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

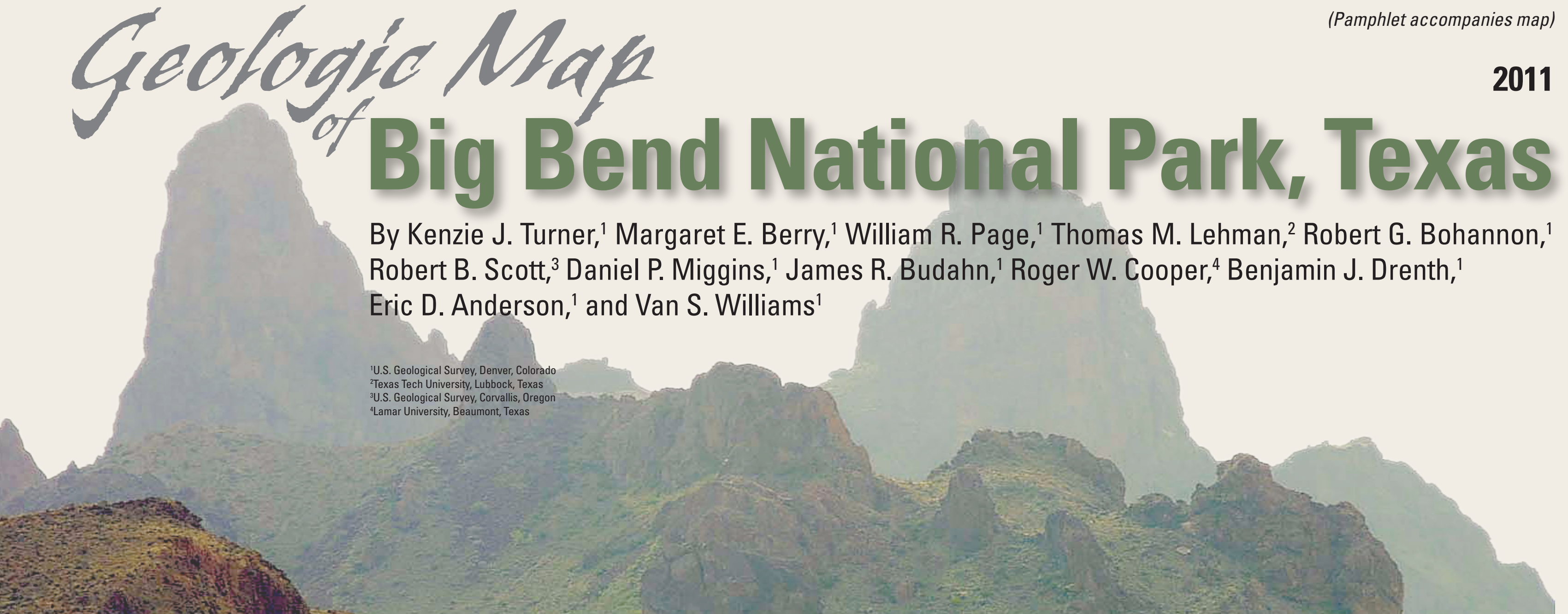
Scientific Investigations Map 3142
Prepared in cooperation with the **National Park Service**
(Pamphlet accompanies map)

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

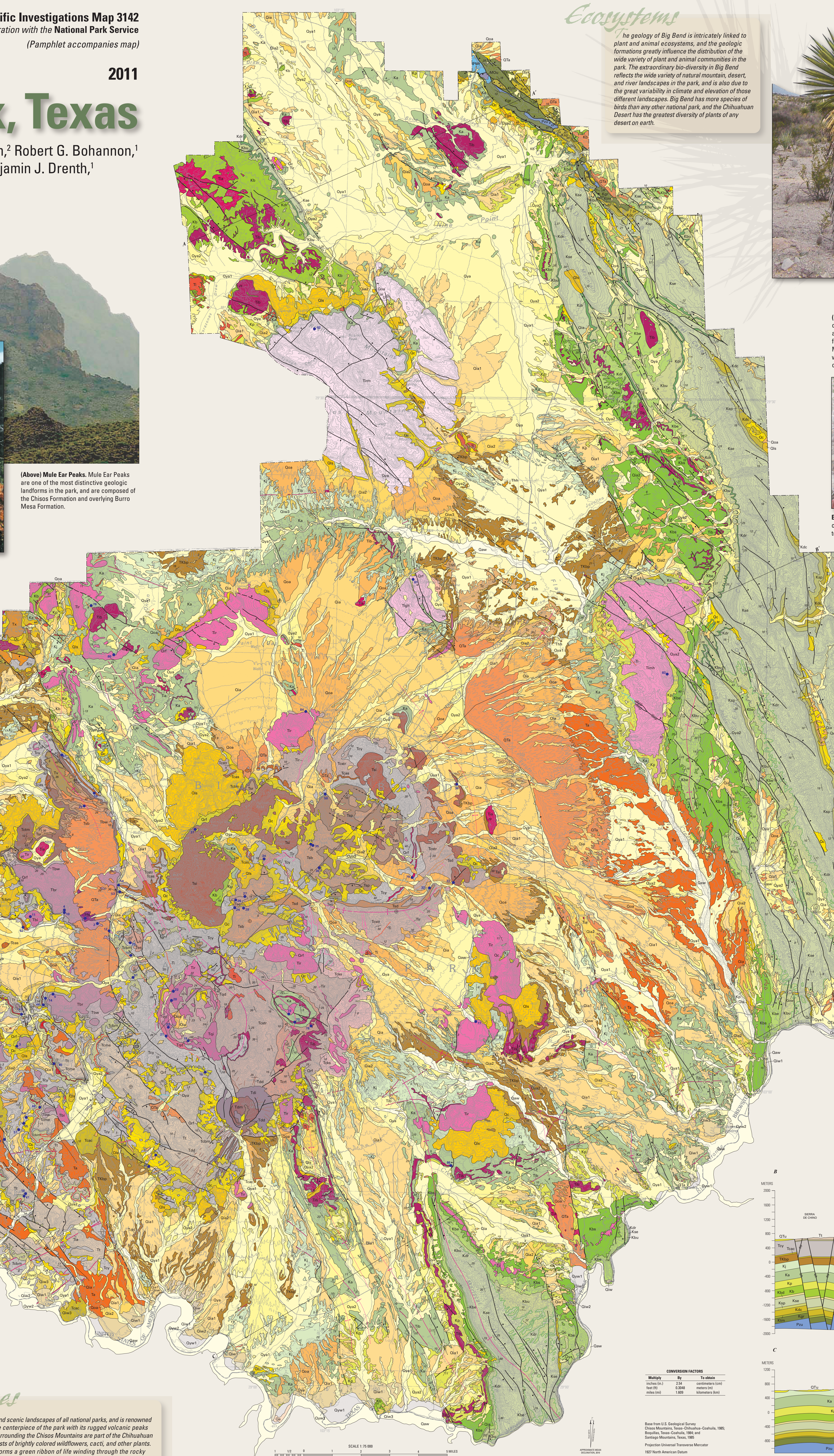


(Above) Mule Ear Peaks. Mule Ear Peaks are one of the most distinctive geologic landforms in the park, and are composed of the Chisos Formation and overlying Burro Mesa Formation.

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.



SCALE 1:75 000

CONTOUR INTERVAL 20 METERS
NATIONAL GEODETIC VERTICAL DATUM OF 1929

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

CONVERSION FACTORS

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

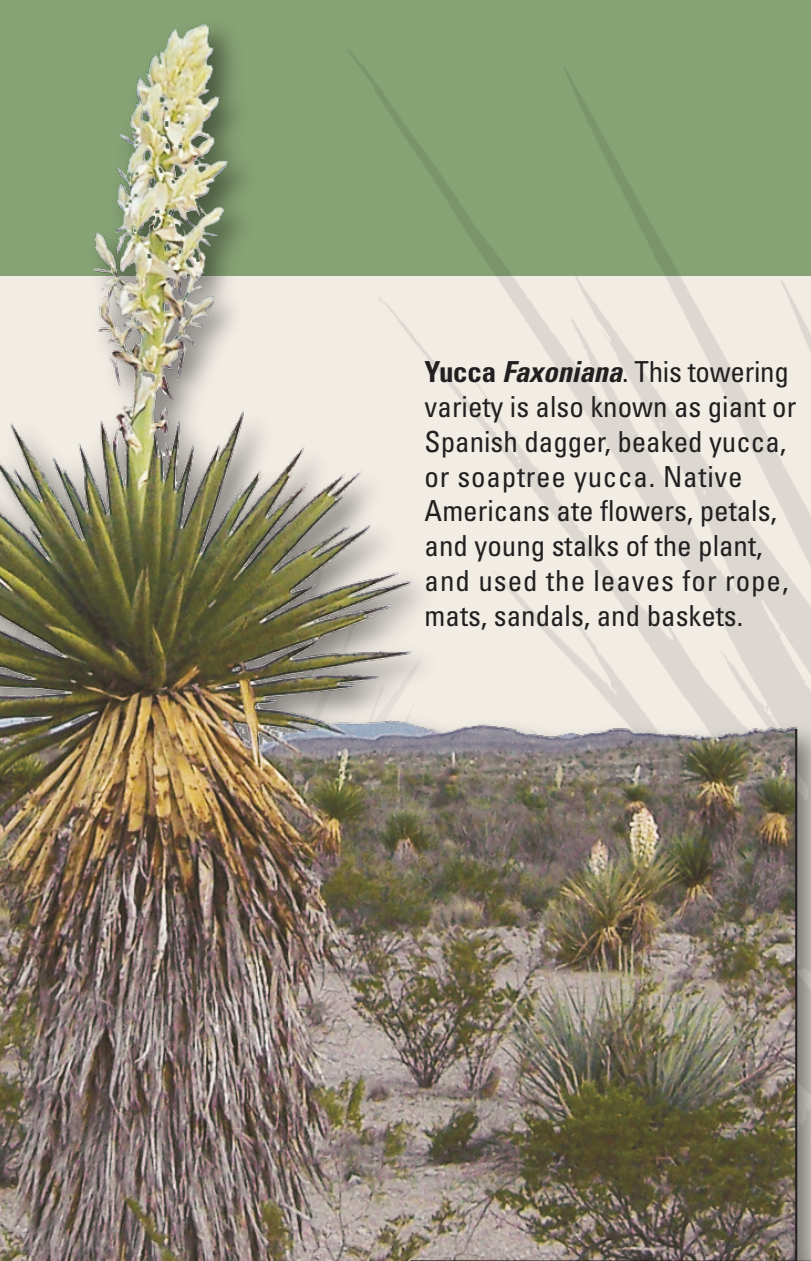
View of El Pico in the Sierra del Carmen. Although El Pico is located across the Rio Grande from Big Bend, in Coahuila, Mexico, the Sierra del Carmen extends northward into Big Bend National Park, where the range forms towering limestone cliffs, originally deposited in ancient seas during Cretaceous 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.

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.



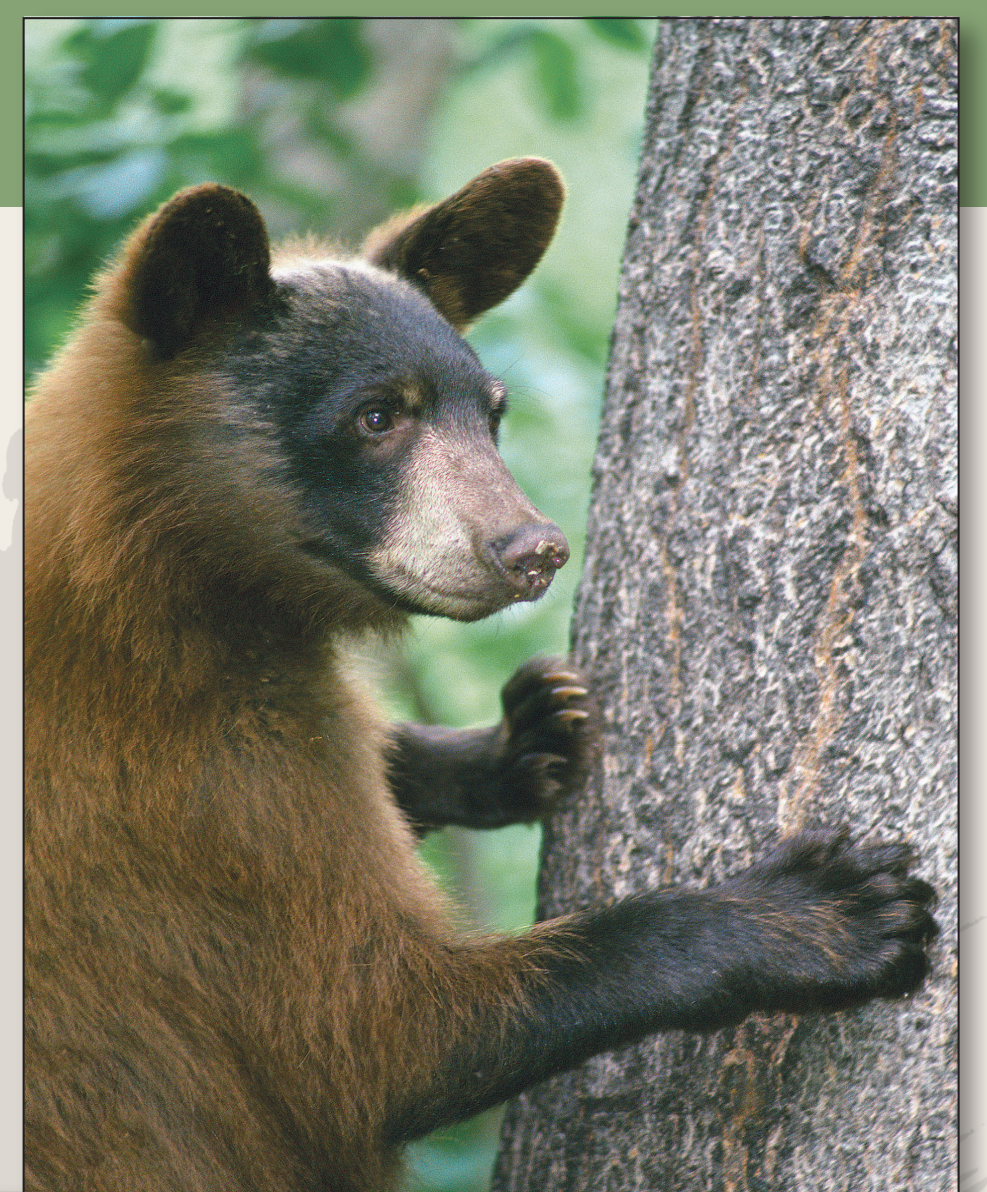
Yucca *Faxoniana*. This towering variety is also known as giant or Spanish dagger, beaked yucca, or soaptree yucca. Native Americans ate flowers, petals, and young stalks of the plant, and used the leaves for rope, mats, sandals, and baskets.

(Right) 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.



(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.

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

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)
IPMt	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

50 **Inclined**

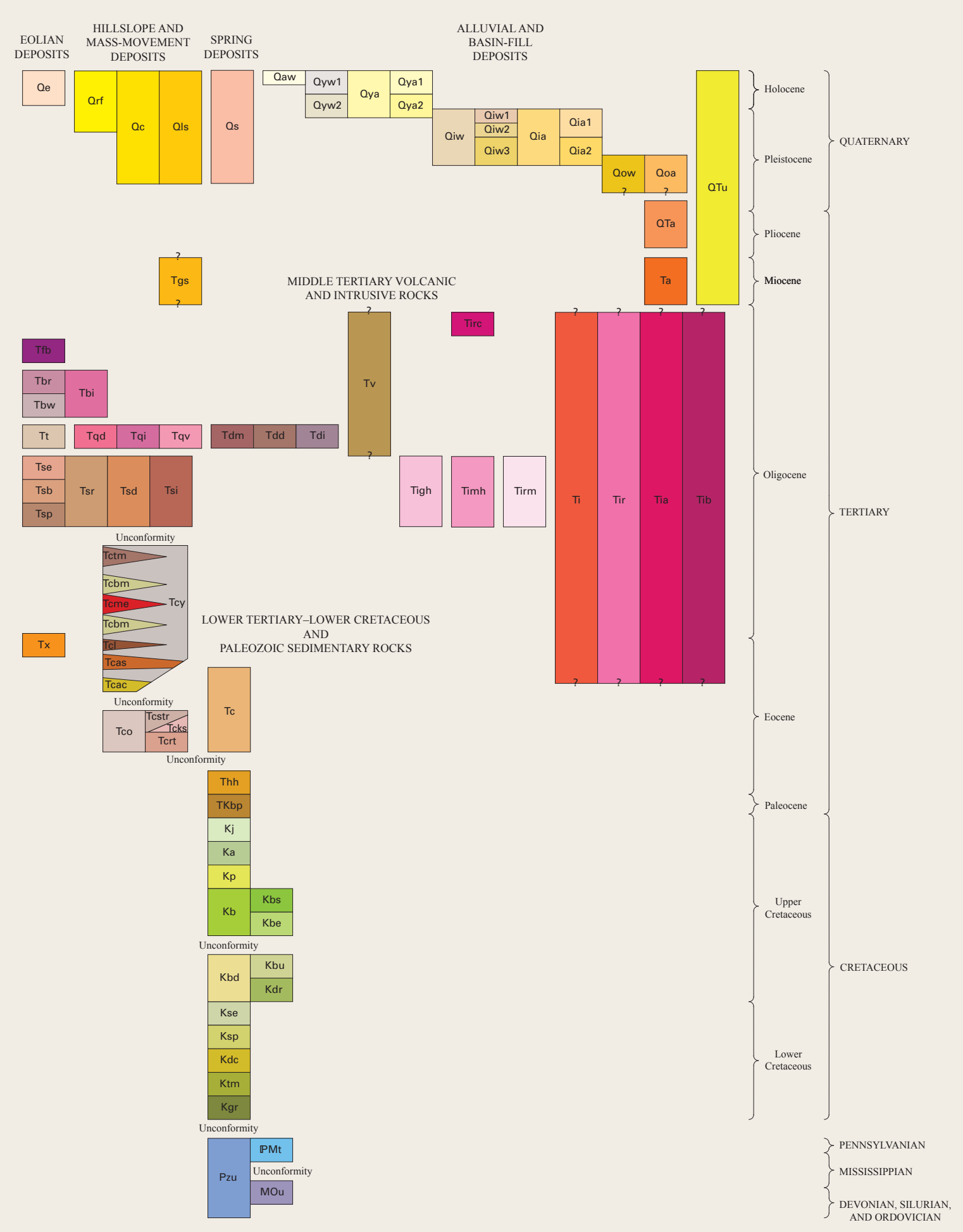
⊕ **Horizontal**

Vertical

51 **Overturned**

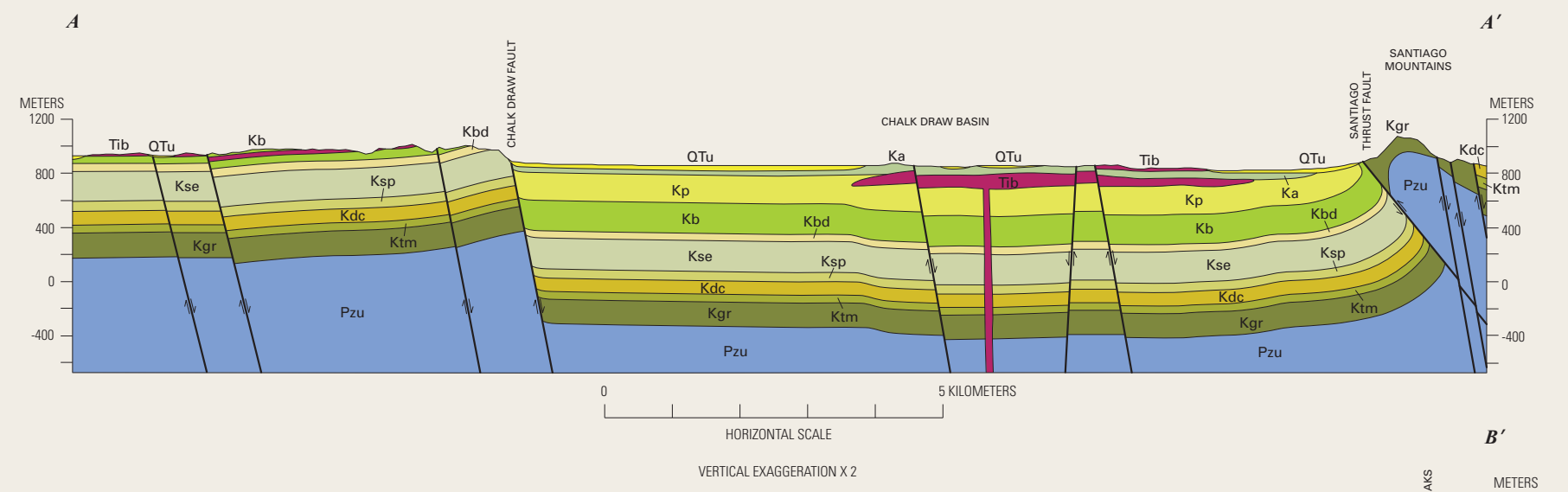
● 46 **Geochronology sample location and map sample number (Appendix)**

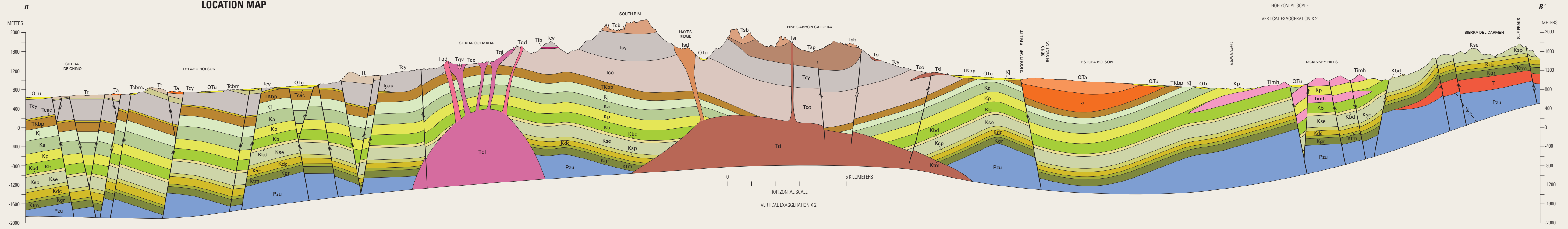
CORRELATION OF MAP UNITS

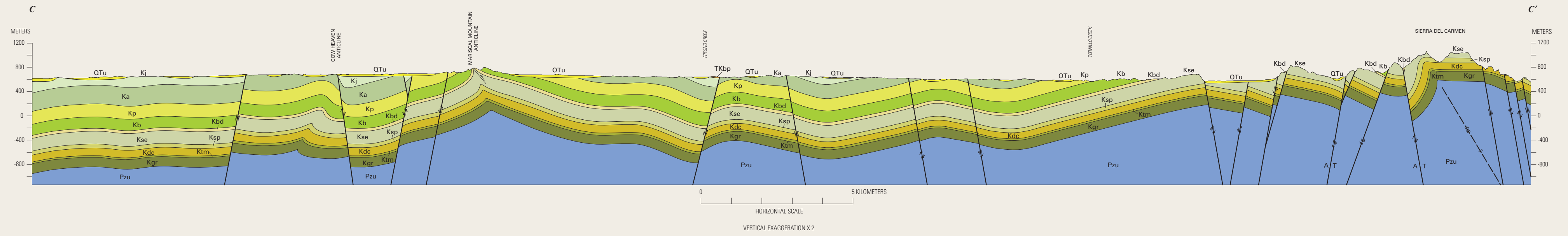

EOLIAN DEPOSITS
HILLSLOPE AND MASS-MOVEMENT DEPOSITS
SPRING DEPOSITS
ALLUVIAL AND BASIN-FILL DEPOSITS
MIDDLE TERTIARY VOLCANIC AND INTRUSIVE ROCKS
LOWER TERTIARY–LOWER CRETACEOUS AND PALEOZOIC SEDIMENTARY ROCKS
Unconformity
Holocene
Pleistocene
Pliocene
Miocene
Oligocene
Eocene
Paleocene
Upper Cretaceous
Lower Cretaceous
QUATERNARY
TERTIARY
CRETACEOUS
PENNSYLVANIAN
MISSISSIPPIAN
DEVONIAN, SILURIAN, AND ORDOVICIAN

TEXAS
Big Bend National Park

LOCATION MAP







Photograph Credits

Mule Ear Peaks *(Courtesy of the National Park Service, Big Bend National Park Visitor Photo Gallery)*
Santa Elena Canyon *(Photograph by Van S. Williams, U.S. Geological Survey)*
Casa Grande in fog *(Courtesy of the National Park Service)*
Chisos Formation sandstone *(Photograph by Daniel P. Miggins, U.S. Geological Survey)*
Full moon over El Pico *(Courtesy of the National Park Service, Big Bend National Park Visitor Photo Gallery)*
Yucca cactus *(Courtesy of the National Park Service)*
Century plant *(Photograph by Daniel P. Miggins, U.S. Geological Survey)*
Prickly pear cactus *(Photograph by Margaret E. Berry, U.S. Geological Survey)*
Gulf Fritillary, large *(Courtesy of the National Park Service)*
Gulf Fritillary, Small *(Modified from photograph by Calibas. Any use is licensed under GNU Free Document License 1.2 or later and Creative Commons 3.0)*
Mexican Jay *(Photograph by Alan Vernon. Any use is licensed under Creative Commons 2.0)*
American black bear cub *(Courtesy of the U.S. Fish and Wildlife Service)*
Coyote *(Photograph by Rebecca Richardson. Any use is licensed under Creative Commons 2.0)*
Collared lizard *(Photograph by Daniel Schwen. Any use is licensed under GNU Free Document License 1.2 or later and Creative Commons 3.0)*
Black-tailed jackrabbit *(Photograph by pschemp. Any use is licensed under GNU Free Document License 1.2 or later and Creative Commons 3.0)*
Tarantula *(Photograph by Kenzie J. Turner, U.S. Geological Survey)*

Any use of trade names is for descriptive purposes only and does not imply endorsement by the U.S. Government

For sale by U.S. Geological Survey Information Services, Box 25286, Federal Center, Denver, CO 80225
1-888-ASK-USGS

ArcInfo coverages and a PDF for this map are available at *http://pubs.usgs.gov/sim/3142/*

Suggested citation:
Turner, K.J., Berry, M.E., Page, W.R., Lehman, T.M., Bohannon, R.G., Scott, R.B., Miggins, D.P., Budahn, J.R., Cooper, R.W., Drenth, B.J., Anderson, E.D., and Williams, V.S., 2011, Geologic map of Big Bend National Park, Texas: U.S. Geological Survey Scientific Investigations Map 3142, scale 1:75,000, pamphlet 84 p.

Author and Production Credits

Surficial geology mapped and compiled by ***Margaret E. Berry***, 2004–2009; and ***Van S. Williams***, 2004–2009

Bedrock geology mapped and compiled by ***Kenzie J. Turner***, 2005–2009; ***William R. Page***, 2003–2009; ***Thomas M. Lehman***, 2001–2007; ***Robert G. Bohannon***, 2003–2007; ***Robert B. Scott***, 2003–2005; ***Lawrence W. Snee***, 2003–2005; ***Kay Wache***, 2003–2004; and ***Roger W. Cooper***, 2004–2010

Digital map database prepared by ***Kenzie J. Turner***

Editing and digital cartography by ***Gayle M. Dumonceaux***, *Denver Publishing Service Center*

Graphic design and layout by ***Carol A. Quesenberry***, *Denver Publishing Service Center*

Manuscript approved for publication November 30, 2010