

Geology of the Eagle Spring Area, Eagle Mountain, Hudspeth County, Texas

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The Eagle Spring area is on the northern flank of Eagle Mountain, a dissected mountain mass with a maximum elevation of 7,512 feet in southeastern Hudspeth County, Trans-Pecos Texas (Plate 1). It is included on the Sierra Blanca and Eagle Mountain topographic quadrangles of the United States Geological Survey. Although the region includes only a small area, it is important geologically because it apparently has the same stratigraphic and structural relations to be found in the larger area of Eagle Mountain. It is on the northern border of the folded and thrust-faulted province that extends to the south into Mexico and to the Devil Ridge¹ and Malone Mountain² areas.

Eagle Spring has been important in the development of this section of western Texas, as it was at one time the source of water for a station on the stage route between San Antonio and El Paso and for a soldiers' garrison during the pioneer days. Since the discontinuance of the stage line, it has supplied water for numerous ranchers and their cattle.

The area is drained to the north by the typical arroyos of a semi-arid region. The drainage pattern is dendritic, although faults have affected the locations of some arroyos. The maximum relief is 832 feet, from 4,670 feet to 5,502 feet.

Eagle Mountain is an area of volcanic and intrusive igneous rocks with sedimentary strata of Permian and Cretaceous ages around the flanks. The volcanics truncate the folded and faulted sediments. Alluvial fill overlaps the bedrock of the mountain area and is in extensive embay-

¹Smith, J. Fred, Jr.: "Stratigraphy and Structure of the Devil Ridge Area, Texas," *Bull., Geol. Soc. Am.*, Vol. 51 (1940) pp. 597-638.

²Albritton, C. C., Jr.: "Stratigraphy and Structure of the Malone Mountains, Texas," *Bull., Geol. Soc. Am.*, Vol. 49 (1938) pp. 1747-1806.

ments and valleys cut into the hills. Plate 1 shows the bedrock of the Eagle Spring area, although some of it is covered with alluvial fill and pediment gravel.

Reconnaissance studies of this region have been made by C. L. Baker.³

The field work was done during the first half of the summer of 1940 in connection with a field course from the Agricultural and Mechanical College of Texas.

Stratigraphy

The consolidated sedimentary rocks of the Eagle Spring area include Permian and both Lower and Upper Cretaceous strata. They consist of sandstone, limestone, shale and various gradational types between these three. The lowermost Cretaceous beds are unconformable on the Permian, although the actual contact was not observed because it is covered with alluvial fill. The Cretaceous strata are conformable. The sediments have been cut by numerous dikes and sills. On the Eagle Mountain side, the south side, of the area the truncated sediments are overlain by rhyolite volcanic rocks and by trachyte. In places alluvial fill and pediment gravel cover the bedrock.

Permian

The Permian is composed of thin- and thick-bedded, pure to arenaceous, gray limestone strata, in which there are local brown streaks of limonite stain and numerous thin secondary calcite seams. In places small chert nodules are common, and fossils replaced by chert stand out on the weathered surface of the limestone.

The total thickness of the exposed Permian strata is not included in the area of Plate 1, but in the adjacent vicinity it is probably at least 1,000 feet. However, the base of the Permian is not exposed. According to Baker⁴ these beds are probably in the lower part of the Permian.

³Baker, C. L.: "Exploratory Geology of a Part of Southwestern Trans-Pecos Texas." *Univ. Tex. Bull.* 2745 (1927).

⁴Baker, op. cit., p. 10.

Lower Cretaceous

Yucca formation—Limestone, sandstone and shale compose the Yucca formation. As in the Devil Ridge area farther west red limestone and red shale beds are distinctive of the Yucca, although there are also strata of limestone-pebble conglomerate and coarse- to fine-grained reddish and yellow sandstone, some of which is quartzitic.

The Yucca in the Eagle Spring area is about 640 feet thick. It is lower Trinity in age.

Bluff formation—The Bluff formation is made up of strata of gray limestone, massive arenaceous limestone, and fine- to coarse-grained, well cemented ferruginous sandstone. The calcareous strata predominate. *Orbitolina texana*, the typical Glen Rose foraminifer, is common throughout the Bluff in the area.

The thickness of the Bluff is approximately 200 feet, which is considerably less than the minimum of 1,080 feet in the Devil Ridge area 3 miles to the northwest. However, this paper will not attempt to consider the regional stratigraphic changes within this section of west Texas. The Bluff is correlated with the Glen Rose formation of the Trinity group.

Cox formation—Fine- to coarse-grained brown and reddish sandstone, much of which is quartzitic, is the principal rock type in the Cox formation. The sandstone is commonly cross-bedded and has numerous small brown spots of limonite stain. There are thin beds of slightly arenaceous gray limestone and thin strata of yellowish and red shale.

The Cox formation is approximately 1,000 feet thick in the Eagle Spring area. It ranges in age from the upper part of the Trinity group through the lower part of the Fredericksburg group.⁵

Finlay formation—The Finlay formation is composed of gray limestone, arenaceous limestone, nodular limestone, and some thin beds of brown sandstone. *Orbitolina walnutensis*, a common Fredericksburg foraminifer, occurs in these limestone beds.

⁵Smith, op. cit.

Only a thin section of the Finlay strata is exposed in this area. These beds are in the Fredericksburg group.

Washita—The Washita strata are predominantly thin- and medium-bedded light gray limestone. Interbedded with the limestone in places are thin shale layers and flaggy calcareous shale beds.

The Washita beds are similar lithologically throughout the area and, as no fossils were found to be used for dividing these strata into separate formations, they are mapped as a single unit (Plate 1).

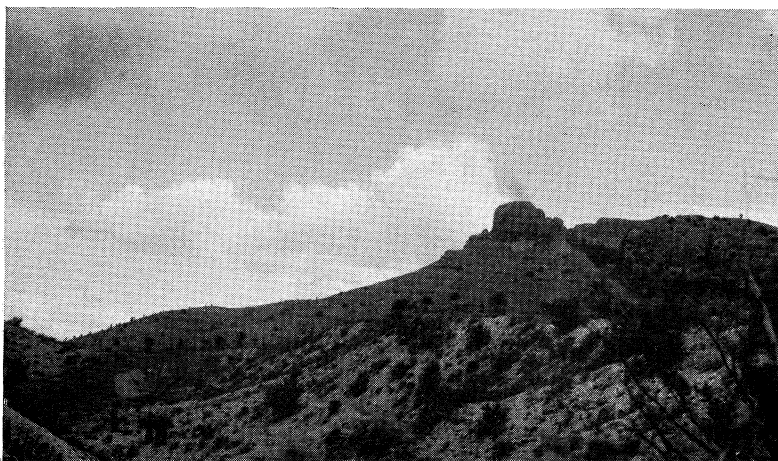


Fig. 1. T-C Peak viewed from the northwest. The cliff, and about half the slope below it, is flow breccia. Eagle Ford shale crops out in the cut in the left middle ground.

Upper Cretaceous

Eagle Ford formation—Dark gray and brownish shale beds are most prominent in the Eagle Ford formation. There are also thin-bedded, well-consolidated, fine-grained sandstone strata and some layers of gray to brown arenaceous limestone. Numerous concretions, which are as much as 18 inches in diameter, are in the Eagle Ford. On the south side of T-C Peak a conglomerate of limestone phenoclasts crops out. In the lower part of this conglomerate there are limestone boulders as much as 2 feet in diameter, but the texture becomes much finer toward the top. There are

several thin seams of coal in the Eagle Ford shale, mainly in the area of Coal Mine Arroyo.

The complete stratigraphic section of the Eagle Ford is not exposed in the Eagle Spring area, because it has been broken by faults. However, the thickness must be more than 1,400 feet.

Igneous Rocks

Rhyolite volcanics—The rocks grouped under this classification include tuffs, rhyolite flows and flow breccia; the latter is the predominant type. The flow breccia, best exposed on T-C Peak (Figure 1), consists of both angular and well rounded fragments of rhyolite, tuff, limestone, and sandstone. Some of the boulders are as much as 2 feet across, while other fragments are of pebble size. Most of the limestone and sandstone fragments were apparently derived from the Cretaceous sedimentary rocks and are well rounded. They were probably in a pediment gravel which was incorporated in the breccia when the volcanic material flowed over the surface.

The tuffs are fine-grained and appear to be about the same composition as the flows, which are similar to but finer-grained than the rhyolite intrusives to be described later.

The rhyolite volcanics at T-C Peak are about 450 feet thick. Their age can not be determined other than that they are post-Cretaceous and pre-trachyte volcanics. They have been cut by a rhyolite dike on the south side of T-C Peak (Figure 2), but the intrusives and rhyolite volcanics as a whole may well have been contemporaneous.

Rhyolite intrusives—The intrusives are dikes and sills of varying thicknesses. The rock is porphyritic with quartz phenocrysts ranging from one-sixteenth to one-fifth of an inch in diameter in a fine-grained groundmass. It is white and weathers to a chalky white with numerous concentric oval brown bands on the weathered surface.

Olive green pitchstone is associated with some of the rhyolite dikes. In one place what appear to be orthoclase

phenocrysts are in a pitchstone groundmass. No microscopic studies have been made of this rock.

The dikes, which are the most common intrusive forms, are usually less than 50 feet thick, although the largest one has a maximum thickness of more than 200 feet. Most of the large dikes have risen along fault zones.

The intrusives are mainly post-faulting and are probably about the same age as the rhyolite volcanics.

Trachyte—The trachyte is a porphyritic flow rock which has orthoclase phenocrysts, some of which are 2 inches long, in a fine groundmass. It is dark red and weathers to a red color.

The trachyte is younger than the other igneous rocks in this area. West of Coal Mine Arroyo it rests on tuff and farther south and southwest in the Eagle Mountain area thick trachyte flows overlie a thick series of rhyolite volcanics. North of Coal Mine Arroyo the trachyte is on the Eagle Ford, so evidently there the rhyolite volcanics were removed by erosion before the trachyte flowed over the surface.

Structure

The structural trend in the Eagle Spring area is mainly to the northwest, although in the northern part of the region it swings to the north and in some places the beds strike slightly east of north. In general the strata dip to the southwest and west with angles varying between a few degrees and almost ninety degrees. There are some small local folds, which are relatively unimportant in the major structural picture.

Devil Ridge Thrust

The largest single structural feature in the area is the Devil Ridge thrust fault. Along this thrust the Bluff formation overlies the Eagle Ford formation. Actual exposures near the fault zone are poor, but around T-C Peak in several places the Bluff may be observed over the Eagle Ford, although the contact is not exposed. The fault has a low angle of dip to the southwest, and on the east side of T-C Peak it appears to dip slightly to the northeast for a

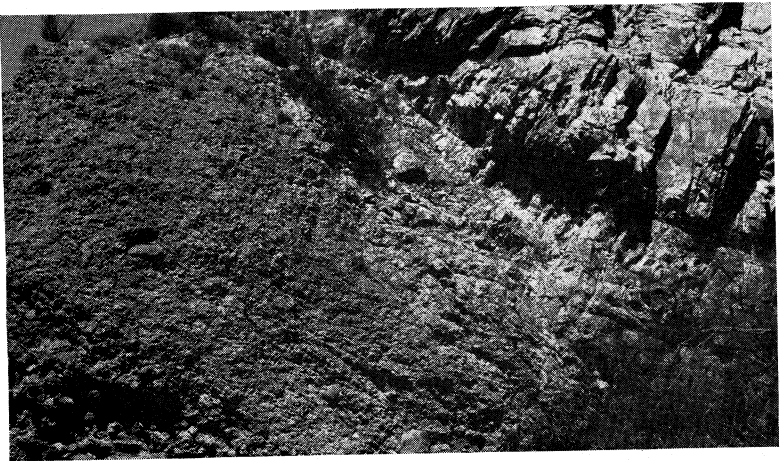


Fig. 2. Rhyolite dike, in upper right, cutting flow breccia on south side of T-C Peak. The rounded cobbles near the bottom are limestone.

short distance. Because of the low dip angle, the trace of the fault is irregular and conforms closely to the topography.

Accurate measurements of the displacement along the thrust are not obtainable in the Eagle Spring area, because the fault surface is not exposed for determination of the dip of the fault and the exact horizons within the Bluff and Eagle Ford formations above and below the fault are not known. The stratigraphic throw is probably between 3,500 and 4,000 feet. As the fault appears to have a low angle of dip, the displacement in this region is probably at least as much as the 4.5 miles displacement determined in the Devil Ridge area.⁶

The Devil Ridge thrust was traced in reconnaissance to the Devil Ridge area west of Eagle Mountain, and Mr. Roy Huffington reports that he has traced the same fault west of Devil Ridge to the Quitman Mountains. This is a total distance of almost 30 miles, and there is evidence that the same fault continues for a considerable distance east of the Eagle Spring area, although it was not traced much farther in that direction. As in the Eagle Spring area the trace of the fault is irregular in the Eagle Mountain region.

⁶Smith, *op. cit.*, p. 630.

Normal Faults

Most of the normal faults trend east-west with slight variations from this direction. The largest faults have produced zones of weakness along which has risen the magma to form the rhyolite dikes.

The largest normal fault extends from the west edge of the area through the central section along the north side of West Arroyo and east to Eagle Spring. Two hundred and fifteen feet west of Eagle Spring it splits into two faults, one of which continues to the northeast and the other to the southeast beyond Eagle Spring. These faults may be traced by the dikes.

West of Eagle Spring the Eagle Ford and Washita strata have been faulted down against the Yucca, Bluff, and Cox formations on the north. The fault is an oblique one throughout most of its length. It is apparently a normal fault, although there is no definite evidence to prove this. The stratigraphic throw is approximately 2,500 feet.

The fault extending southeast from Eagle Spring, which is located on the south side of the fault, has a smaller throw than the fault to the west; the Washita on the south is downthrown against the Cox on the north. This fault extends at least a mile southeast of the Eagle Spring area.

The fault northeast of Eagle Spring has brought the Permian beds on the north into contact with the Cox, Bluff, and Yucca on the south. The throw of this fault is also less than that of the major fault west of Eagle Spring. A small normal fault breaks off from this one on the east edge of the area. Although this small fault was not observed, it was assumed to exist because there is not a broad enough outcrop to allow for the total thickness of the Bluff formation. Perhaps the Bluff is thinner in this section, but such rapid thinning would not be compatible with the thickness of the Bluff farther west.

A small fault trends northeast on the western edge of the region. It dips to the southeast, with the Eagle Ford formation downthrown against the Washita strata to the northwest.

A normal fault, which trends N. 80° W. and has a throw of about 200 feet, breaks the Devil Ridge thrust on the south side of T-C Peak. The north side is the downthrown one.

A cross fault trending N. 15° E. breaks the Devil Ridge thrust in Coal Mine Arroyo. The thrust on the east side of this fault is offset about 750 feet to the north. There was probably some vertical movement along the fault, but the major displacement appears to have been horizontal. It also cuts off a coal seam along which a mine shaft was sunk about 50 years ago.

Age of Folding and Faulting

The deformation of the strata in this region began sometime after the deposition of the Eagle Ford sediments. It can be stated definitely only that the major folding was post-Eagle Ford and pre-rhyolite volcanics; it was probably Laramide and early Tertiary deformation. The movement along the Devil Ridge thrust probably accompanied the folding. This area is along the zone where the Lower Cretaceous strata thin rapidly to the north, and as such was a region where the beds might have been expected to break readily during the deformation, as was the situation farther west.⁷

The normal faulting took place after the deposition of the Cretaceous sediments, probably after the folding, and certainly before the deposition of the alluvial fill. That much of the faulting was pre-rhyolite intrusion is shown by the fact that the major dikes followed the fault zones; the magma rising along these zones may have served as feeders to the volcanic flows above. However, one fault cuts the rhyolite volcanics on the south side of T-C Peak, so some of the faulting followed the extrusion of the volcanics. The rhyolite volcanics as a whole and the rhyolite intrusive rocks are probably about the same age. Thus the faulting apparently preceded this igneous activity and continued

⁷Smith, *op. cit.*, p. 636.

until after it had ceased. No conclusive evidence was found to indicate whether the trachyte volcanics were faulted.

The largest normal faults were downthrown to the south, so perhaps these were formed as a result of the removal of some of the magma from beneath and the consequent settling of the central area of Eagle Mountain.

The volcanics in the Eagle Mountain area flowed over an erosion surface truncating Cretaceous sedimentary rocks. Consequently there must have been a considerable time interval of erosion between the deformation of the sediments and the extrusion of the volcanics. There is no evidence in the Eagle Spring area to indicate whether the faulting preceded or followed this erosional interval.

Summary

The Eagle Spring area, on the northern flank of Eagle Mountain in southeastern Hudspeth County, Texas, is one of consolidated sedimentary rocks of Permian and Lower and Upper Cretaceous ages. These strata are cut by rhyolite dikes and sills, and on the mountain side of the region are overlain by rhyolite and trachyte.

The sedimentary rocks have a regional dip to the southwest and have been broken by the southwestward-dipping Devil Ridge thrust, which has been traced for a distance of 30 miles from the Quitman Mountains east to the Eagle Spring area. The thrust also continues east of the area, although it has been traced in reconnaissance for only a short distance in that direction.

There are several normal faults in the region, the largest of which trend almost east-west and have the south sides downthrown. Rhyolite dikes have followed the zones of weakness produced by the larger normal faults.

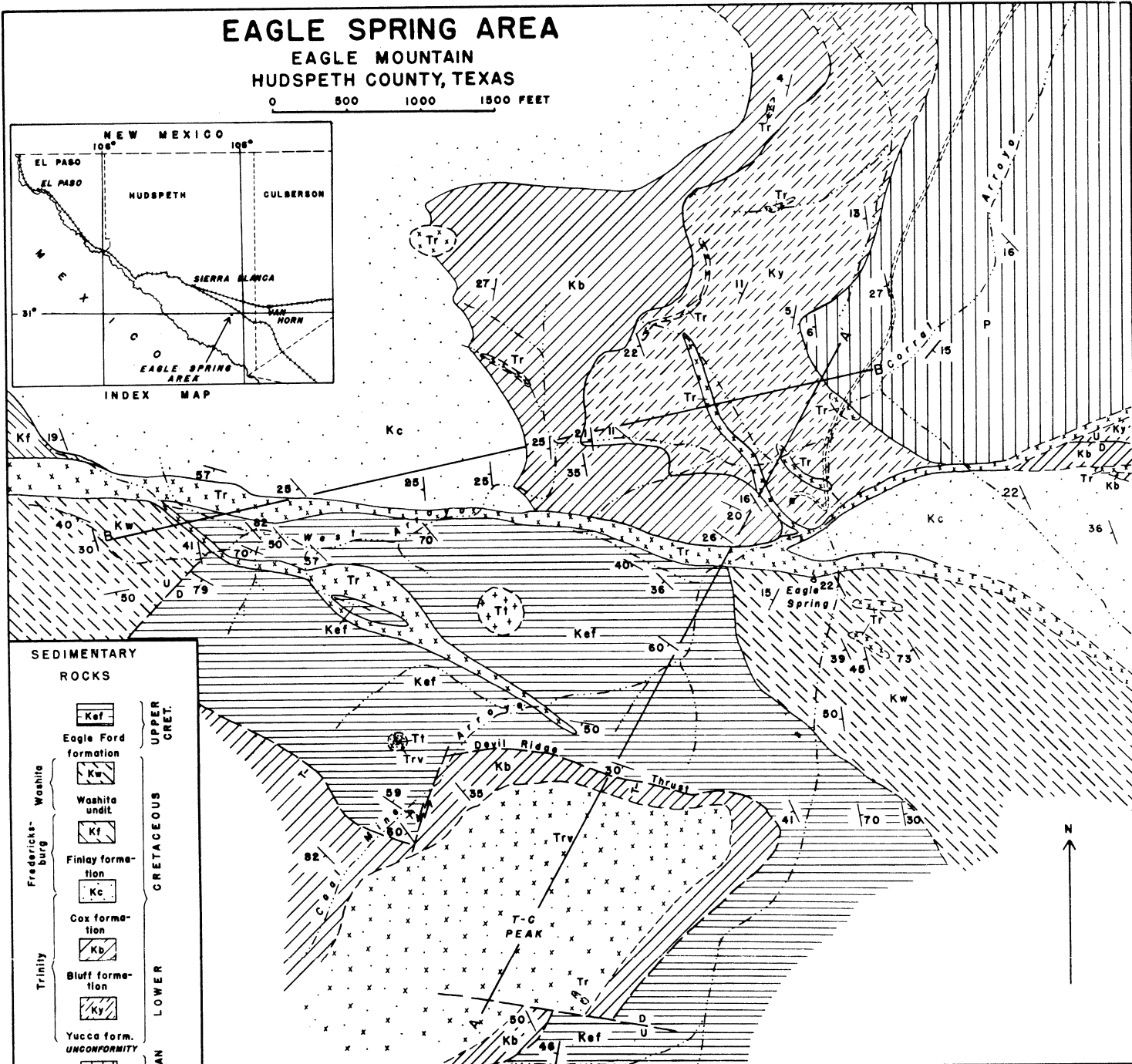
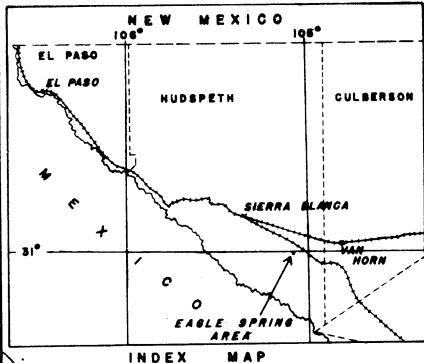
The area is important geologically because it is probably typical of the flank regions of the Eagle Mountain area.

EAGLE SPRING AREA

EAGLE MOUNTAIN

HUDSPETH COUNTY, TEXAS

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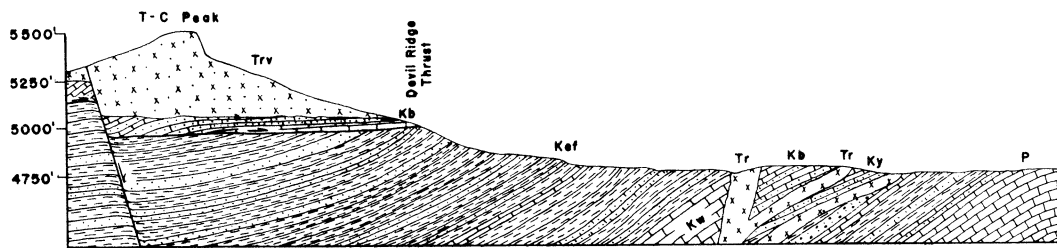


SEDIMENTARY ROCKS

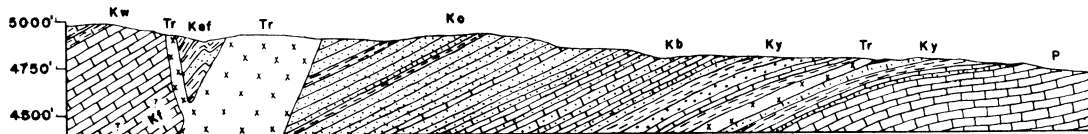
- UPPER CRET.**
- Eagle Ford formation (Kef)
- CRETACEOUS**
- Washita (Kw)
- Washita unit (Kf)
- Fredericksburg (Kc)
- Finlay formation (Kb)
- Cox formation (Ky)
- Bluff formation (Tr)
- Yucca form. (Trv)
- UNCONFORMITY (P)
- PERMIAN**

IGNEOUS ROCKS

- TERTIARY**
- Trachyte (Tt)
- Rhyolite intrusives (Trv)
- Rhyolite volcanics (Trv)



A - A'



B - B'