

N134: Carbonate and Shale Faulting and Fracturing Field Seminar (*Texas, USA*)

Instructor(s): David Ferrill and Adam Cawood

Format and Duration

Field - 5 Days
Moderate Physical Demand

Summary

This course provides an in-depth analysis of faulting and fracturing in carbonate and shale strata using superb exposures in central and west Texas. The outcrops offer analogs for deformation in carbonate reservoirs and shale resource plays around the world. It concentrates on extensional fault systems and contractional structures, with a minor component on strike-slip deformation features. The course covers a range of scales from regional fault networks to details of fault block deformation, relay ramp development, and fault zone processes. It also examines relationships between fracture spacing and mechanical layering, including bed thickness. Excellent exposures of the Eagle Ford and equivalent Boquillas formations provide the opportunity to explore the range of depositional facies and diverse tectonic regimes that influence the style and intensity of faulting, folding, and fracture development in this important resource play.

Business impact: This course examines **factors that influence the style and intensity** of faulting, folding, and fracture development and the **relationship between fracture spacing and mechanical layering**.

Learning Outcomes

Participants will learn to:

1. Perform structural interpretations using the basic concepts of faulting, fracturing, and mechanical stratigraphy.
2. Assess the role of mechanical stratigraphy and stress conditions on fracture and fault formation in carbonate and shale strata.
3. Evaluate deformation mechanisms that operate in fault zones.
4. Evaluate complex structures like those that control hydrocarbon migration and trapping in carbonate petroleum provinces around the world. The course concentrates on extensional fault systems and contractional structures, with a minor component on strike-slip deformation.
5. Evaluate maps and cross sections that are based on available data and are consistent with structural styles, rules, and relationships appropriate for the structural regime, stratigraphic setting, and deformation conditions.
6. Assess the relationship between faulting and associated folding.
7. Evaluate many of the fault system features they will encounter during interpretation of seismic and well data in the context of field examples they will observe.
8. Develop an understanding of the regional tectonic setting, stratigraphy, and development of central and west Texas.
9. Assess structural styles to be expected in the Eagle Ford Formation, and relate deformation features to mechanical stratigraphy and structural position.

Training Method

This is a field course starting in San Antonio, Texas and ending in Midland, Texas.

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Physical Demand

The physical demands for this course are MODERATE according to the RPS field course grading system; the course requires good general fitness levels. Fieldwork is in the Hill Country near San Antonio, where conditions are typically warm-hot and humid, and in west Texas, where the climate is warm-hot and dry. Hikes are typically less than 3.2 km (2 miles) each over flat to hilly terrain with a maximum elevation change on a hike of 200 m (660 ft). Transport is by SUVs, mostly on black-top roads, but with some localities reached by well marked dirt roads. The total driving distance on this course is about 1600 km (1000 miles).

Who Should Attend

The course is aimed at geoscientists, petrophysicists, reservoir engineers, and production engineers working in mechanically layered, deformed rocks especially carbonates and shales in extensional or contractional tectonic settings. It will be of particular interest to any geoscientists, petrophysicists, and engineers working in the Eagle Ford play.

Course Content

The itinerary below is pending and subject to change

Day 0

- Arrive in San Antonio, Texas
- Late afternoon or evening lecture to discuss concepts (faulting, fracturing, and mechanical stratigraphy), itinerary, logistics, and safety.

Day 1

- Field trip to nearby outcrops of Cretaceous carbonate and shale strata (including the Eagle Ford Formation) in the Balcones fault system
- Hidden Valley fault (Canyon Lake Gorge) – seismic-scale normal fault with world class exposure of subseismic-scale fault zone deformation features
- Spend night in San Antonio, Texas

Day 2

- Drive from San Antonio to Del Rio, Texas; visit outcrops of the Eagle Ford Formation and equivalent Boquillas Formation and underlying Buda Formation and overlying Austin Chalk to study structural style in different facies and mechanical units
- Continue drive from Del Rio to Marathon, Texas; discussion of various geological features along the route; stops to discuss contractional folding west of Del Rio including outcrops of the Eagle Ford (and equivalent Boquillas) Formation and overlying and underlying units and relationship of fracturing

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to regional structural setting, stress field, and mechanical stratigraphy. If time permits will stop west of Sanderson to discuss Marathon fold-thrust belt exposed as a window through the Cretaceous cover

- Spend night in Marathon, Texas

Day 3

- Marathon fold-thrust belt structures (Simpson Springs/Bourland Mountain anticlinorium/synclinorium structural style)
- Hike through Big Brushy Canyon monocline (Black Gap Wildlife Management Area). This is a seismic-scale normal fault and related extensional monocline developed in carbonate and shale strata formed by Basin and Range extensional tectonism.
- Contractional folding at Persimmon Gap
- Spend night in Marathon or Chisos Basin, Texas

Day 4

- Big Bend National Park – study contractional folding, thrust faulting, extensional faulting, and extensional fracturing in the Eagle Ford equivalent Boquillas Formation at Ernst Tinaja; normal fault relay ramp development at Cuesta Carlotta; strike-slip and normal faulting in Cretaceous limestones at Boquillas Canyon
- Spend night in Chisos Basin or Study Butte, Texas

Day 5

- Santa Elena Canyon normal fault zone and footwall analysis in Big Bend National Park
- End in Midland, Texas; stay overnight in Midland

Day 6

- Depart from Midland