Geologic Column

| CENC_ ZOI Quaternary (2.2M) Instant forms modern danage, laciones fulling Oil 10104< | Era | Period & Age | Environments/Events | Rock Units Description |
|--|---------------|-----------------|---|--|
| OPDOC -110 Ma Nearshore, restricted, shallow marine sediments. Upper Gen Rose (Rgw). Interbedded Imstein, and cakerous day, Base of the unit comparison of appropriate and youth and photoparaphy of the Hill Country. Opper Gen Rose (Rgw). Interbedded Imstein, and cakerous day, Base of the unit comparison of appropriate and youth and the characteristic stainset propagative and youth and the base of the unit comparison of appropriate and youth and the characteristic stainset propagative and youth and youthand youthand and youthand the upper and youthand youthand youthand | CENO- ZOIC | | Balcones faulting | Qalo generally unconsolidated poorly sorted cobble, pebble, sand, silt and clay clastic and calcareous |
| Opcom Createcous Costatil and marine safetiments. Overlies abuindantly fossiliferous limetone with local reef (rudist) development. Maximum of about 125 ft thick. Createcous Costatil and meanhore marine sediments. Costatil and meanhore marine sediments representing fluvial triver ands), floodplain, bay, and extend to the formation into limestone at the top. Sandstones have weak calcareous centents. Local intervals of thin, fossiliferous limestone. Maximum of about 20 ft thick. Unconformity Springs Top represents beach shoreline, and the lower portion nearshore marine. Springs Over Create Limestone (Kcc). Upper portion is white, medium- to coarse-grainstone (coquina), quartz and calcareous graina, and croas-bedded. The upper 20 feet is generally cliff-forming and may how springs in initiative clone Springs to the lower portion nearshore marine. -1374b -1374b -1374b -1374b -1374b Pangea (Mountain-building) -1374b Sinthwick Shale (Paw), Creenish-gray shale. Not exposed and mapped at the base of Pedmales Falls from blief exposure after floods. Opporty Sorted, grains composed of pre-Cretaceous units of Clept spring the field in the composed and mapped at the base of Pedmales Falls from blief exposure after floods. -1374b Sinthwick shale (Paw), Creenish-gray shale. Not exposed and mapped at the base of Pedmales Falls from blief exposure after floods. Pennsylvannian Sinthwick represents an open-marine shefif Sinthwick shale (IPaw), Creenish-gra | | ~110 Ma | Nearshore, restricted, shallow | contains remnants of evaporite (anhydrite and gypsum) beds from tidal flat. Unit blankets the hills |
| OPODE Cretaceous Costal and nearshore marine sedments. Legg and the service marine sedments representing fluvial (river sands), floodplain, bay, and extra of extr of extr of extra of extra of extra of extra of extre | | | | minute clam <i>Carycorbula matinae</i> . Overlies abundantly fossiliferous unit called the |
| Oppose Cretaceous Castal and nearshore marine sediments representing fluvial river ands, hoodplain, bay, and estuary environments. Hersel Sand (Khe). Cobble- to pebble-conglomerates, coarse- to fine- sandstones, and mudstones, transitions into limestone at the top. Sandstones have weak calcareous cements. Local intervals of thin, fossiliferous limestone. Maximum of about 80 ft thick. Unconformity Top represents basch shoreline, and the lower portion nearshore marine. No Springs: Antine, offshore shelf. Nameer, offshore shelf. No Nover cell. Limestone (Kcc). Upper portion is white, medium- to coarse-grainstone (coquina), quartz and calcareous grains, and cross-bedded. The upper 20 feet is generally diff-forming and may see springs in tributaries (lower spring). -1374b Marine, offshore shelf. No | | | - | |
| Unconformity Top represents beach shoreline, and the lower portion nearshorm marine. For oper sents beach shoreline, and the lower portion nearshorm marine. Comparison of the comparison of | U | | | "reef" fossils |
| Opport Pennsylvannian Sinithwick represents and generation of North America. Marine and the lais represents and generation of North America. Sinithwick represents and generation of North America. Marine and full Sinithwick represents and for North America. Sinithwick represents and for North America. Marine and full Sinithwick represents and generation of North America. Sinithwick represents and generation of North America. Marine and full Coastal alluvial fails and fluvial sediments. Sinithwick represents from the passive margin of North America. Marine and fill Sinithwick represents and generation of North America. Sinithwick represents and generation of North America. Marine and fill Coastal alluvial fails and fluvial sediments. Sinithwick represents from the passive margin of North America. Coord By collustion of North America. Sinithwick represents from the passive margin of North America. Marble Fails Einestone (IPM). Linestone. Gray to light gray, crinoid (fossil) Coord Dy collustion of North America. Sinithwick represents and open-marine shelf environment. Correct Control for Sils | MESOZOI | Cretaceous | sediments representing fluvial (river sands), floodplain, bay, and | mudstones, transitions into limestone at the top. Sandstones have weak calcareous cements. |
| Opensylvanian Smithwick represents and generation of North America. Marble Fails represents an open-marine shelf environment. Smithwick Shale (IPsw), Greenish-gray shale. Not exposed and mapped at the base of Pederales Fails from brief exposure after floods. Correct Limestone (Rcc). Upper portion is white, medium- to coarse-grainstone (coquina), quart and calcareous grains, and cross-bedded. The upper 20 feet is generally cliff-forming and mark the average in tributaries clones Spring). Lower portion consists of clay explaced and covered by colluvium and is slope-forming. Lower portion consists of clay clacareous shale and muddone. Gray to greenish, sandy, silty, calcareous shale and covered by colluvium and is slope-forming between the underlying Sycamore and overlying Cow Creek. Up to 40 ft thick. -137 Ma Coastal alluvial fan and fluvial sediments. -137 Ma Pangea (Mountain-building) -137 Ma Pangea (Mountain-building) -137 Ma Faulting and tilting of Paleozoic units during the Permina (~250 Ma). -137 Ma Pangea (Mountain-building) -137 Ma Faulting and tilting of Paleozoic units during the Permina (~250 Ma). -137 Ma Smithwick Represents from the passive margin of North America. -315 Ma Smithwick Represents an open-marine shelf environment. -316 Ma Smithwick Shale (IPsw). Greenish-gray shale. Not exposed and mapped at the base of Pederales Fails from brief exposure after floods. <td></td> <td></td> <td>Unconformity</td> <td>Springs</td> | | | Unconformity | Springs |
| Marine, offshore shelf. Marine, offshore shelf. Marine, offshore shelf. Marine, offshore shelf. Marine, offshore shelf. Marine, offshore shelf. Marine, offshore shelf. Coastal alluvial fan and fluvial sediments. Marine add fluvial sediments from the passive margin of North America. Marine add fluvial sediments form the passive margin of North America. Marine add fluvial sediments form the passive margin of North America. Marine shelf environment. Marine shelf environment. Marine fails Limestone (IPmf). Limestone. Gray to light gray, crinoid (fossil) limestones with chert common. Dense and resistent limestones comprise the fails and are fractured and tilted due to the formation of the supercontinent Pangea. Up to 400 ft thick. Crinoid fossils | | | and the lower portion nearshore | Kcc Cow Creek Limestone (Kcc). Upper portion is white, medium- to coarse-grainstone (coquina), quartz and calcareous grains, and cross-bedded. The upper 20 feet is generally cliff-forming and may have springs in tributaries (Jones Spring). Lower portion consists of clayey calcareous mudstone and dolomite containing oysters and is more recessive and slope-forming. Maximum |
| Victor Sediments. Sycamore Sand (Ksy). Well-rounded, Well-cemented, conglomerate with cobble- to coarse-sand; poorly sorted, grains composed of pre-Cretaceous units of Central Texas. Victor Pangea (Mountain-building) Faulting and tilting of Paleozoic units during the Permian (~250 Ma). Smithwick Shale (IPsw). Greenish-gray shale. Not exposed and mapped at the base of Pedernales Falls from brief exposure after floods. Victor Pennsylvannian Smithwick represents nearshore sediments from the passive margin of North America. Simithwick represents an open-marine shelf environment. Fault Marble Falls Limestone (IPmf). Limestone. Gray to light gray, crinoid (fossil) Imestones with chert common. Crinoid fossils Crinoid fossils | | | Marine, offshore shelf. | Kha mudstones (limestone) with oyster fossils locally abundant. The unit is rarely exposed and covered by colluvium and is slope-forming between the underlying Sycamore and overlying |
| Uncomfinity, missing -200 Ma of time -315 Ma Pennsylvannian Marble Falls represents an open-marine shelf environment. Pangea (Mountain-building) Faulting and tilting of Paleozoic units during the Permian (~250 Ma) Pennsylvannian Marble Falls Limestone (IPmf). Limestone. Gray to light gray, crinoid (fossil) limestones with chert common. Dense and resistent limestones comprise the falls and are fractured and tilted due to the formation of the supercontinent Pangea. Uncomformation of the supercontinent Pangea. | | ~137 Ma | | |
| VIDE -315 Ma units during the Permian (~250 Ma). Permsylvannian Smithwick Shale (IPsw). Greenish-gray shale. Not exposed and mapped at the base of Pedernales Falls from brief exposure after floods. Pennsylvannian Smithwick represents nearshore sediments from the passive margin of North America. Smithwick represents an open-marine shelf environment. Marble Falls Limestone (IPmf). Limestone. Gray to light gray, crinoid (fossil) limestones with chert common. Dense and resistent limestones comprise the falls and are fractured and tilted due to the formation of the supercontinent Pangea. Up to 400 ft thick. Crinoid fossils | | ormity, missing | | |
| Marble Falls represents an open-marine shelf environment. | | | | Smithwick Shale (IPsw). Greenish-gray shale. Not exposed and mapped at the base of |
| Marble Falls represents an open-marine shelf environment. | ALEOZOIC | Pennsylvannian | nearshore sediments from the passive margin of North | A A A A A A A A A A A A A A A A A A A |
| | 4 | | open-marine shelf | and are fractured and tilted due to the formation of the supercontinent Pangea. Up to 400 ft thick. |
| | | ~322 Ma | eomment. | |

Ma = Millions of years ago

Figure 3. Geologic column describing the rocks, their ages, geologic environments, and events.

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Geology of Pedernales Falls State Park

The rocks at Pedernales State Park tell the story of major chapters in the geologic history of Texas. Ancient oceans are evidenced by the 300-million-year-old limestones at the falls. The tilt of those limestones, seen at the falls, resulted from a continental collision that created the supercontinent Pangea about 250 million years ago. Younger strata that blanket most of the park formed at the time of the dinosaurs (about 100 million years ago), when shallow seas covered this part of Texas. The final chapter of the story tells how rivers and waterways continue to sculpt the landscape.



more ancient, tilted rock units and the overlying flat-lying strata. That gap in time is termed an unconformity by geologists.

The retreat of the ocean water was recorded by the cliff-forming Cow Creek Overview Limestone, representing a beach environment. As the sea level declined, river Observing layers of geology is like reading the chapters of a history book. and coastal plain sediments of Hensel Sandstone covered the beach with The story begins with the oldest rocks units and geologic events, with subsands and muds. Later, the Hensel Sandstone graded into the Lower Glen sequent younger events of the story told by overlying rock units (fig. 3). Rose Limestone, marking the return of warm shallow seas that would per-At Pedernales Falls State Park, water has been the key agent of geologic sist through the rest of the Cretaceous. Sea levels and sediments continued processes for millions of years. It consisted of saltwater oceans-in which to fluctuate, reflected in the variety of limestone strata within the Glen Rose the limestone strata formed—as well as the freshwater streams that eroded Formation. The Upper Glen Rose Limestone represents a continuation of the modern landscape. shallow marine sediments, which weathered and eroded into the stair-step topography typical of the Central Texas Hill Country.

The strata that make up the falls are the Marble Falls Limestone, which are over 300 million years old. These rocks were deposited in an ancient Finally, the landscape we see today is the result of millions of years of erosea as evidenced by marine fossils (crinoids) embedded in the rock. These sion that was initiated by displacements from the Balcones Fault Zone that fossils occur as small white discs in the dense gray limestone. Later, sedioccurred about 15 million years ago. Today, unconsolidated sediments comments in this ancient ocean became more muddy and locally sandy, shed posed of gravels and sands are found next to rivers and show the ongoing from mountains to the east, resulting in the sediments composing the erosion and deposition of the landscape. Water is always working to gradually level Smithwick Shale. These mountains were located about where Austin the land as it carries water and sediment to the Gulf. is now and formed about 250 million years ago when North America collided with another land mass from the south. This massive collision created the supercontinent of Pangea, and we can still see results of that collision today in West Texas near Marathon and in the Ouachita Mountains of Oklahoma and Arkansas. In Central Texas the mountain ranges were eroded long ago and are buried beneath younger rocks. Although these ancient mountains lay east of the park, the force of the collision faulted and tilted the limestone we see at the falls. Today we can see the 15-degree eastward dip of the resistant limestone that underlie the falls. After millions of years of erosion the land was lowered, and the TEXAS mountains sank beneath the waters of the newly created Gulf of Mexico.

Later, about 100 million years ago, during the age of the dinosaurs, warm shallow seas advanced over the limestone landscape, creating a coastal environment that deposited thick layers of sandstone, mudstone, and limestone. During this period of geologic time (the Cretaceous), sea levels rose and fell, influencing sediment layers that became the rocks we see covering the park today. The Sycamore Sand unit represents a coastline that received coarse sediment from nearby uplands. The rising sea level is evidenced by the marine Hammett Shale with its oyster fossils.





Figure 1. Photograph of Pedernales Falls. The falls are created by 300-million-year-old Marble Falls Limestones that were deformed during the creation of the supercontinent Pangea. Cretaceous river and marine sediments (Sycamore Sand) are draped over the older limestone beds. Erosion by the Pedernales River and its tributaries have sculpted the landscape as we see it today. Note the dashed line that represents a gap in time of up to 200 million years between the

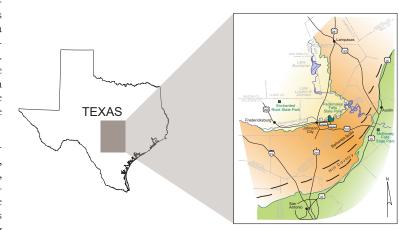
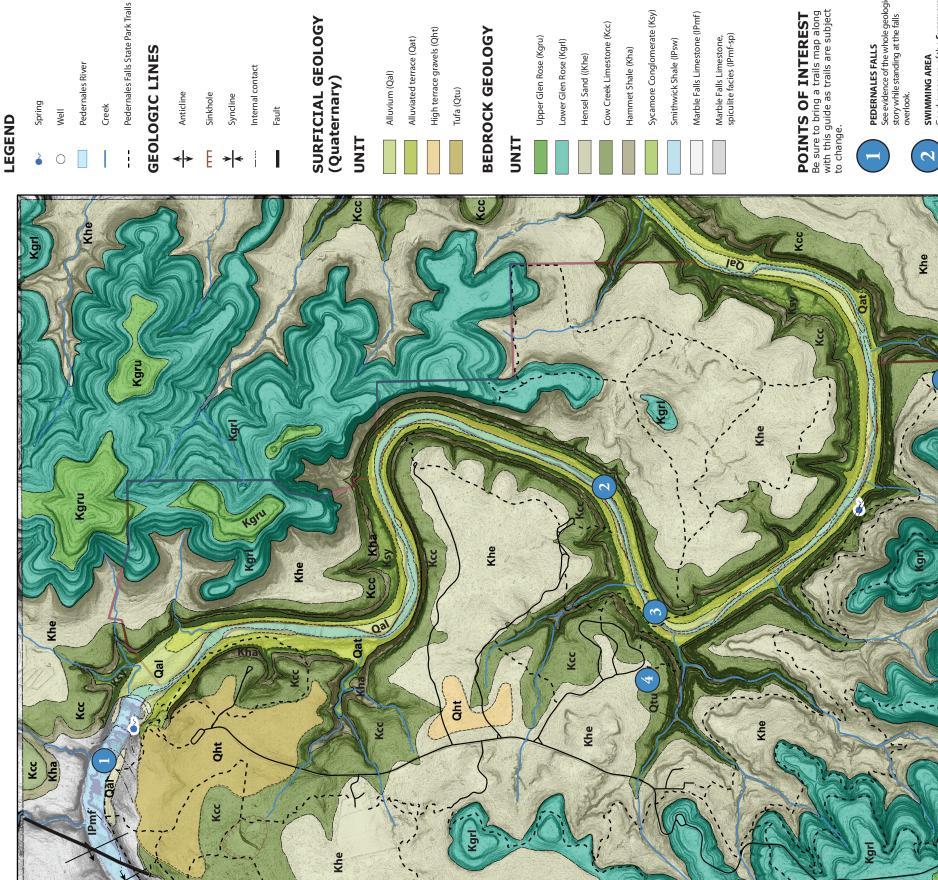


Figure 2. Location of Pedernales Falls in Texas

Geologic Map of Pedernales Falls State Park

Kcc

les River



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SWIMMING AREA Good exposure of the Sycamore Sand conglomerate in the large boulders and bedrock of the PEDERNALES FALLS See evidence of the whole geolog story while standing at the falls overlook. iver.

TRAMMEL'S CROSSING Traverse the entire Cretace section as you walk to the Note the differing elevatio alluvium and terraces alor the river. A flood in 1952 w 20 feet above the crossing

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TWIN FALLS NATURE TRAIL A close up look at the **Cow Cree** Limestone as you walk along th trail through the fractured and eroding cliff edge.

WOLF MOUNTAIN TRAIL TO JONE SPRING

In lower elevation route take: along the contact of the cliff-forming Cow Creek Limestone the softer **Hensel Sandstone**. It als a softer **Hensel Sandstone**. It als a softer **Hensel Softer** suing from the Cow Creek Limestone. The more elevated oortion of the trail takes you harine Low **Rose Lim**