

# **PS Detailed Geologic Map of Big Brushy Canyon Graben, Big Bend Region, Displays Extensional Monoclines\***

**Dillon D. Hughes<sup>1</sup>, Austin G. Hafner<sup>2</sup>, José L. Hermosillo<sup>2</sup>, and Joseph I. Satterfield<sup>2</sup>**

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<sup>1</sup>Department of Physics and Geosciences, Angelo State University, San Angelo, Texas ([dhughes9@angelo.edu](mailto:dhughes9@angelo.edu))

<sup>2</sup>Department of Physics and Geosciences, Angelo State University, San Angelo, Texas

## **Abstract**

Recent 1:12,000-scale geologic mapping in the Big Brushy Canyon graben, eastern Big Bend Region shows folds and faults caused by three deformation events; Early Cretaceous Chihuahua trough opening, Late Cretaceous – Tertiary Laramide shortening, and Tertiary – Quaternary Basin and Range extension. The graben is located in the SW flank of the Black Gap graben, near the NE margin of the Basin and Range Province. Mapping complements regional mapping by Moustafa (1988) and St. John (1966). Smart and others (2010) described a well-exposed extensional fault-propagation fold within Big Brushy Canyon. Our compilation of detailed mapping by Angelo State University students now covers 180 km<sup>2</sup> (70 mi<sup>2</sup>). Map areas show exposed Upper Cretaceous carbonate and minor siliciclastic rocks intruded by Tertiary mafic sills and overlain by several Quaternary sediment map units. NW-trending monoclines, anticlines, and synclines are crosscut and underlain by NW- and NNW-striking high-angle faults.

Four separate geologic maps are being compiled into a single map by using ESRI ArcGIS. Thin-section petrography improves map unit descriptions. Stereographic projections prepared with Stereonet 10 software show fold and fault orientations. Discoveries made while mapping include: a) several high-angle faults cross-cut older Quaternary alluvium, b) widespread boudins in Cretaceous Boquillas Formation adjacent to Tertiary sills document forceful emplacement, c) map-scale drag folds adjacent to high-angle faults document normal slip, and d) abrupt changes in thickness and rock type of Lower Cretaceous units may result from Early Cretaceous Chihuahua trough growth faults. Overall, our geologic map, grid of cross-sections, and fold orientations shown on stereonet can explain Big Brushy Canyon monoclines as extensional fault-propagation folds. Many monoclines could have an earlier history as Laramide reverse faults and even earlier Chihuahua trough growth faults.

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St. John, B.E., 1966, Geology of Black Area, Brewster County, Texas: University of Texas, Austin, Bureau of Economic Geology Geologic Quadrangle Map No. 30, Map Scale 1:62,500, 18 p.

# DETAILED GEOLOGIC MAP OF BIG BRUSHY CANYON GRABEN, BIG BEND REGION, DISPLAYS EXTENSIONAL MONOCLINES

Dillon Hughes, Austin Hafner, José Hermsillo, Dr. Joseph Satterfield, Angelo State University, San Angelo, Texas



## Regional Setting

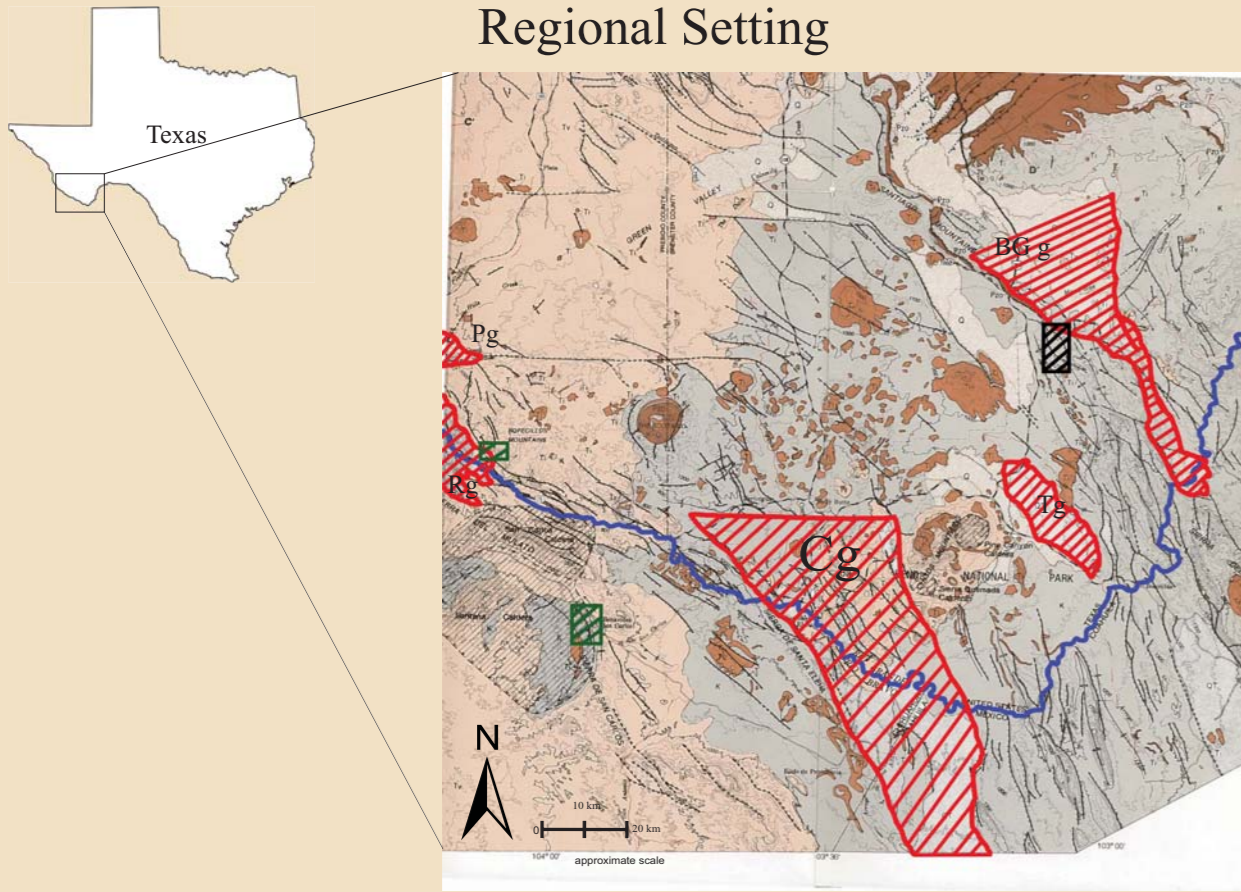


Figure shows geologic structures created by three deformation events; Early Cretaceous Chihuahua trough opening, Late Cretaceous - Tertiary Laramide shortening, and Tertiary - Quaternary Basin and Range extension. Areas shaded in red represent named grabens within the region. Black shaded rectangle represents mapping area. Green shaded areas represent future Angelo State mapping areas. Map modified by José Hermsillo from Henry and Price (1985) using graben locations from Dickerson and Muehlberger (1994).

## Objectives

- Make precise descriptions of the igneous and sedimentary rocks present in the area
- Interpret depositional environments for the geologic units in the area
- Measure and describe folds and faults present in the mapping area at an outcrop scale as well as a map-scale.
- Compare and correlate the mapped geologic units at the Shackelford Ranch to neighboring regional rock types in the Big Bend Region.

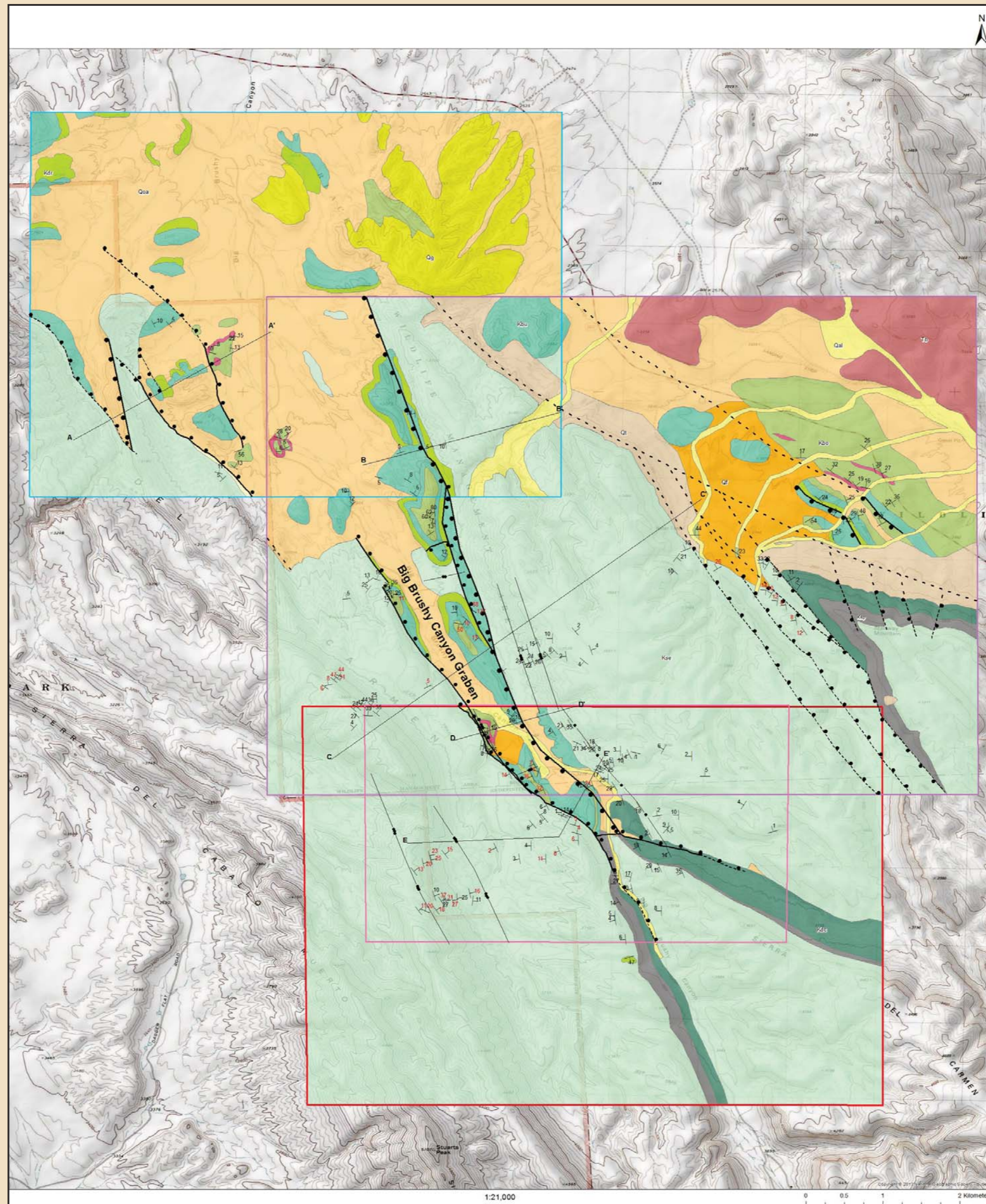
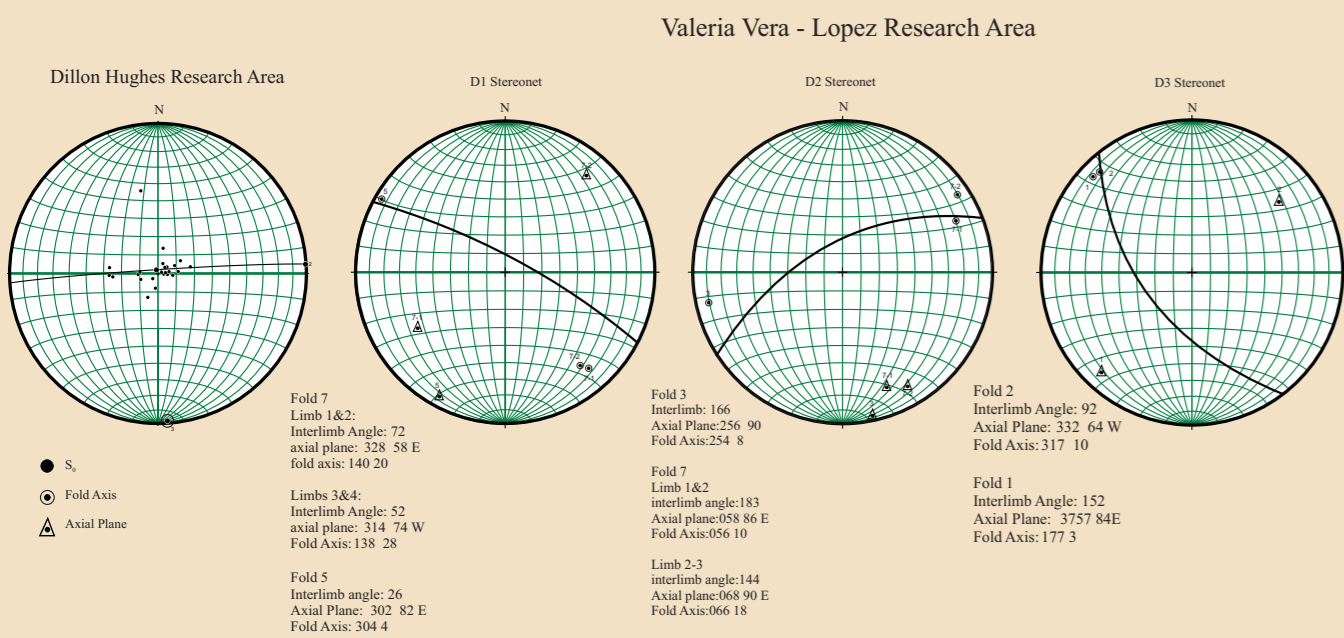
## Methods

- 1:12,000 scale geologic mapping
- Cross Sections were drafted to interpret the subsurface geology of the region
- Stereonets were create using Stereonet 10 software
- Map compilation was created using Esri ArcGIS

## Legend

- Strike
- Normal Fault (Known)
- Buried Fault
- Normal Fault (Interpreted)
- Laiza Lopez Research Area
- Bailey Welch Research Area
- Austin Hafner Research Area
- Dillon Hughes Research Area
- Quaternary Alluvium (Qal)
- Quaternary Older Alluvium (Qoa)
- Quaternary Alluvial Fan Deposits (Qf)
- Quaternary Gravel (Qg)
- Quaternary Landslide (Qls)
- Quaternary Talus (Qt)
- Tertiary Basalt (Tb)
- Tertiary Intrusion (Ti)
- Boquillas Formation (Kbo)
- Buda Limestone (Kbu)
- Del Rio Clay (Kdr)
- Santa Elena Limestone (Kse)
- Sue Peaks Formation (Ksp)
- Del Carmen Limestone (Kdc)

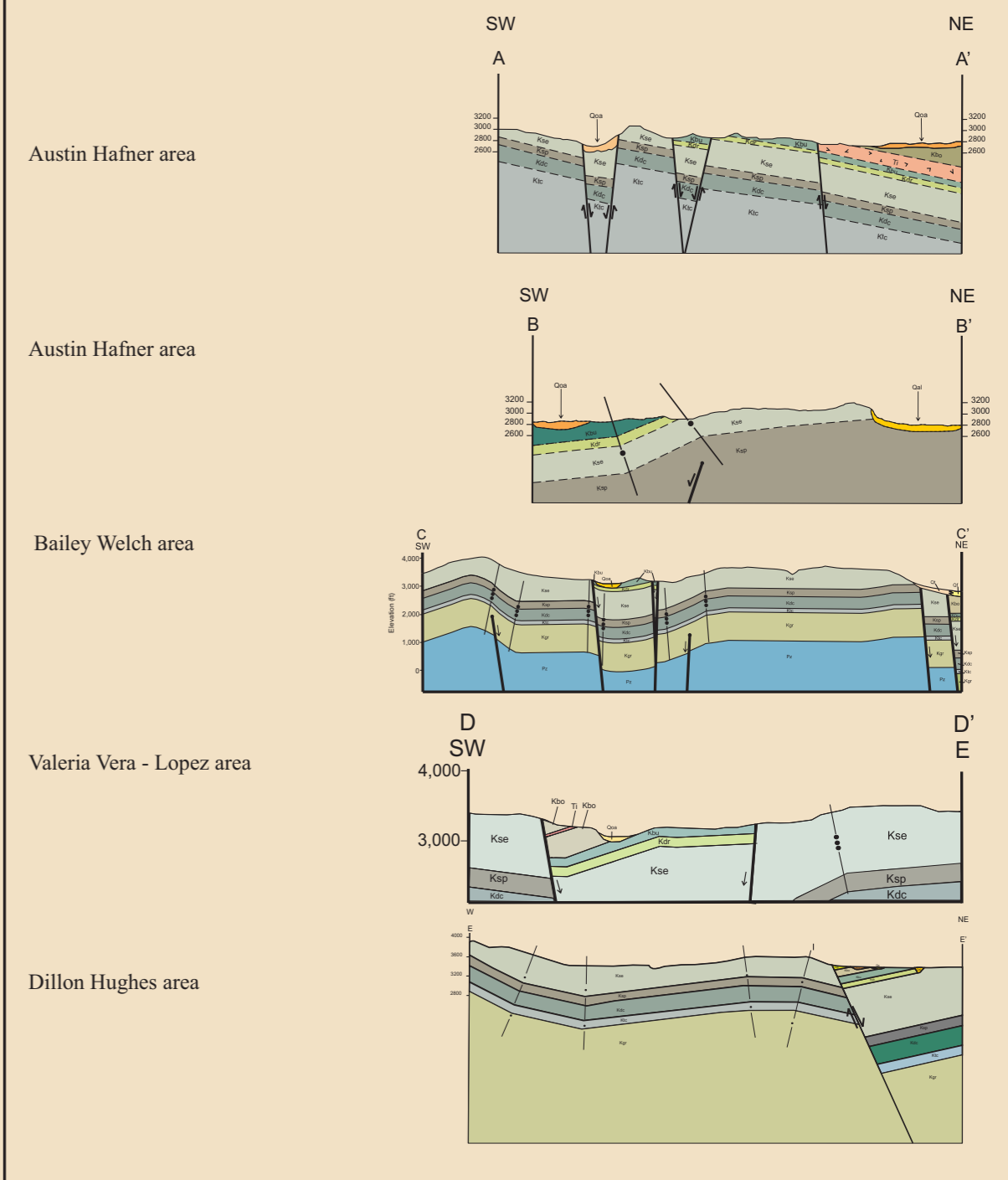
## Stereographic Projections



## Accomplishments and Conclusions

- First detailed geologic map of a West Texas graben produced using Esri ArcGIS
- Several high-angle faults cross-cut older Quaternary alluvium
- Widespread boudins in Cretaceous Boquillas Formation adjacent to Tertiary sills document forceful emplacement
- Map-scale drag folds adjacent to high-angle faults document normal slip
- Abrupt changes in thickness and rock type of Lower Cretaceous units may result from Early Cretaceous Chihuahua trough growth faults

## Cross Sections



## Field Photos

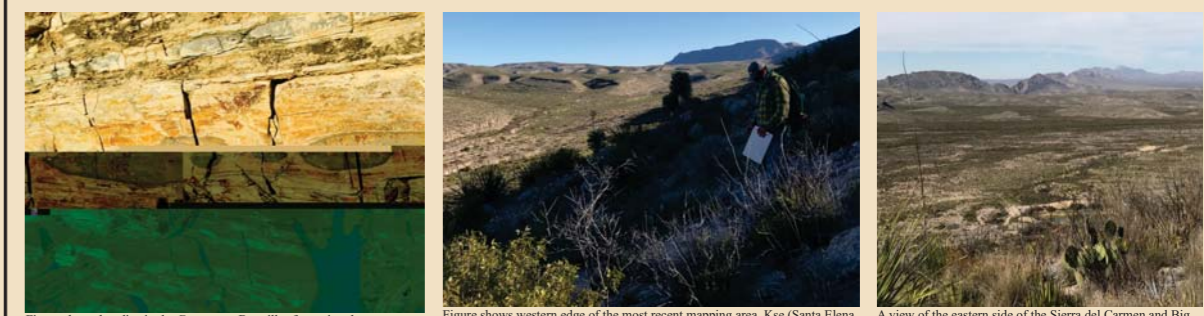


Figure shows boudins in the Cretaceous Boquillas formation that support the theory of forceful emplacement of adjacent Tertiary sills. Figure shows western edge of the most recent mapping area. Kse (Santa Elena Limestone) beds in this location were dipping to the east. A view of the eastern side of the Sierra del Carmen and Big Bend National Park.

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