Peaks Formation (Paleocene to Upper Cretaceous)
🟩 < Ti >Intrusive rocks, undivided (Oligocene to Eocene)
🟨 < Tib >Basaltic and other mafic composition intrusive rocks, undivided (Oligocene to Eocene)
▨ < Tirm >Syenite of Rosillos Mountains (Oligocene)

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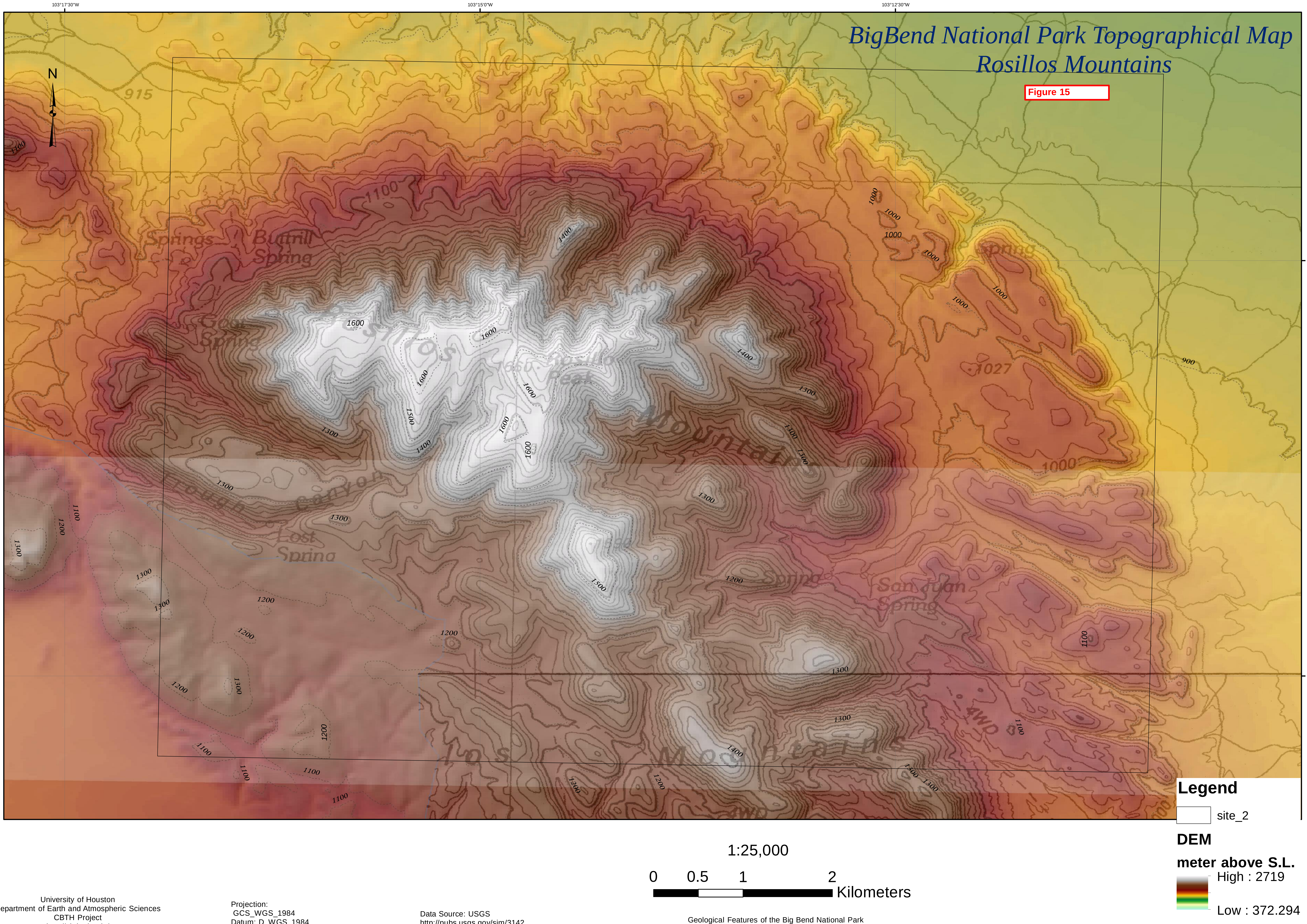
BigBend National Park Topographical Map
Rosillos Mountains

Figure 15



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Projection:
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Datum: D_WGS_1984

Data Source: USGS
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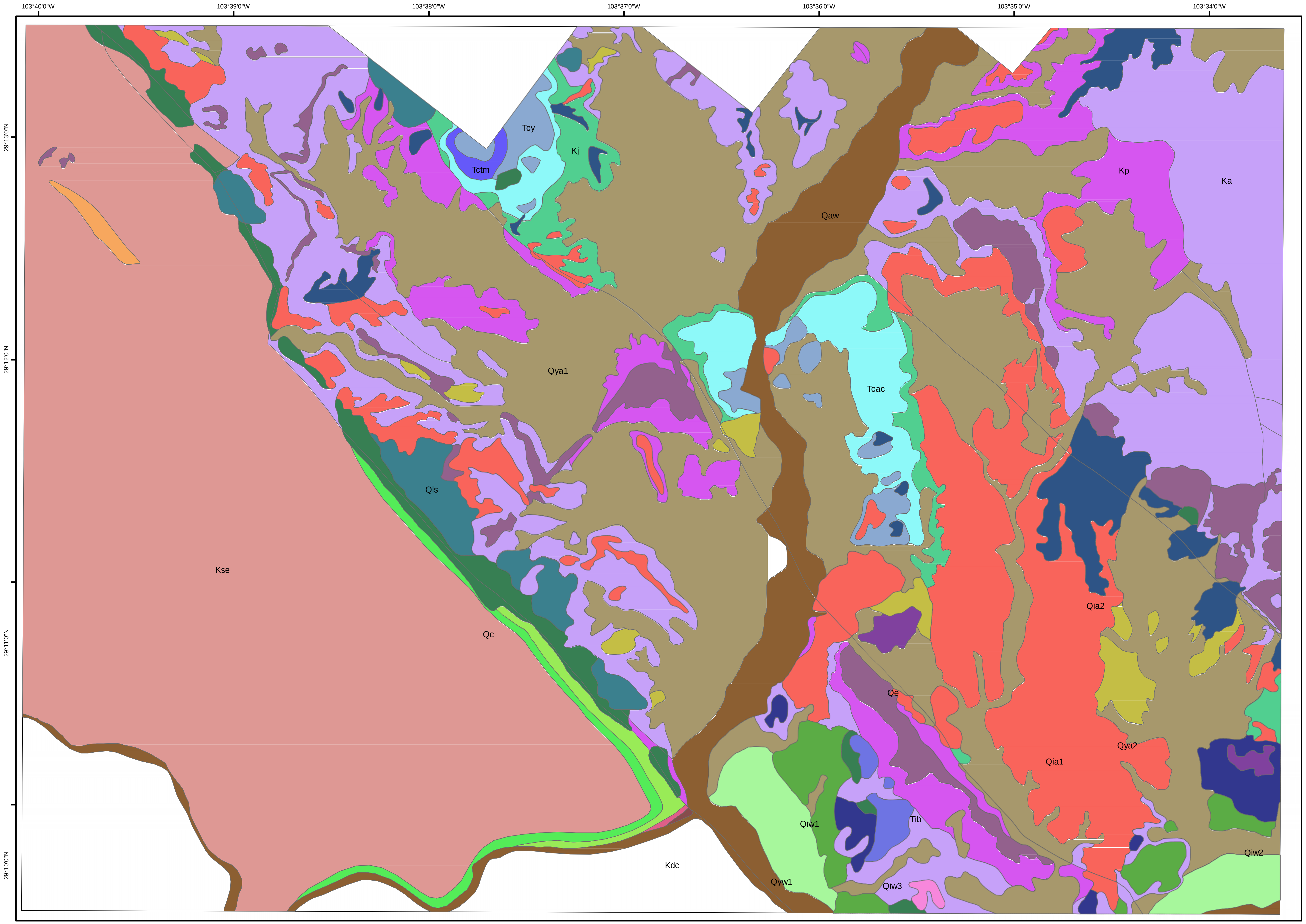
Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution

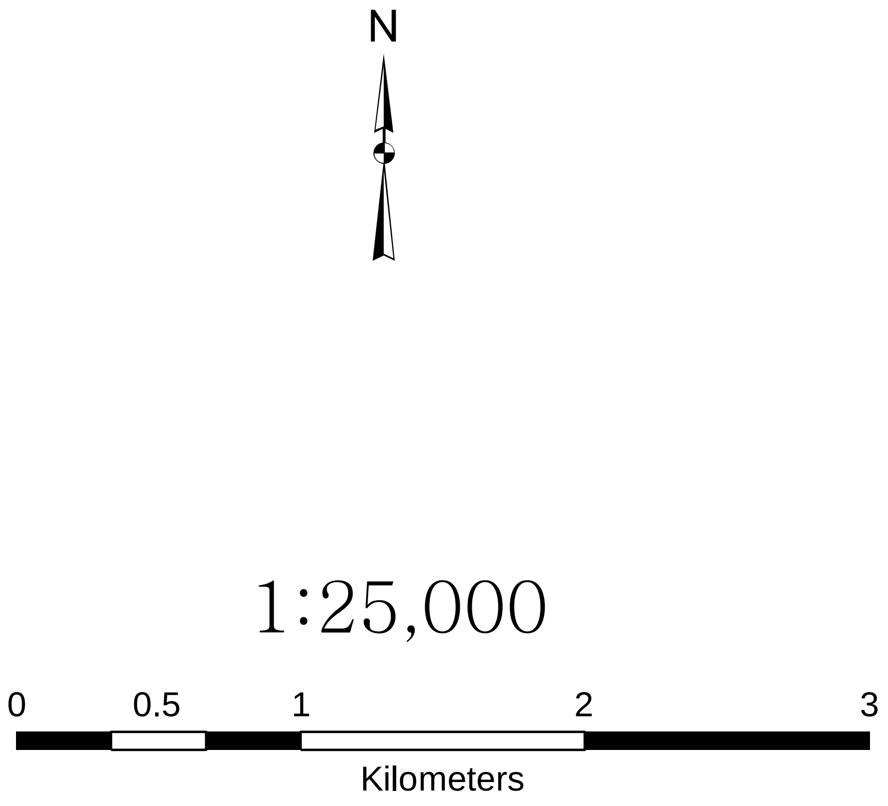
Big Bend National Park

Geological Map

(Terlingua Area)

Figure 16





Projection Information :
NAD_1927_UTM_Zone_13N
Projection: Transverse_Mercator
GCS_North_American_1927
Datum: D_North_American_1927

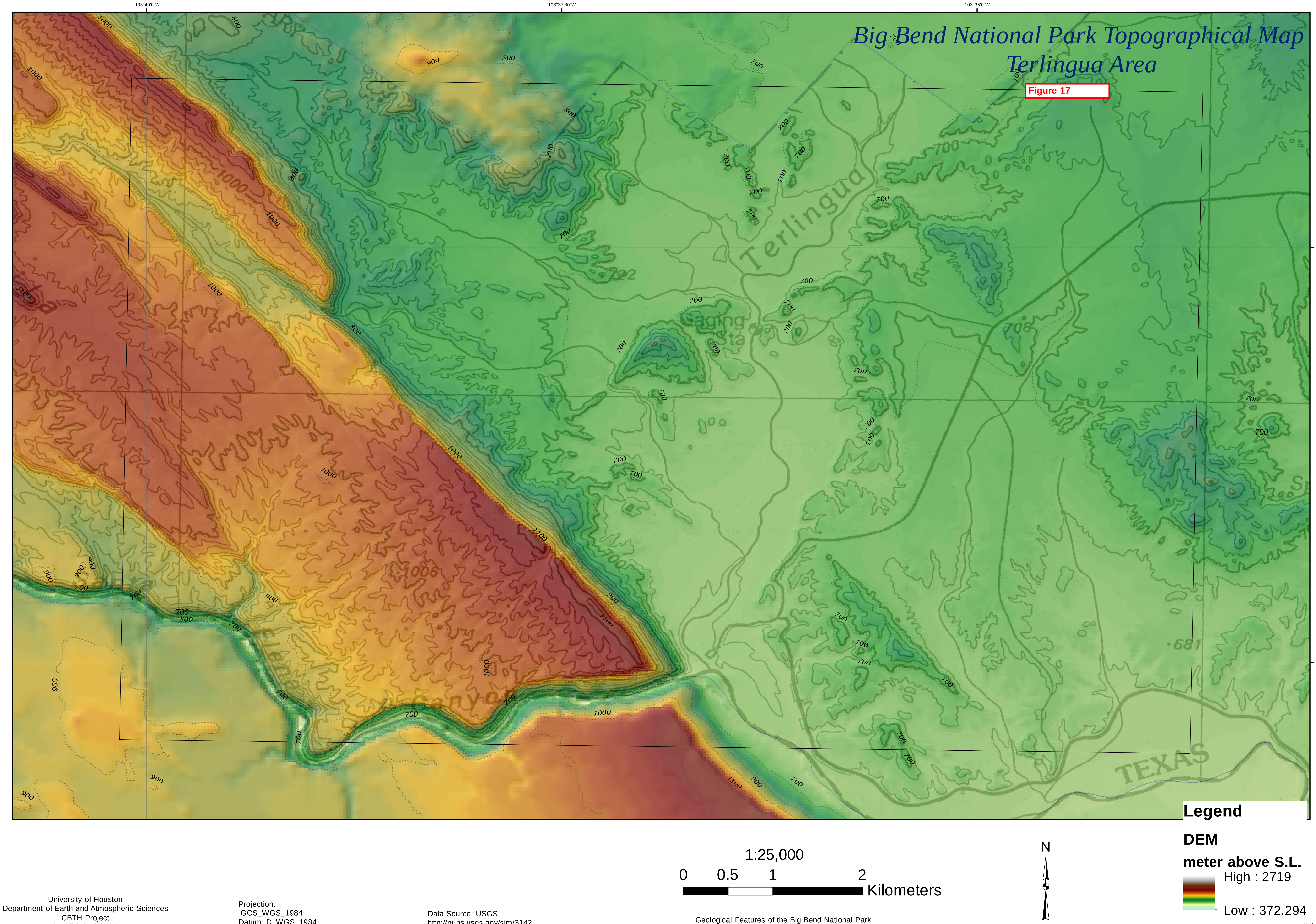
Legend

Geological Features

Symbol & Name

- 🟪 < Ka >Aguja Formation (Upper Cretaceous)
- 🟩 < Kdc >Del Carmen Limestone (Lower Cretaceous)
- 🟫 < Kgr >Glen Rose Limestone (Lower Cretaceous)
- 🟩 < Kj >Javelina Formation (Upper Cretaceous)
- 🟪 < Kp >Pen Formation (Upper Cretaceous)
- 🟥 < Kse >Santa Elena Limestone (Lower Cretaceous)
- 🟩 < Ksp >Sue Peaks Formation (Lower Cretaceous)
- 🟥 < Ktm >Telephone Canyon Formation and Maxon Sandstone, undivided (Lower Cretaceous)
- 🟫 < Qaw >Active tributary wash and river deposits (latest Holocene)
- 🟩 < Qc >Colluvium and colluvial-fan deposits (Holocene and Pleistocene)
- 🟪 < Qe >Eolian sand (Holocene)
- 🟥 < Qia1 >Younger of the intermediate alluvial deposits (late to middle Pleistocene)
- 🟦 < Qia2 >Older of the intermediate alluvial deposits (middle Pleistocene)
- 🟩 < Qiw1 >Youngest intermediate axial river deposits (late Pleistocene)
- < Qiw2 >Older intermediate axial river deposits (late to middle Pleistocene)
- < Qiw3 >Oldest intermediate axial river deposits (middle Pleistocene)
- 🟦 < Qls >Landslide deposits (Holocene and Pleistocene)
- 🟪 < Qow >Old axial river deposits (middle to early? Pleistocene)
- 🟧 < Qya >Young alluvial deposits, undivided (Holocene to late Pleistocene)
- 🟫 < Qya1 >Younger of the young alluvial deposits (Holocene)
- 🟨 < Qya2 >Older of the young alluvial deposits (Holocene to late Pleistocene)
- 🟩 < Qyw1 >Younger of the young axial river deposits (Holocene)
- 🟦 < Tcac >Alamo Creek Basalt Member, Younger part of Chisos Formation (Eocene)
- 🟦 < Tctm >Tule Mountain Trachyandesite Member, Younger part of Chisos Formation (Oligocene)
- 🟦 < Tcy >Younger part, undivided, Chisos Formation (Oligocene and Eocene)
- 🟪 < Tib >Basaltic and other mafic composition intrusive rocks, undivided (Oligocene to Eocene)

Big Bend National Park Topographical Map
Terlingua Area



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Datum: D_WGS_1984

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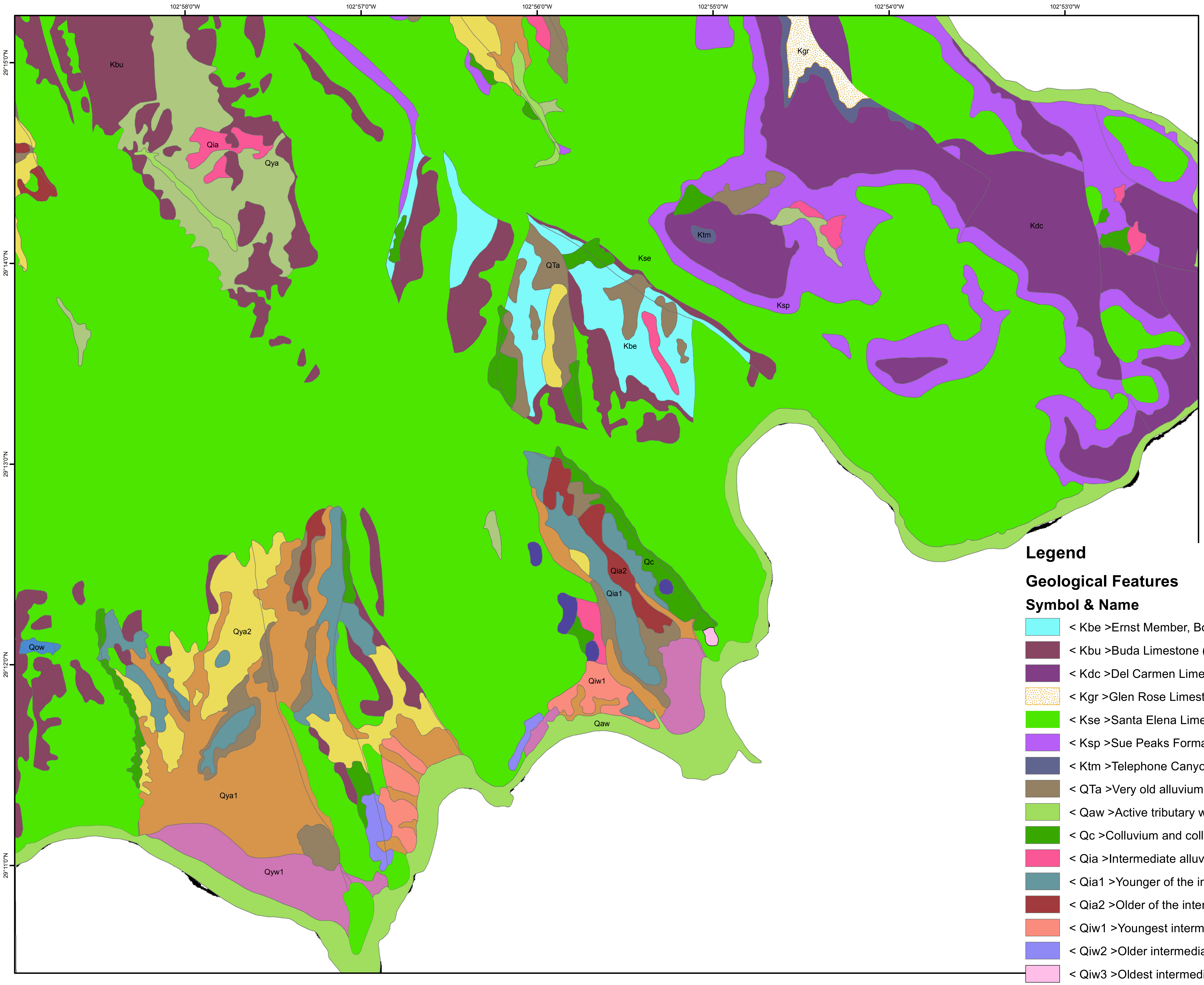
Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution

Big Bend National Park

Geological Map

(Boquillas Area)

Figure 18



N

Legend

Geological Features

Symbol & Name

🟦 < Kbe >Ernst Member, Boquillas Formation (Upper Cretaceous)
🟫 < Kbu >Buda Limestone (Upper Cretaceous)
🟪 < Kdc >Del Carmen Limestone (Lower Cretaceous)
▨ < Kgr >Glen Rose Limestone (Lower Cretaceous)
🟩 < Kse >Santa Elena Limestone (Lower Cretaceous)
🟪 < Ksp >Sue Peaks Formation (Lower Cretaceous)
🟦 < Ktm >Telephone Canyon Formation and Maxon Sandstone, undivided (Lower Cretaceous)
🟫 < QTa >Very old alluvium (early Pleistocene and Pliocene)
🟩 < Qaw >Active tributary wash and river deposits (latest Holocene)
🟩 < Qc >Colluvium and colluvial-fan deposits (Holocene and Pleistocene)
🟥 < Qia >Intermediate alluvial deposits, undivided (late and middle Pleistocene)
🟦 < Qia1 >Younger of the intermediate alluvial deposits (late to middle Pleistocene)
🟥 < Qia2 >Older of the intermediate alluvial deposits (middle Pleistocene)
🟧 < Qiw1 >Youngest intermediate axial river deposits (late Pleistocene)
🟪 < Qiw2 >Older intermediate axial river deposits (late to middle Pleistocene)
🟪 < Qiw3 >Oldest intermediate axial river deposits (middle Pleistocene)
🟦 < Qoa >Old alluvial deposits, undivided (middle to early? Pleistocene)
🟦 < Qow >Old axial river deposits (middle to early? Pleistocene)
🟩 < Qya >Young alluvial deposits, undivided (Holocene to late Pleistocene)
🟧 < Qya1 >Younger of the young alluvial deposits (Holocene)
🟨 < Qya2 >Older of the young alluvial deposits (Holocene to late Pleistocene)
🟪 < Qyw1 >Younger of the young axial river deposits (Holocene)

1:25,000

0 0.5 1 2 3
Kilometers

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Projection Information :
NAD_1927_UTM_Zone_13N
Projection: Transverse_Mercator
GCS_North_American_1927
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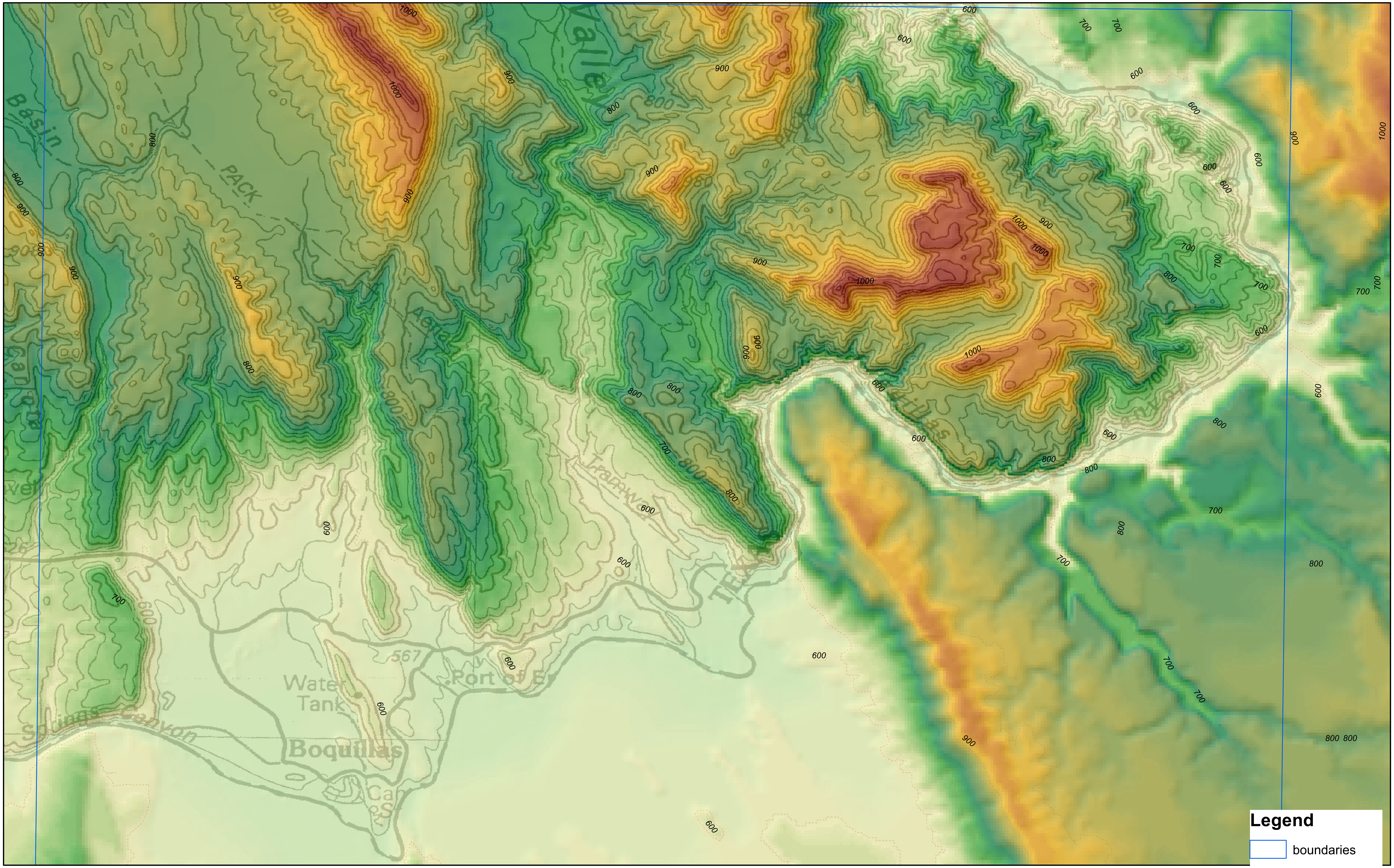

Big Bend National Park Topographical Map
Boquillos Area

Figure 19

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Projection:
GCS_WGS_1984
Datum: D_WGS_1984

Data Source: USGS
http://pubs.usgs.gov/sim/3142

Geological Features of the Big Bend National Park
are shown over a DEM (30 meter Resolution

Fossils - Common fossils found in each formation.

Del Rio:

The Del Rio Formation at Cerro de Cristo Rey yields bivalves (especially *Gyrostrea whitneyi* and *Ilymatogyra arietina*), gastropods, spatangoids, and ammonoids. In thin section we observed foraminiferans, ostracods, echinoderms, and annelid worm tubes. From the Del Rio Formation at Cerro de Cristo Rey, Mauldin (1985) and Mauldin and Cornell (1986) determined 52 species of foraminiferans. The foraminiferal assemblage is dominated by rotaliine foraminiferans (38 species), which constitute 82% of the individuals. Agglutinated foraminiferans (suborder Textulariina) comprise 12 species and 17% of all individuals.Two species belong to milioline foraminiferans, constituting 1% of the individuals. These foraminiferans support correlation of the Del Rio outcrops with the Grayson Formation elsewhere in Texas.

Figure 1: Texigryphaea graysonana (Stanton) Age: Cenomanian Stage, Cretaceous Period
Rock unit: Del Rio Formation

Figure 2: Ptychodus decurrens (shark tooth) Age: Cenomanian Stage, Cretaceous Period
Rock unit: Del Rio Formation

Figure 5: Cretodus semiplicatus (shark tooth Age: Cenomanian Stage, Cretaceous Period
Rock unit: Del Rio Formation)

Figure 4: Taxon: Mariella (Wintonia) bosquensis (Adkins) Age: Cenomanian Stage, Cretaceous Period
Rock unit: Del Rio Formation

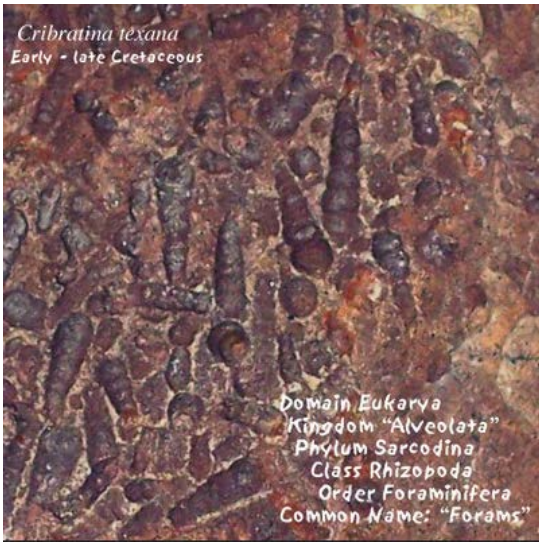

Figure 3: Cribrantia Texana, Rock Unit: Del Rio Formation

Boquillas Formation:

Kennedy et al. (1988) described a middle Cenomanian molluscan fauna of bivalves (*Ostrea beloiti* Logan and *Inoceramus arvanus* Stephenson) and diverse ammonoids (including *Acanthoceras amphibolum*) from a thin bed of calcarenitic and coquinoidal limestone near the base of the Mancos. Turnšek et al. (2003) also state that shark teeth (notably *Ptychodus*) are present in the Mancos Formation at Cerro de Cristo Rey. Cornell (1997) reported dinoflagellate cysts. We observed dasycladacean algae, foraminiferans, ostracods, echinoderms, and bryozoans(?) in thin section.

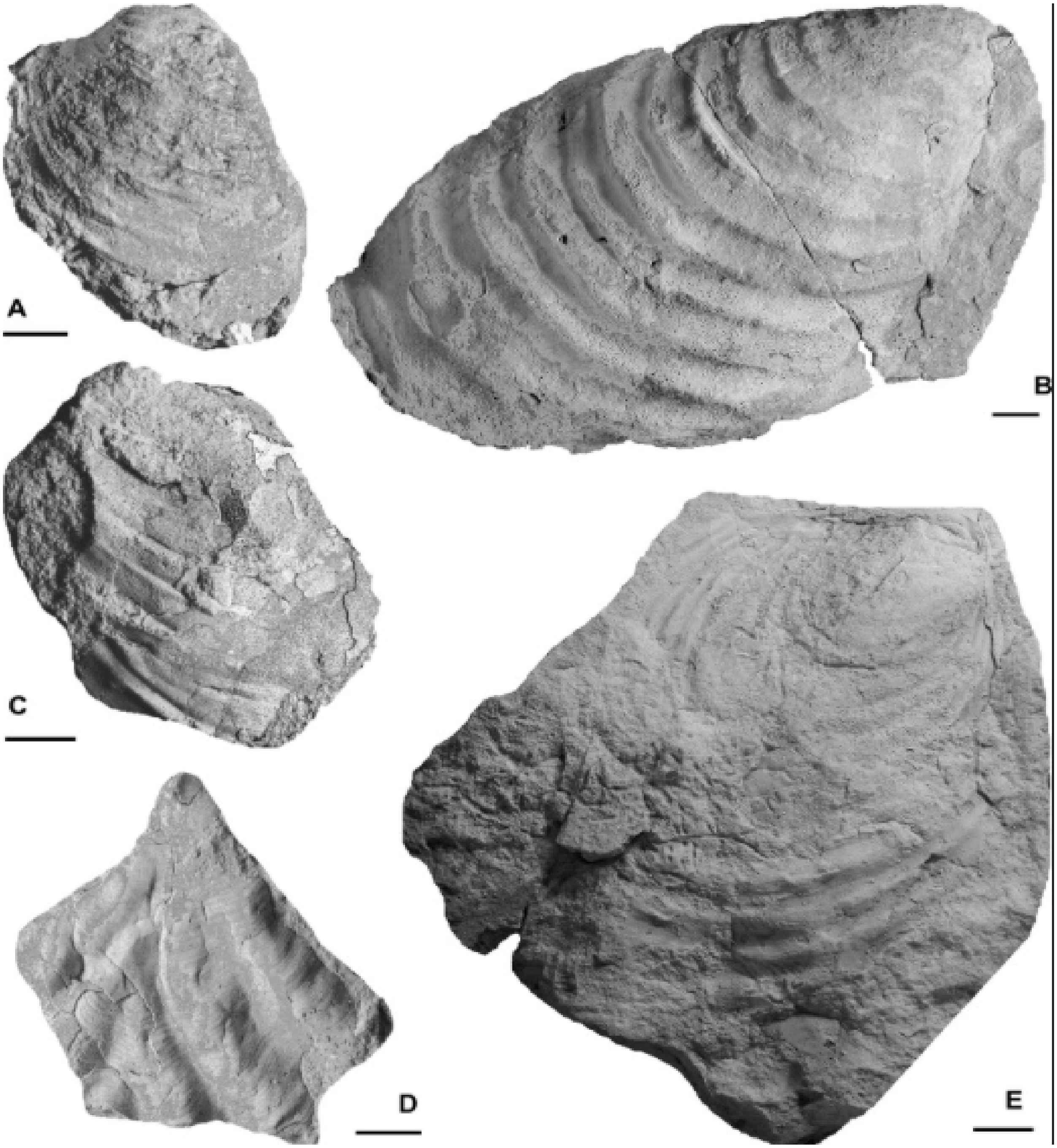

Figure 6: Genus: Inoceramus, Rock Unit: Boquillas

Buda Formation

The Buda Formation yields many gastropods (mostly turritellids) and bivalves, as well as some ammonoids, dinoflagellates, serpulids, spatangoid echinoderms, crustaceans, corals, and fish teeth (Böse 1910; Young 1979; Cornell 1997; Turnšek et al. 2003). Ammonoids we have collected (and will document elsewhere) place it in the early Cenomanian zone of *Neophlycticeras*(=*Budaiceras*) *hyatti* (Young 1979).

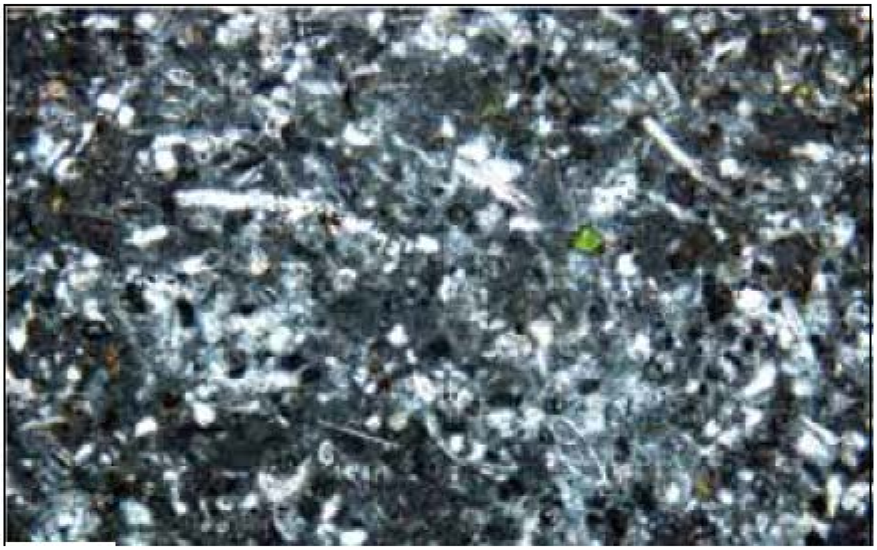

Figure 7: Buda Formation: Peloidal bioclastic mudstone containing a few angular quartz grains, some

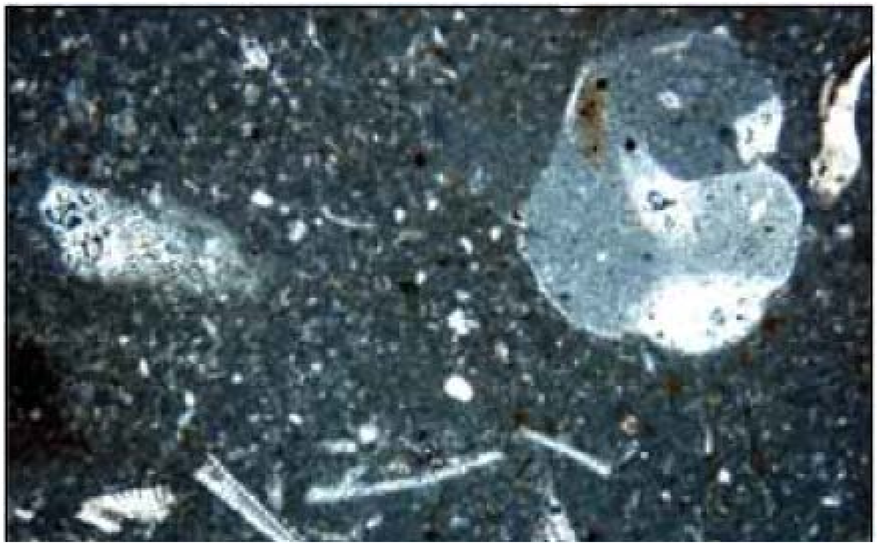

Figure 8: Buda Formation: Bioclastic mudstone composed of gray micrite with

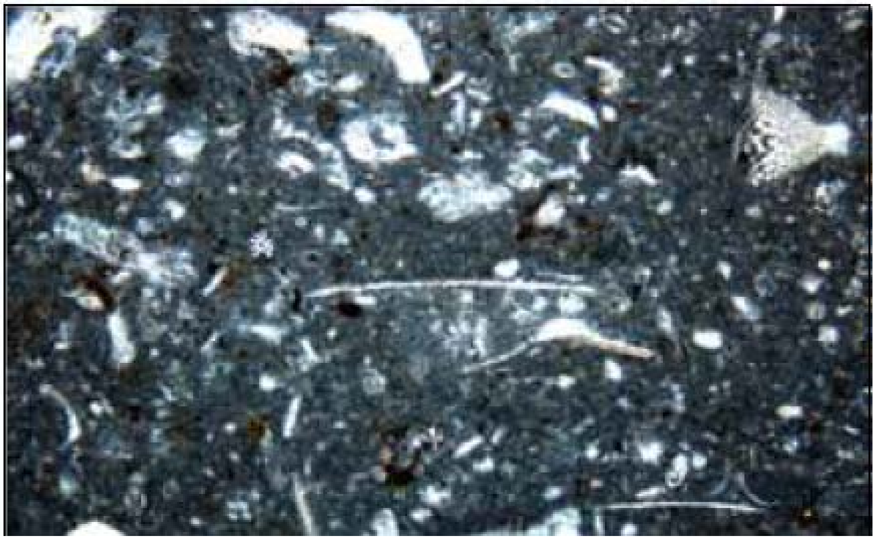

Figure 9: Buda Formation, Fine-grained bioclastic

Santa Elena Formation

Figure 10: Santa Elena Formation

Formation	**Rock Type**	**Age**	**Environment**
Santa Elena Formation	Limestone	Mid Cretaceous	Deep Ocean
Del Rio Clay	Shale/Clay	Mid Cretaceous	Shallow Ocean
Buda Limestone	Marly / Limestone	Mid Cretaceous	Deep Ocean
Boquillas Formation	Chalk/Limestone	Mid Cretaceous	Deep Ocean