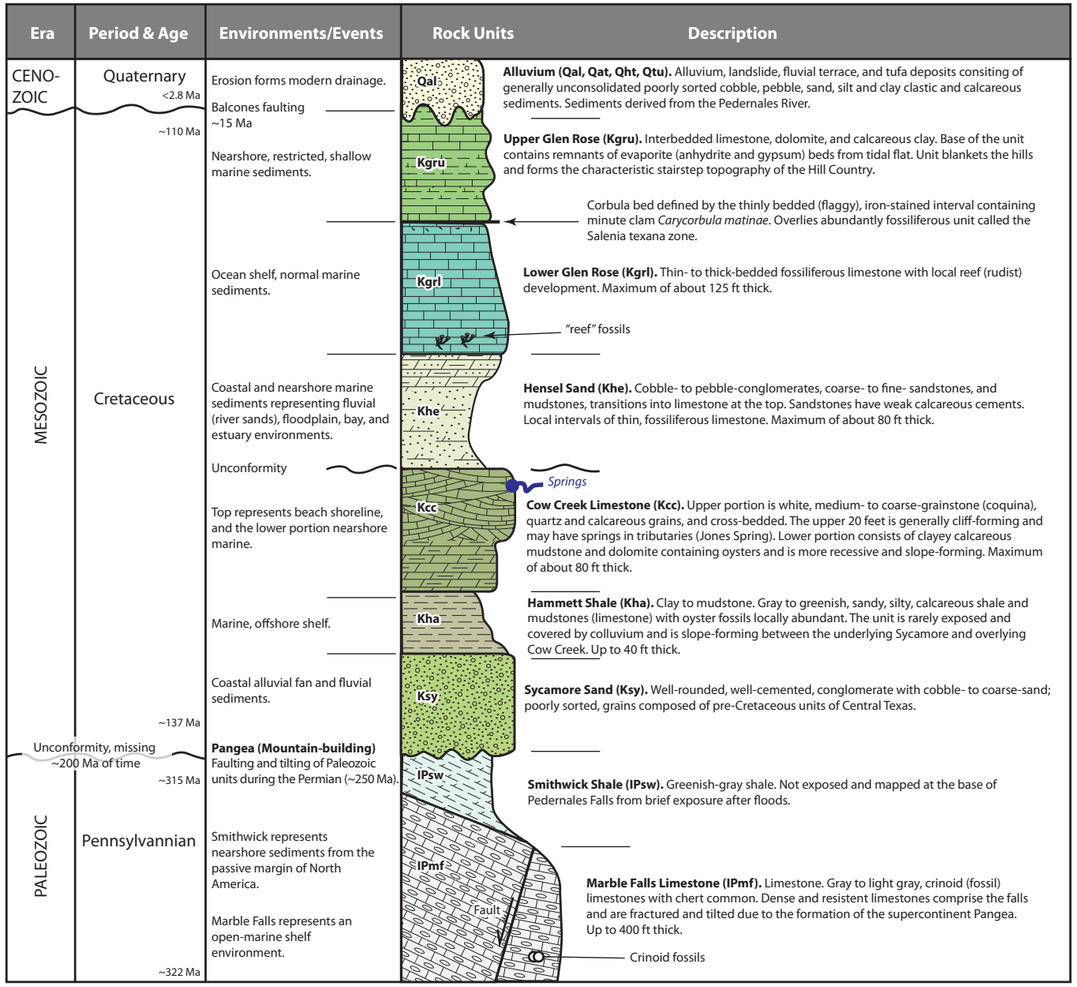
Geologic Column



Not to scale.
Ma = Millions of years ago

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

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UT BEG: Brian B. Hunt (geologist), Charles M. Woodruff (geologist), Linda Ruiz McCall (public information geologist), Francine M. Mastrangelo (graphic designer), Elyse Vane, (editor); **TPWD:** John Alvis, Greg Creacy, Justin Fleury (Planning and Geospatial Resource Manager), Stephen Garmon, Jason Hairston (Assistant Park Superintendent), Katie Raney (Regional Interpretive Specialist - Region 3).

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Geology of Pedernales Falls State Park

BUREAU OF ECONOMIC GEOLOGY

TEXAS PARKS & WILDLIFE

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.

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

Overview

Observing layers of geology is like reading the chapters of a history book. The story begins with the oldest rocks units and geologic events, with subsequent younger events of the story told by overlying rock units (fig. 3). At Pedernales Falls State Park, water has been the key agent of geologic processes for millions of years. It consisted of saltwater oceans—in which the limestone strata formed—as well as the freshwater streams that eroded the modern landscape.

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 sea as evidenced by marine fossils (crinoids) embedded in the rock. These fossils occur as small white discs in the dense gray limestone. Later, sediments in this ancient ocean became more muddy and locally sandy, shed from mountains to the east, resulting in the sediments composing the **Smithwick Shale**. These mountains were located about where Austin 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 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. The retreat of the ocean water was recorded by the cliff-forming **Cow Creek Limestone**, representing a beach environment. As the sea level declined, river and coastal plain sediments of **Hensel Sandstone** covered the beach with sands and muds. Later, the Hensel Sandstone graded into the **Lower Glen Rose Limestone,** marking the return of warm shallow seas that would persist through the rest of the Cretaceous. Sea levels and sediments continued to fluctuate, reflected in the variety of limestone strata within the Glen Rose Formation. The **Upper Glen Rose Limestone** represents a continuation of shallow marine sediments, which weathered and eroded into the stair-step topography typical of the Central Texas Hill Country.

Finally, the landscape we see today is the result of millions of years of erosion that was initiated by displacements from the Balcones Fault Zone that occurred about 15 million years ago. Today, unconsolidated sediments composed of gravels and sands are found next to rivers and show the ongoing erosion and deposition of the landscape. Water is always working to gradually level the land as it carries water and sediment to the Gulf.

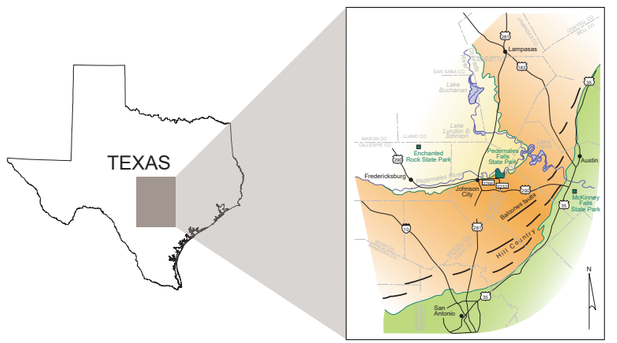
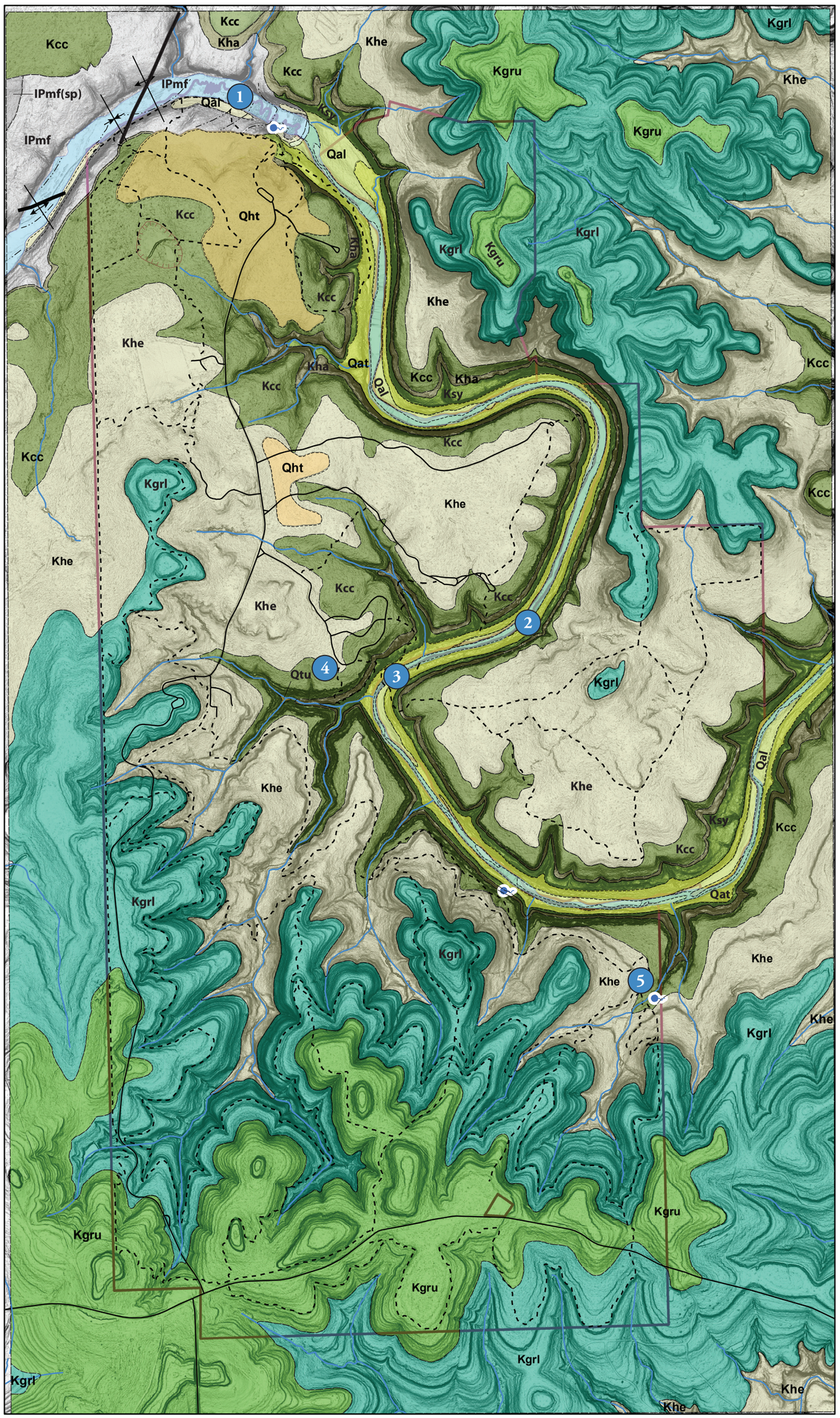


Figure 2. *Location of Pedernales Falls in Texas*

Geologic Map of Pedernales Falls State Park



LEGEND

- Spring
- Well
- Pedernales River
- Creek
- Pedernales Falls State Park Trails

GEOLOGIC LINES

- Anticline
- Sinkhole
- Syncline
- Internal contact
- Fault

SURFICIAL GEOLOGY (Quaternary)

UNIT

- Alluvium (Qal)
- Alluviated terrace (Qat)
- High terrace gravels (Qht)
- Tufa (Qtu)

BEDROCK GEOLOGY

UNIT

- Upper Glen Rose (Kgru)
- Lower Glen Rose (Kgrl)
- Hensel Sand ((Khe)
- Cow Creek Limestone (Kcc)
- Hammet Shale (Kha)
- Sycamore Conglomerate (Ksy)
- Smithwick Shale (IPsw)
- Marble Falls Limestone (IPmf)
- Marble Falls Limestone, spiculite facies (IPmf-sp)

POINTS OF INTEREST

Be sure to bring a trails map along with this guide as trails are subject to change.

1. **PEDERNALES FALLS**
   See evidence of the whole geologic story while standing at the falls overlook.
2. **SWIMMING AREA**
   Good exposure of the **Sycamore Sand** conglomerate in the large boulders and bedrock of the river.
3. **TRAMMEL'S CROSSING**
   Traverse the entire Cretaceous section as you walk to the river. Note the differing elevation of alluvium and terraces along the river. A flood in 1952 was 20 feet above the crossing.
4. **TWIN FALLS NATURE TRAIL**
   A close up look at the **Cow Creek Limestone** as you walk along the trail through the fractured and eroding cliff edge.
5. **WOLF MOUNTAIN TRAIL TO JONES SPRING**
   The lower elevation route takes you along the contact of the cliff-forming Cow Creek Limestone and the softer **Hensel Sandstone**. The trail takes you to Jones Spring issuing from the Cow Creek Limestone. The more elevated portion of the trail takes you along the stair-step benches of the marine Lower and Upper **Glen Rose Limestone**. All these Cretaceous units are an important groundwater resource for the region and make up the Trinity Aquifer.

Geology by Brian B. Hunt and Charles M. Woodruff, modified from Barnes (1982).

0 0.25 0.5 1 Miles

0 0.25 0.5 1 Kilometers

N