Challenges with Marcellus Shale Horizontal Exploration Within or Near the Allegheny Highland*

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Search and Discovery Article #11044 (2018)**
Posted January 29, 2018

*Adapted from oral presentation given at the AAPG Eastern Section 46th Annual Meeting, Morgantown, West Virginia, September 24-27, 2017

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Abstract

Why does the Marcellus not produce as much gas in the Allegheny Highland as it does in other areas due west? Areas like Doddridge and Harrison County West Virginia have proven to produce 1.8 - 2.2 BCFGE per 1,000 feet of lateral consistently, whereas wells in the Allegheny Highland consistently range between 0.8 - 1.2 BCFGE per 1,000 feet of lateral or worse. County scale 2D seismic, a microseismic survey, rock properties from well logs and well production are used to characterize the structural and stratigraphic frame work for Marcellus Shale within the Allegheny Highland.

Three Marcellus Shale horizontal wells in Webster County West Virginia (within the Allegheny Highland) have produced 0 mcfg after stimulation. A microseismic survey on one of the non-producers indicated that fracture stimulation was primarily focused below the Marcellus. It is assumed that basal fracture barrier effectiveness potentially affected well performance in Webster County West Virginia. Therefore, rock properties from well logs of the Marcellus Shale and the underlying Onondaga Limestone were compared over a larger area to highlight the importance of basal fracture barrier effectiveness in relation to production performance. Also, county scale 2D seismic will be shown and interpreted to help determine possible completion hazards. It is proposed that the thickness and volume of shale in the underlying Onondaga Limestone, difference in minimum horizontal stress between the Marcellus and Onondaga, proximity to the structural front, and fault presence at Silurian to Ordovician level all play a role in fracture barrier effectiveness.

CHALLENGES WITH MARCELLUS SHALE HORIZONTAL EXPLORATION WITHIN OR NEAR THE ALLEGHENY HIGHLAND.

Cole Bowers

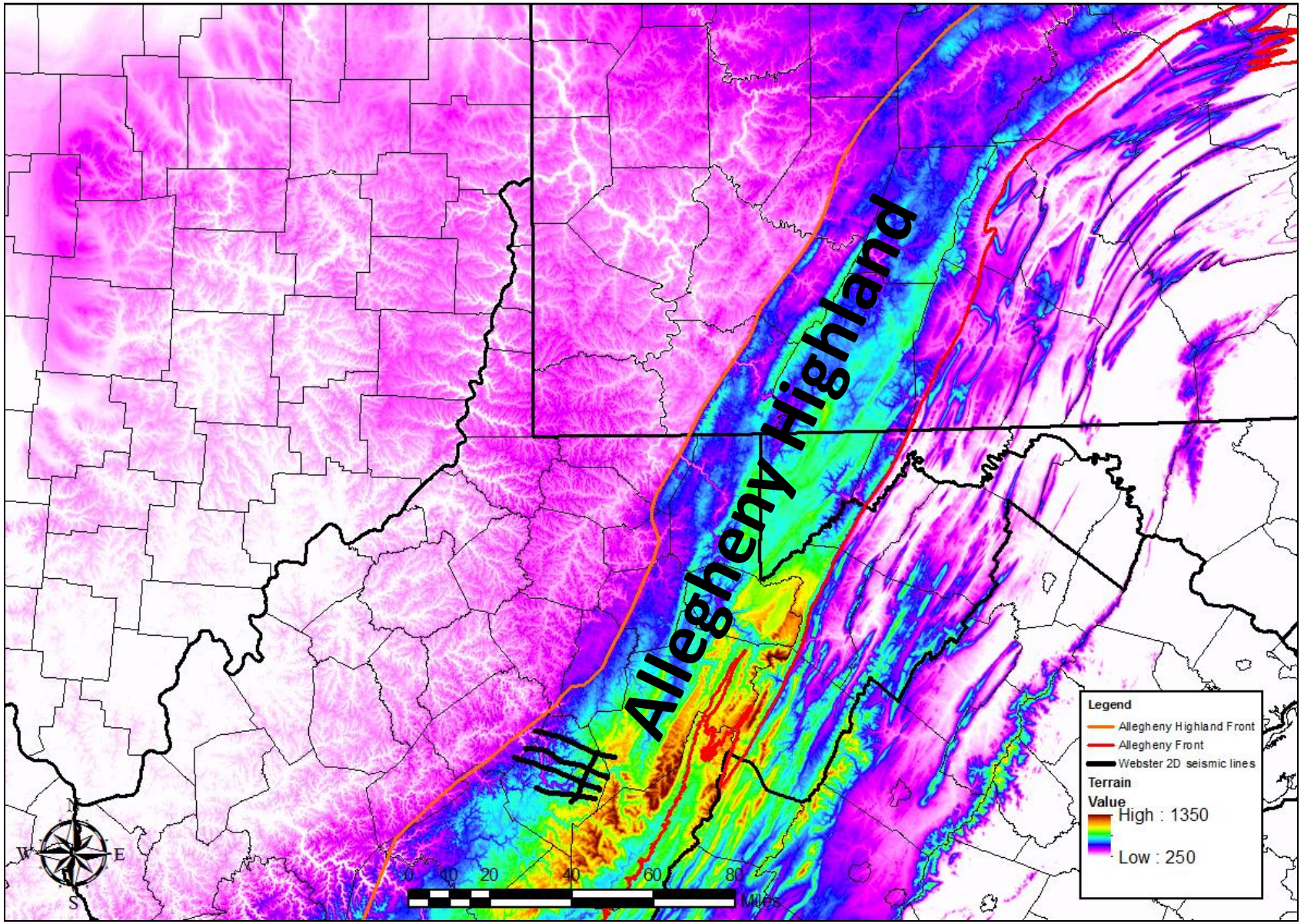
OUTLINE

- Introduction
- Methods and Data
- Results
- Conclusion/Discussion

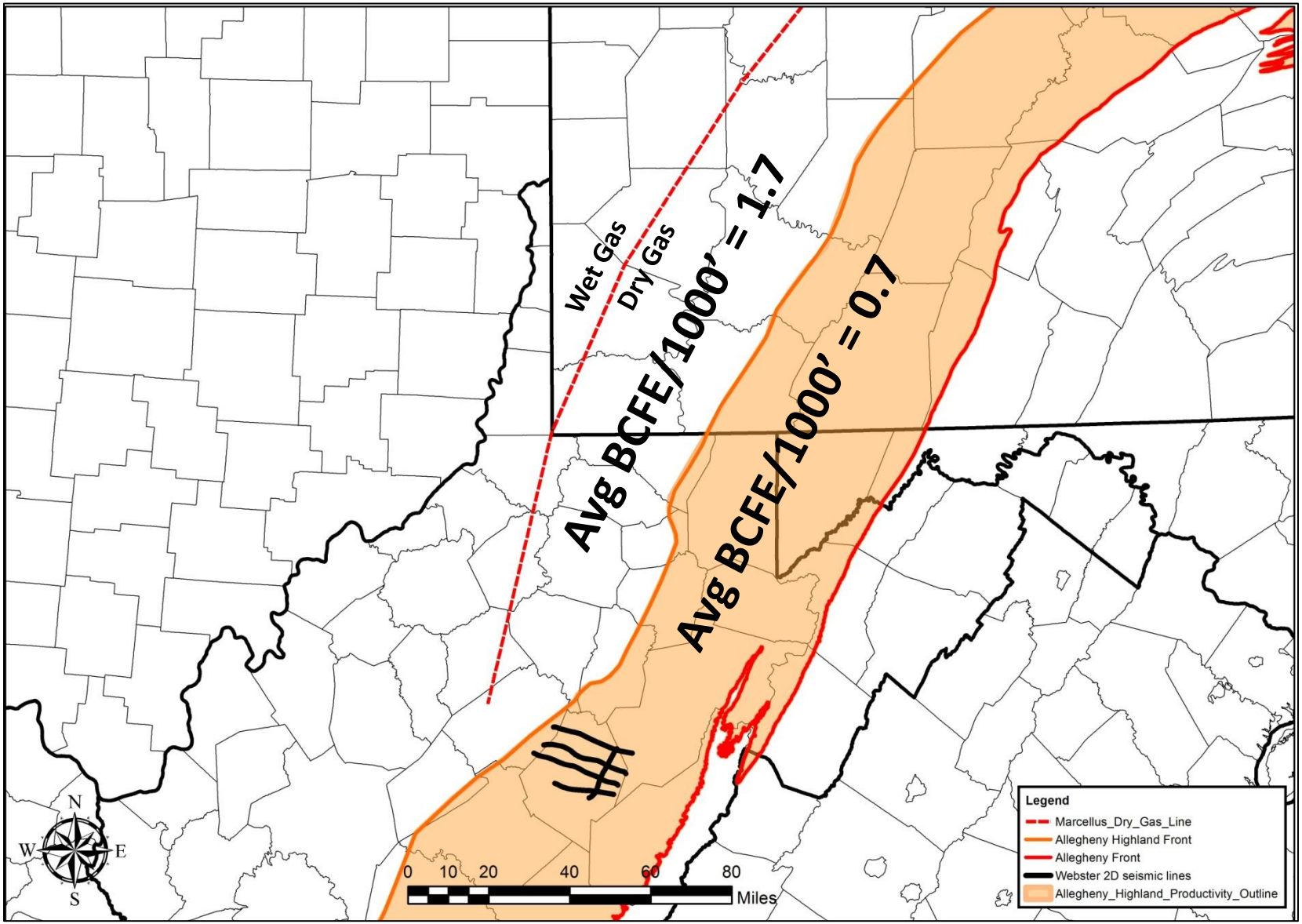
INTRODUCTION
The Big Question

- Why does the Marcellus not produce as much gas in the Allegheny Highland as it does in other areas due west?

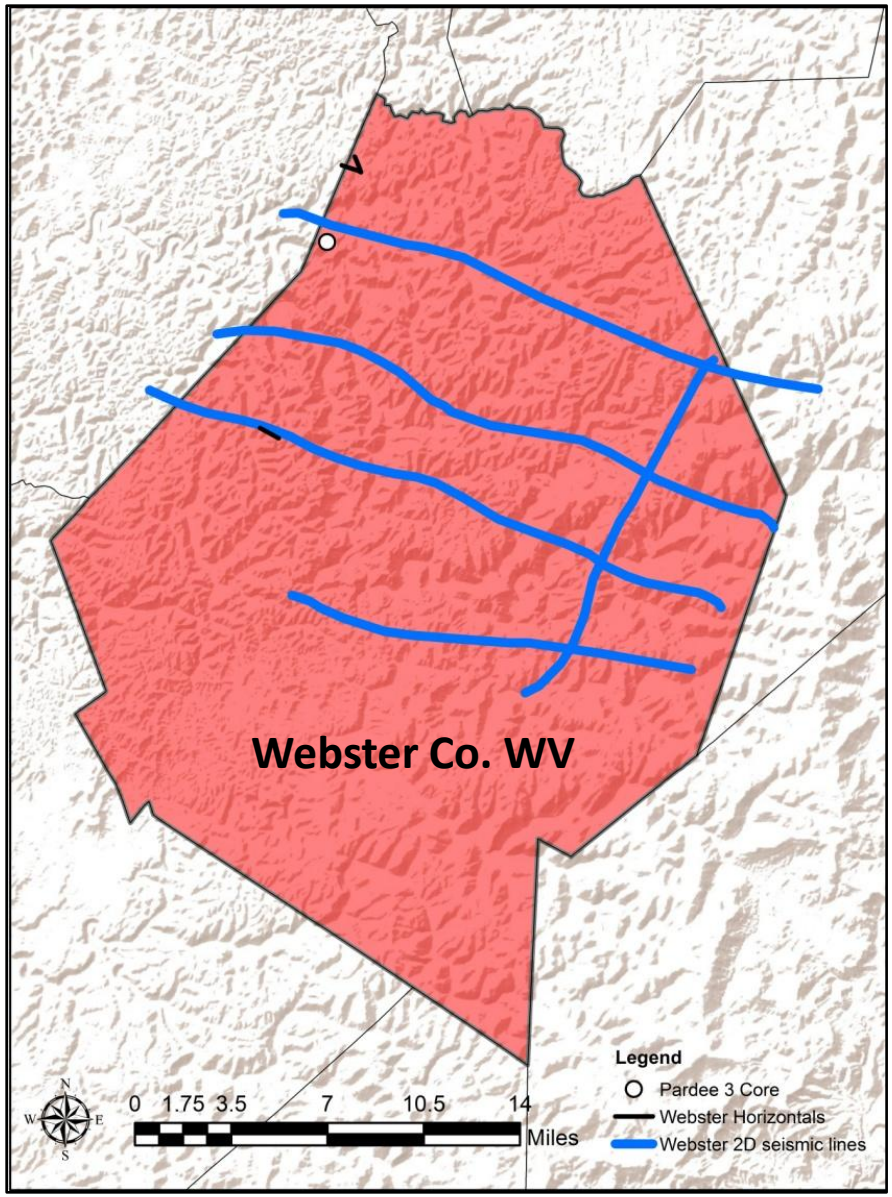
INTRODUCTION
Project Area



INTRODUCTION
Productivity



METHODS
Data



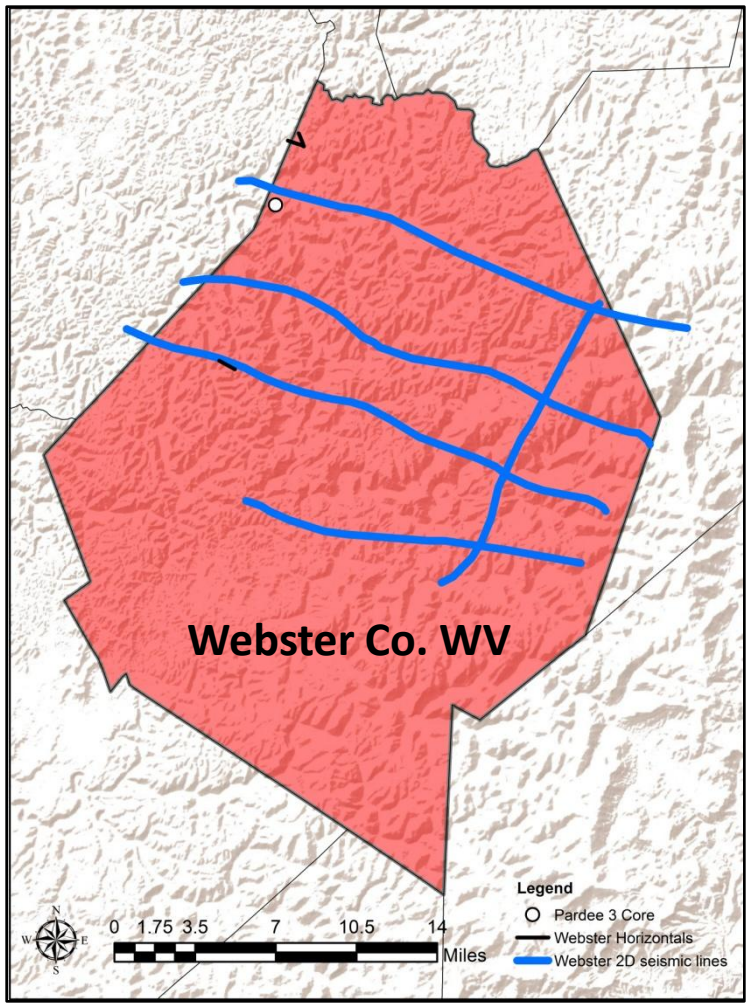
Localized Data

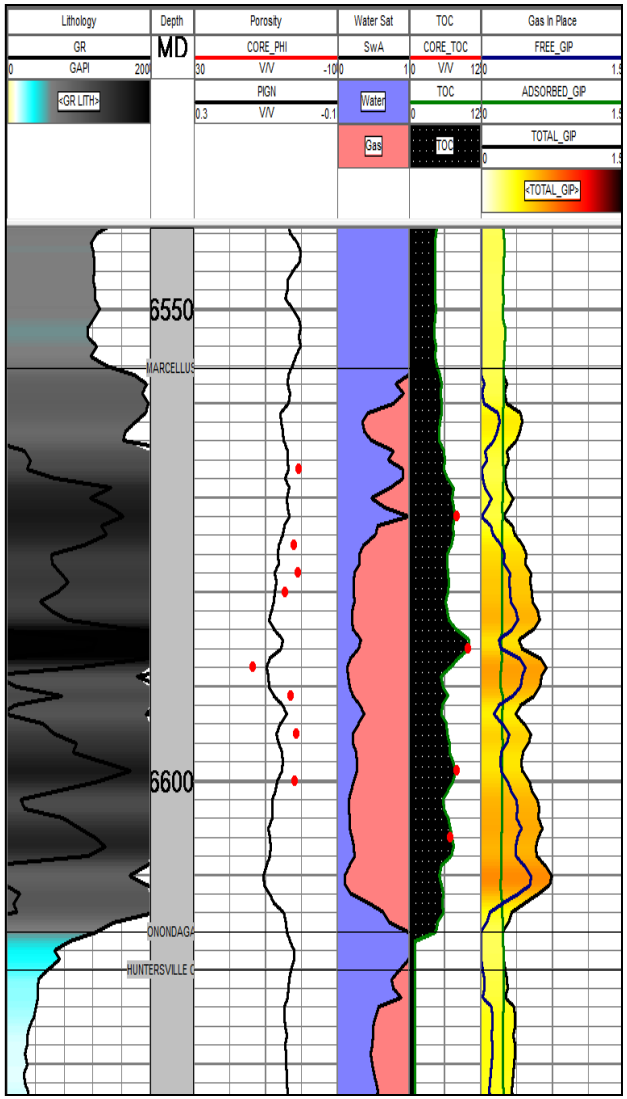
- Core
- 2D Seismic
  - 2009 Vintage
- Microseismic

Regional Data

- Geomechanical Logs
- Production

LOCALIZED RESULTS
Core





Thickness: 60ft

Avg ϕ: 6.2%

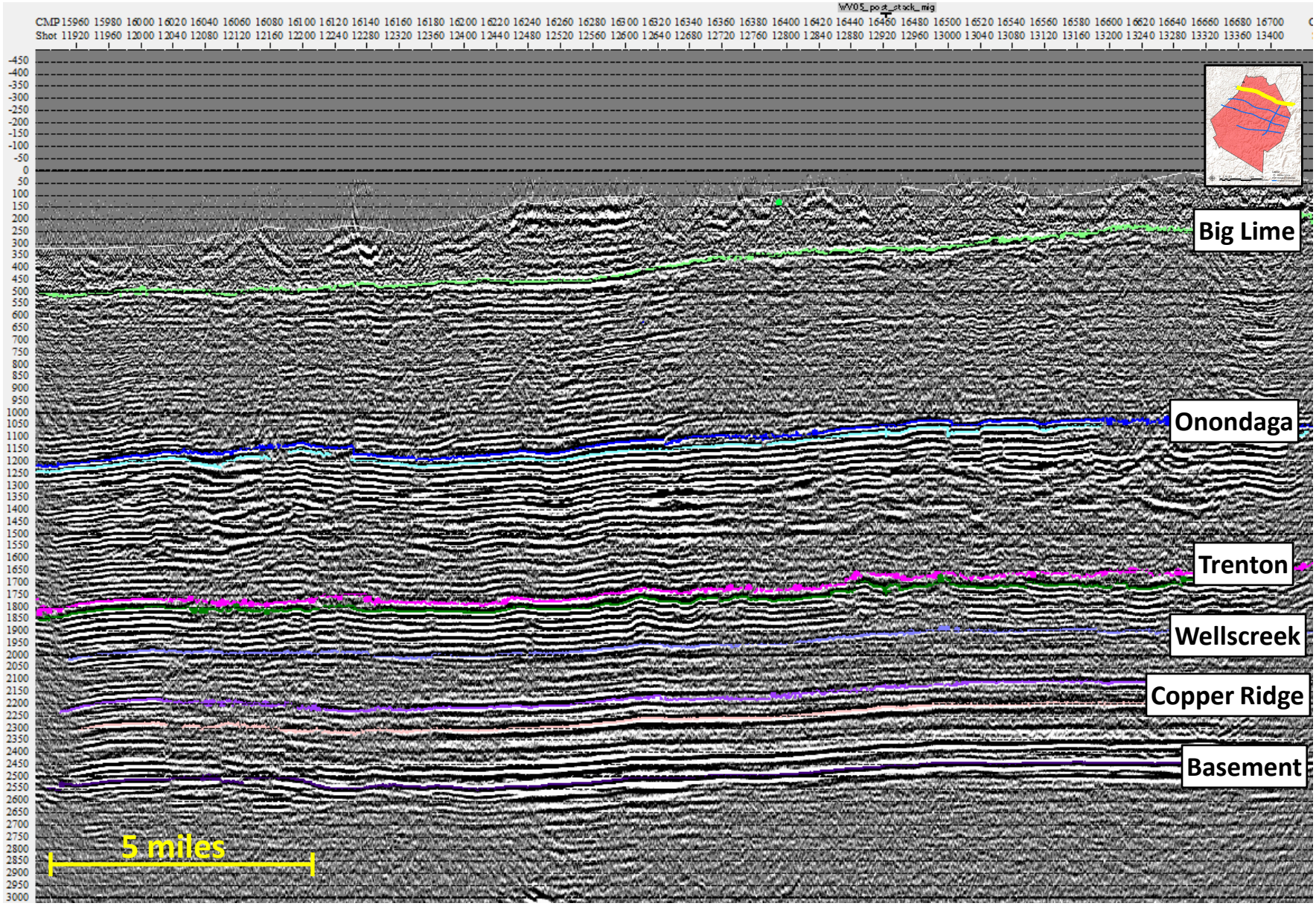
Avg Sw: 39%

TOC : 6.5%

Total GIP: 30.2 Bcf/section

LOCALIZED RESULTS

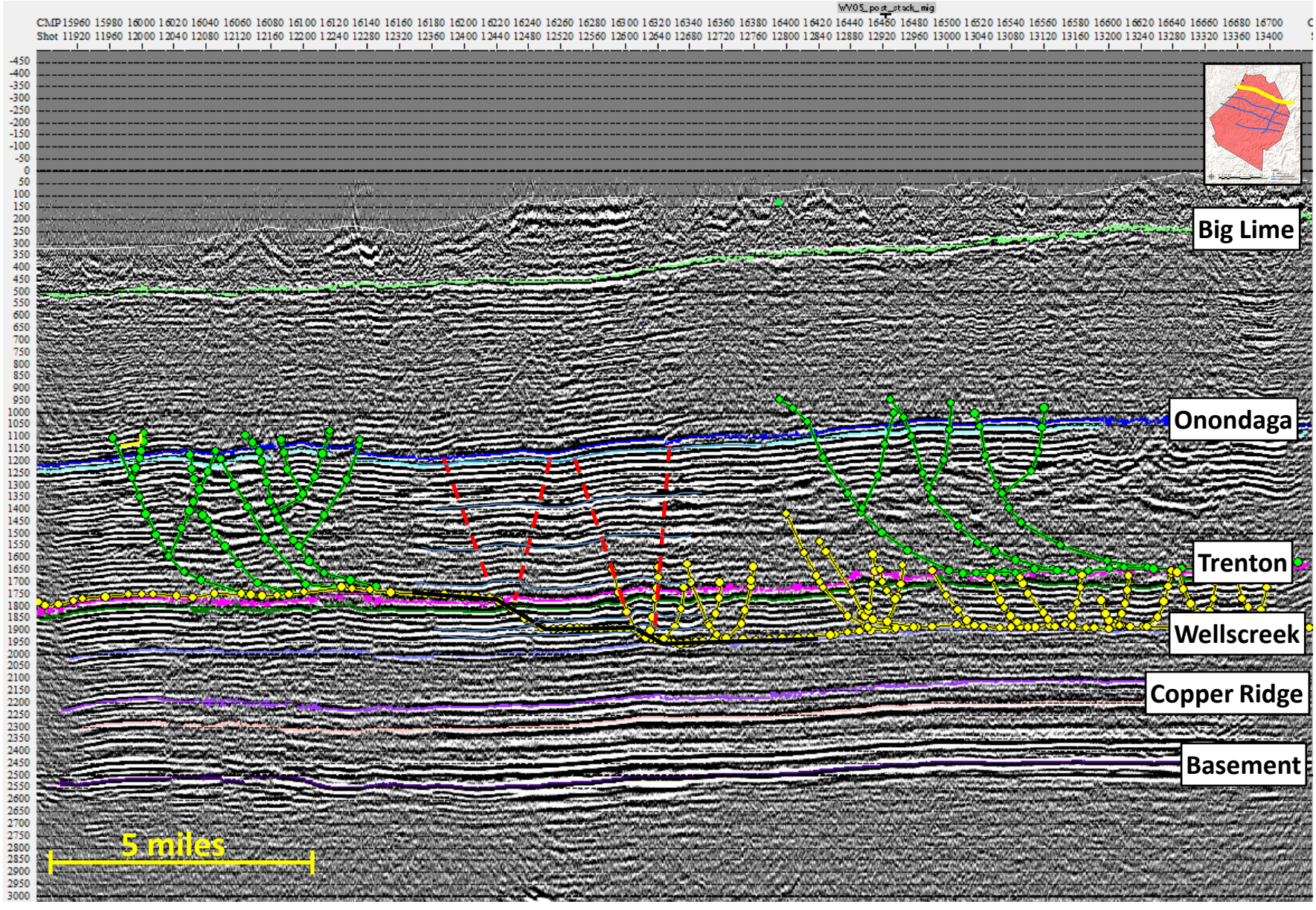
2D Seismic



A

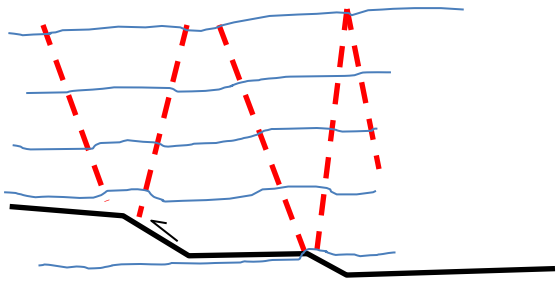
LOCALIZED RESULTS

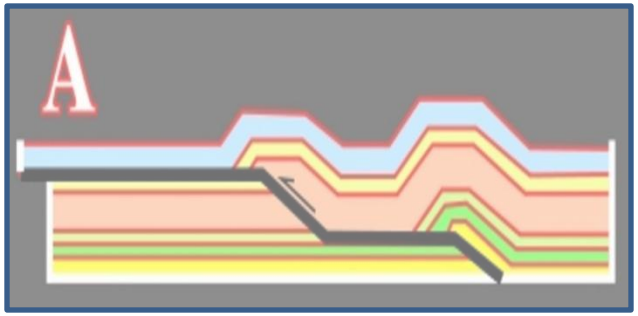
2D Seismic



A

LOCALIZED RESULTS
2D Seismic



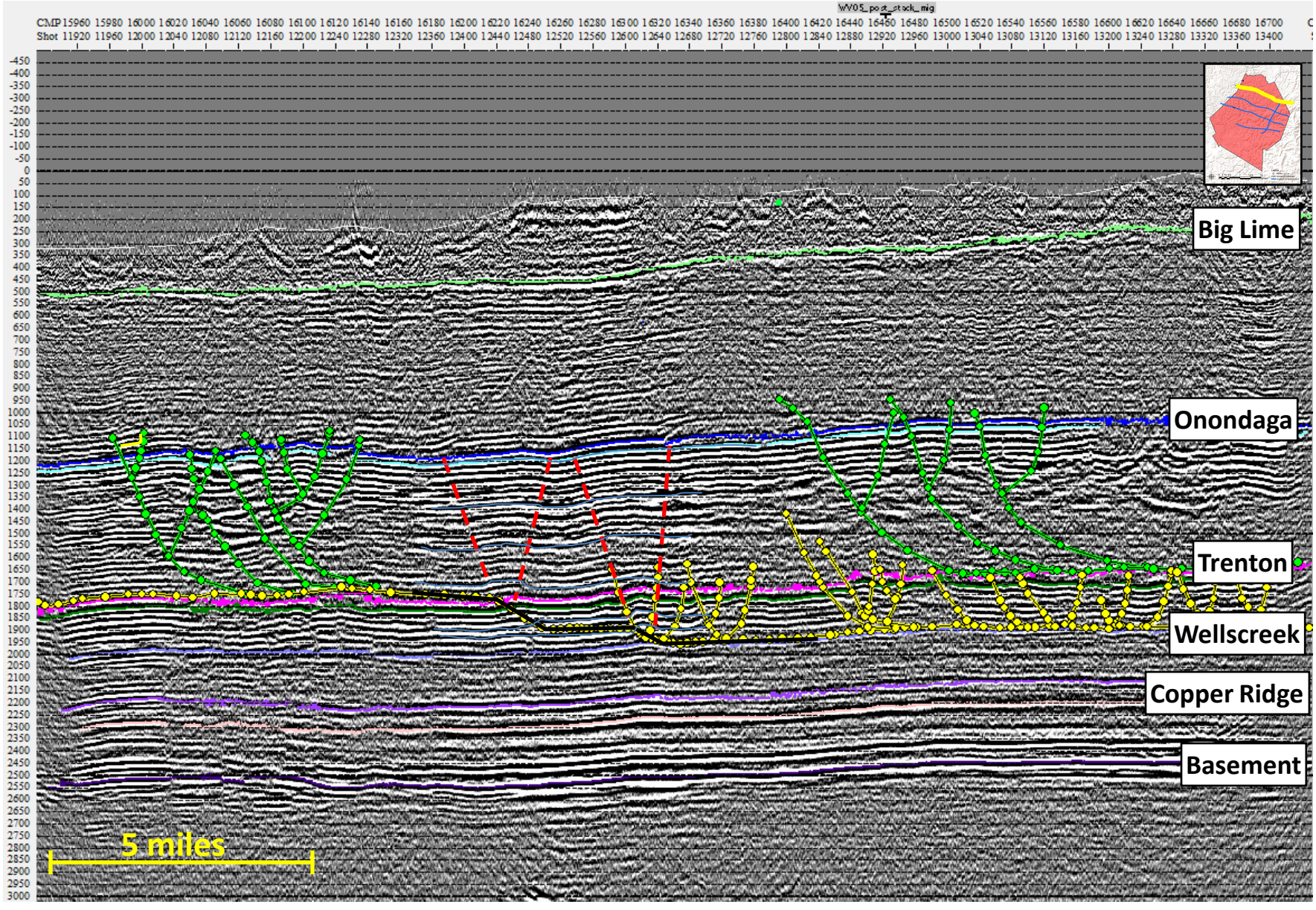


Fault-Bend Fold Model

A

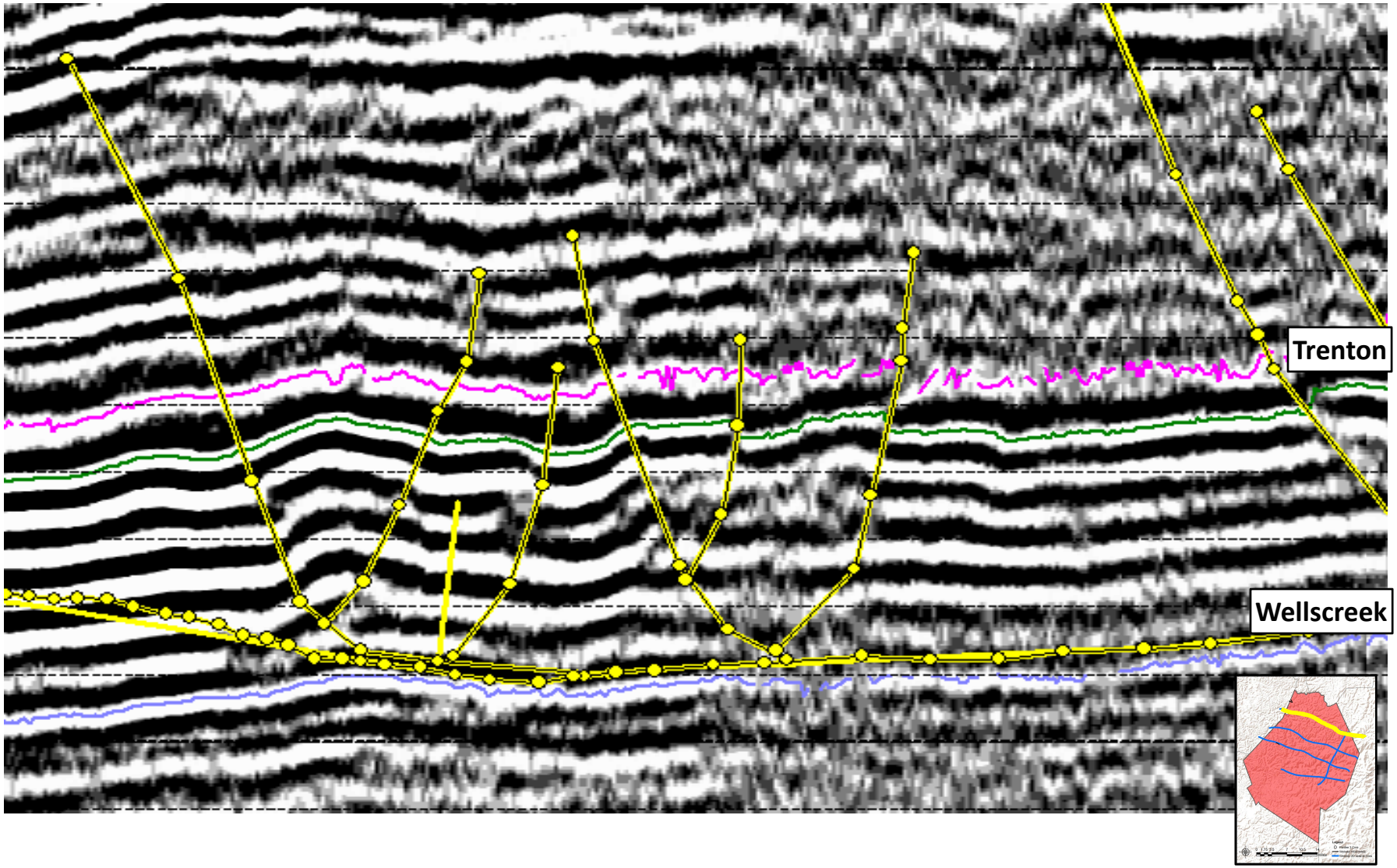
LOCALIZED RESULTS

2D Seismic



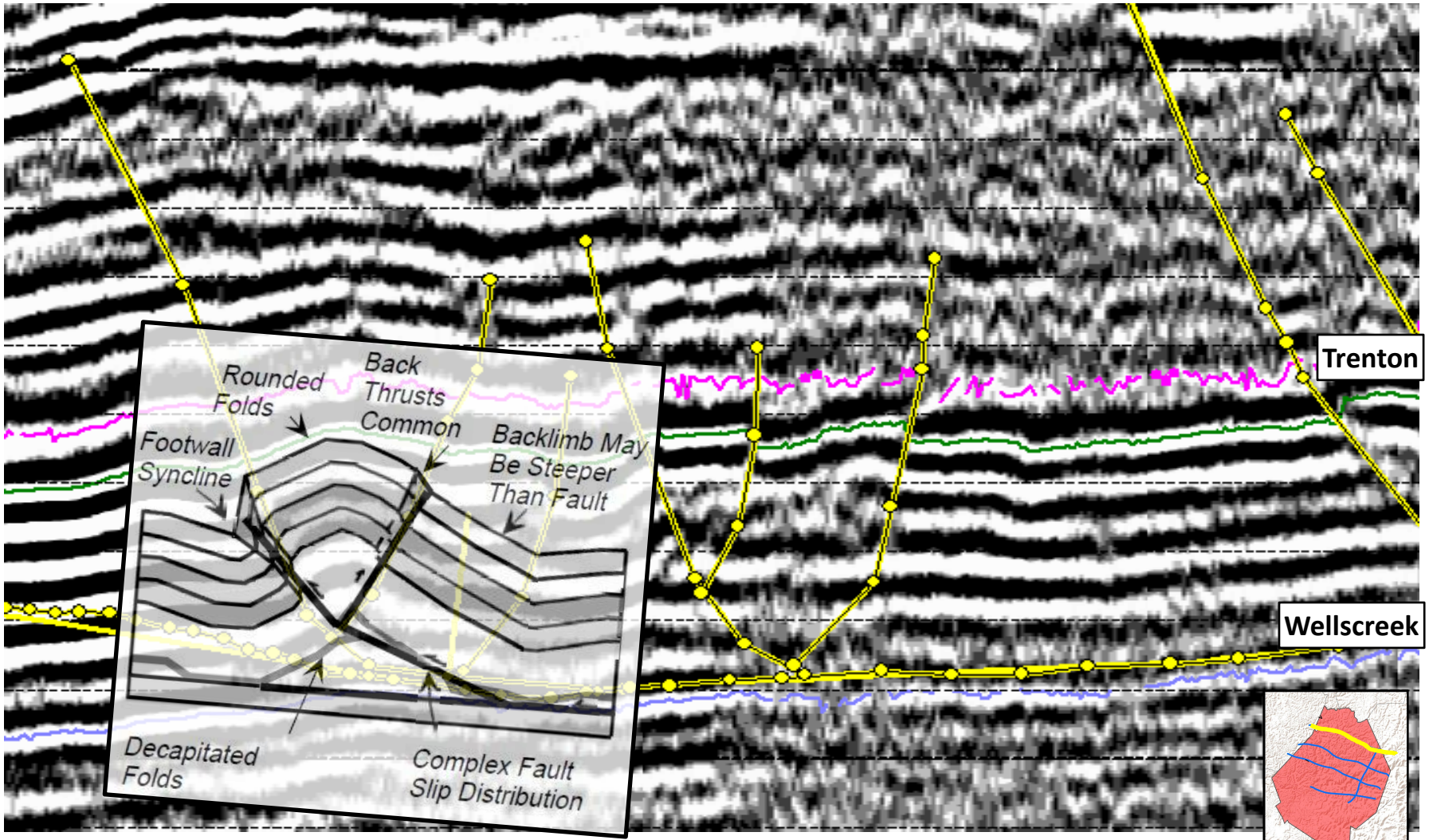
A

LOCALIZED RESULTS
2D Seismic



C

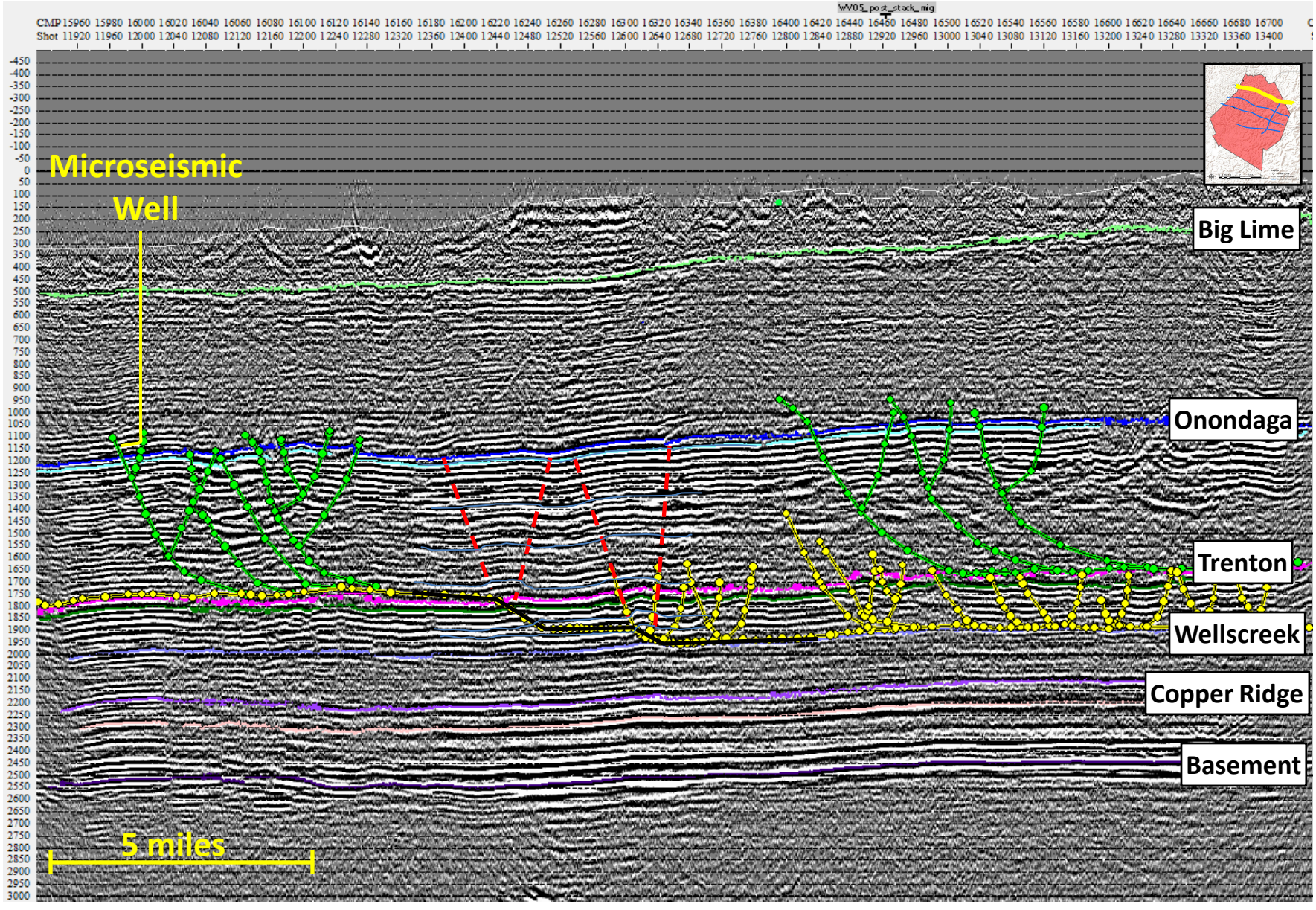
LOCALIZED RESULTS
2D Seismic



C **Faulted Detachment Fold** Shankar Mitra (2002)

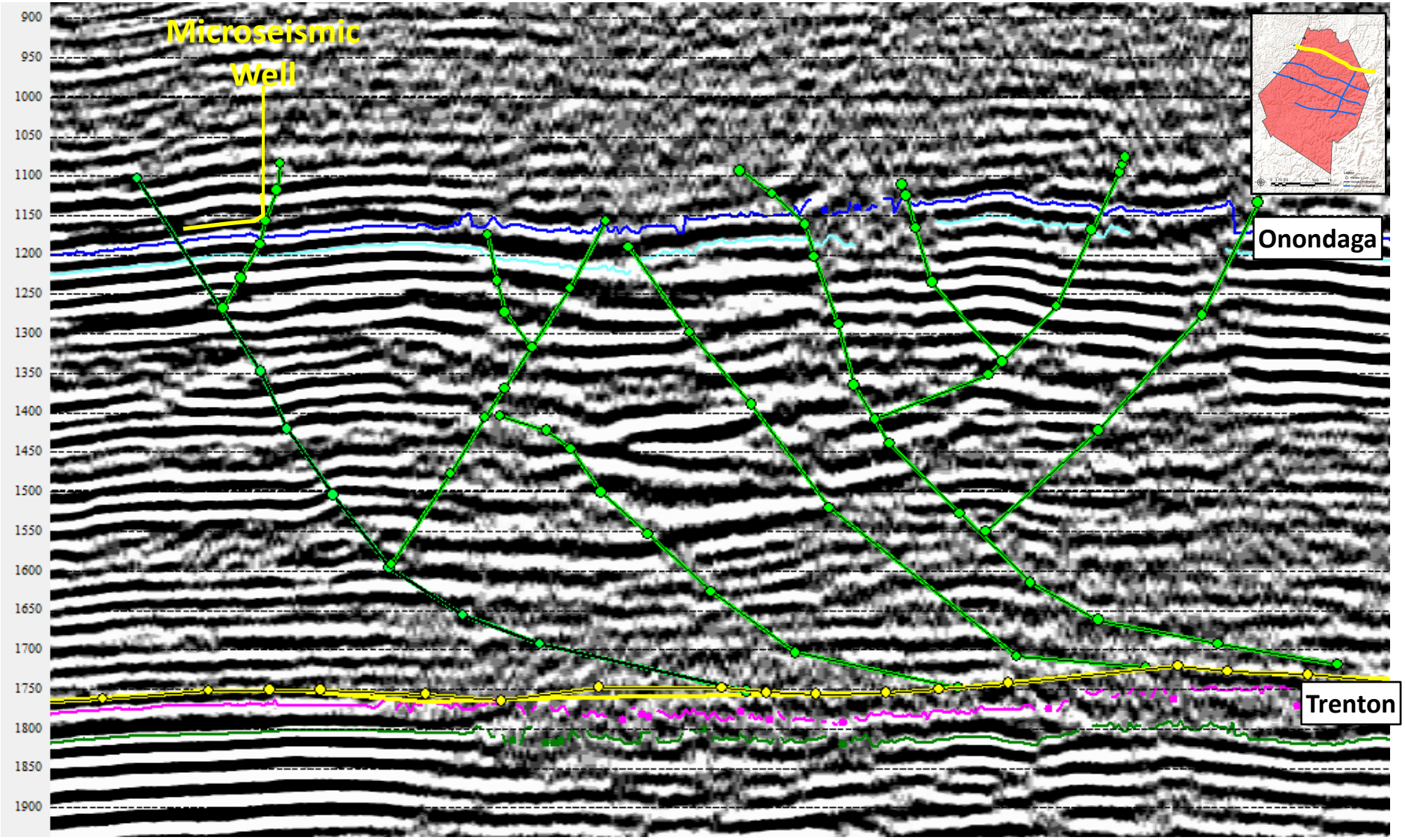
LOCALIZED RESULTS

2D Seismic



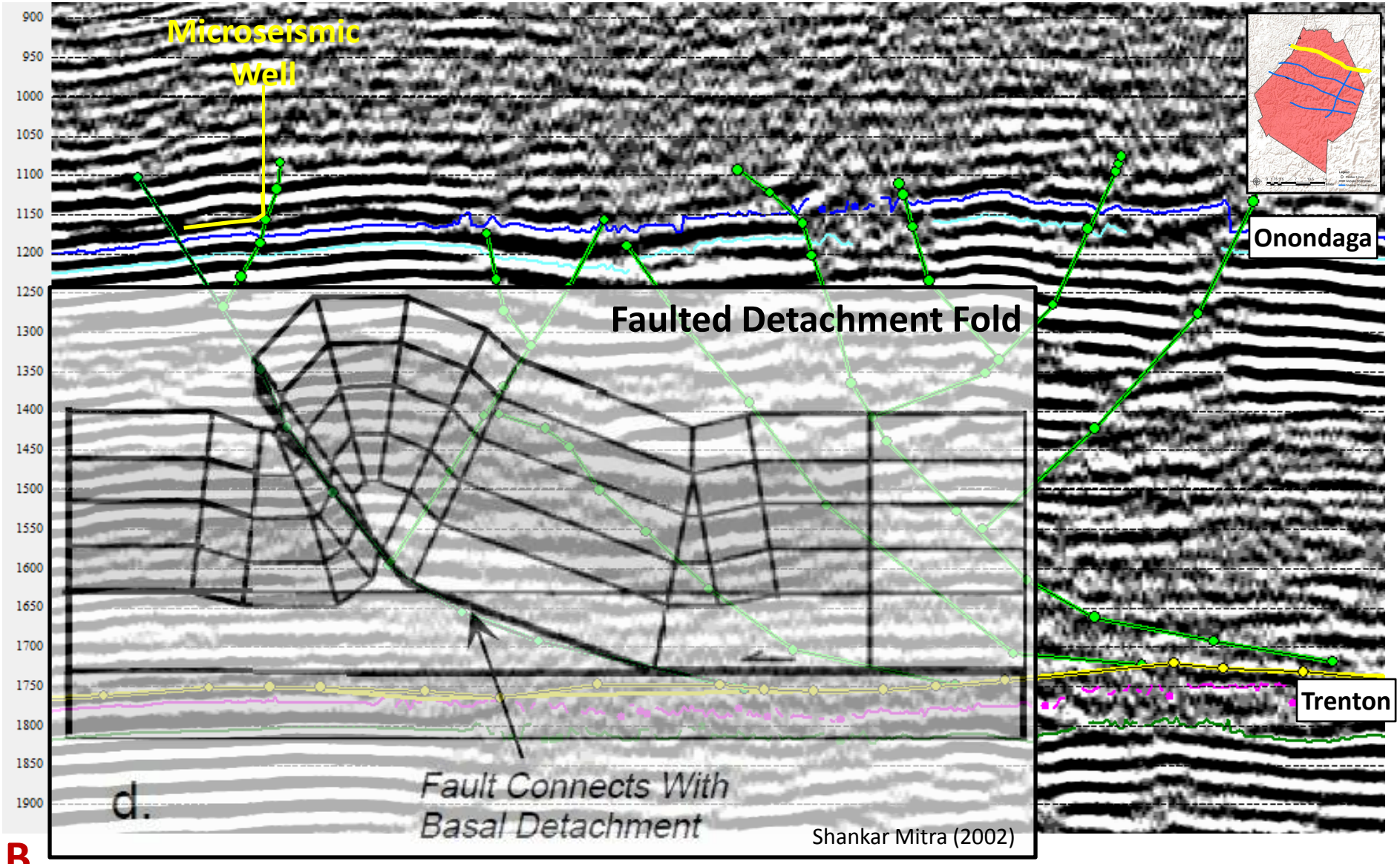
LOCALIZED RESULTS

2D Seismic



B

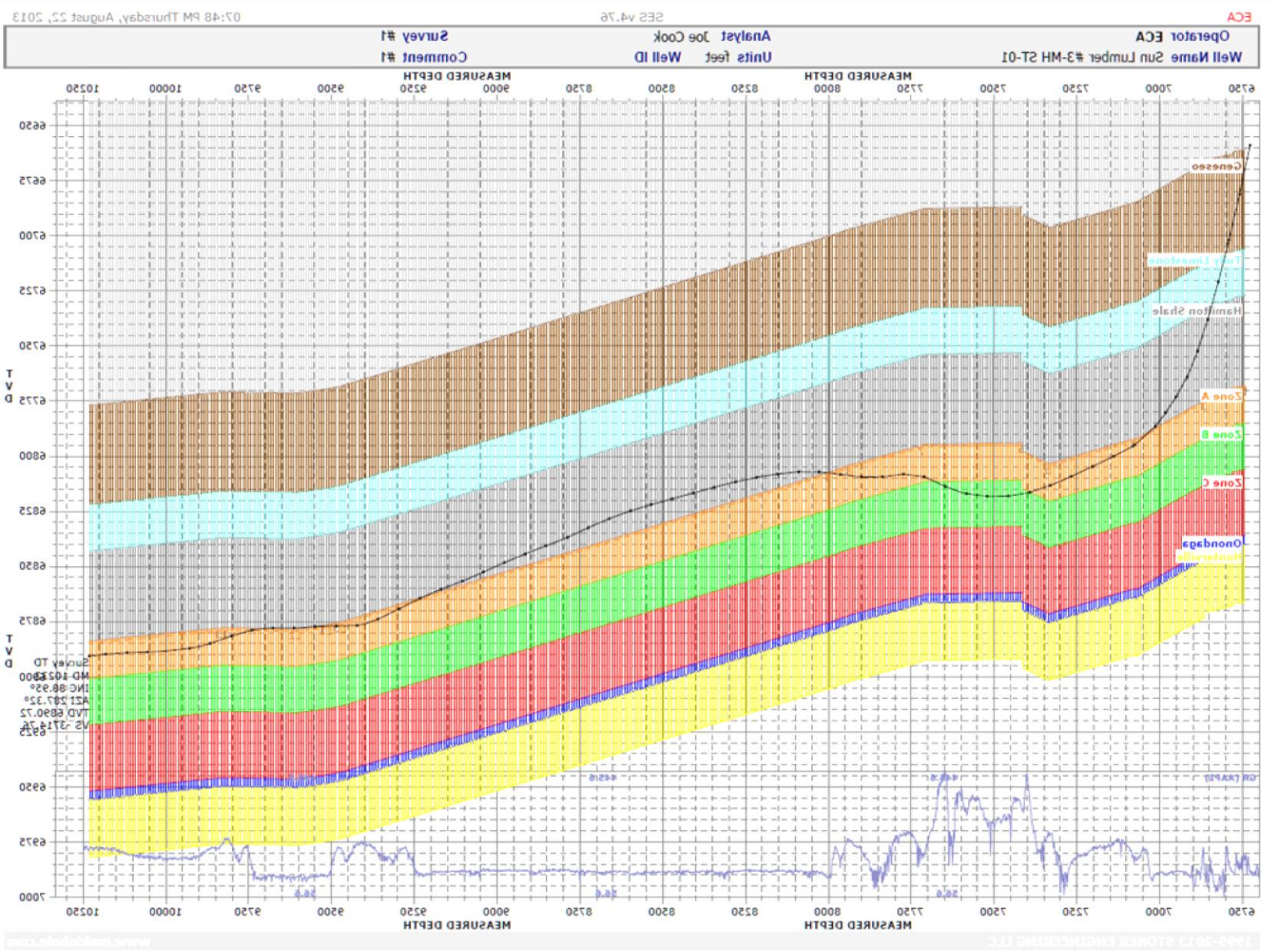
LOCALIZED RESULTS
2D Seismic



B

LOCALIZED RESULTS

2D Seismic



B

RESULTS
Microseismic

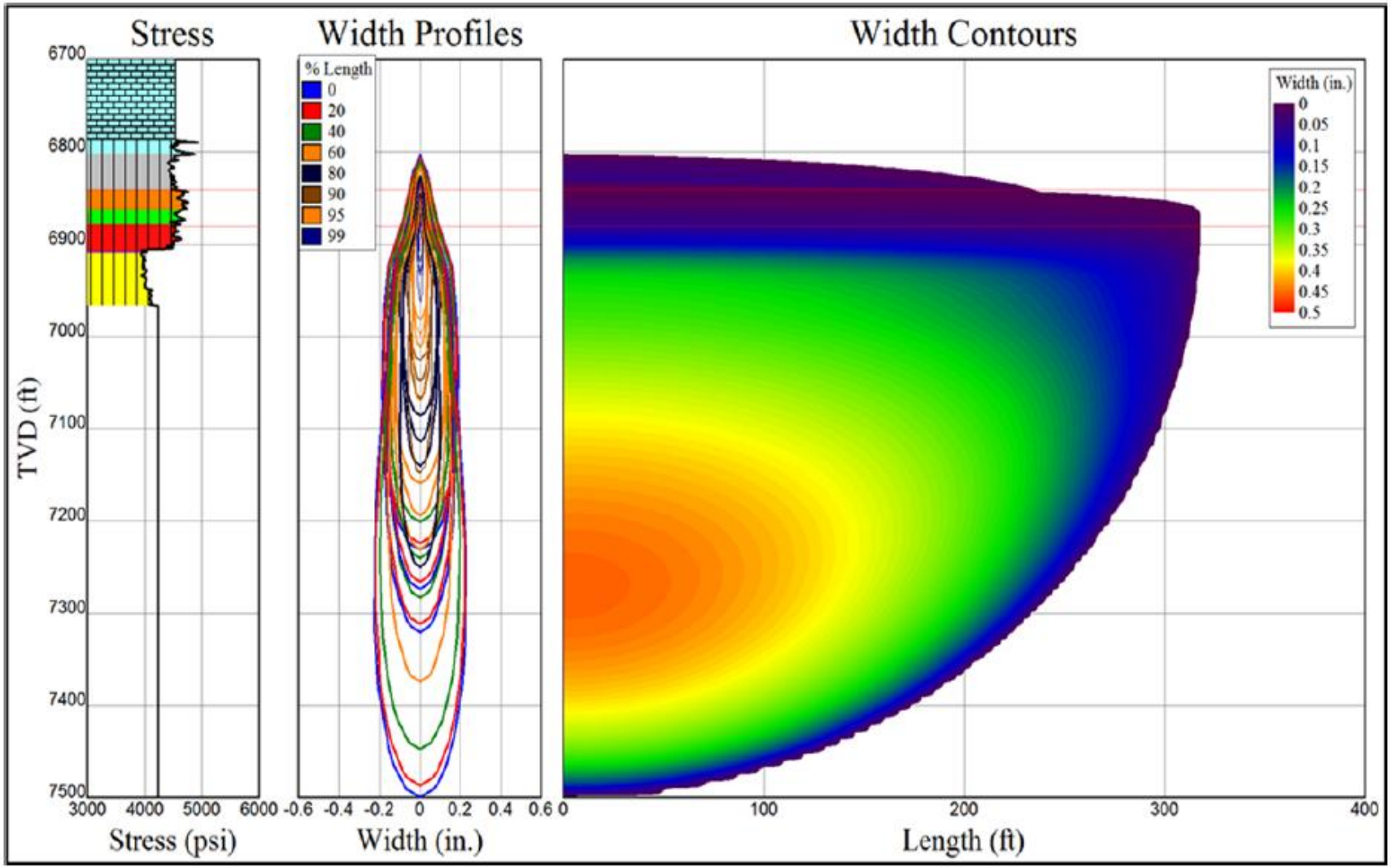


Figure 3 – Sun Lumber 2 MH – Stage 1 width contour geometry using mechanical properties log with data shift causing downward fracture growth below the Marcellus shale.

RESULTS
Microseismic

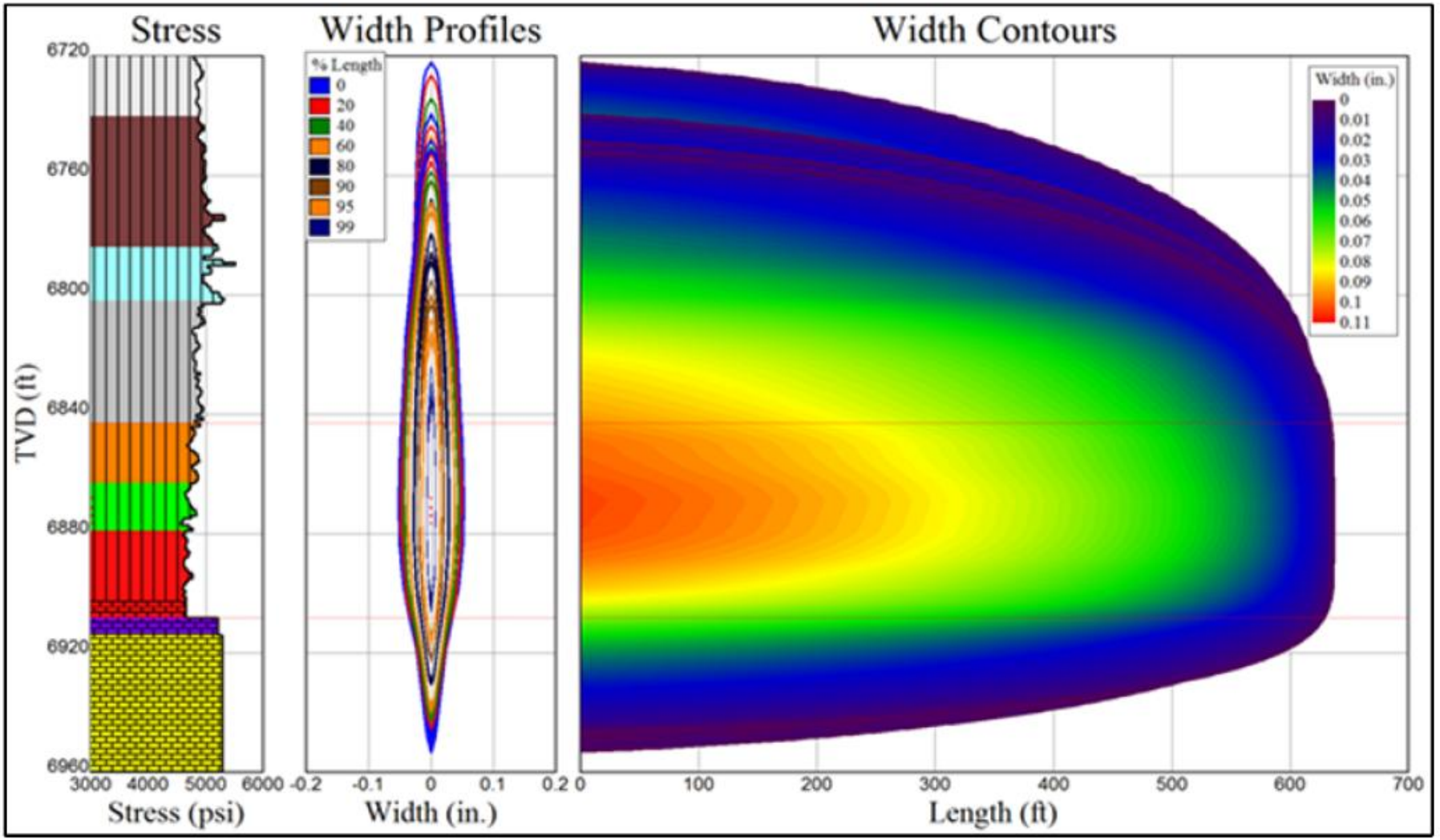
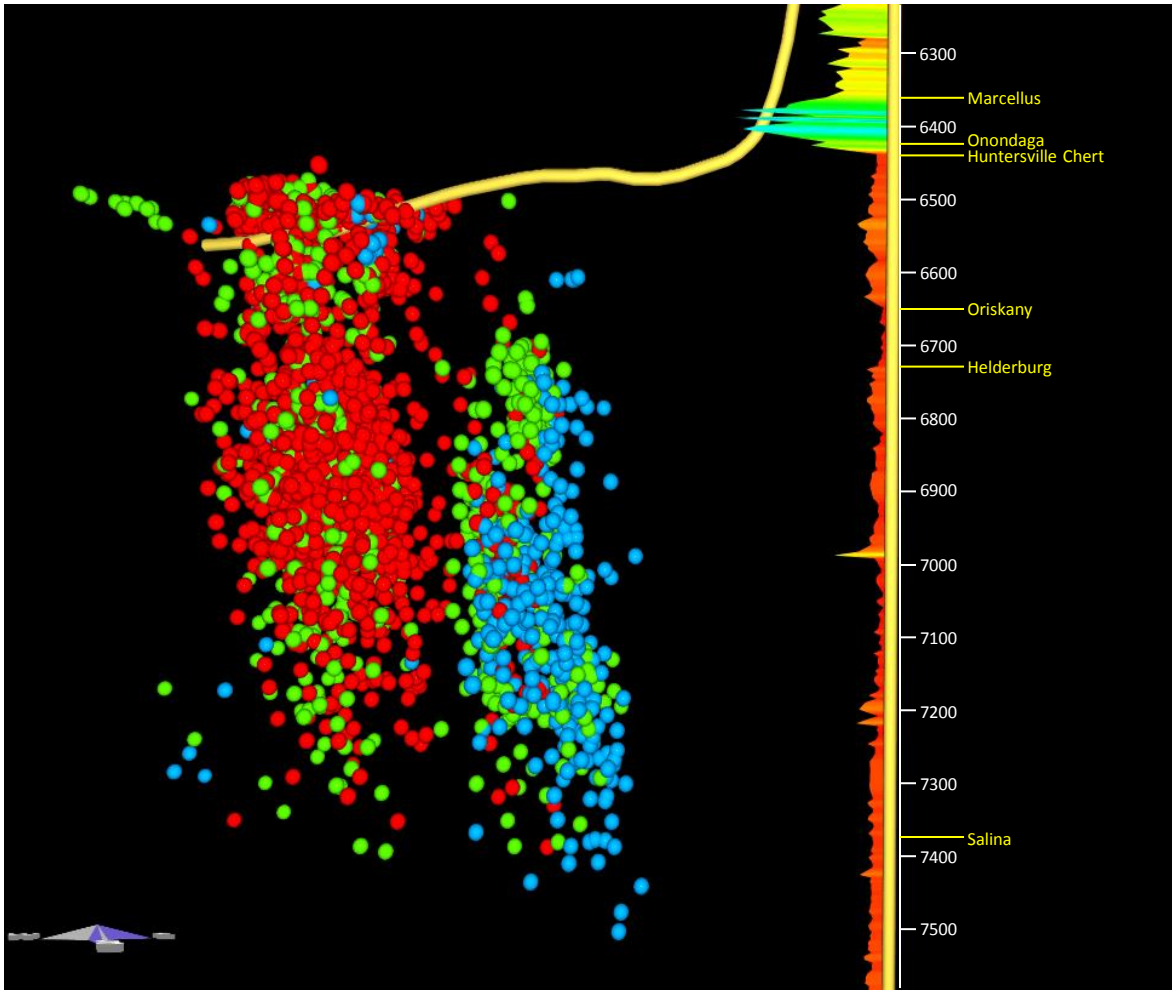
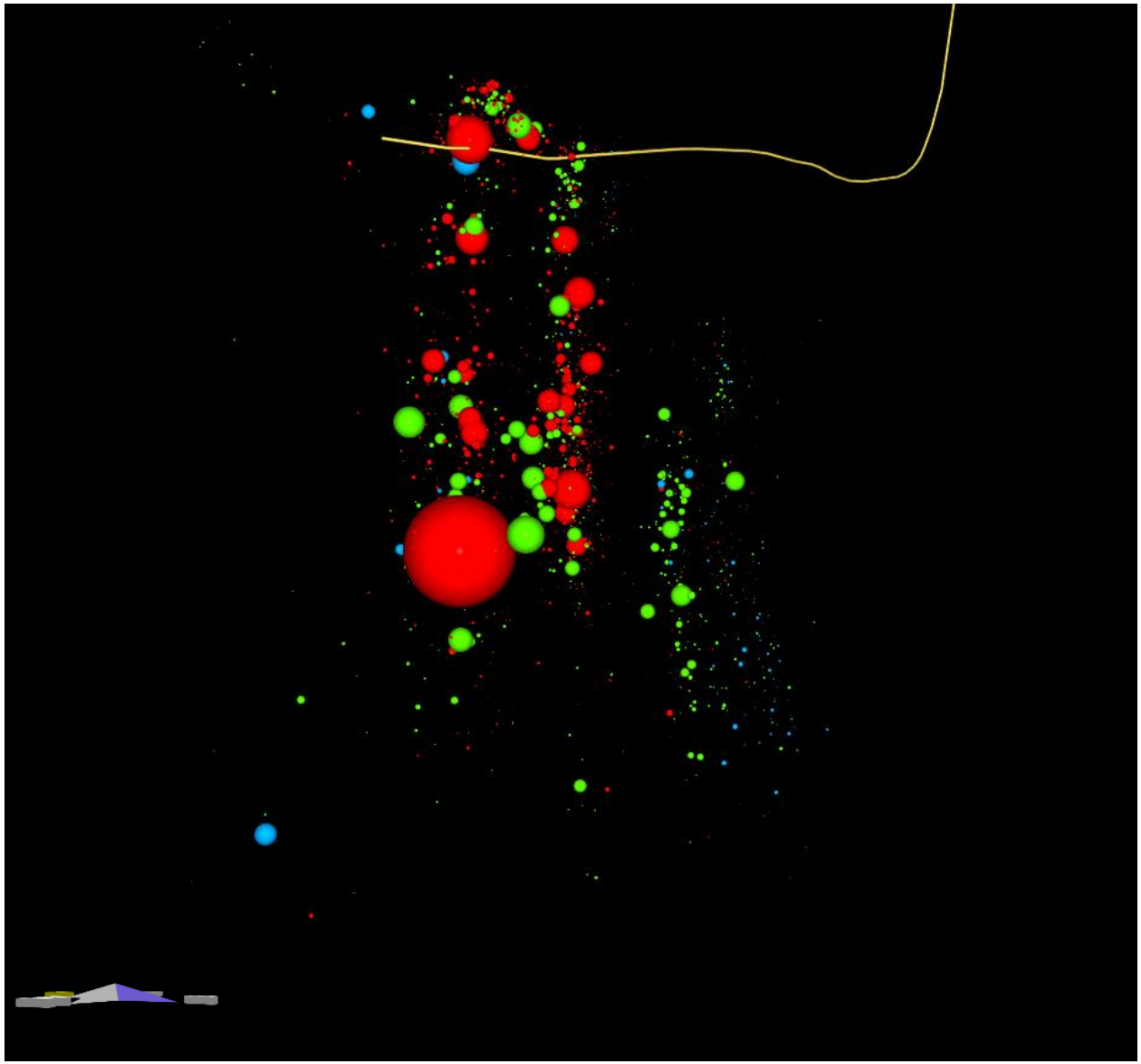


Figure 7 – Stress, width contours and length for Sun Lumber 2MH Stage 1, average fracture width in pay section is 0.052 inches for the created fracture.

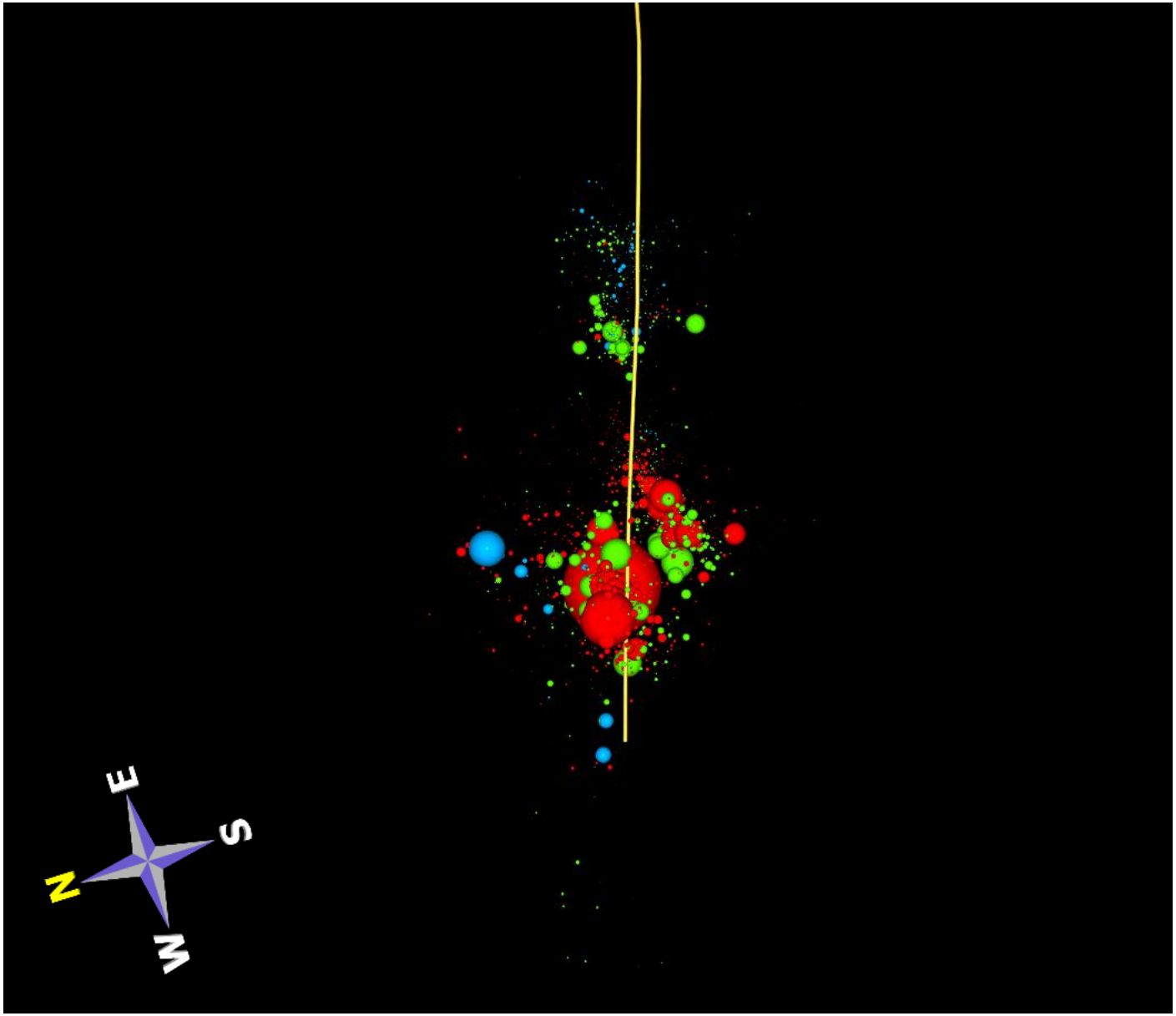
RESULTS
Microseismic



RESULTS
Microseismic

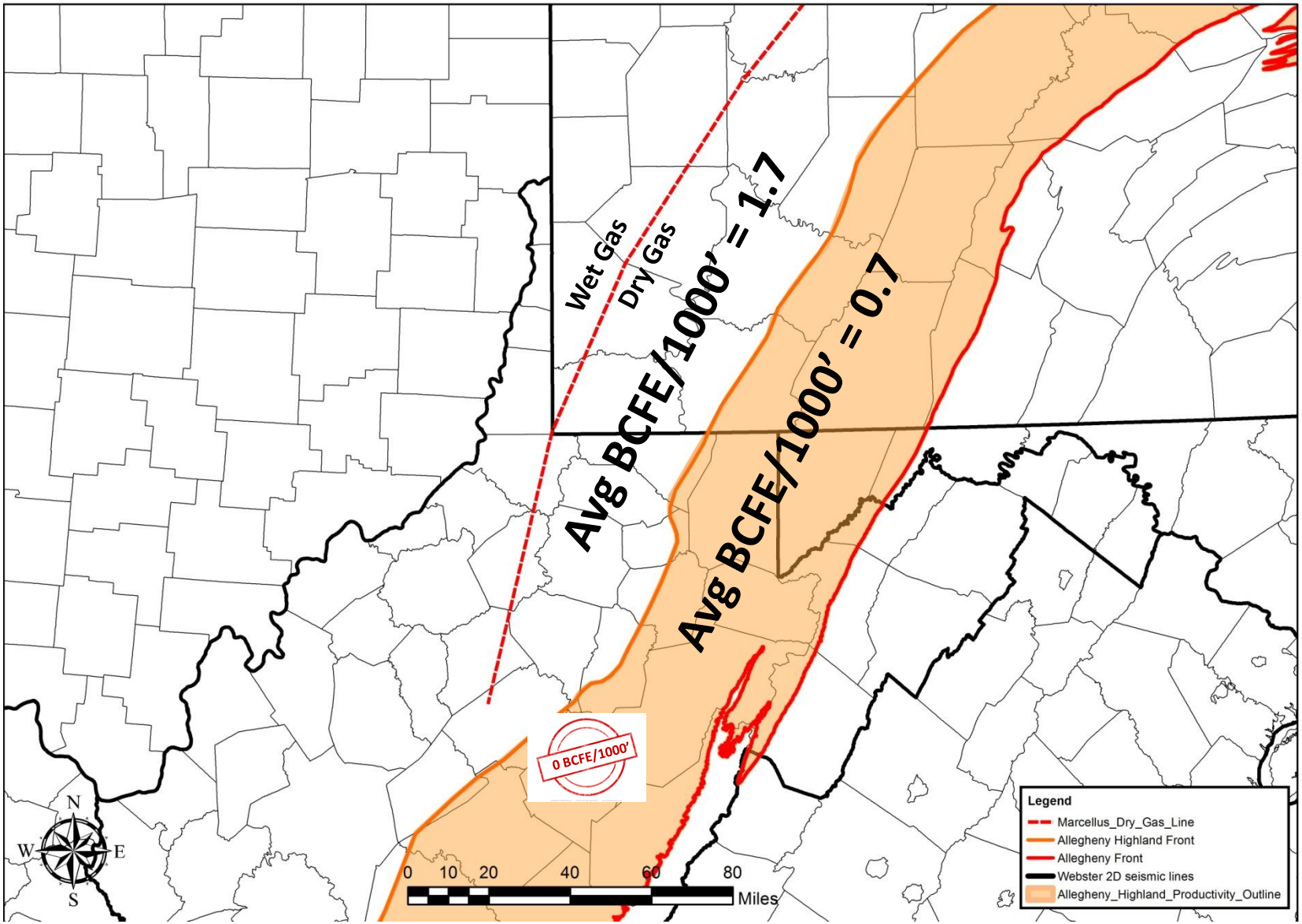


RESULTS
Microseismic

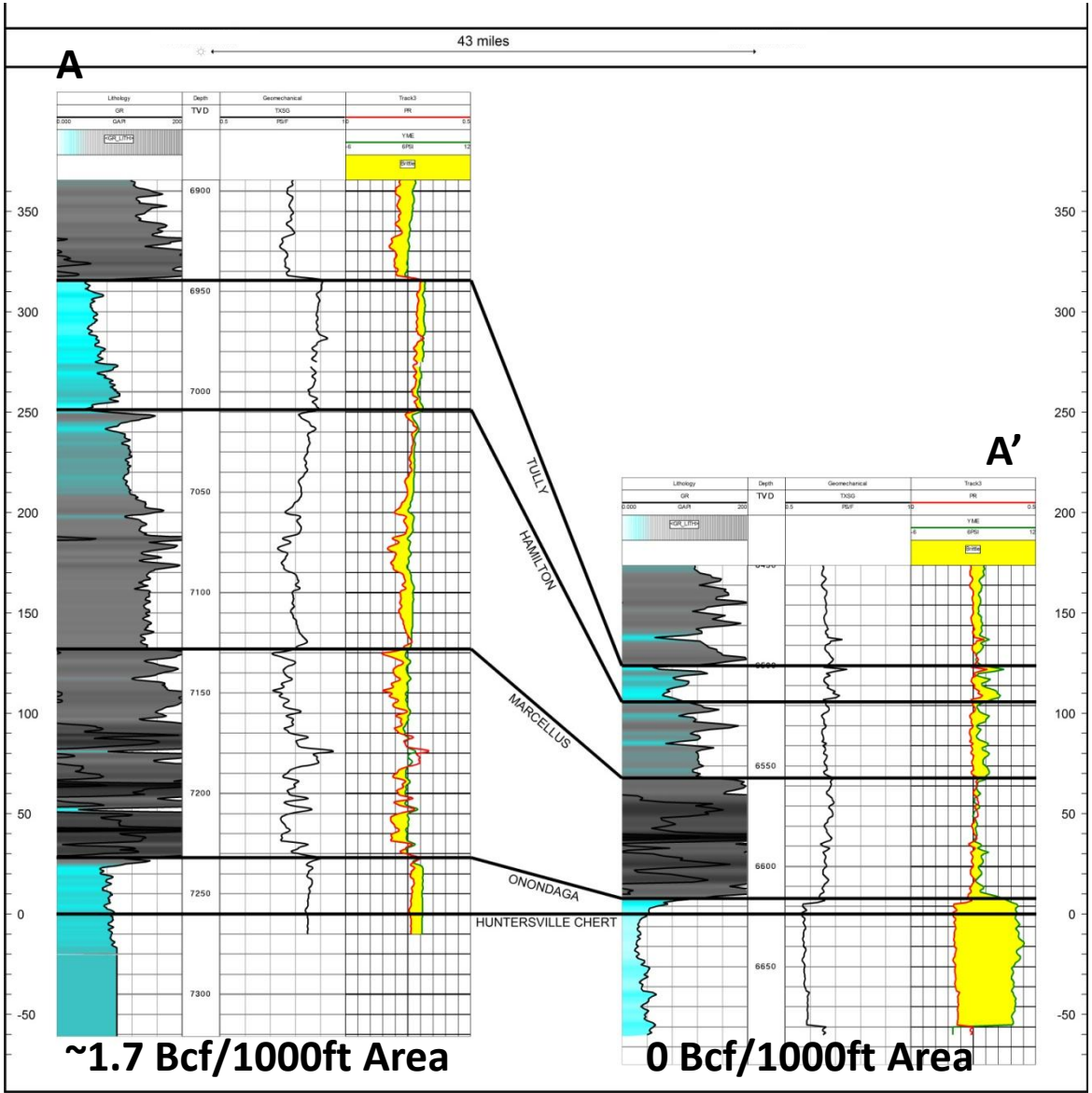


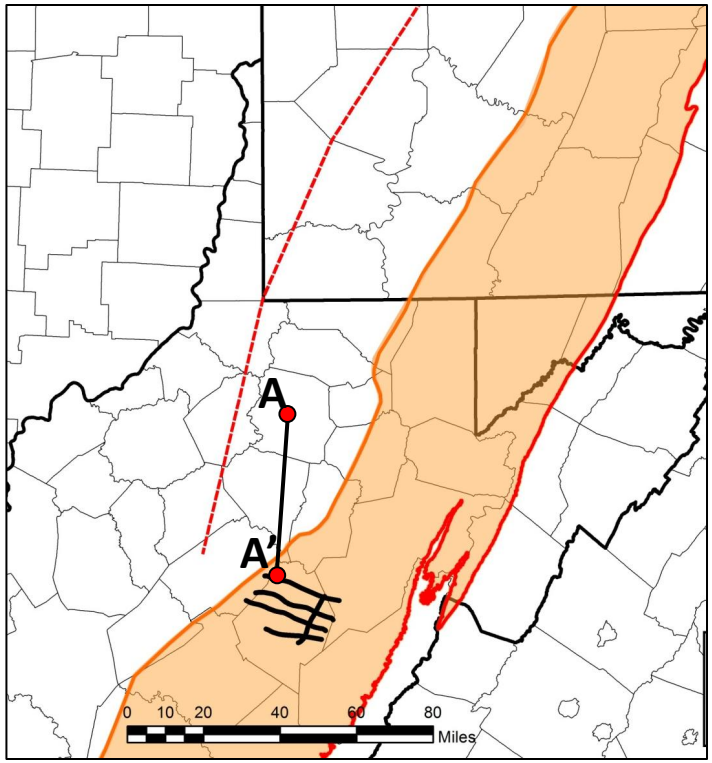
LOCALIZED RESULTS
Production

REGIONAL RESULTS
Productivity

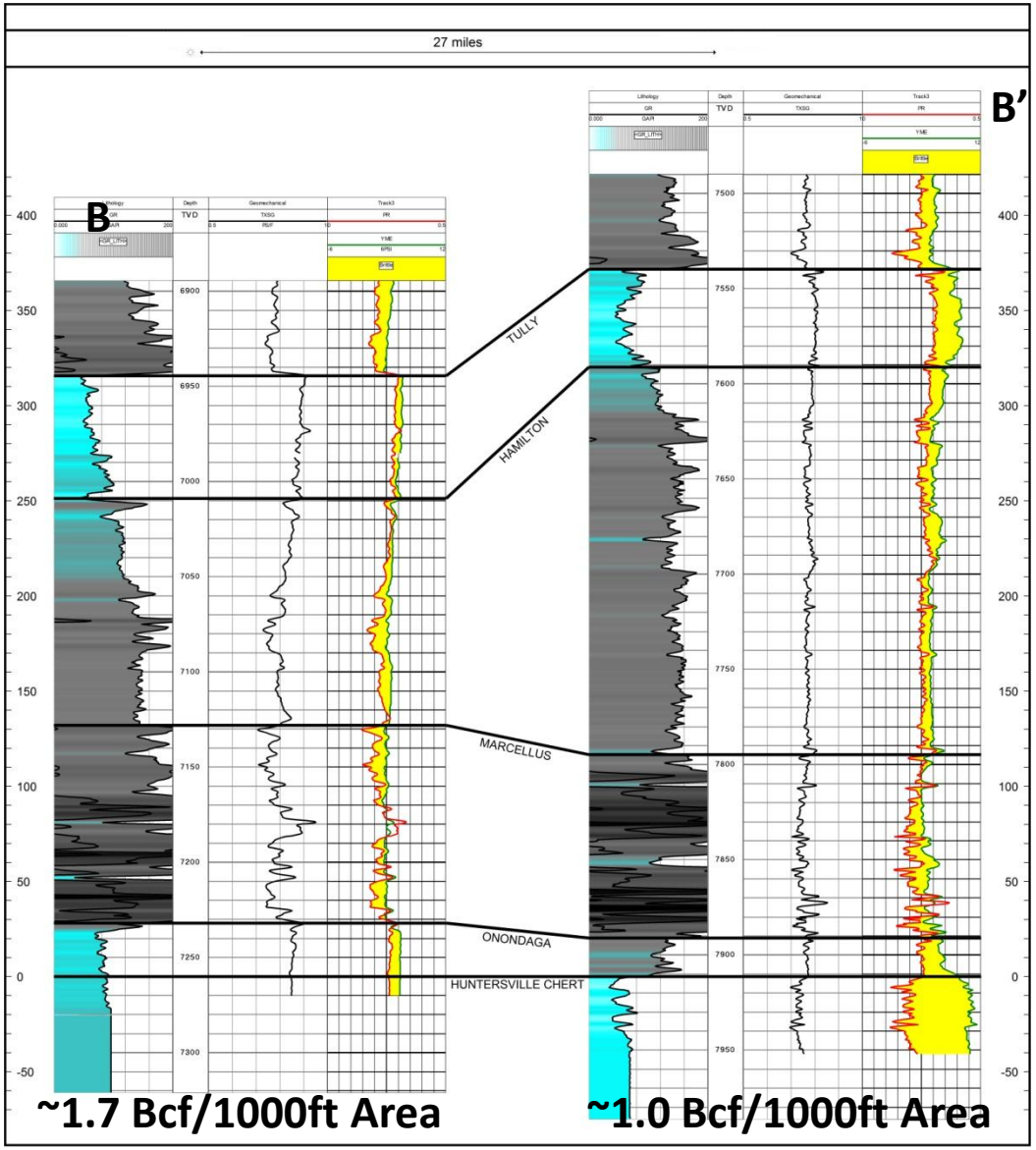


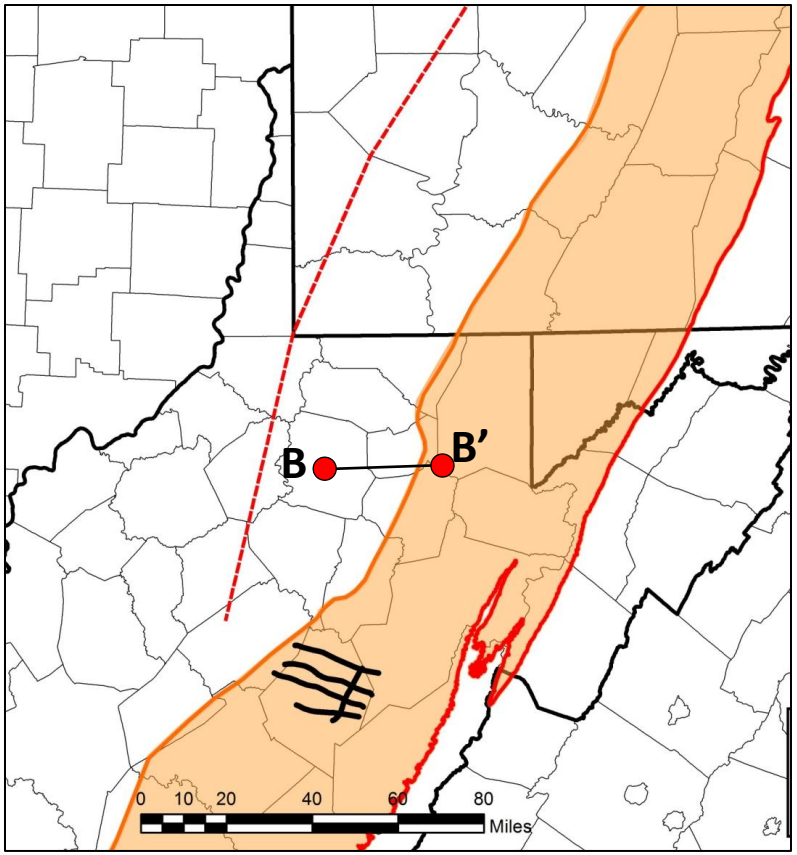
REGIONAL RESULTS
Geomechanical Properties





REGIONAL RESULTS
Geomechanical Properties





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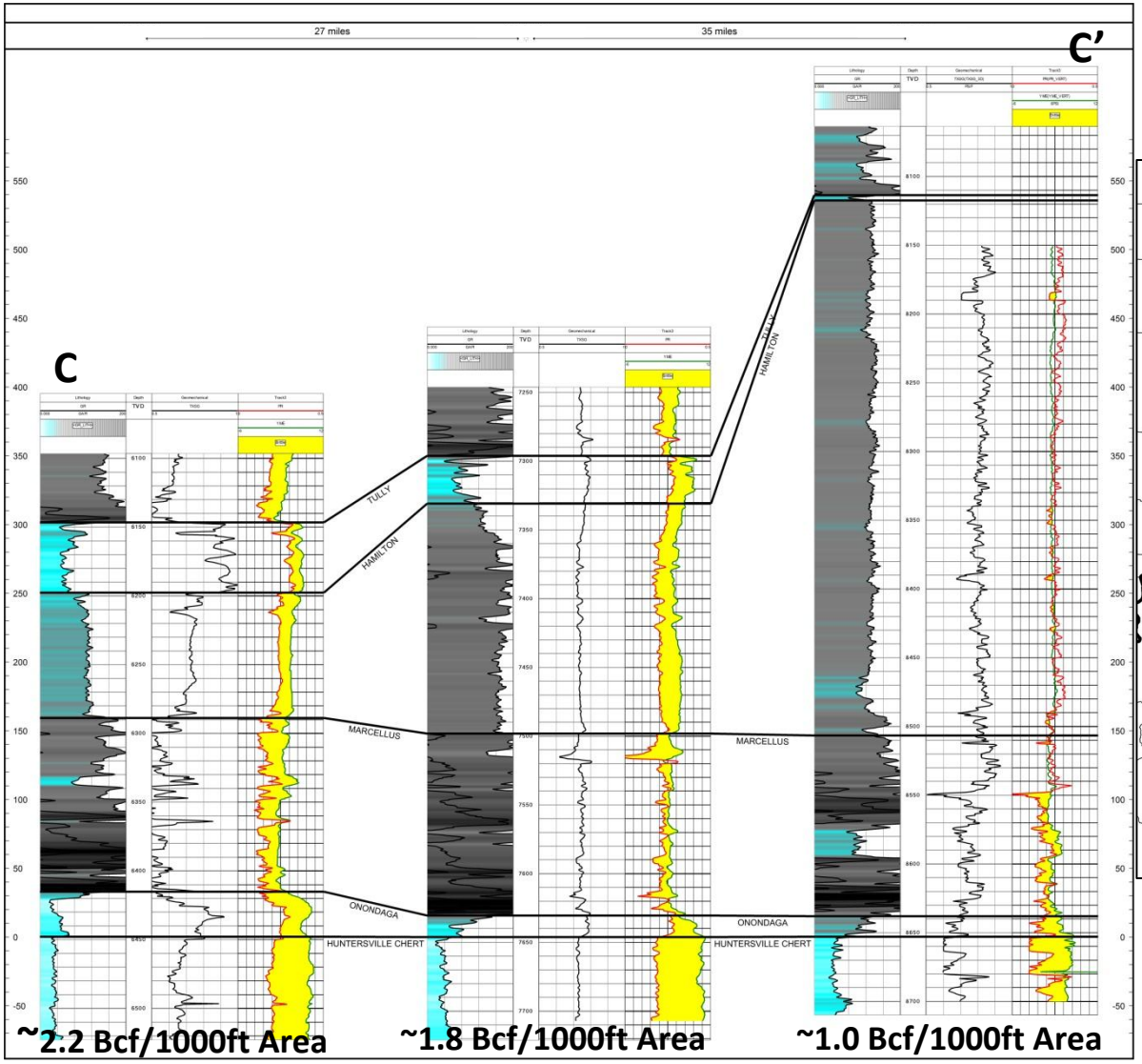
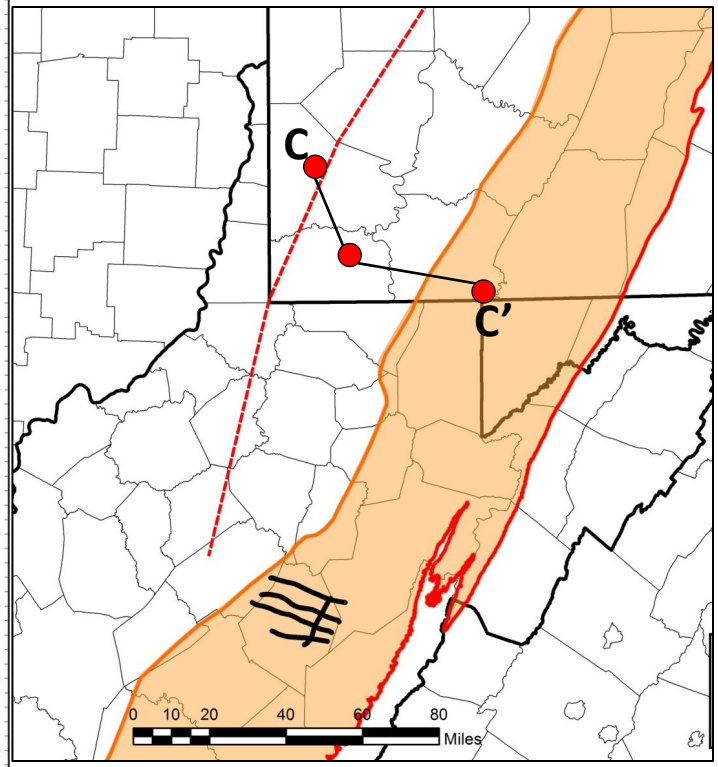
Geomechanical Properties

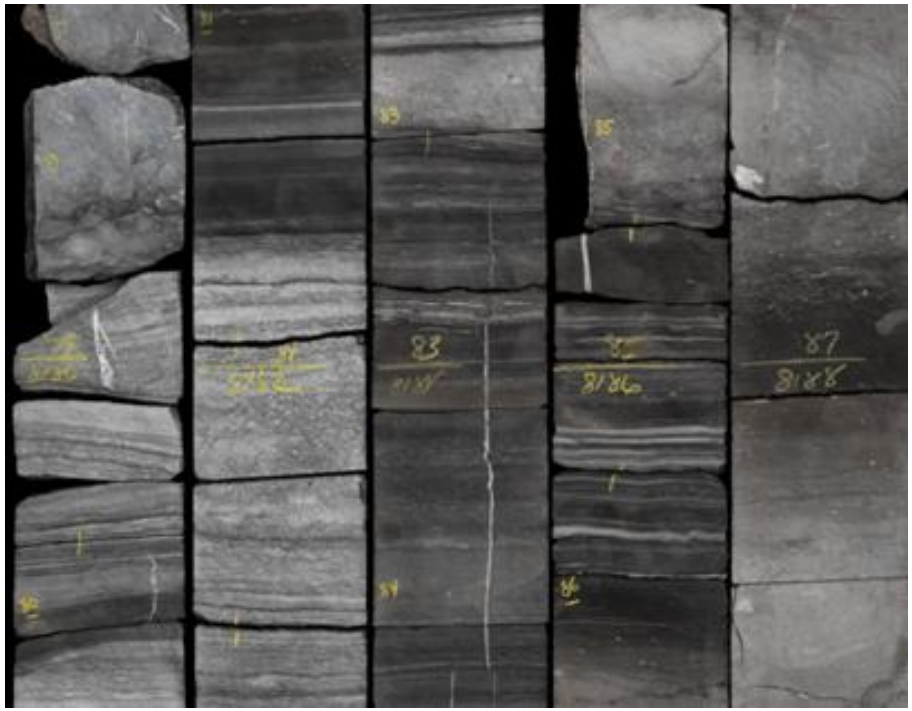




REGIONAL RESULTS
Geomechanical Properties

West

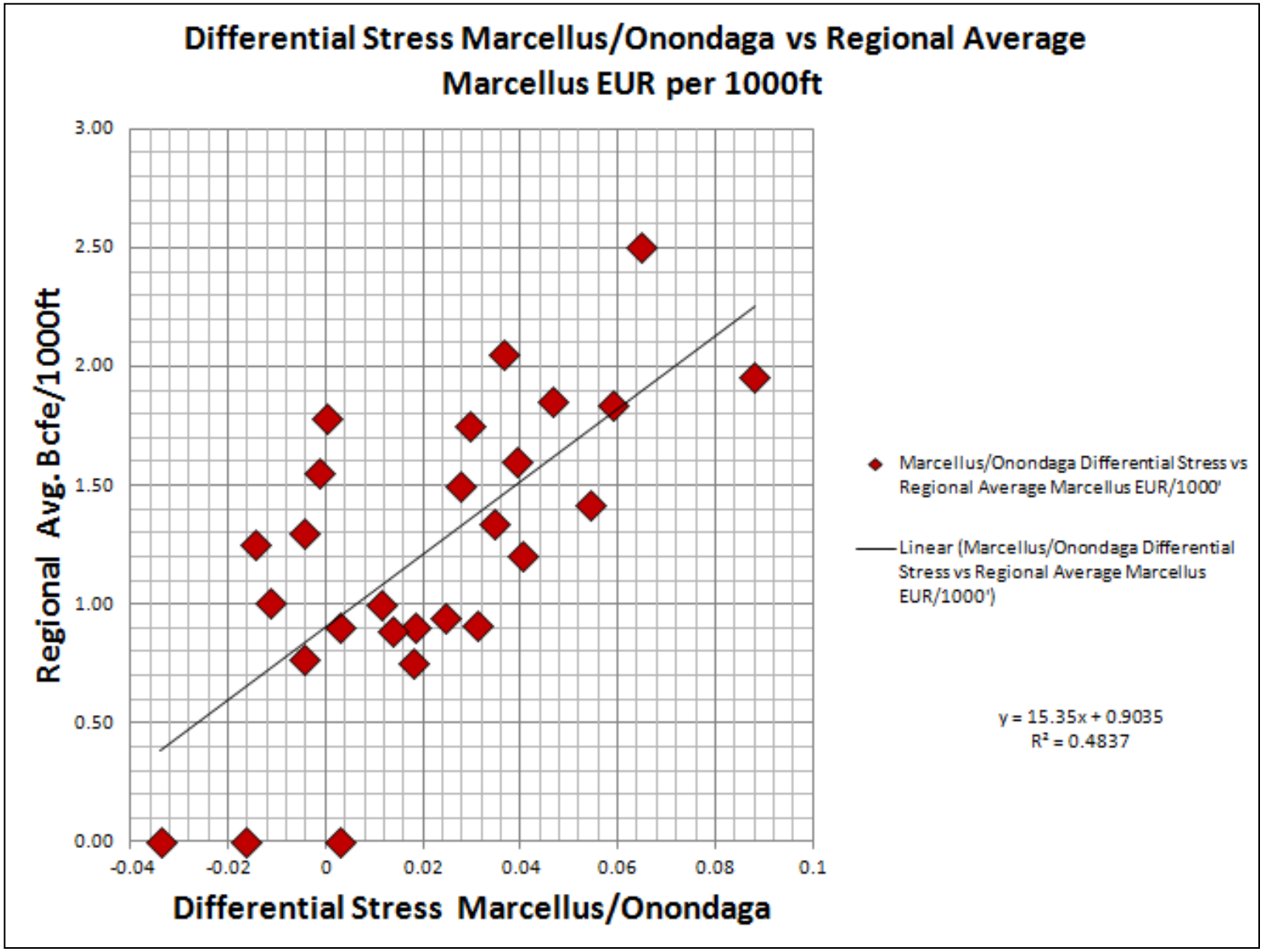
East



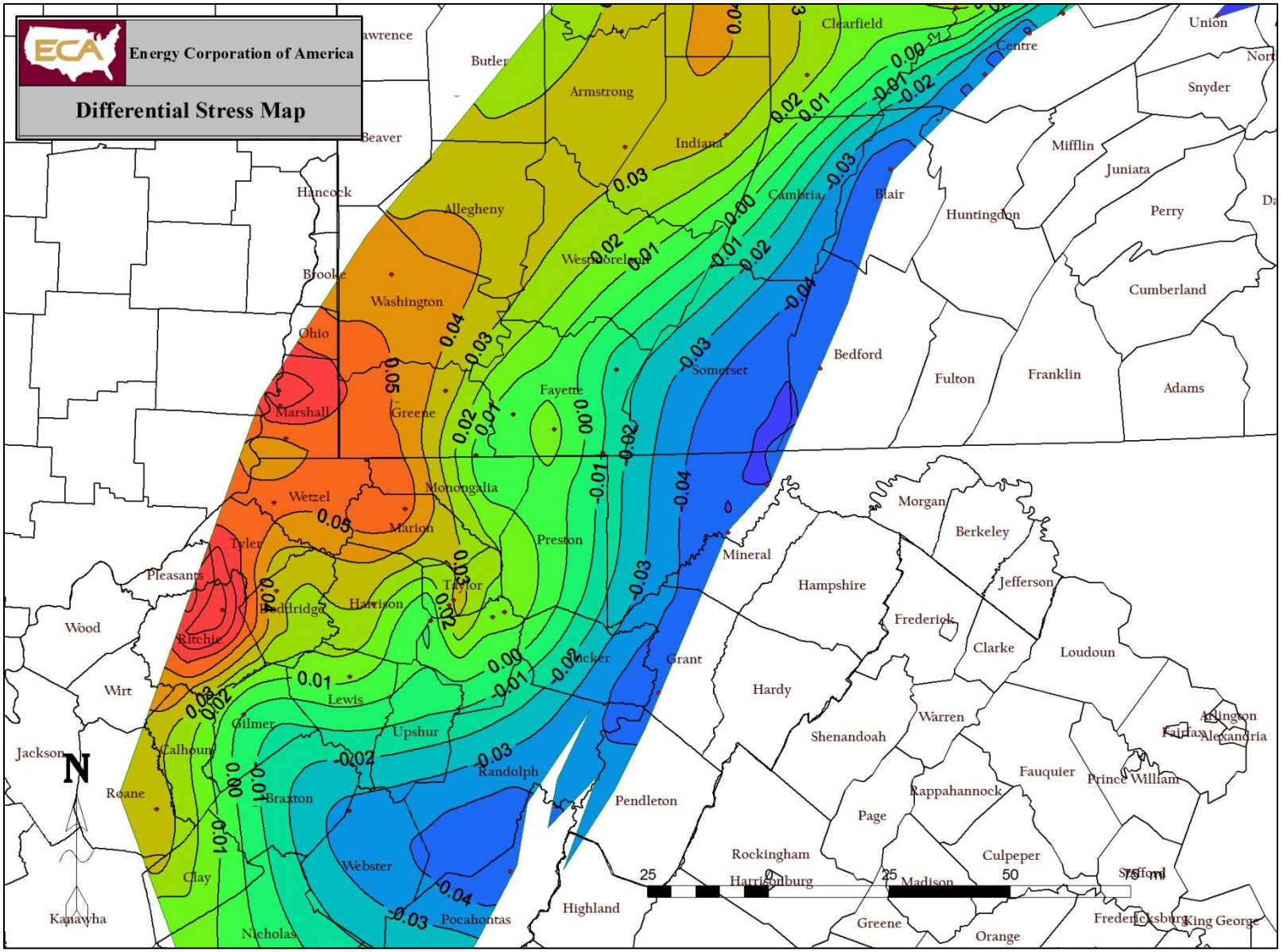
Skeletal limestone interbedded with ***sparse*** amounts calcareous mudstone.

Skeletal limestone interbedded with ***abundant*** amounts of calcareous mudstone.

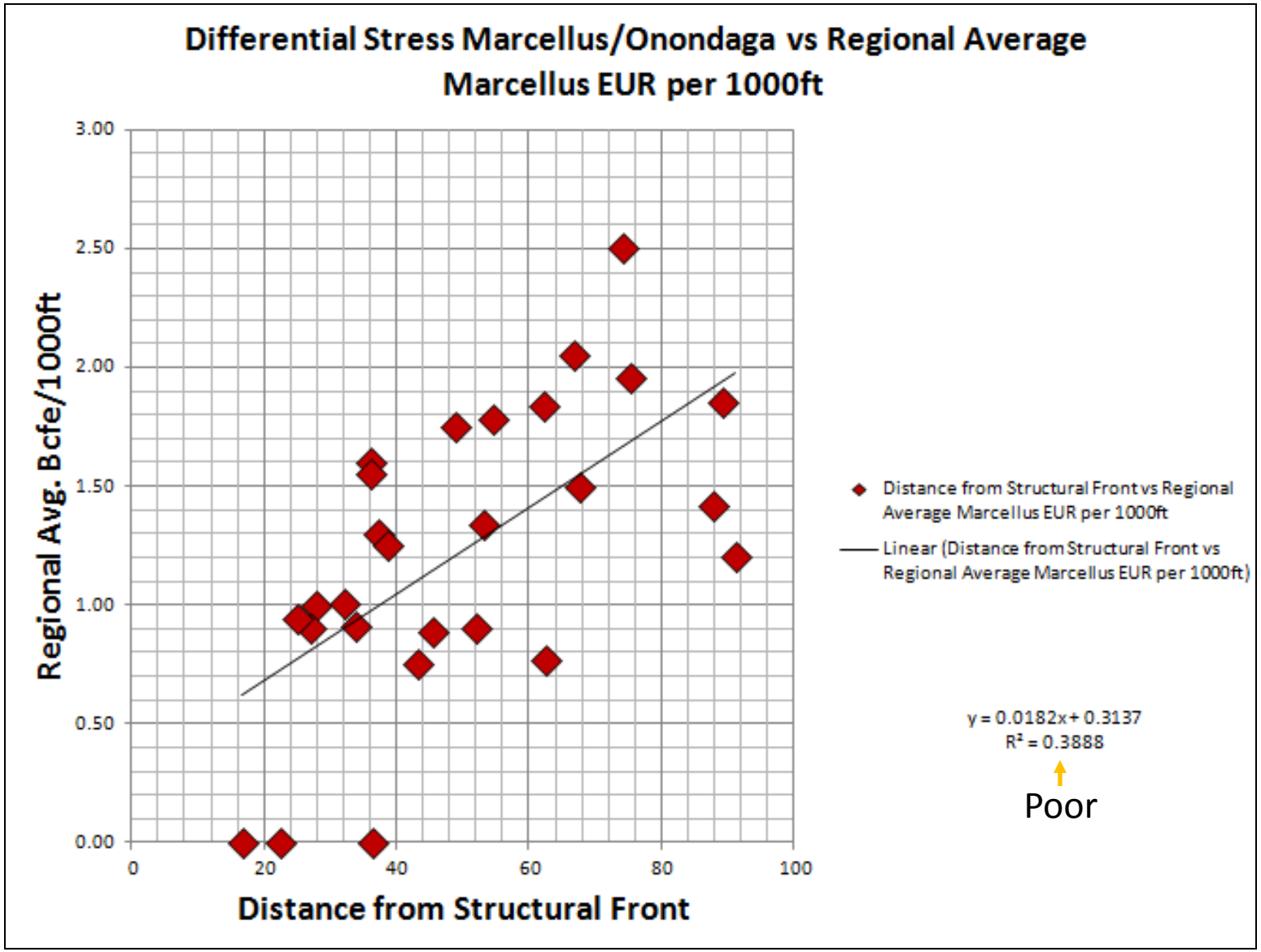
REGIONAL RESULTS
Geomechanical Properties



REGIONAL RESULTS
Geomechanical Properties



REGIONAL RESULTS
Geomechanical Properties



CONCLUSIONS

- Basal frac barrier differential stress seems to have a large impact on hydrualic fracturing, and potentially gas production in the Allegheny Highland.

DISCUSSION

- Has any other operators seen similar results from a microseismic survey in the Allegheny Highland?
- Any other interpretations on why the Allegany Highland doesn't produce as well?
  - Rock Quality? Structure?
- Has anyone else seen stand-out geologic parameters correlating to gas production.
  - Ex. OGIP