

**Identifying Jurassic tight gas
sandstones using 3C-3D
seismic data .**

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JACKSON

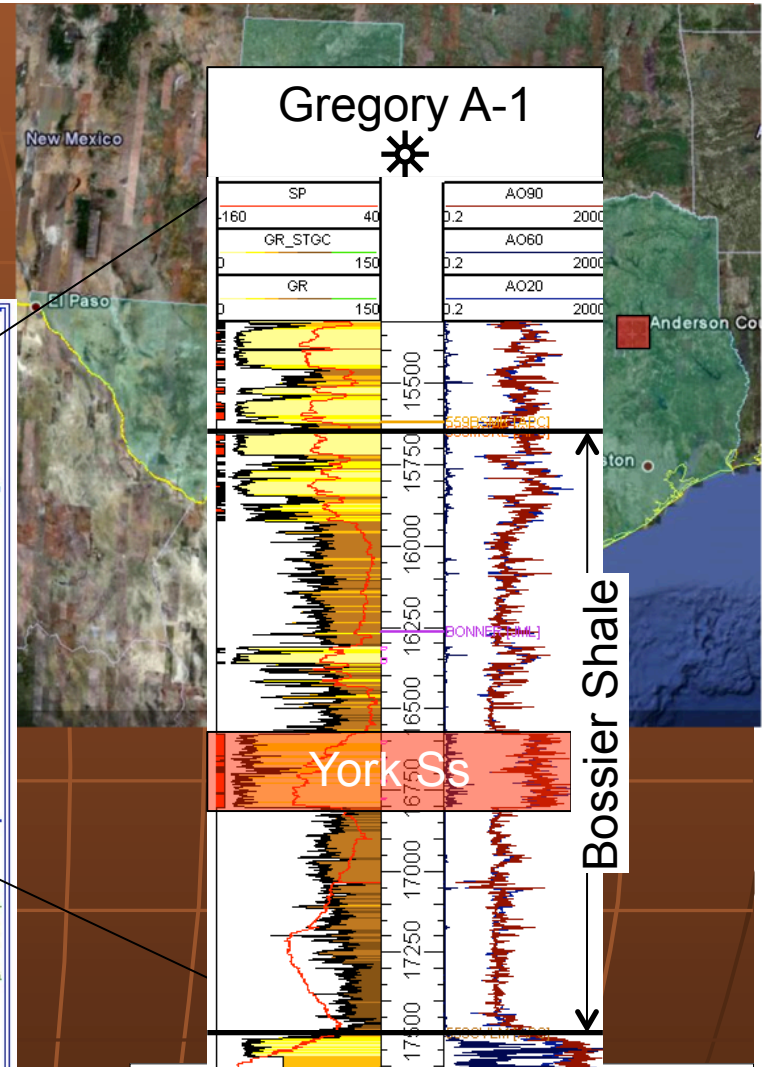
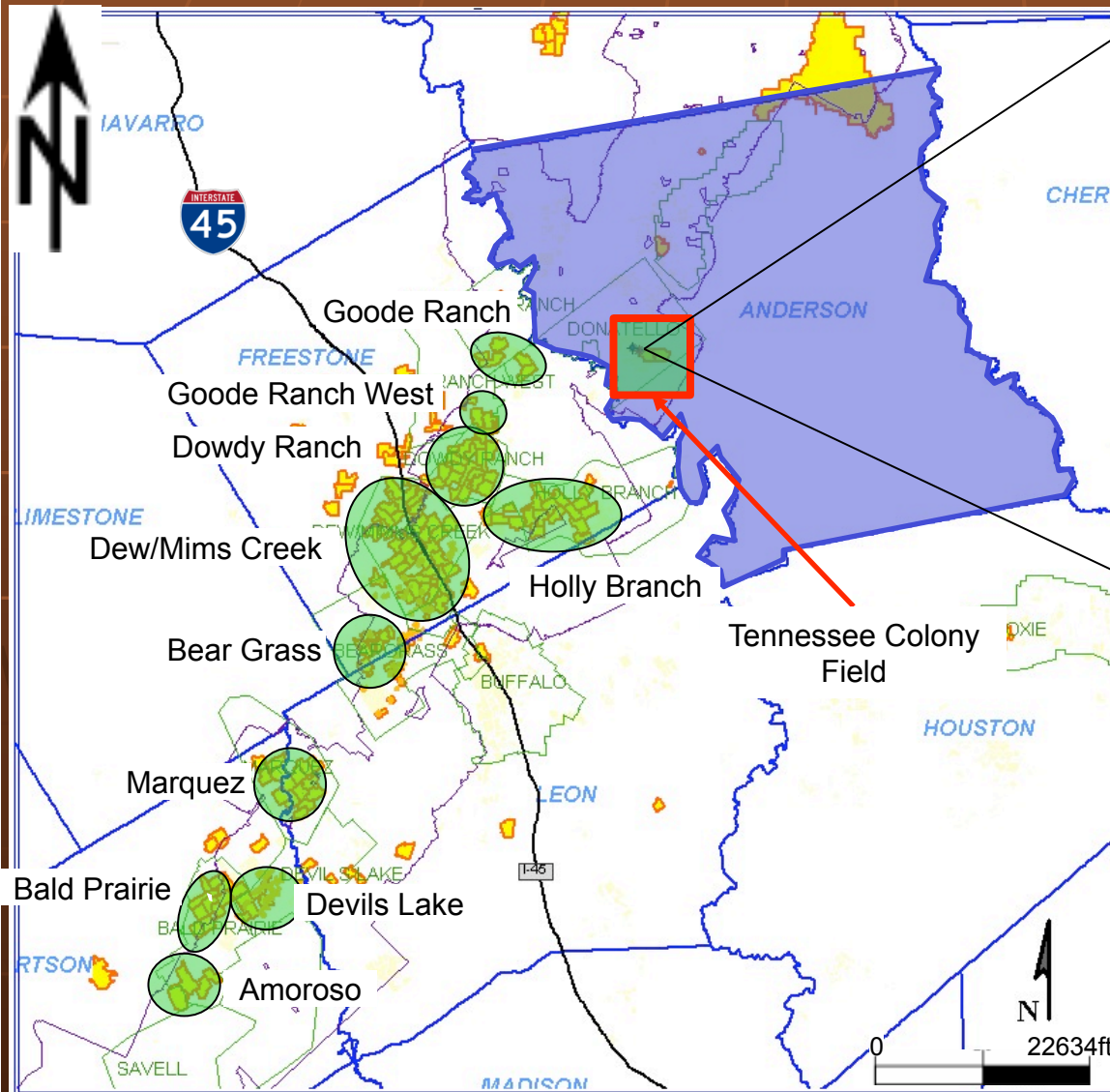
SCHOOL OF GEOSCIENCES

Overview

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1. Introduction

1.1 Location and Generalities



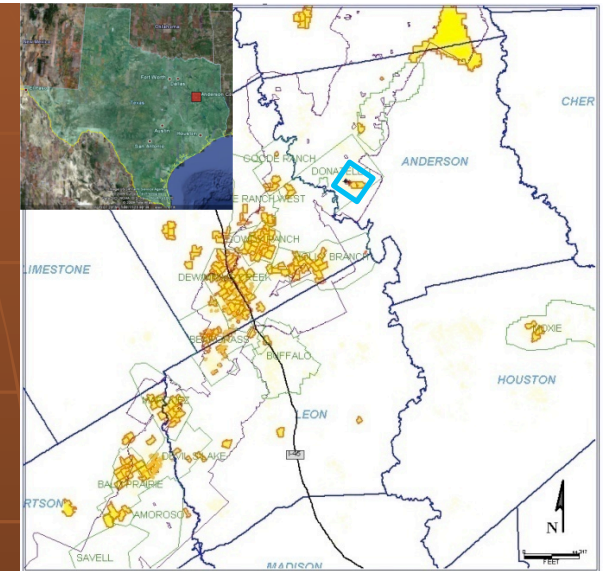
APC Bossier gas trend
Discovery Date: 1975
(Montgomery, 2001).

Porosity: 7%
Permeability: < 0.1 md

Depth: 13,000 – 18,000 ft

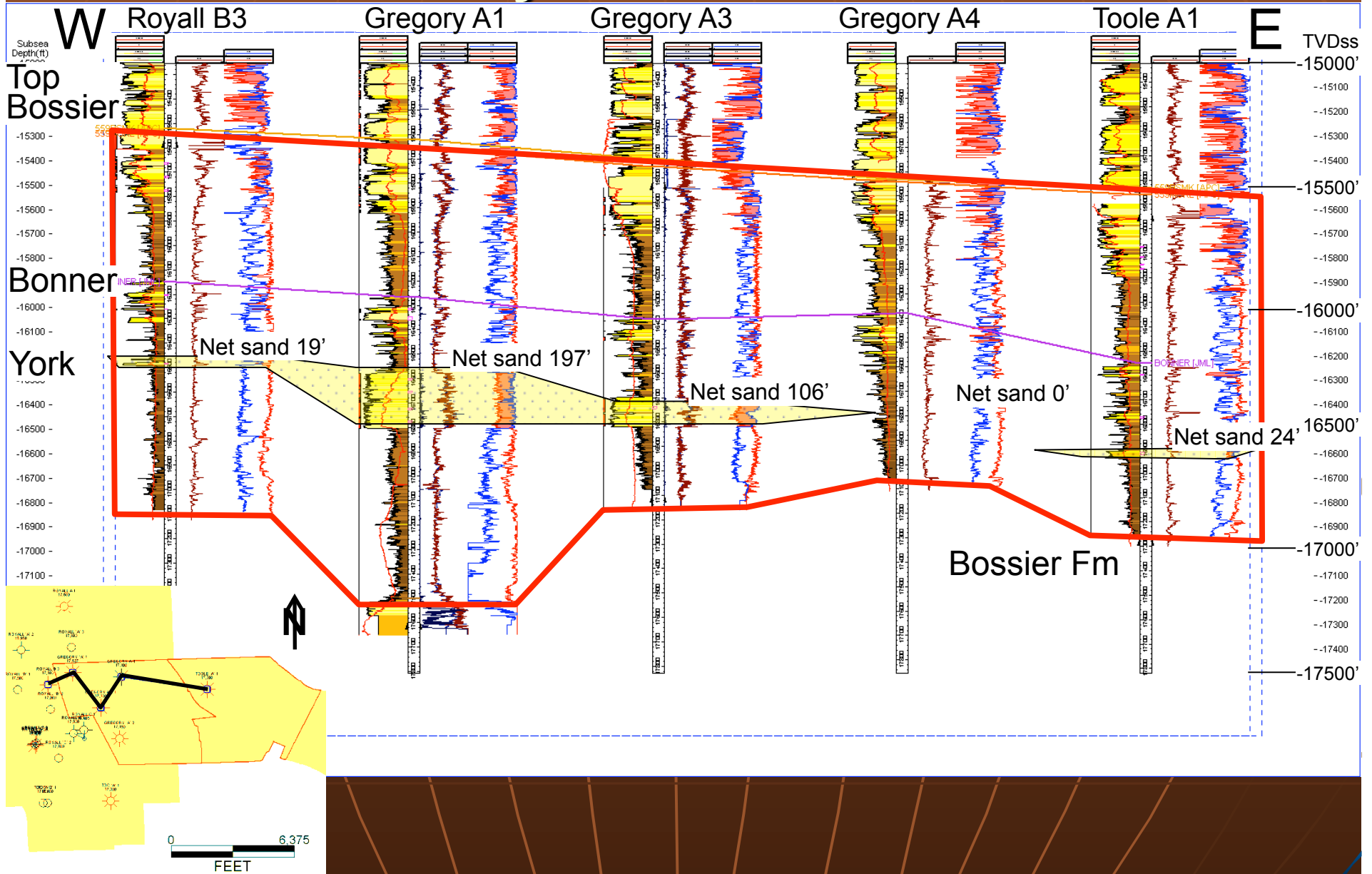
1.2 Summary of the Field

Well map distribution and net sand thickness of the York Ss Tennessee Colony field

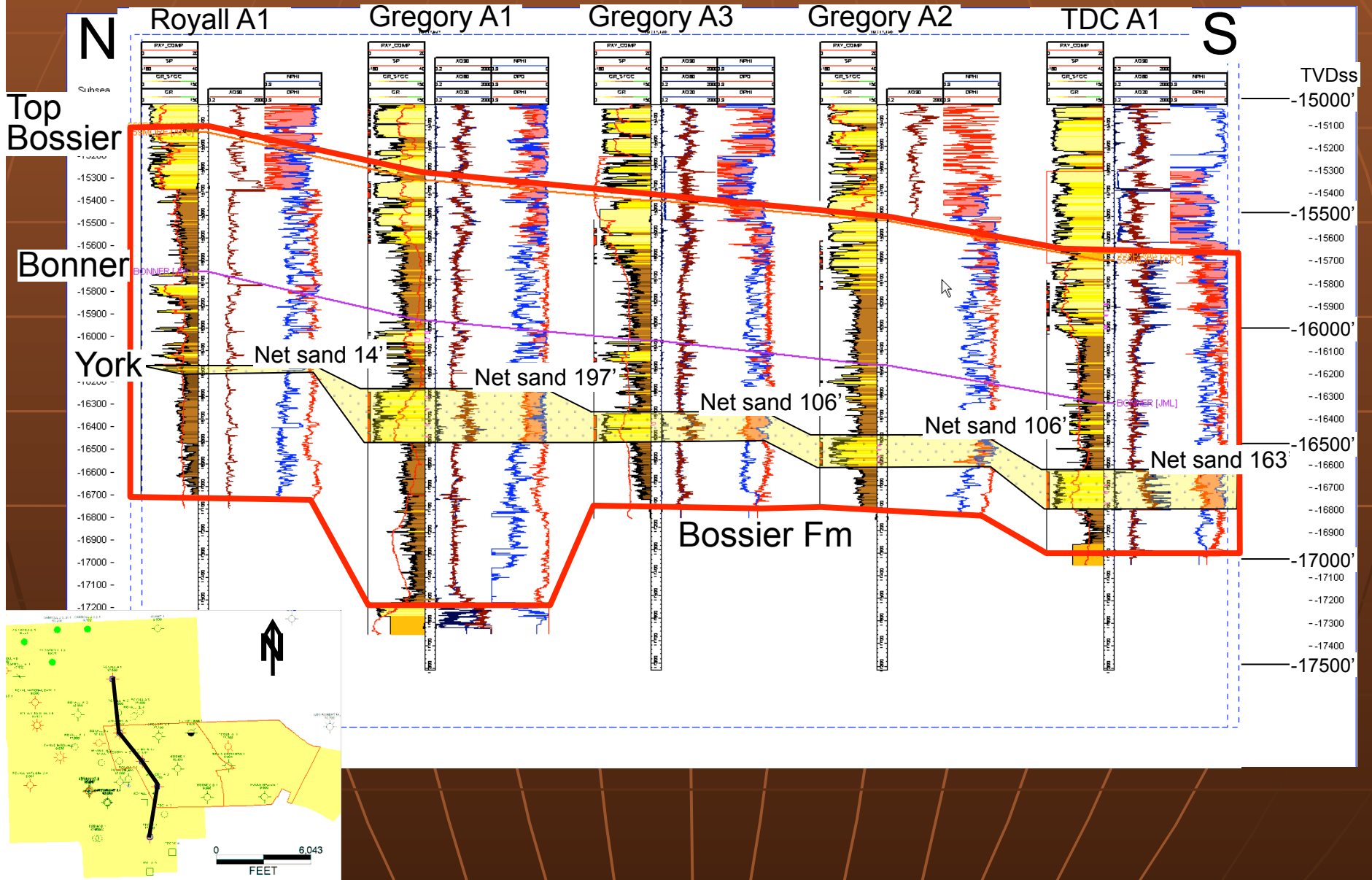


- From 11 wells drilled based on only the interpretation of conventional 2D and 3D seismic only 5 wells present thicknesses larger than 50' at the York level.
- Can other type of geophysical data help us to diminish the uncertainty when planning new development wells?

1.2.1 W-E Structural dip cross section Tennessee Colony field



1.2.2 N-S Structural strike cross section Tennessee Colony field



1.3 Problem

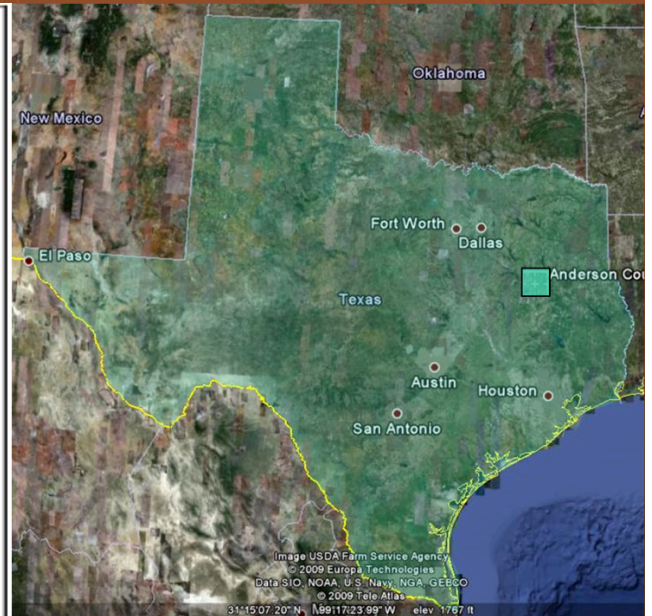
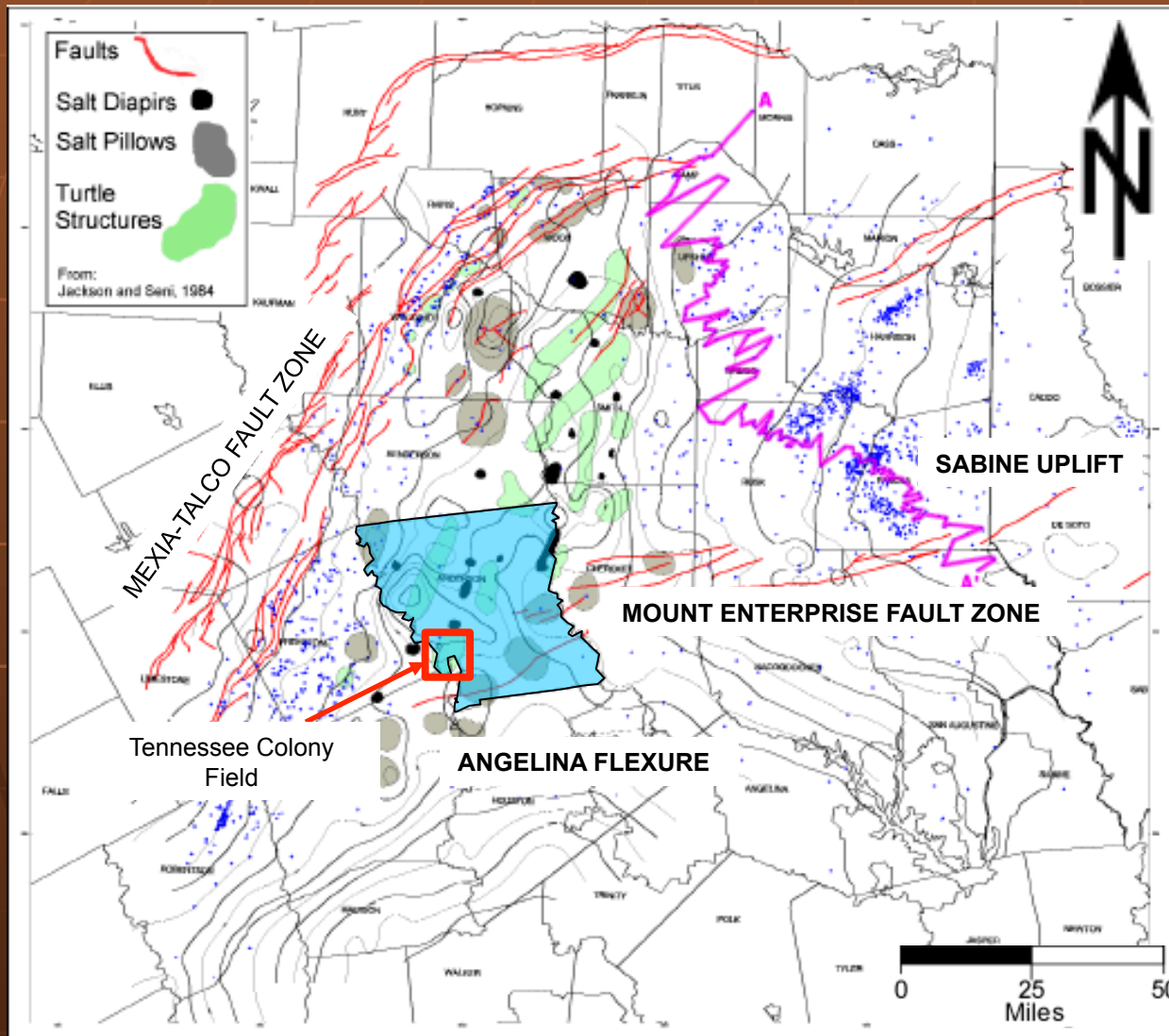
- The analysis of the conventional 3D seismic and attribute extraction (amplitude extraction and AVO), have proved to be not reliable in showing the actual distribution of the York sand in the field., because:
 1. Sand/shale contrast is subtle
 - **Small P impedance contrast**
 - **Class IIP/II AVO response**
 2. Conventional seismic data unsuitable for AVO attribute extraction
 - **Poor far offset SNR**
 - **Low frequency content**
 - **Noise (multiples)**
 - **Tuning effects**

1.4 Objective

- The objective of this research is to test the capabilities and the reliability of attribute extractions from the conventional 3D and 3C-3D seismic data as an alternative effective lithology indicators.

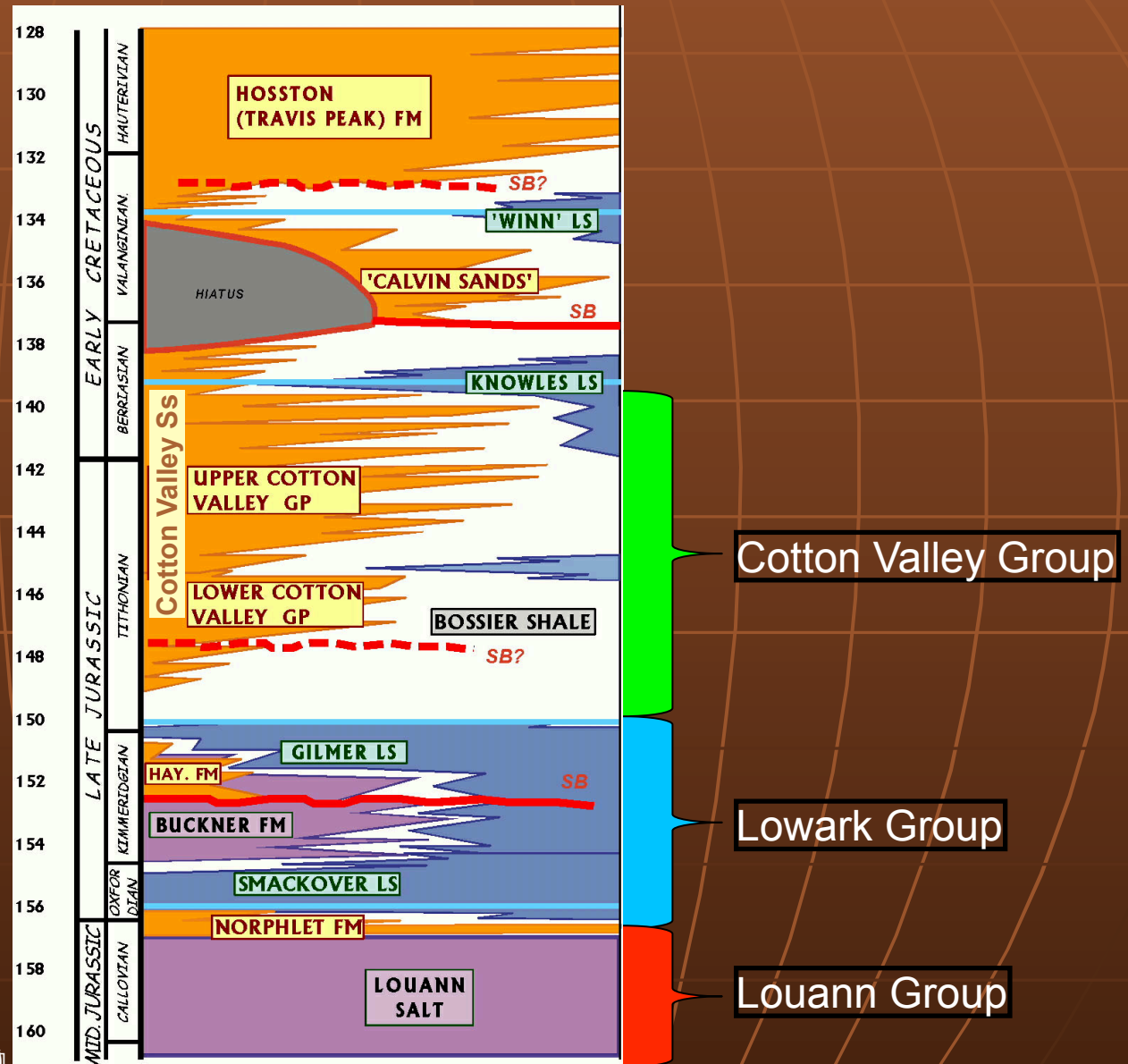
2. Geology of the area

2.1 Structural and tectonic elements of the East Texas Basin



(From Ewing, T. E., 2001)

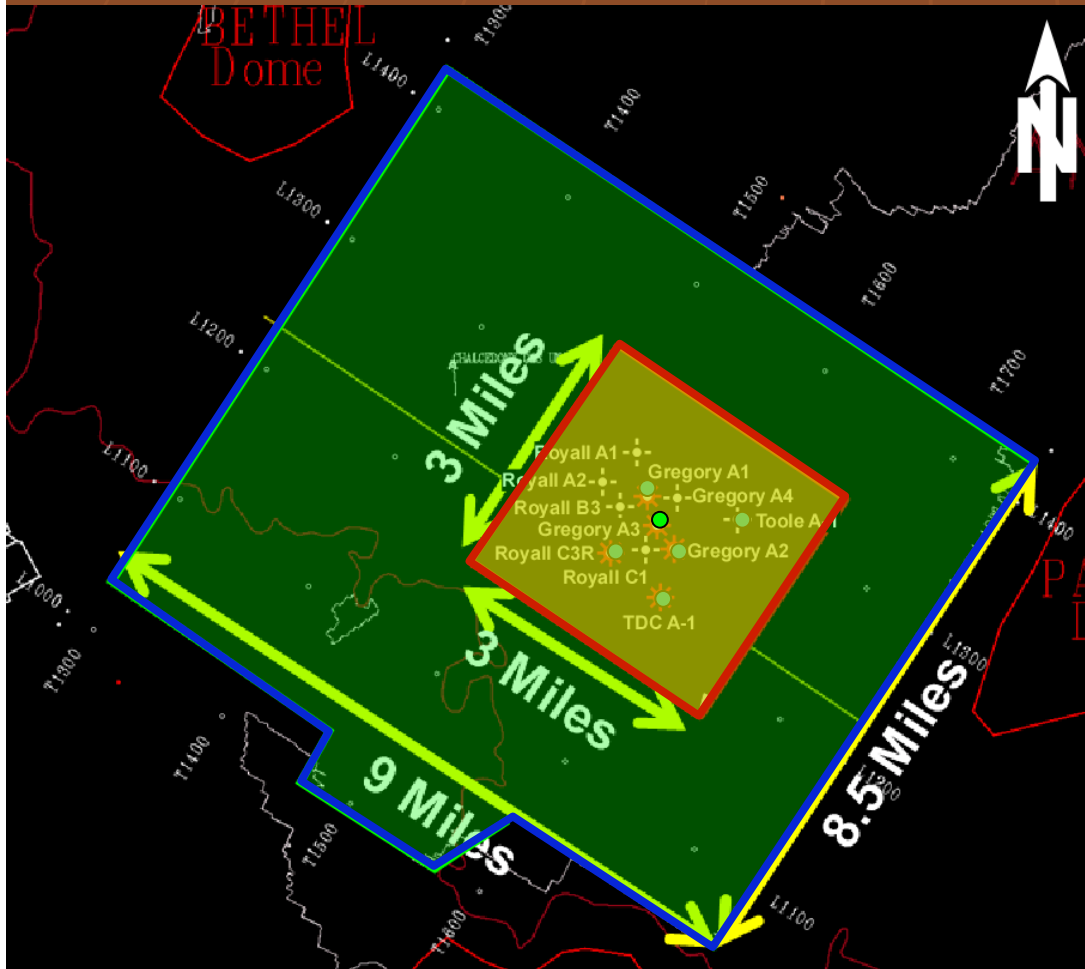
2.2 Mid Jurassic – Early Cretaceous stratigraphy of the East Texas Basin



(From Ewing, T. E., 2001)

3. Data set

3.1 Available data



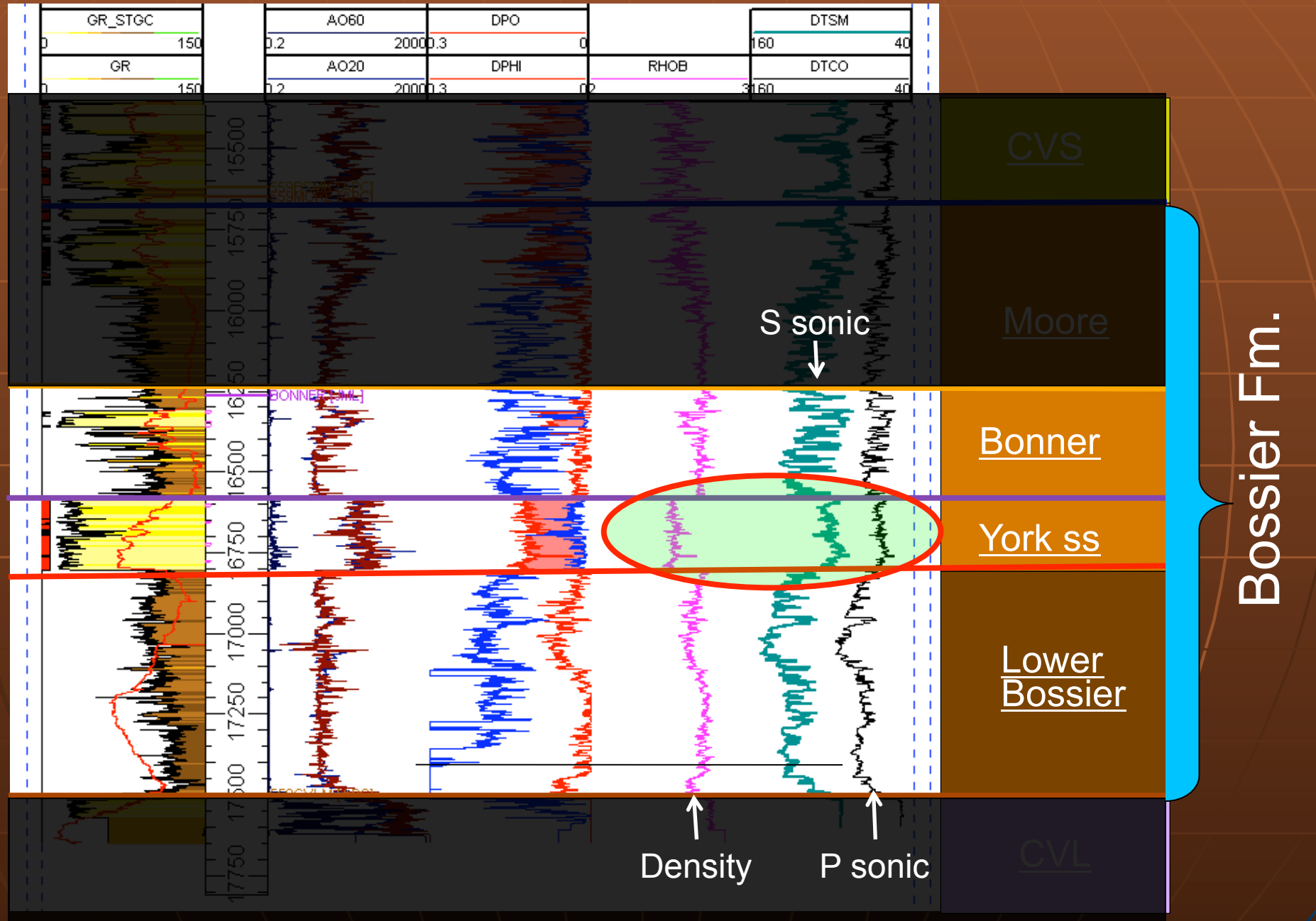
1. One 3D conventional seismic cube (76.5Miles²).
2. One 3C-3D seismic cube (9Miles²).
3. Dipole logs at the Bossier Formation for the wells: Gregory A1, Gregory A2, TDCA1, Royall C3R, Toole A1.
4. One multicomponent VSP validate the horizon picking well: Gregory A3 (deep section).

4. Petrophysics

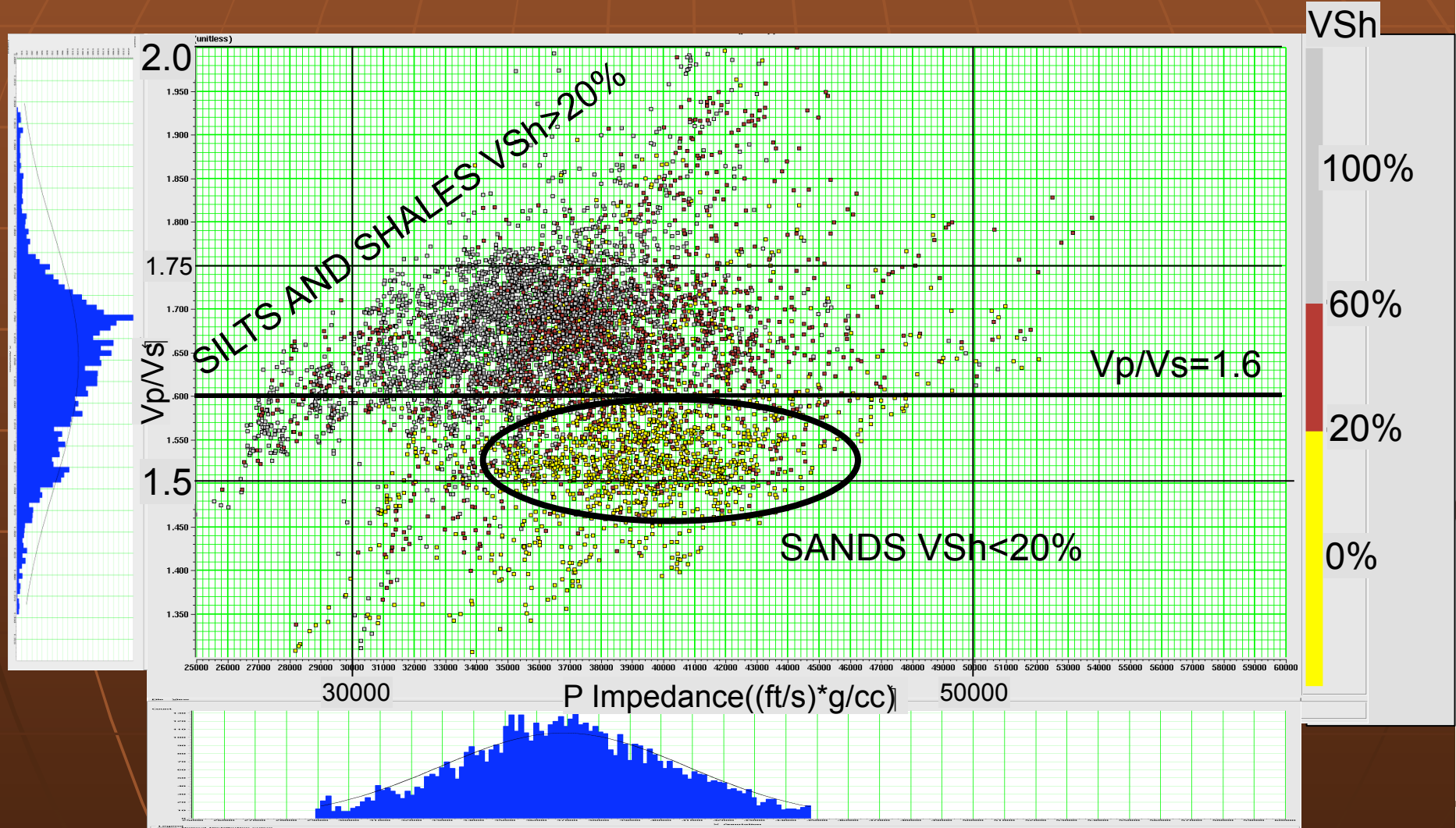
Question

- Is there any physical attribute (acoustic impedance, V_p/V_s , density), that can be extracted from the seismic and be considered as a good lithology indicator?

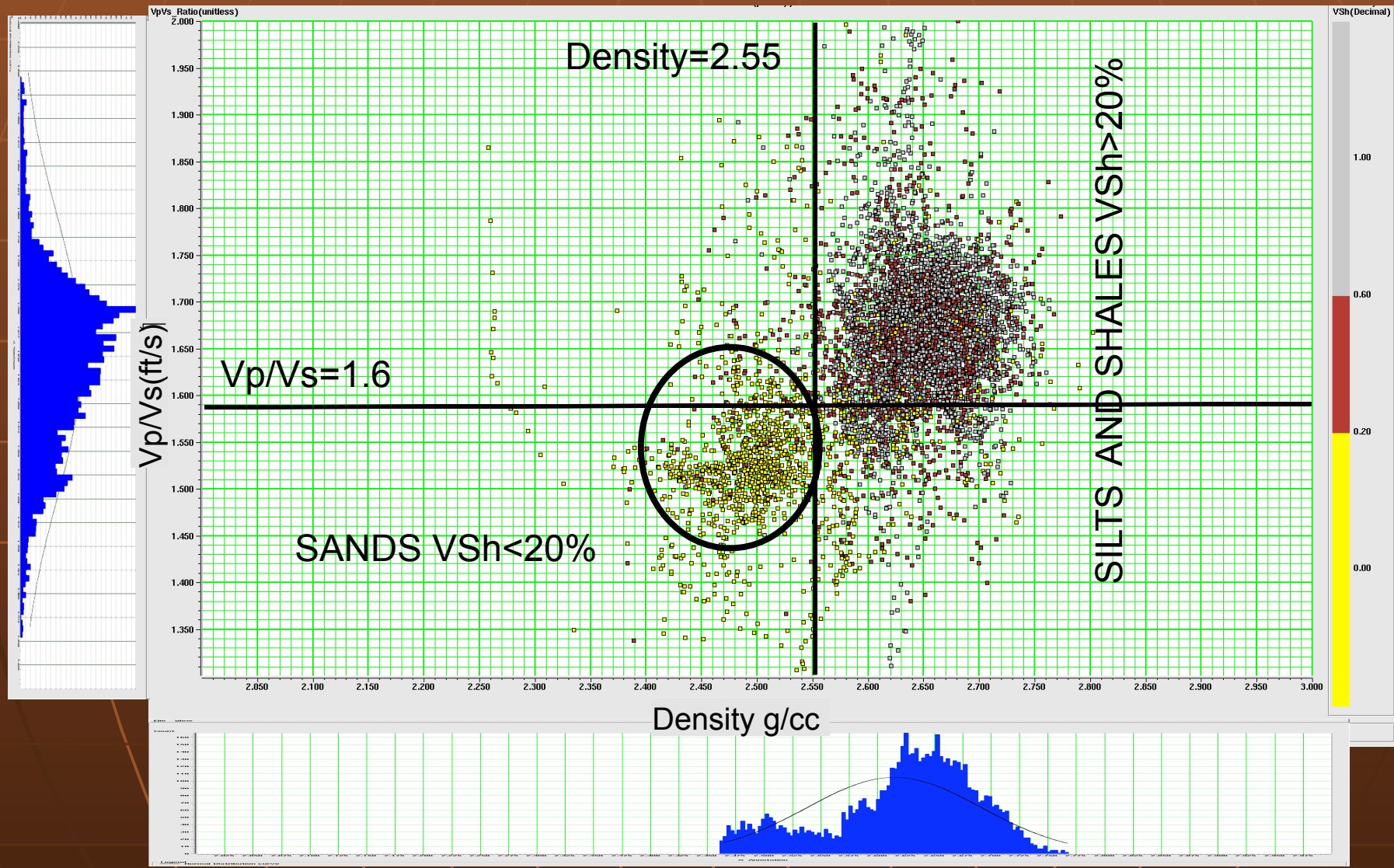
4.1 Type log Well Gregory A1



4.2 Vp/Vs vs. P impedance crossplot

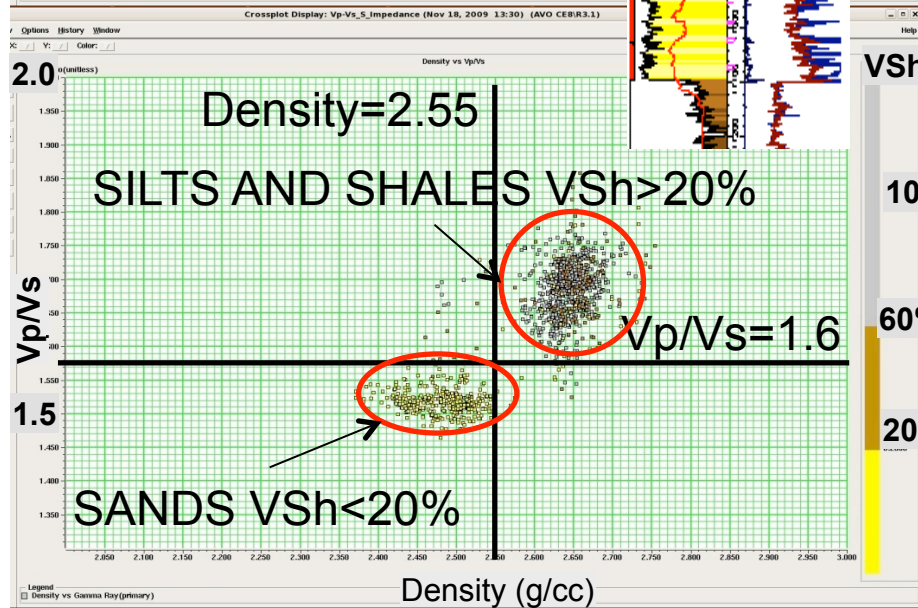
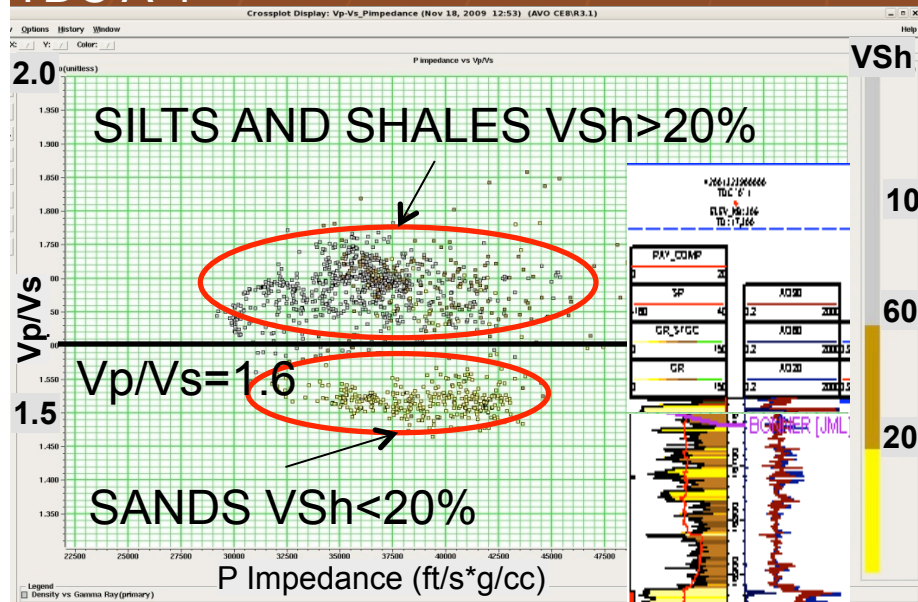


4.3 Vp/Vs vs. density crossplot

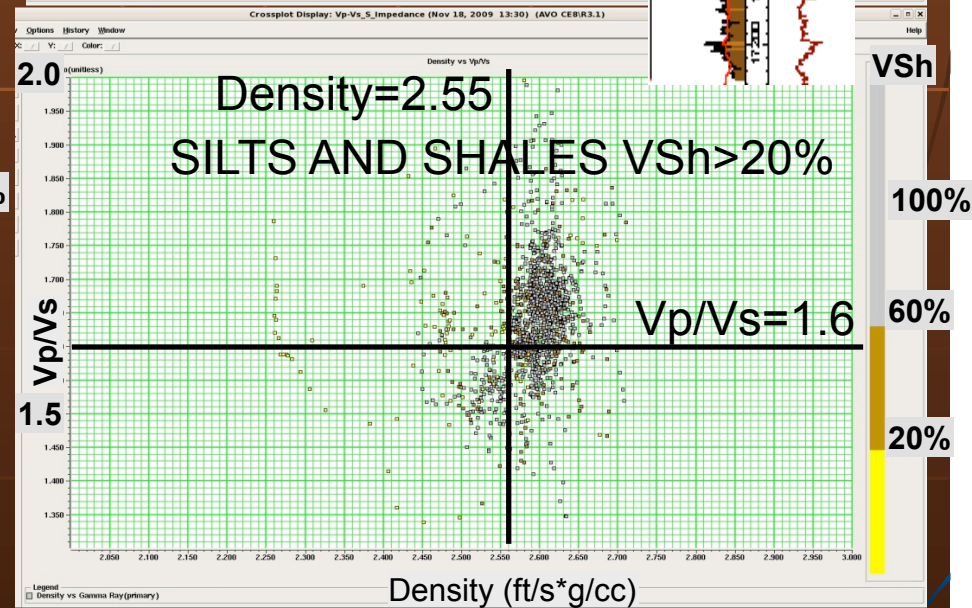
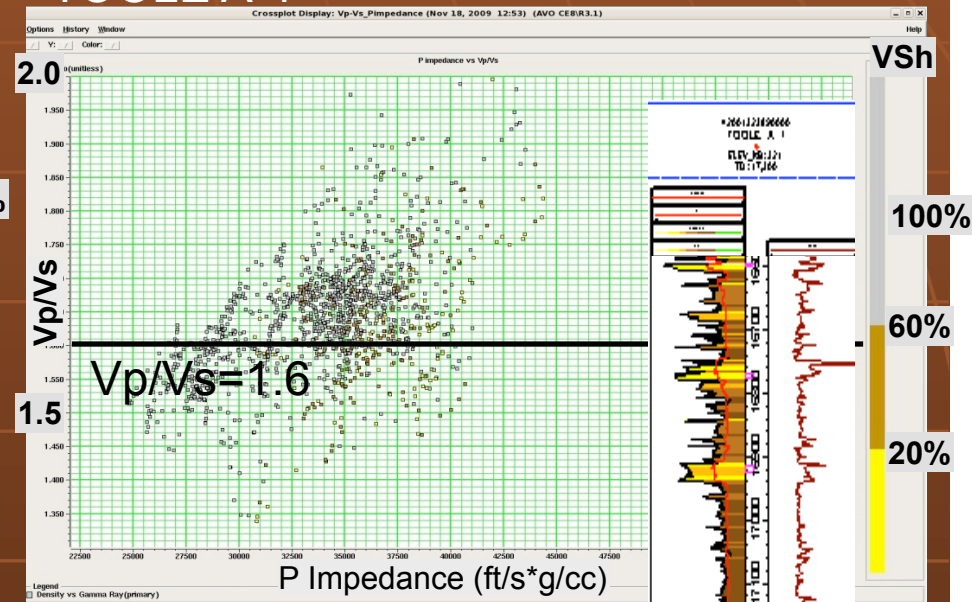


4.4 Comparison of crossplots between wells TDC A-1 and TOOLE A-1

TDC A-1



TOOLE A-1



Answer

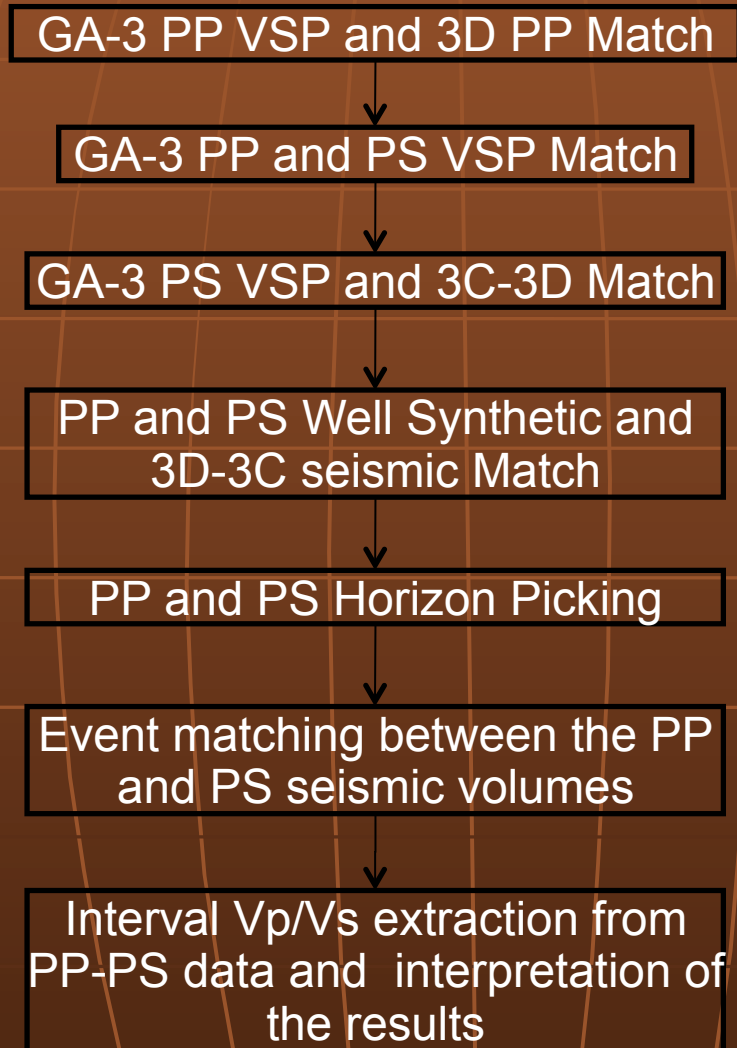
- From the well logs analysis is there any physical attribute (acoustic impedance, V_p/V_s , density), that can be extracted from the seismic and be considered as a good lithology indicator?
- A/. From the crossplots I conclude that density and V_p/V_s ratio could be used as effective lithology discriminators.
- Taking into account the low reliability of attribute extraction from the conventional 3D seismic and that density is a difficult attribute to extract from the seismic, I propose that a good alternative to identify lithology is a V_p/V_s extraction from a joint interpretation of the conventional 3D and the 3C-3D seismic data.

5. 3D and 3C-3D Registration and Interpretation

Question

- Is it possible that interval V_p/V_s ratio, attribute extracted from the registration and interpretation of conventional 3D and 3C-3D seismic data, could be a reliable lithology indicator that diminish the uncertainty when looking for the York sands in the Tennessee Colony area?

5.1 Work flow chart for interval Vp/Vs estimation

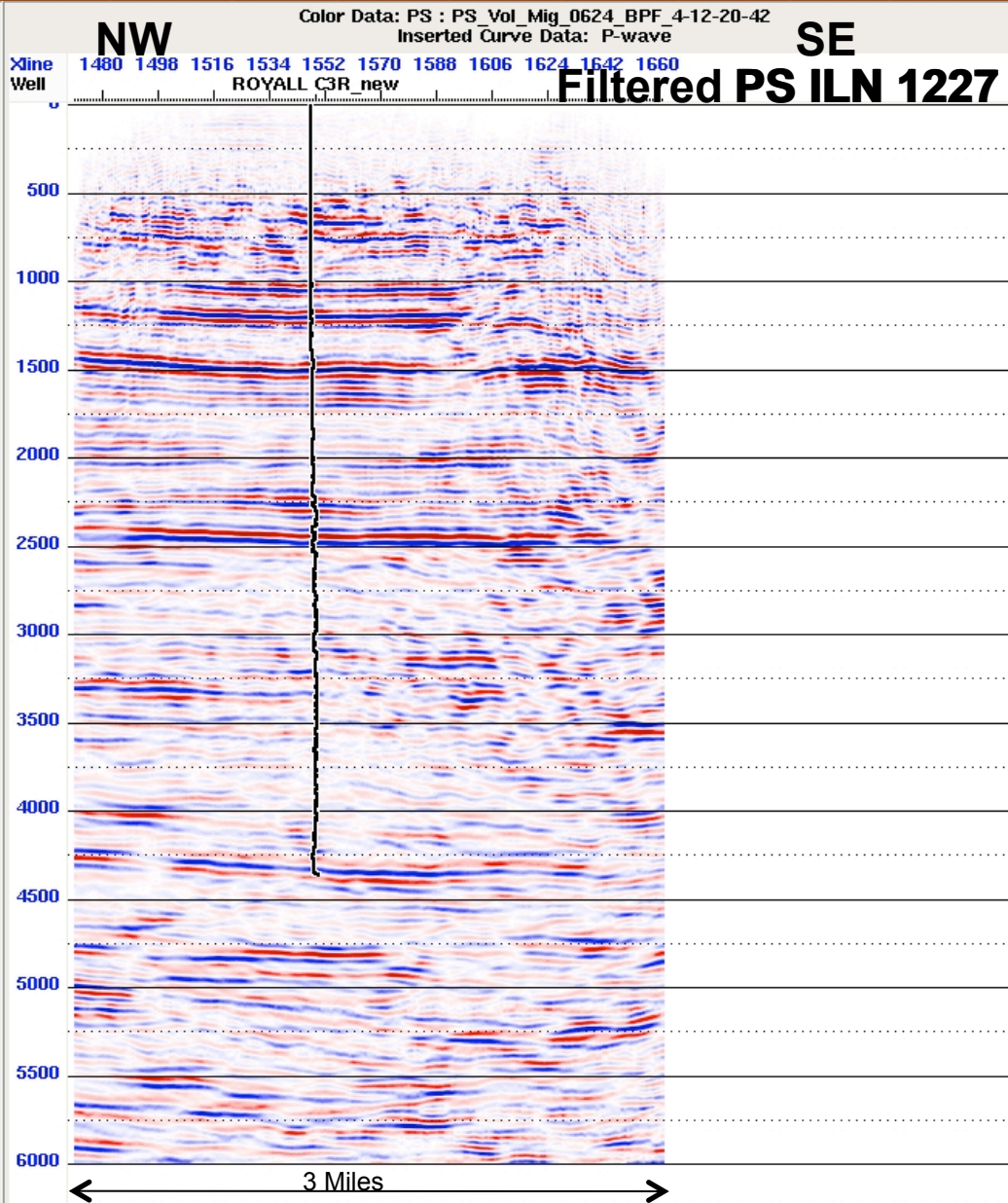


$$\frac{V_p}{V_s} = \frac{2\Delta T_{ps} - \Delta T_{pp}}{\Delta T_{pp}}$$

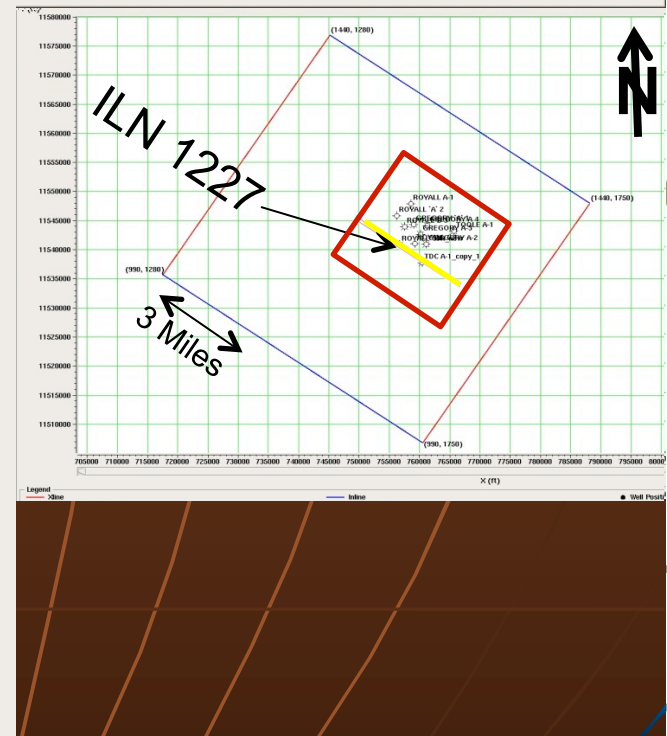
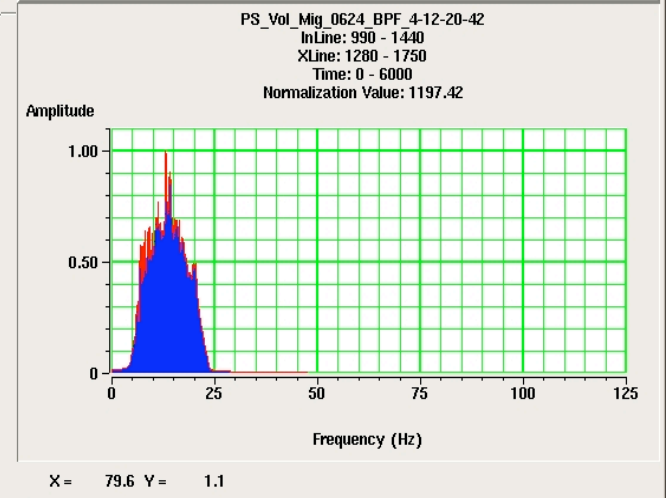
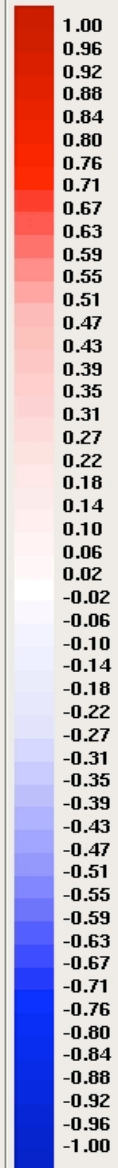
PS seismic data Donatello 3C-3D survey

ILN 1227

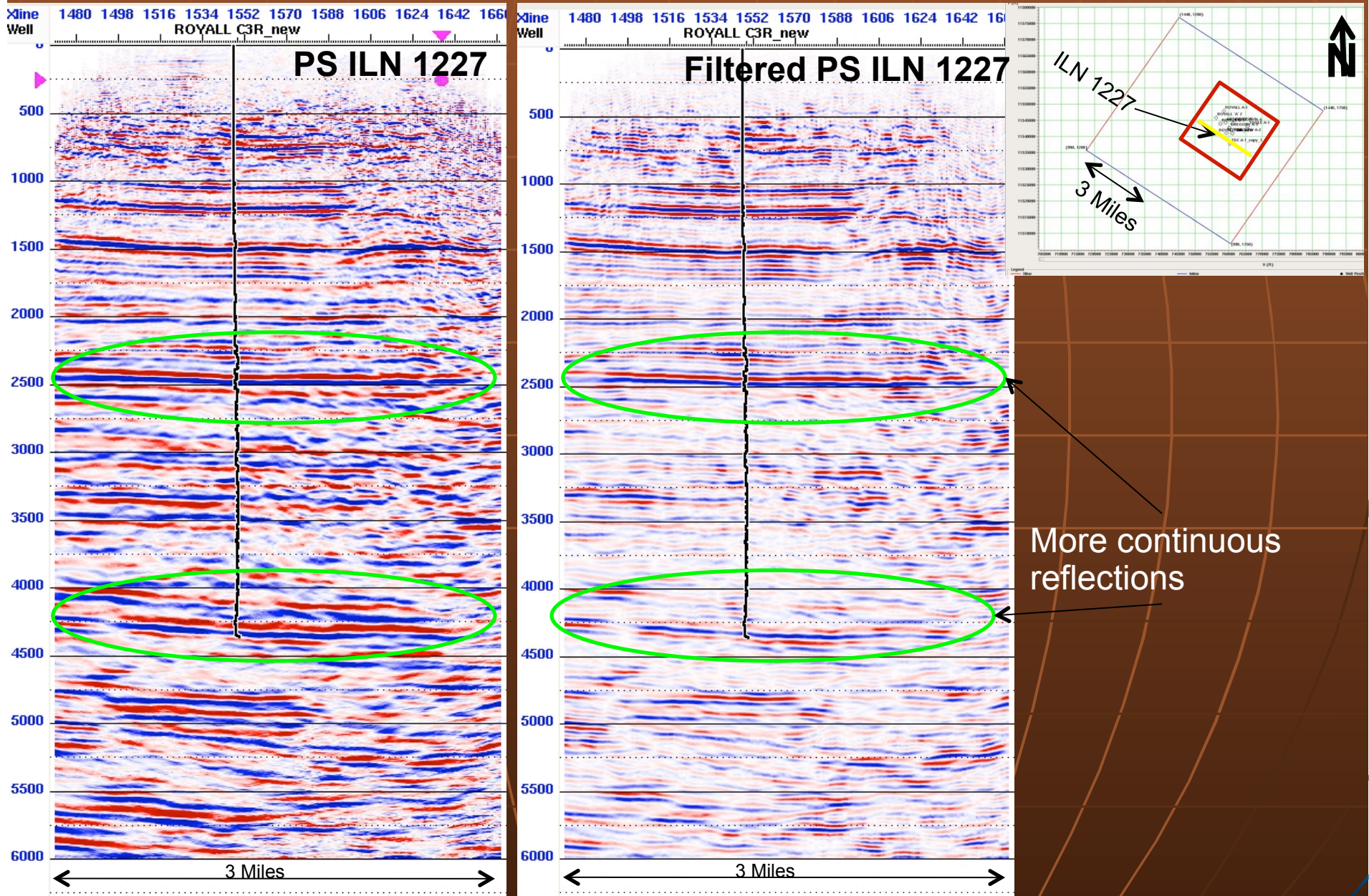
Band pass Filter 4-12-20-24Hz



Color Key

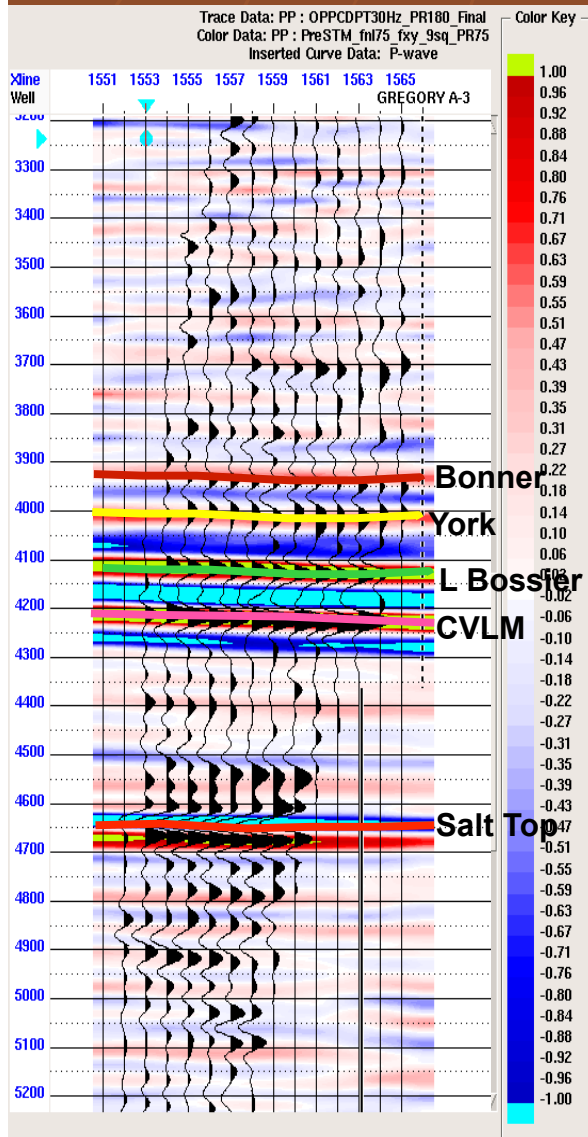


Comparison between original and filtered PS sections

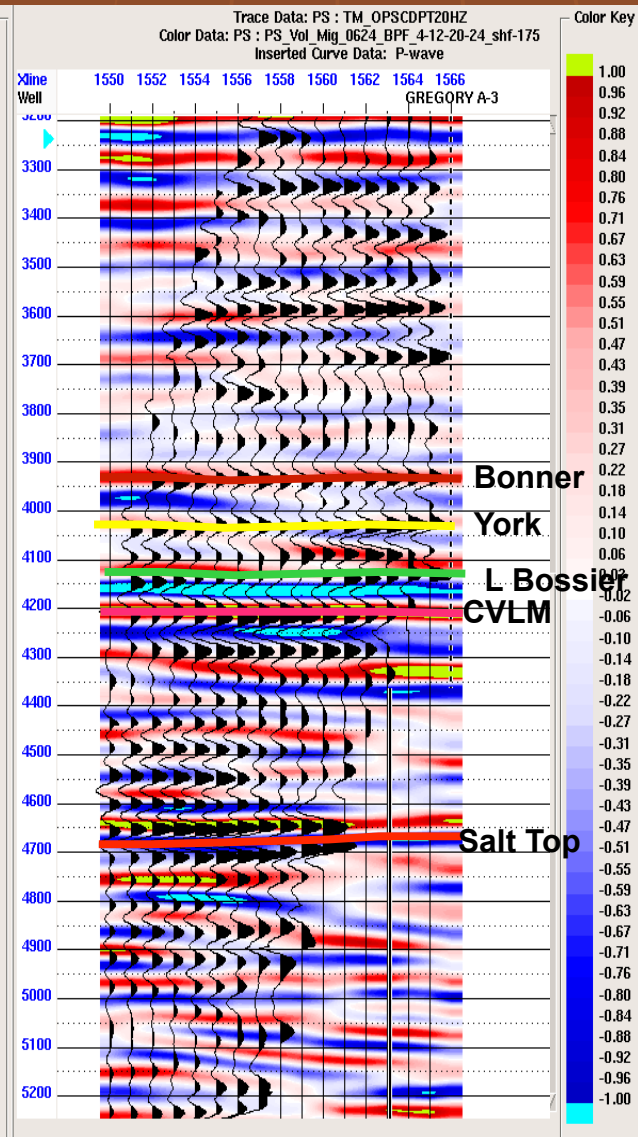


VSP-3C-3D Match

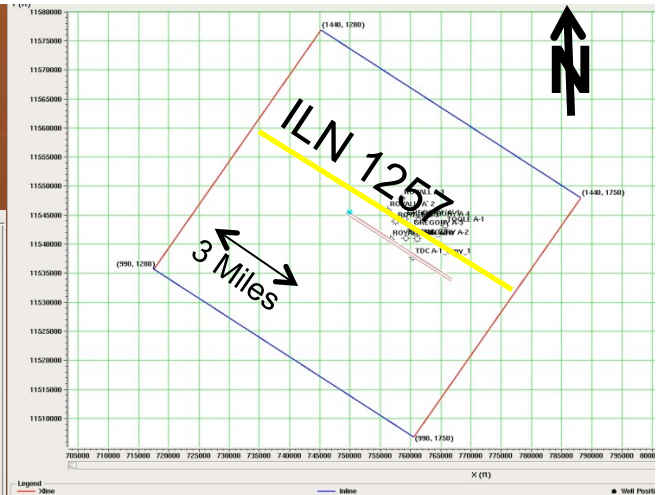
ILN 1257



PP VSP and 3D Volume
 IONS (unsaved) Domain Conversion: V_t



PS VSP and 3C-3D Volume



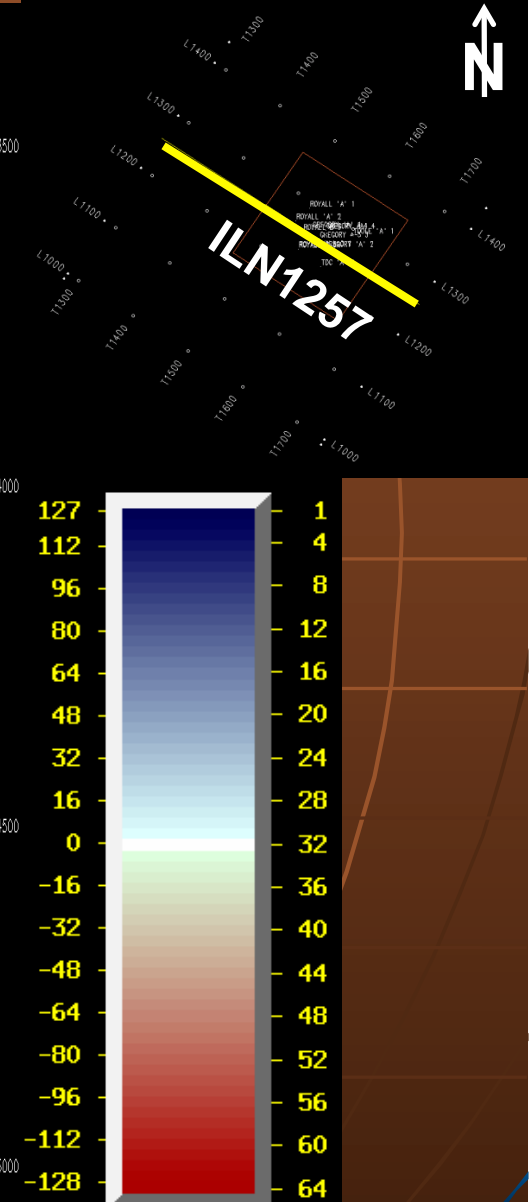
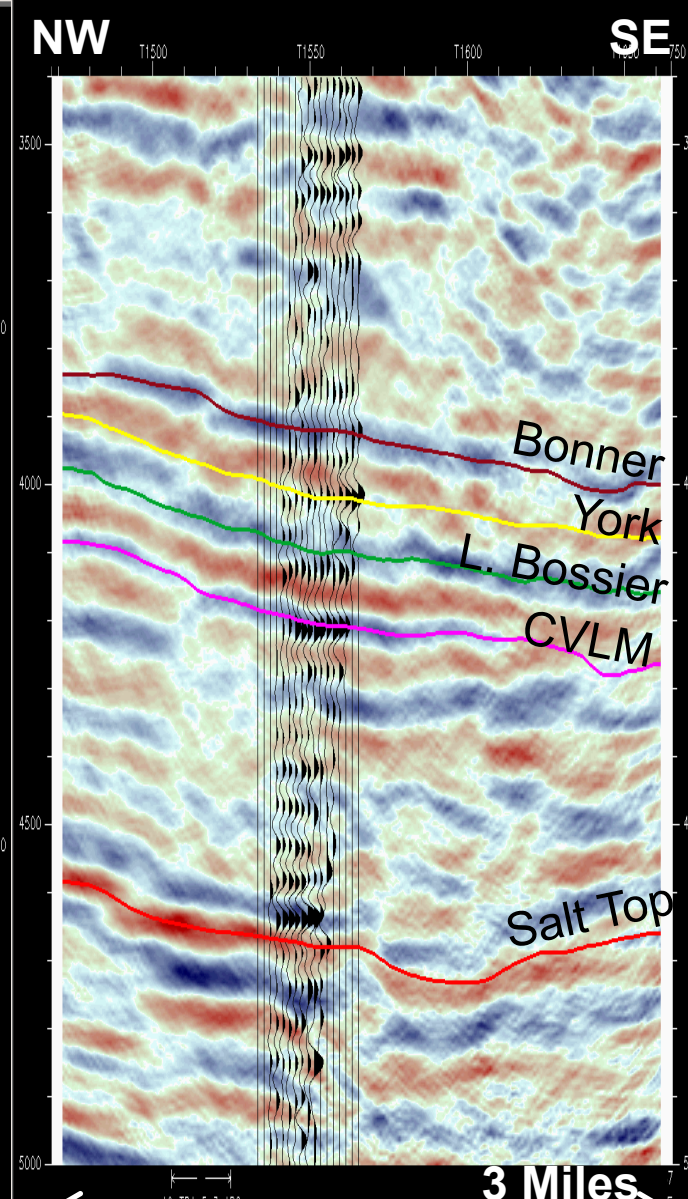
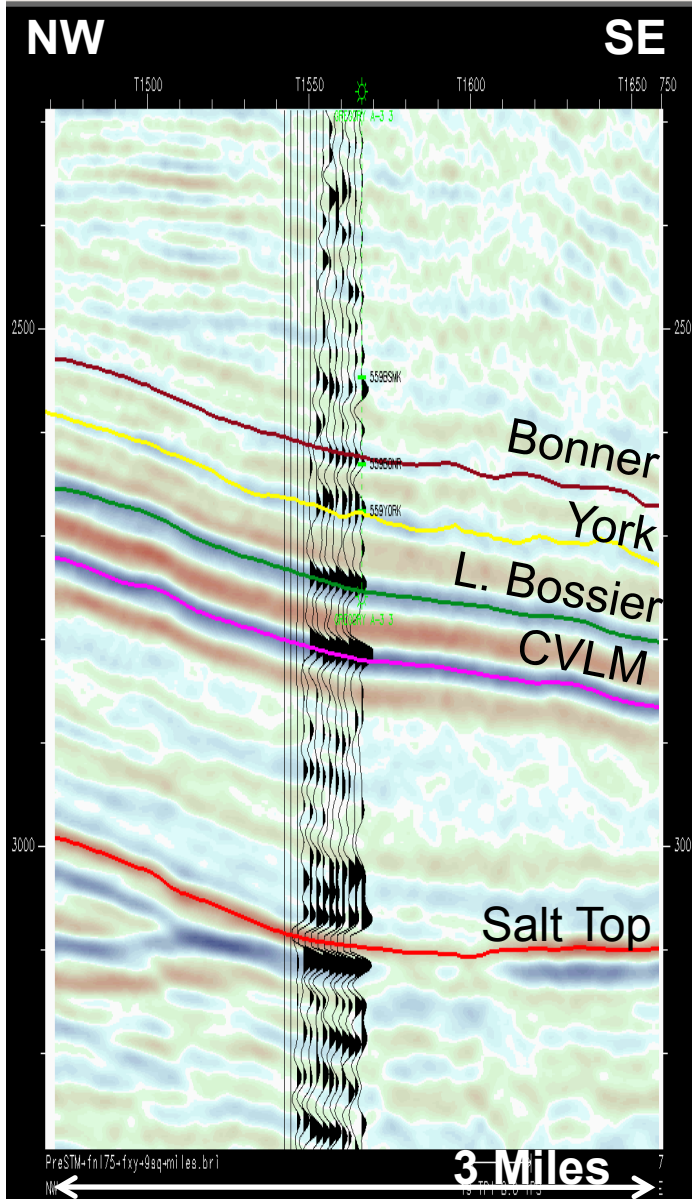
Corrections made to match the information:

1. Time shift of 632ms to match the PP and PS VSP's
2. Time of Shift of -172ms to the 3C-3D volume to match.
3. No phase shift was made

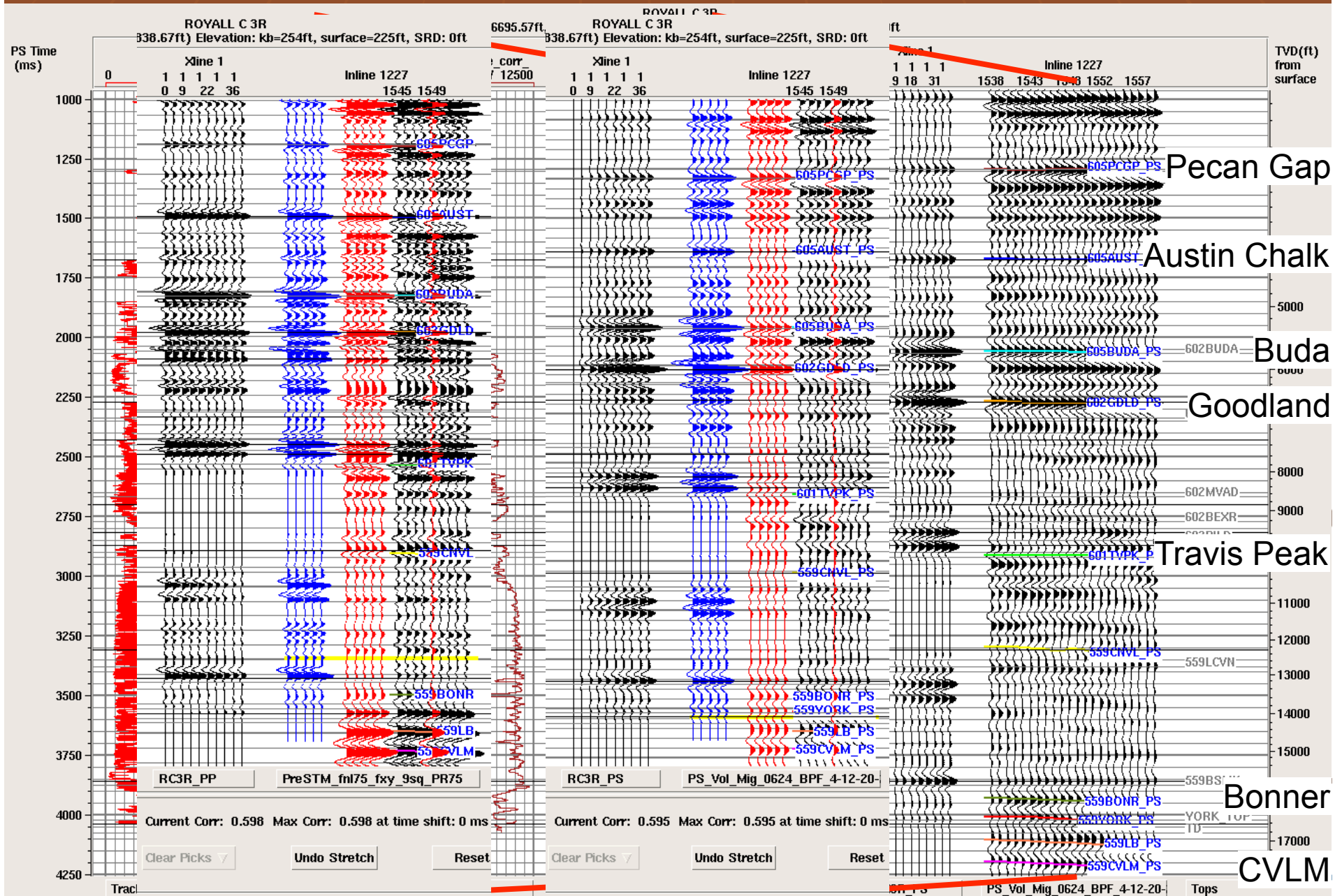
VSP-3C-3D Match

PP ILN1257

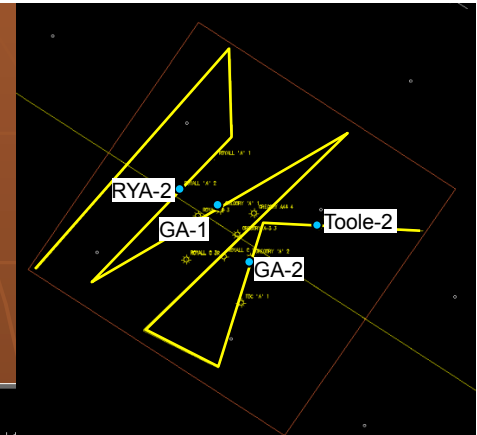
PS ILN1257



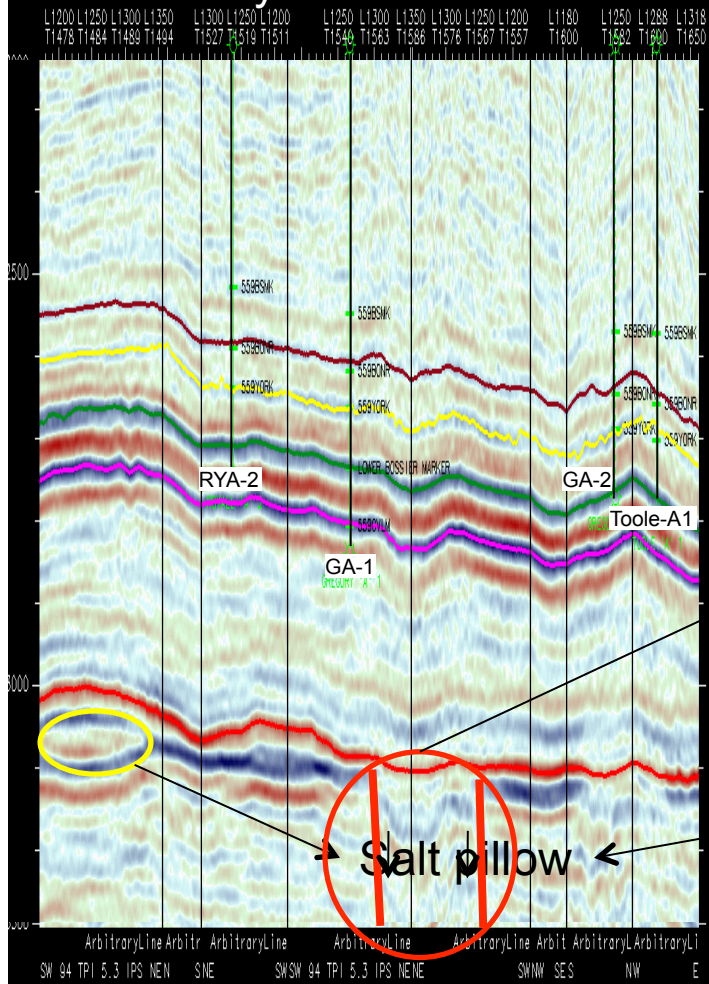
Royall C-3R PP and PS synthetic match



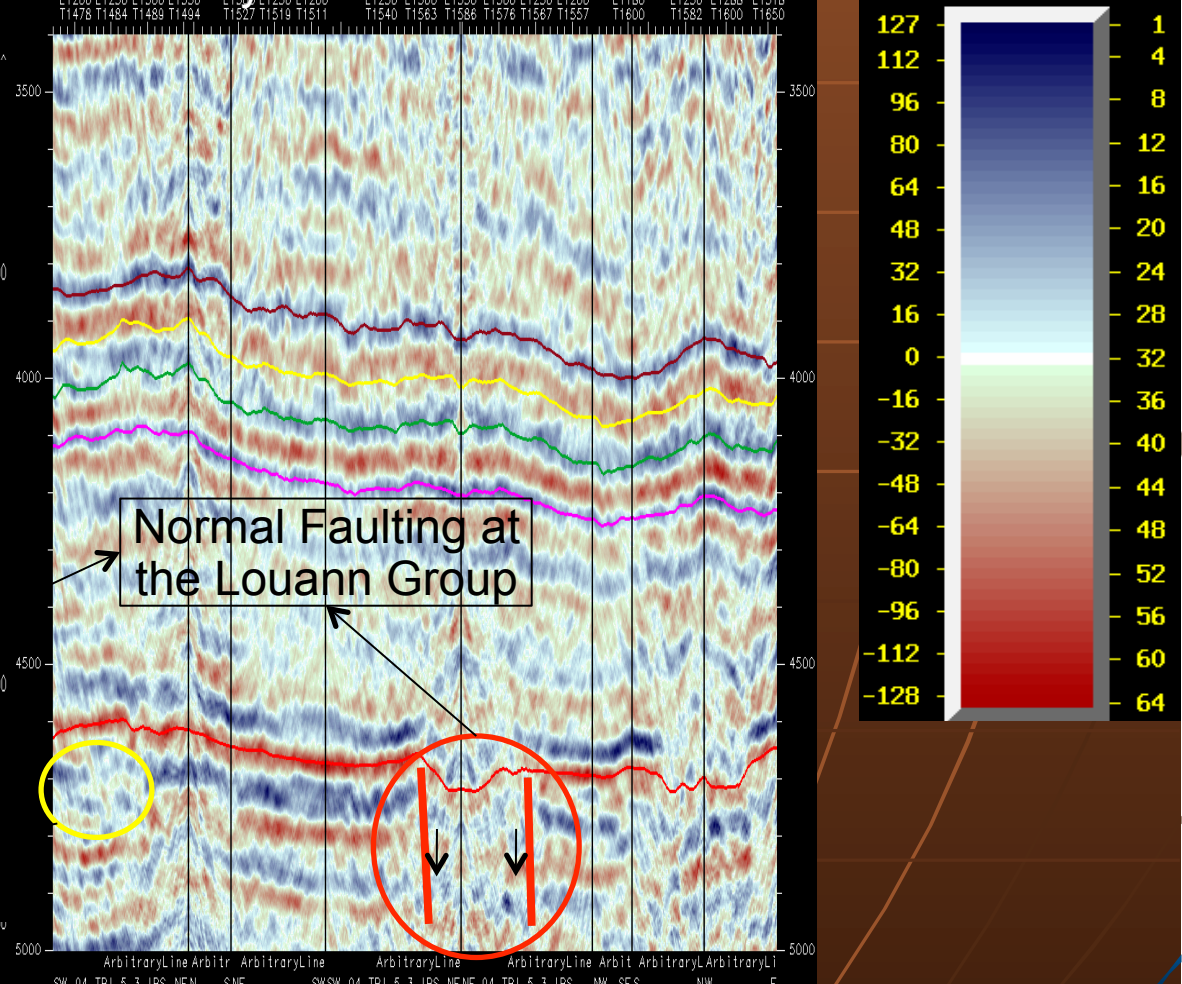
Arbitrary Line Comparison



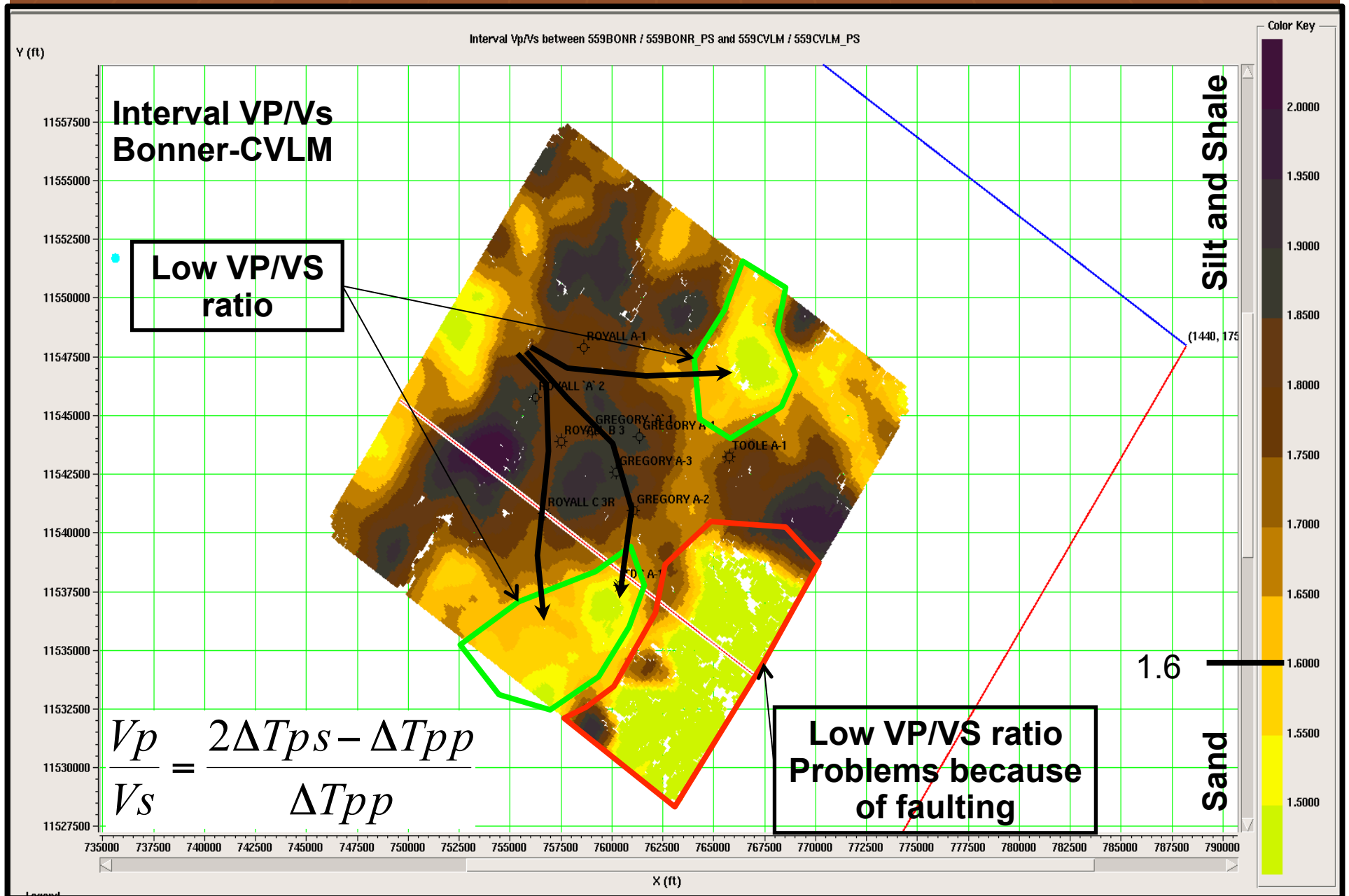
PP arbitrary line



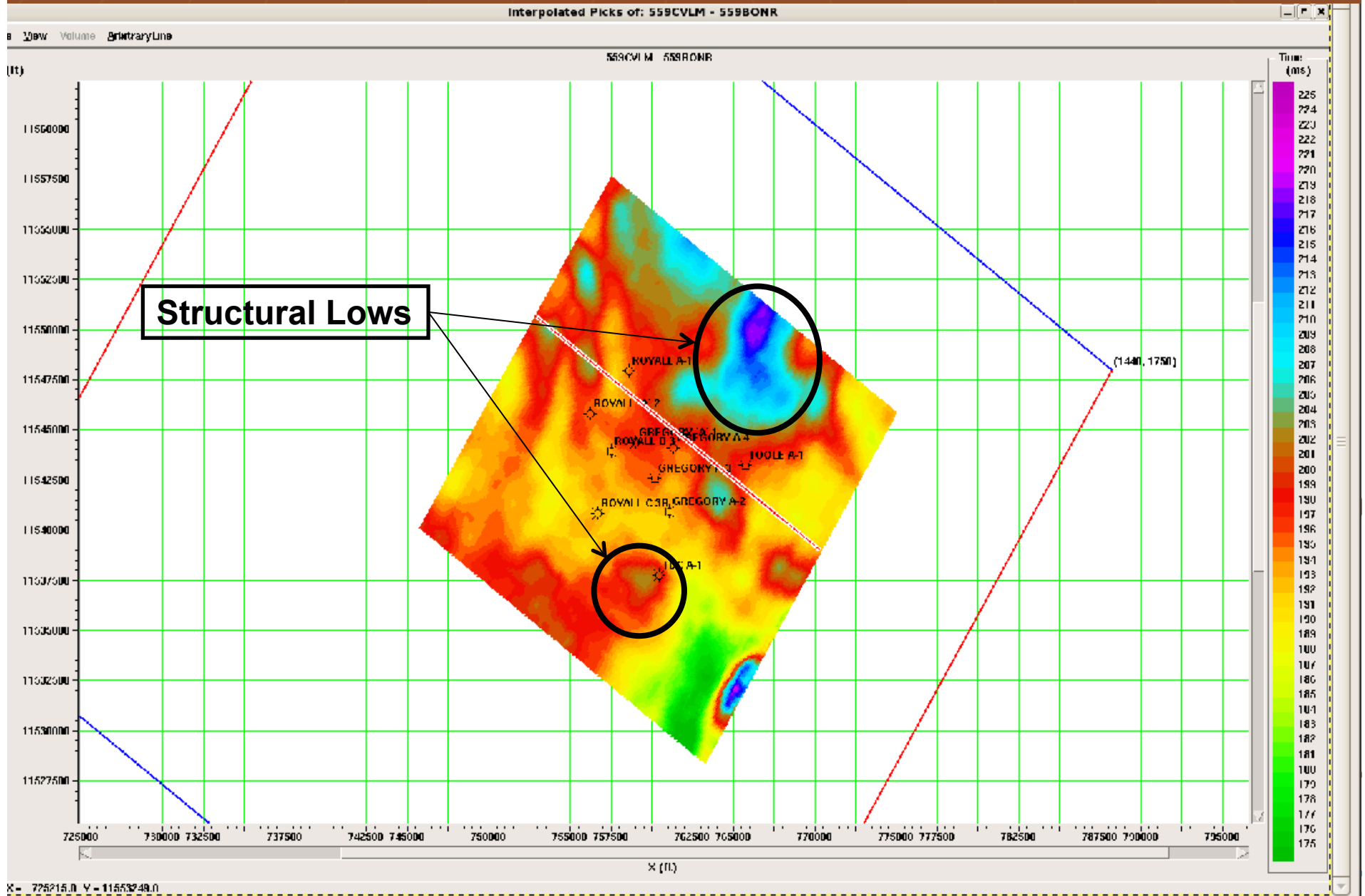
PS arbitrary line



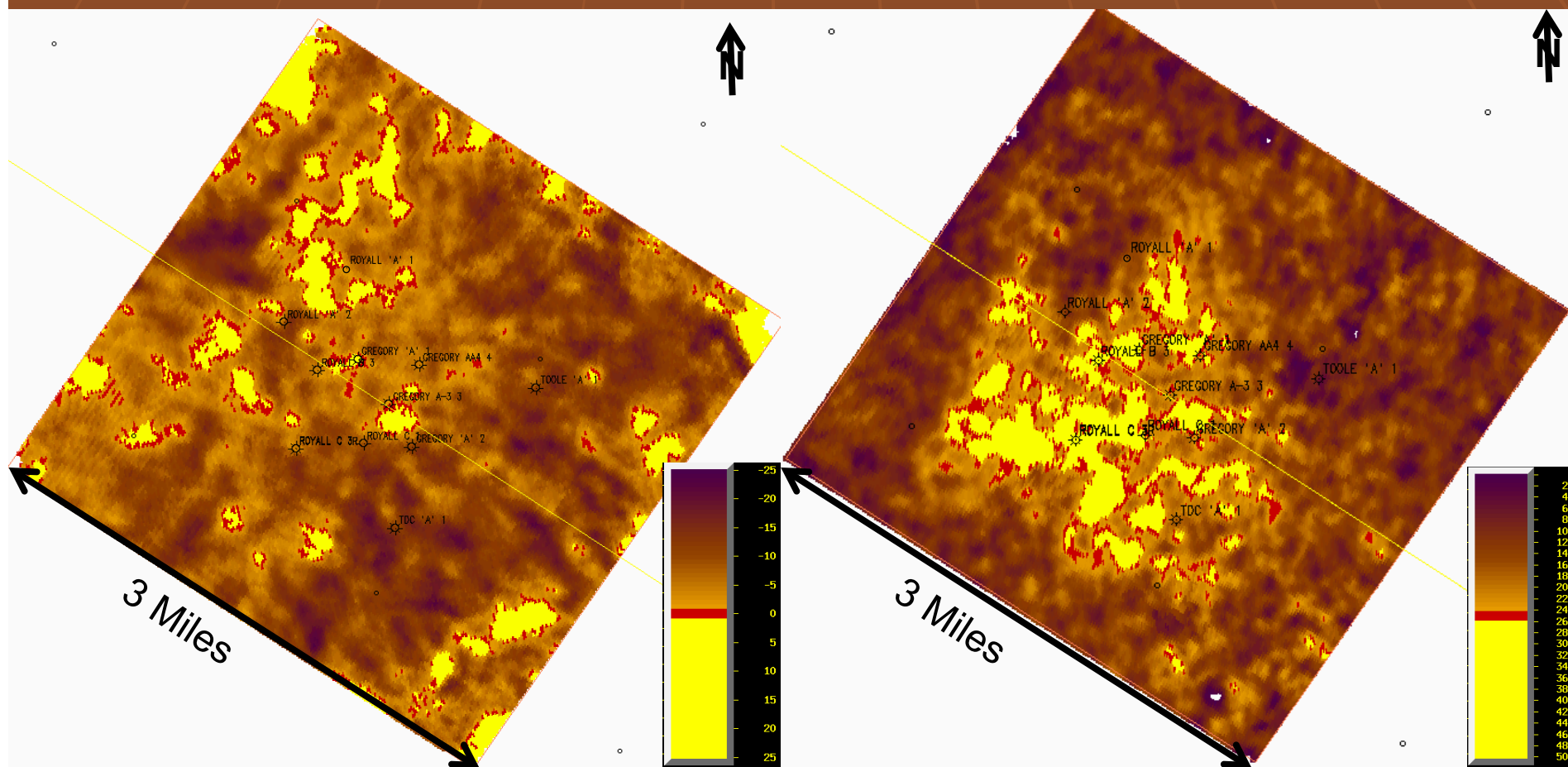
VP/VS Interval maps



Isochron map Bonner – Cotton Valley Limestone



Amplitude Extraction at the York Horizon in the 3C-3D Volume



Answer

- Is it possible that interval V_p/V_s ratio, attribute extracted from the registration and interpretation of conventional 3D and 3C-3D seismic data, could be a reliable lithology indicator and diminish the uncertainty when looking for the York sands in the Tennessee Colony area?
- Yes?,
- The interval V_p/V_s ratio extraction is showing that:
 1. Low V_p/V_s ratios coincide with zones where the calculated isochrons from the conventional 3D seismic data are high and are interpreted as paleolows. These paleolows could have acted as catchment places for turbiditic currents.

2. Despite of the fact that in productive wells like GA-1, GA-2 and Royall C-3R the interval V_p/V_s ratios are higher than the cut off value of 1.6, the map is showing possible pathways that sediment bearing currents could have taken when this kind flows develop.

Future Work

1. Refine the horizon interpretation to get more reliable interval Vp/Vs maps.
2. Inversion.
3. Conclusions.

Thanks!

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