Structural and Stratigraphic Evolution of the North Marine Area, Gulf of Paria, Trinidad, Since the Pliocene*

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Abstract

The North Marine area is located in the east central part of the Gulf of Paria. Today the major structural elements are, from north to south, the Warm Springs Fault, the North marine syncline, the North Marine Master Fault, the Brighton / NM-5 High, the Jubilee Syncline and the Los Bajos Fault. These features are the result of the approach, arrival and continued interaction of the Caribbean plate with the South American plate. A tectonic event in the mid-Miocene created significant topography and lows and have influenced subsequent fault evolution and sediment deposition. The Warm Springs Fault represents the plate boundary between the Caribbean and South American plates and is believed to have about 60 km of right lateral motion. The Los Bajos fault has traditionally been interpreted as a right lateral strike slip fault with 10.4 km displacement. The motion of these two faults has created an area of stretching between them that results in the propagation from west to east of NW - SE trending normal faults with displacement down to the east. These faults merge at their southern ends to form a single fault, the North Marine Master Fault. Deposition of the Pliocene Manzanilla and Springvale Formations and the Pleistocene aged Talparo Formation was influenced by the availability of accommodation space formed by the mid-Miocene tectonics and subsequent extensional faulting. As the lows were filled, the Manzanilla and Springvale sediments onlapped these highs. The Springvale Formation and Durham Member of the Talparo Formation are uniform in thickness through most of the area. The subsidiary faults associated with the North Marine Master generally show no change in sediment thickness on either the up thrown or down thrown sides, indicating that the faulting post dates sedimentation. However, two faults show increased thickness on the down thrown side in Springvale and Durham interval. The interaction of these mid-Miocene structures, Pliocene faults and sediments has influenced the accumulation and distribution of hydrocarbons.

Petroleum Company of Trinidad and Tobago Limited

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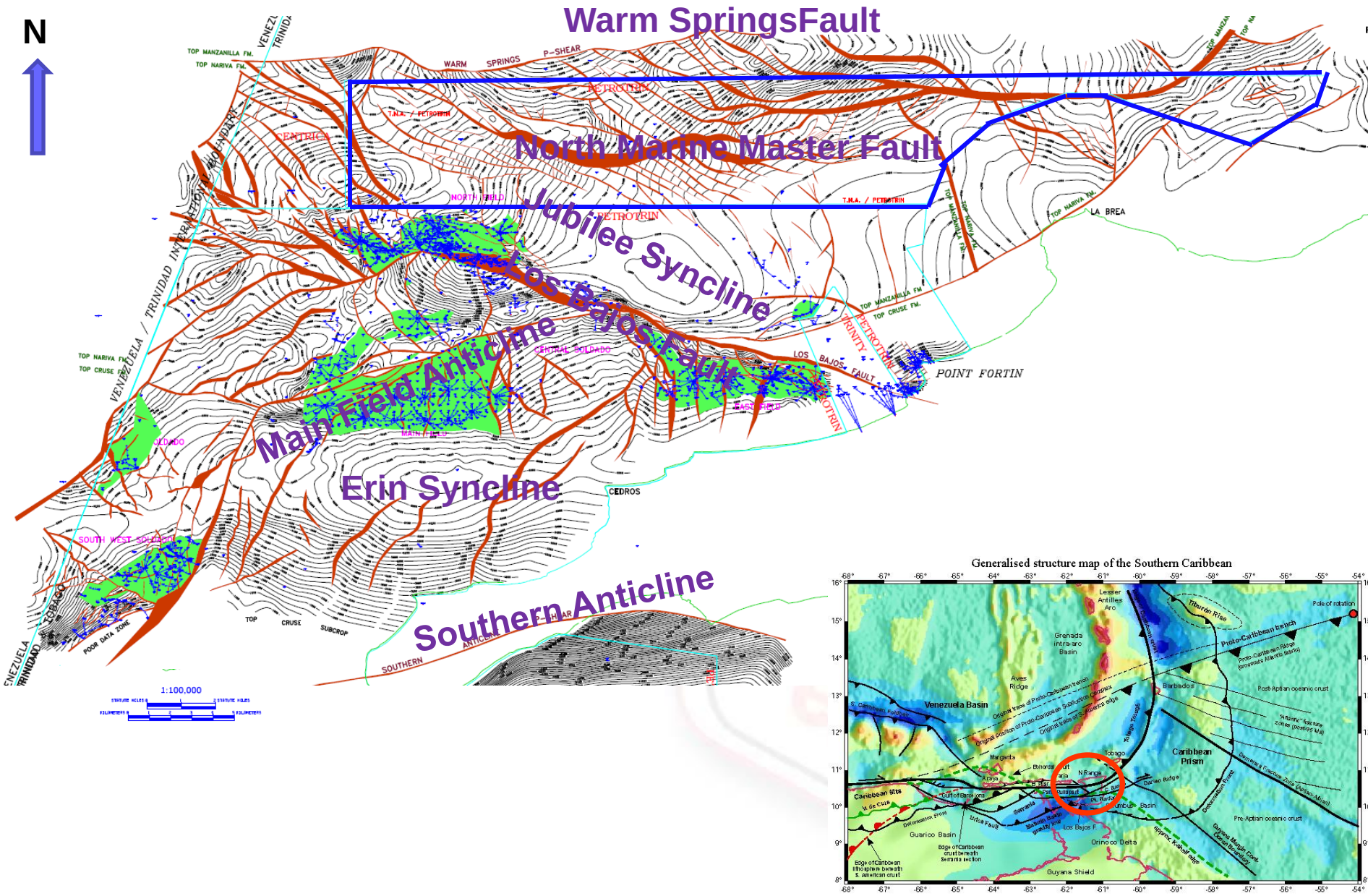
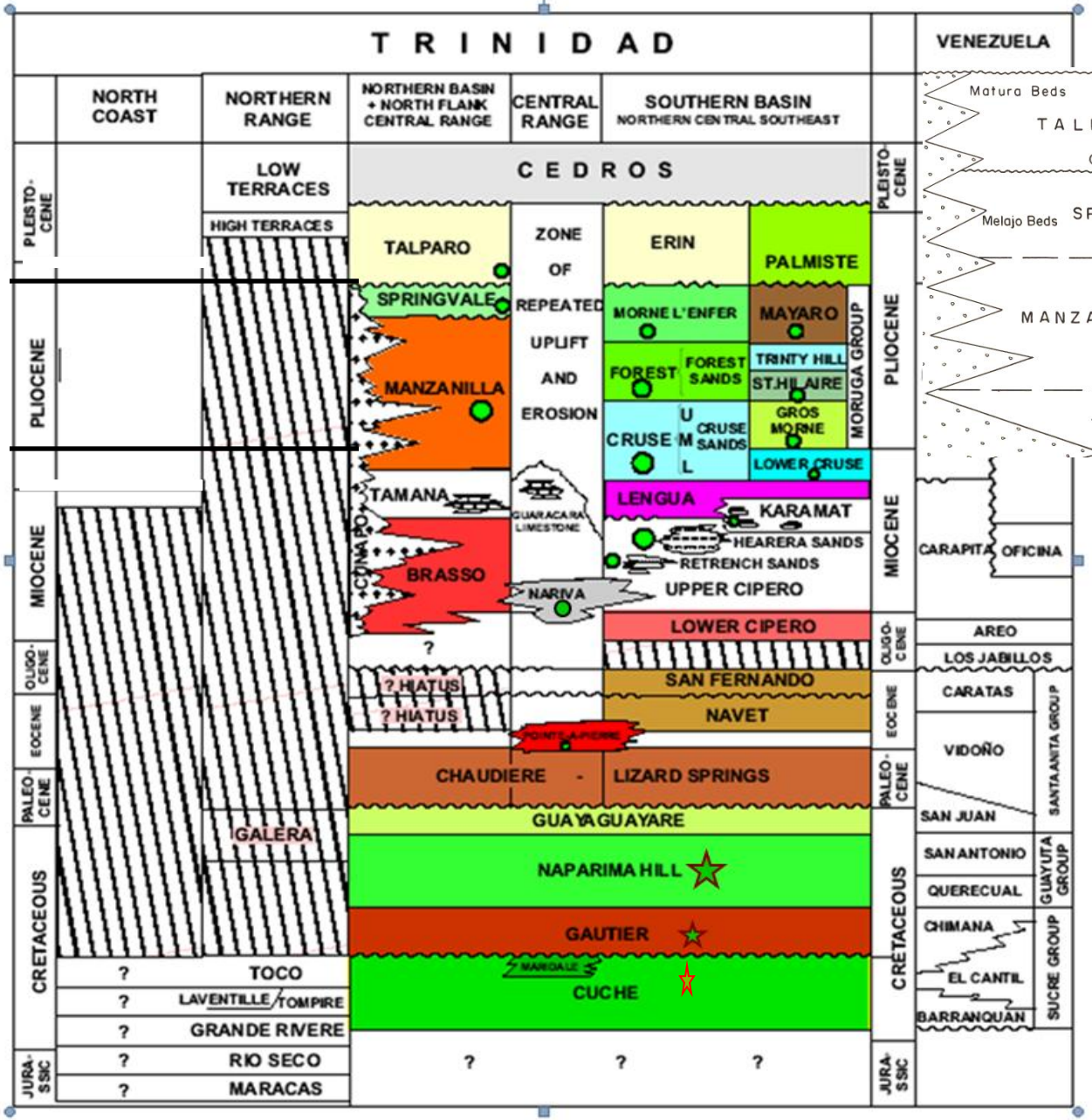
CURTIS ARCHIE
&
NANCY GALLAI-RAGOBAR

Location Map

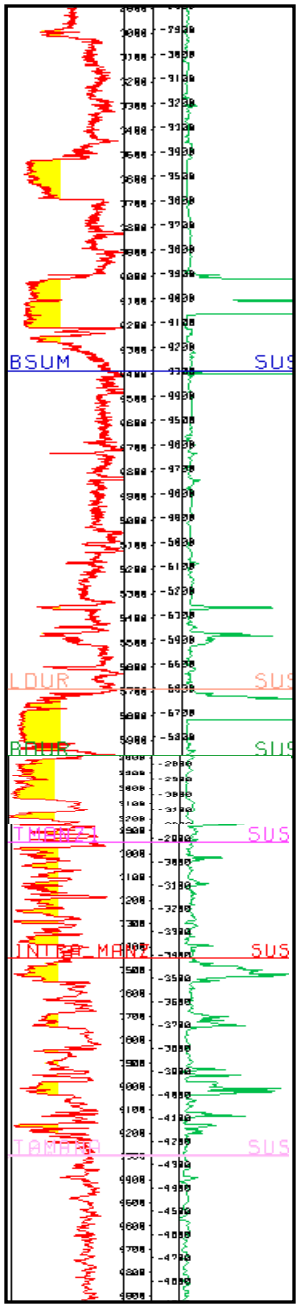


STRATIGRAPHIC CHART



After Carr-Brown & Frampton 1979

Composite log "Northern Basin" sediments



Chin ChinClay Mbr.

SumSum Mbr.

Caparo Clay Mbr.

Durham Mbr.

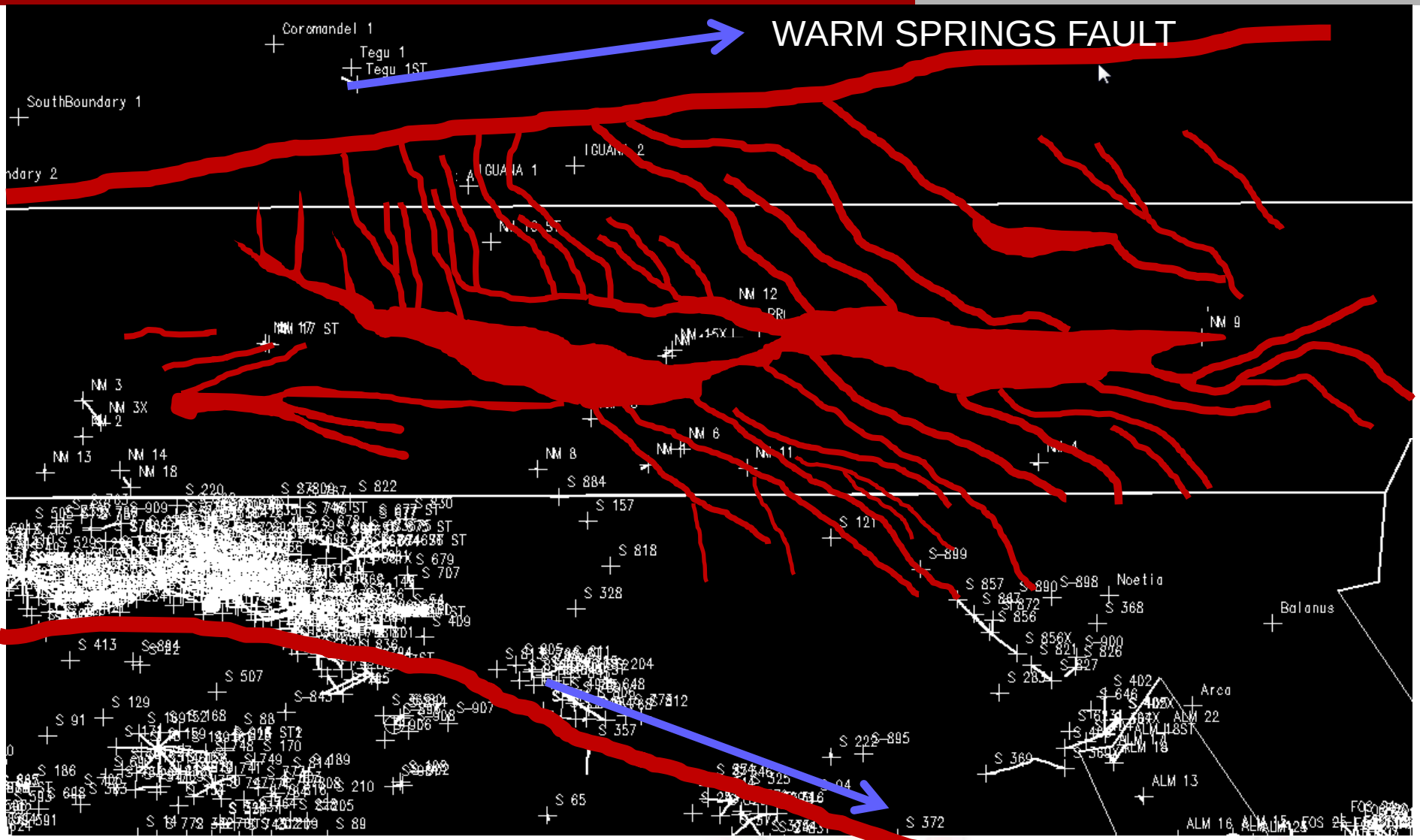
Talparo Fm.

Springvale Fm.

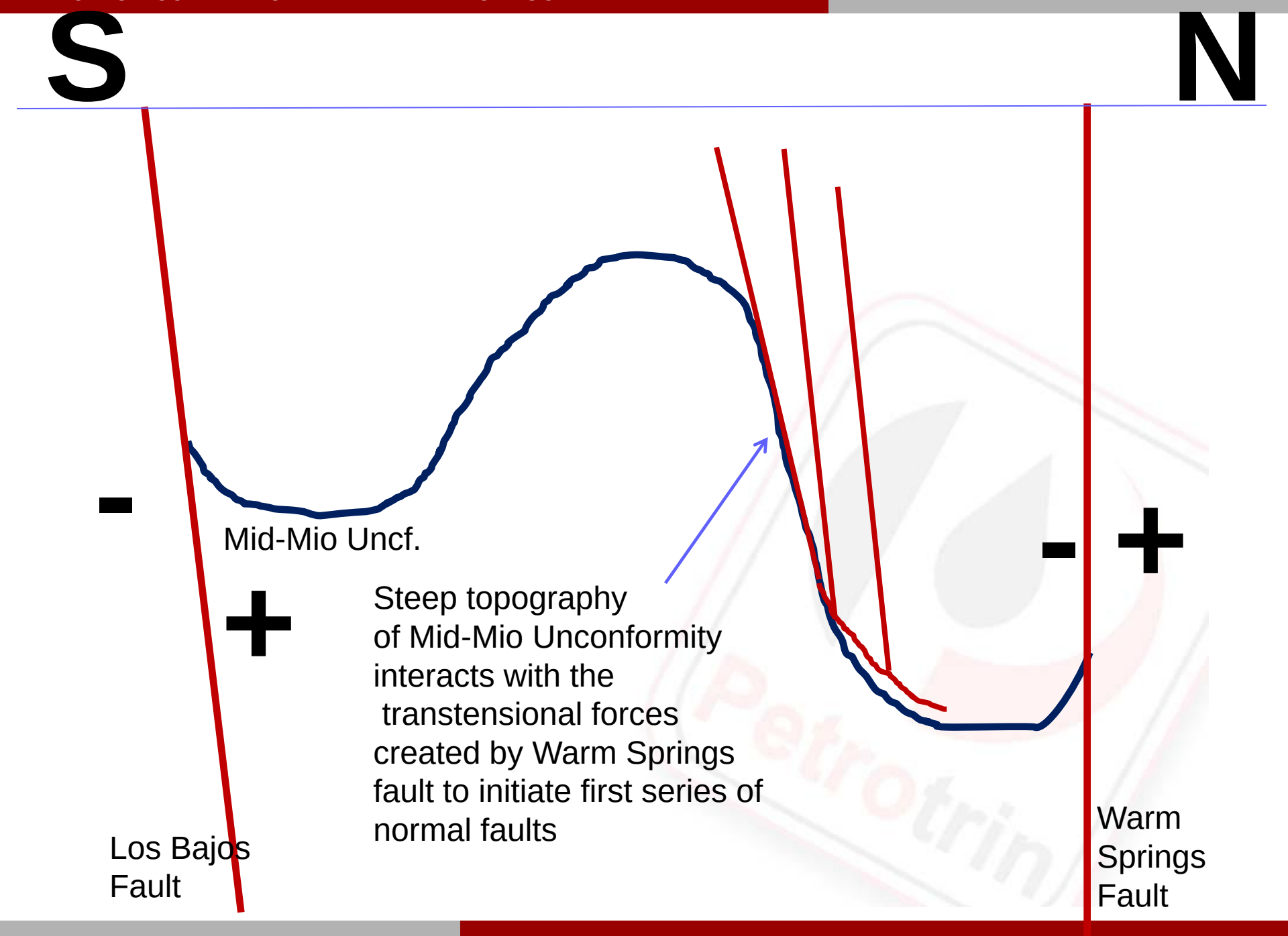
Telemaque Mbr.

Manzanilla Fm.

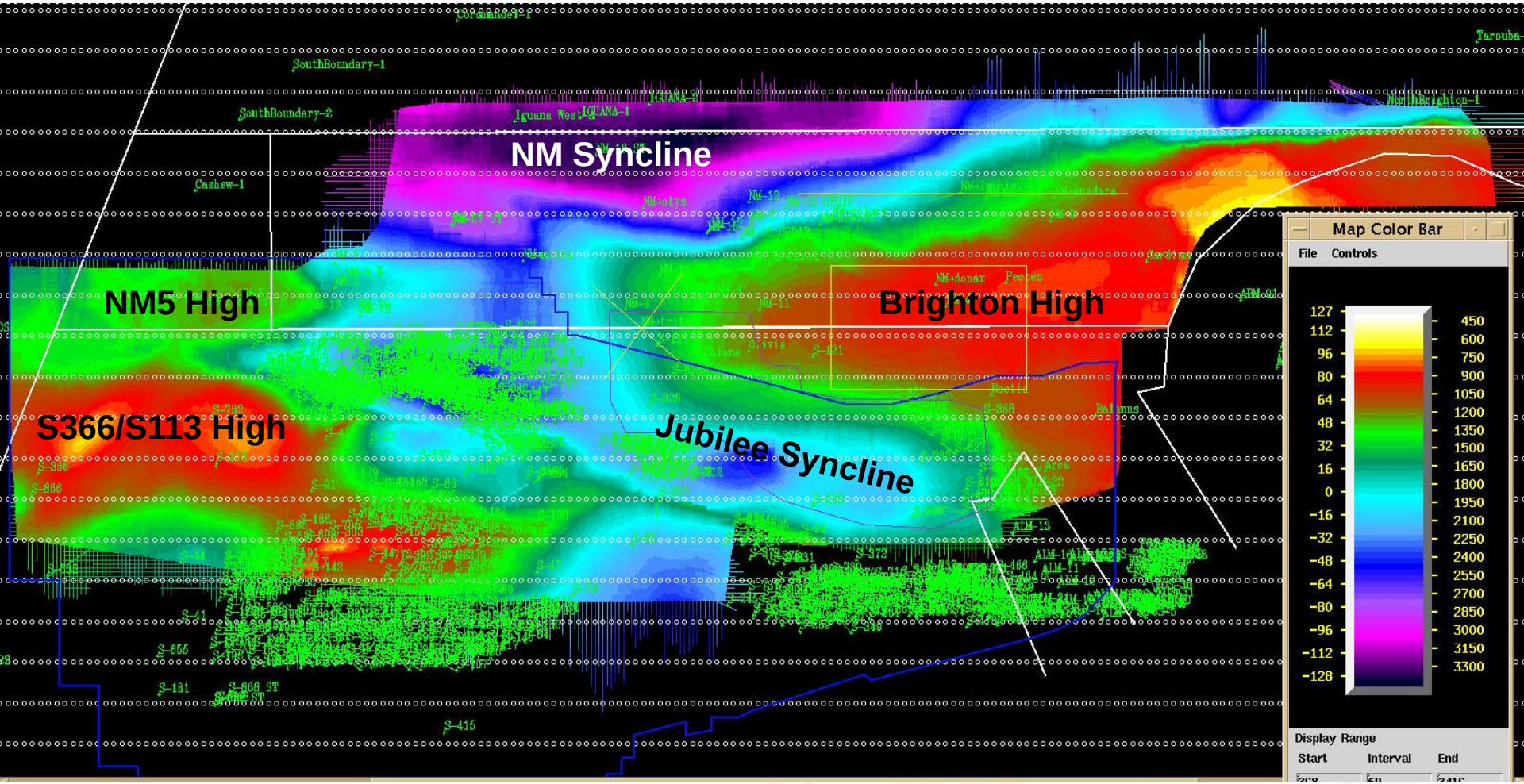
Nariva Fm.



EVOLUTION OF NORTH MARINE MASTER FAULT

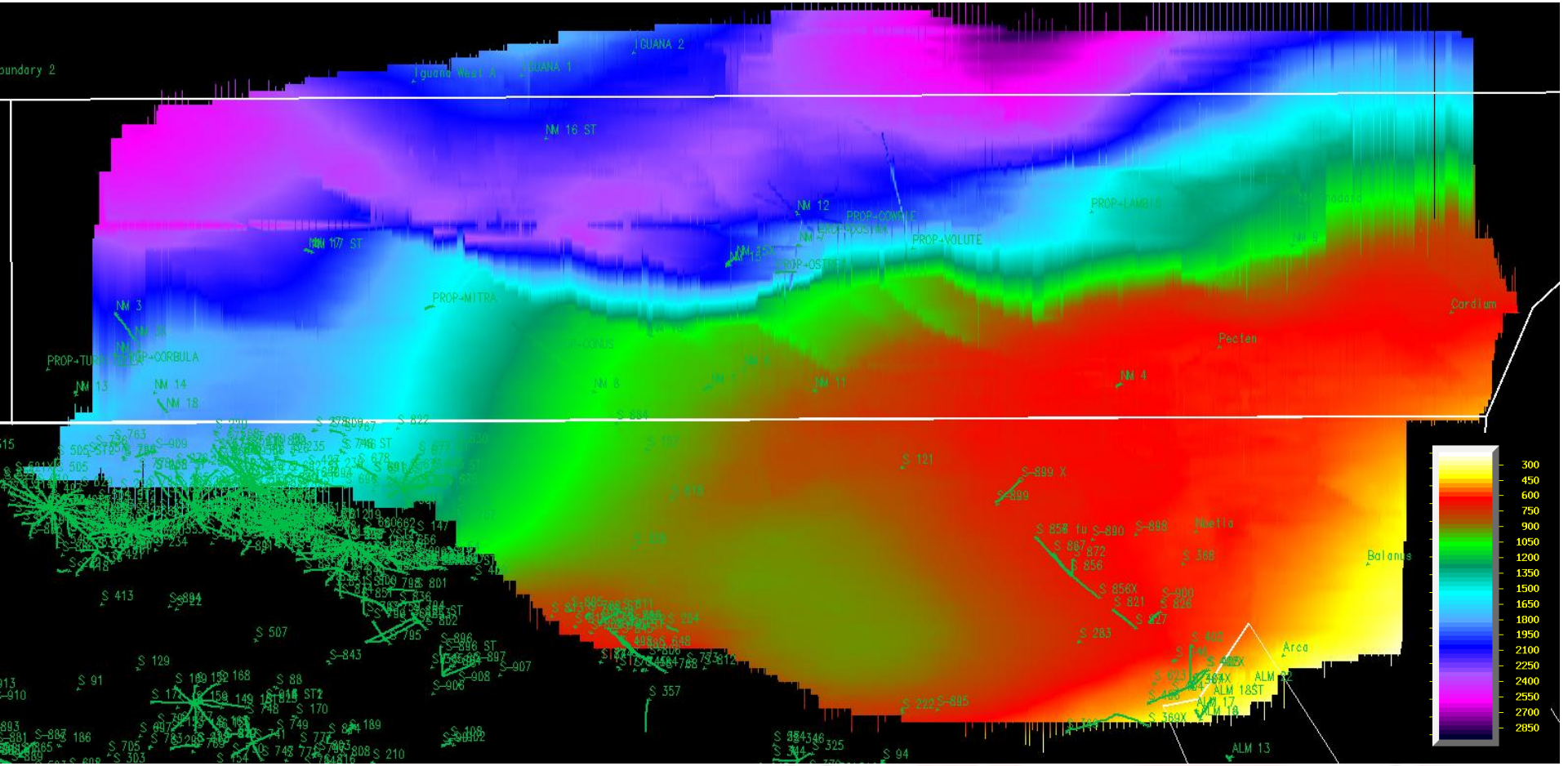

S
N
-
Mid-Mio Uncf.
+
Steep topography
of Mid-Mio Unconformity
interacts with the
transtensional forces
created by Warm Springs
fault to initiate first series of
normal faults
-
+
Los Bajos
Fault
Warm
Springs
Fault

TIME STRUCTURE MAP Top Mid Mio. Uncf



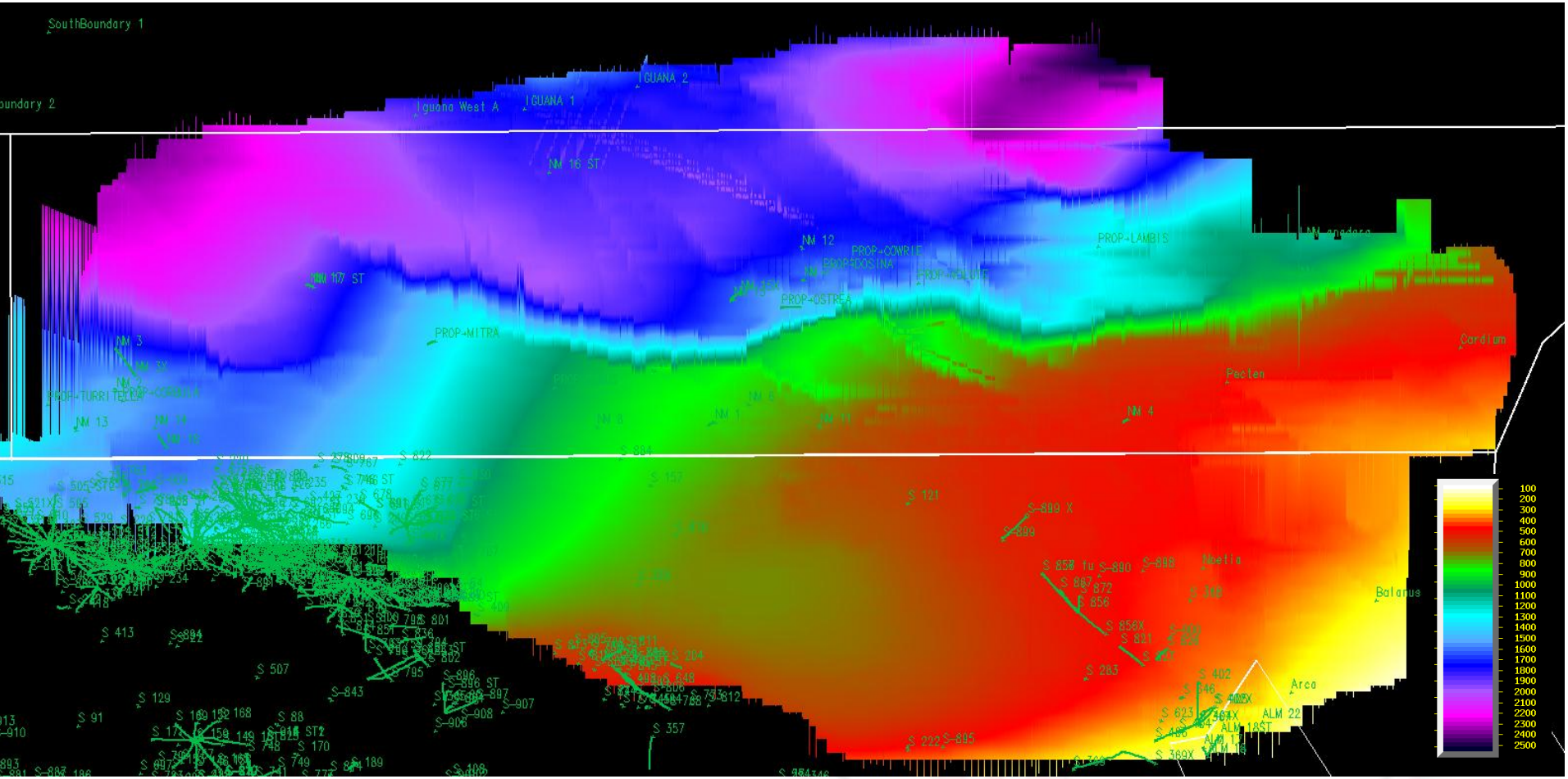
Major structural elements, E – W plunging Brighton high, ESE – WNW trending Jubilee Syncline, W-E trending North Marine Syncline.
The Mid Mio. Unconformity created topography that later strongly influenced later sedimentation.

TIME STRUCTURE – TOP MANZANILLA



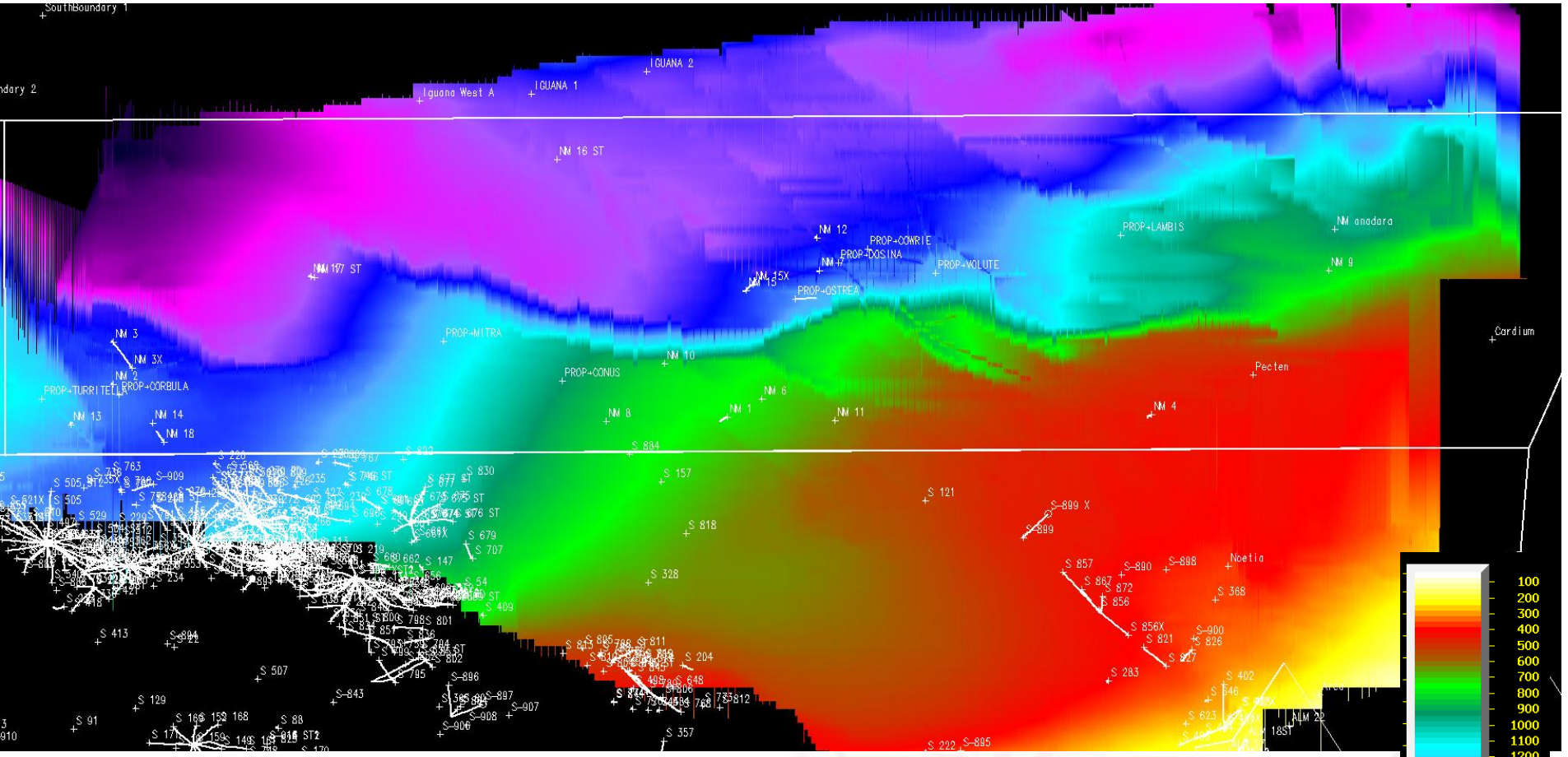
Brighton High persists, Jubilee Syncline and NM syncline appears to become flatter and broader due to infilling by Manzanilla (Telemaque) sediments.

TIME STRUCTURE - TOP SPRINGVALE



Brighton High persists, the Jubilee Syncline being flatter and broader will have thinner Springvale sediments. The NM syncline remains “deep” and can hold more Springvale sediments.

TIME STRUCTURE - TOP DURHAM

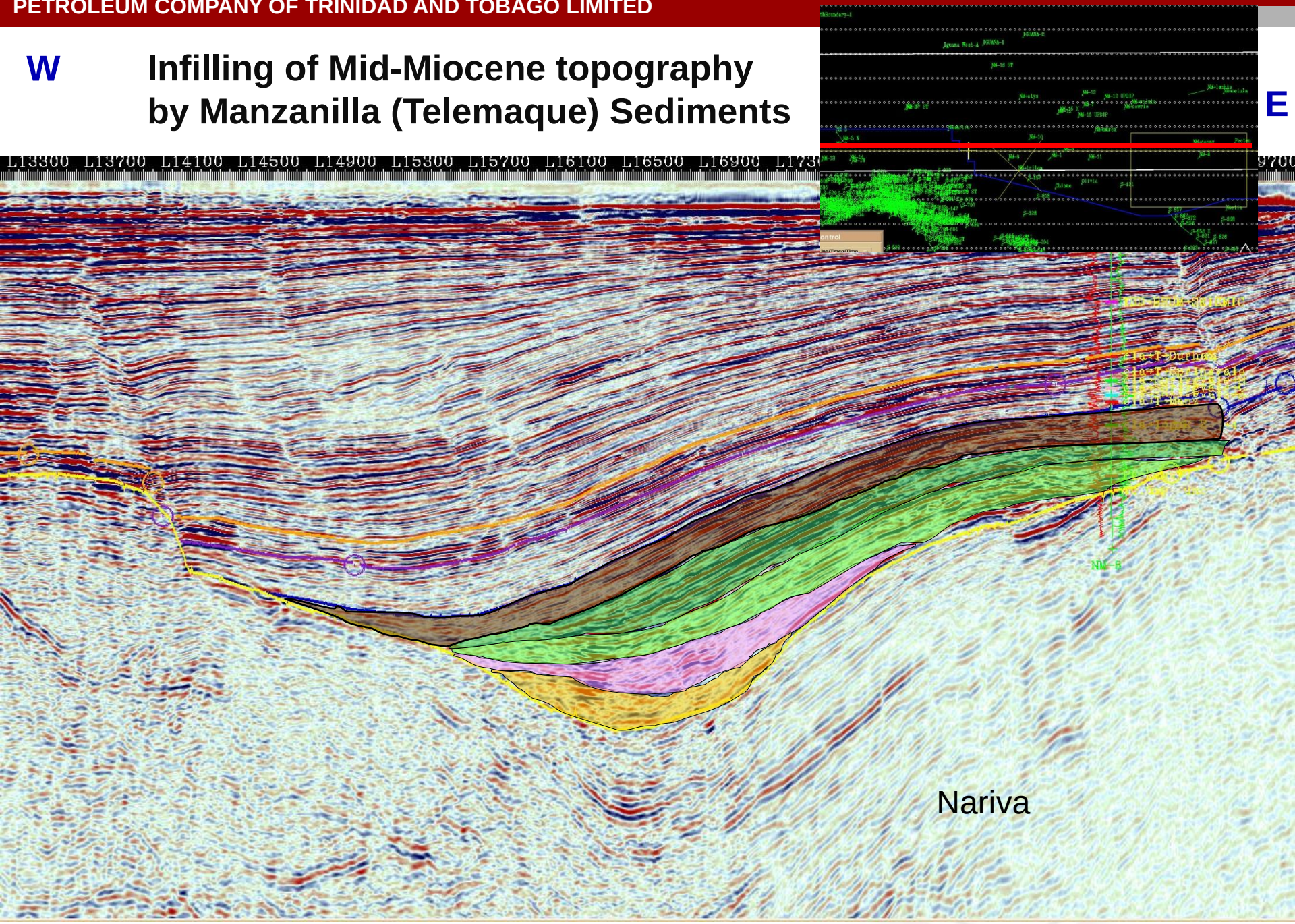


Brighton High persists, the Jubilee Syncline is flatter and broader will have thinner Durham sediments. The NM syncline has a prominent "hump" in the middle of the area, to the east of this area sediments should thicken

W

Infilling of Mid-Miocene topography by Manzanilla (Telemaque) Sediments

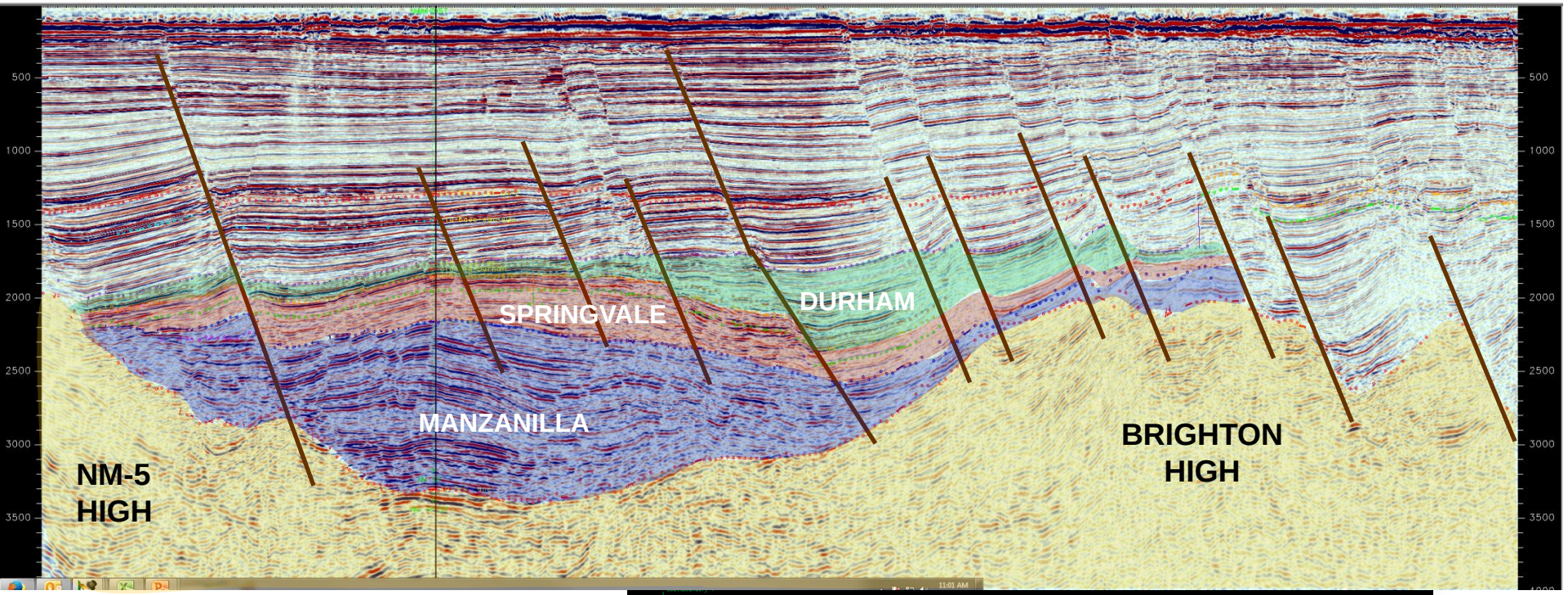
E



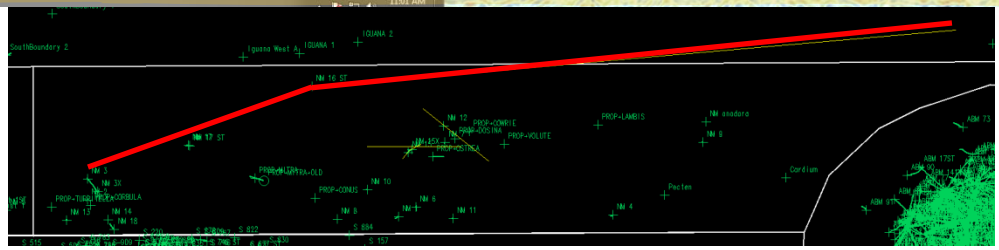
ARBRITARY SEISMIC LINE DOWN THE AXIS OF THE NORTH MARINE SYNCLINE

WSW

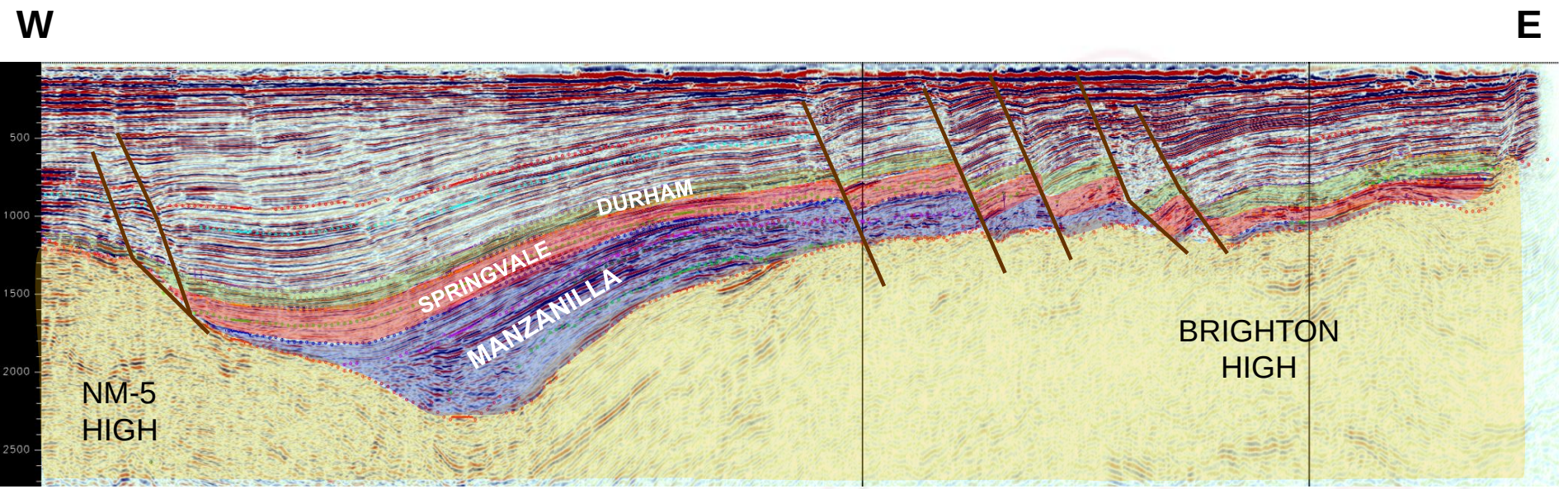
ENE



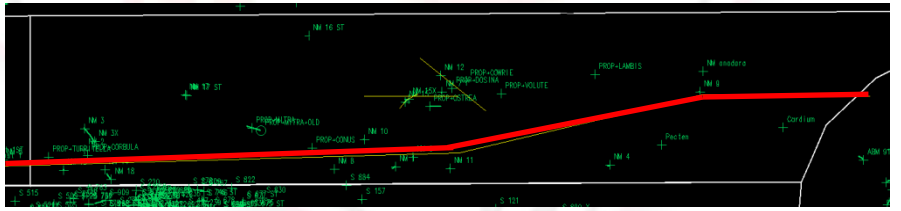
Sediments thickest in low points and thin on the highs



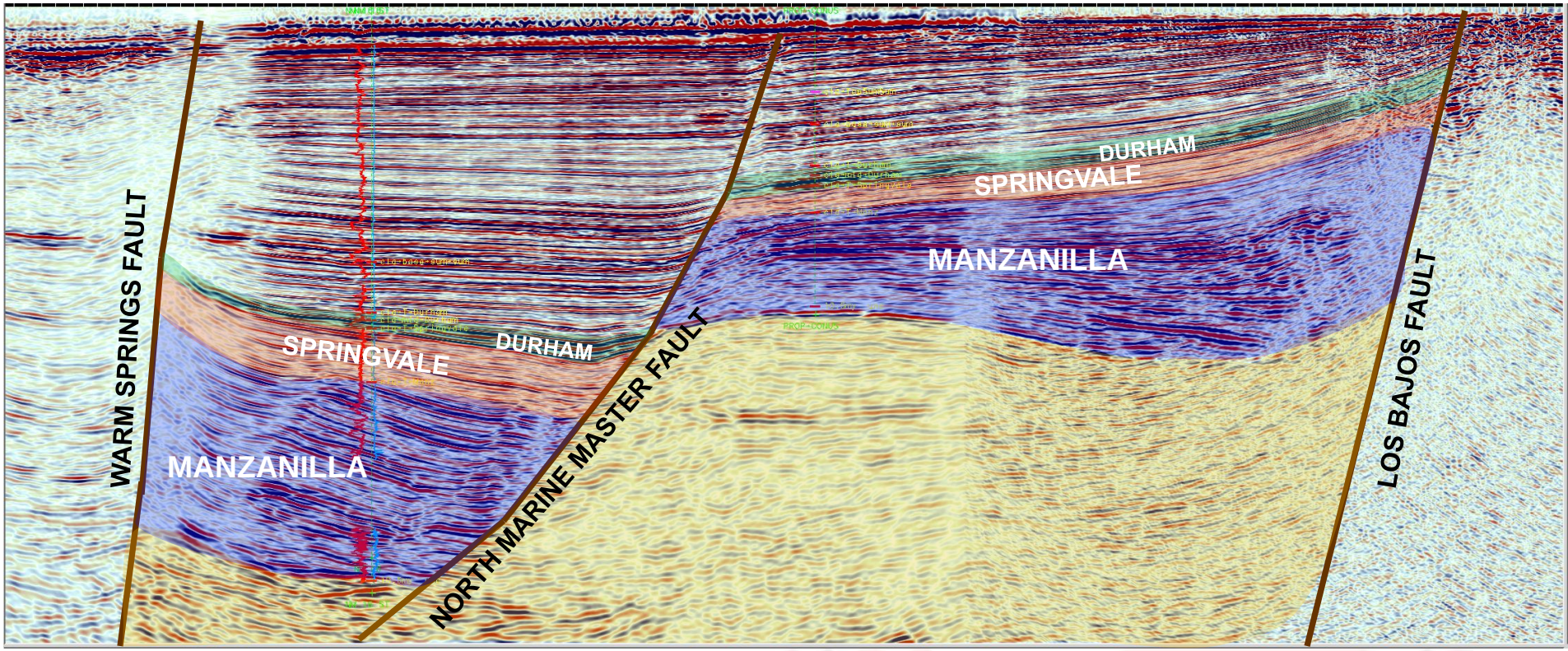
ARBRITARY SEISMIC LINE SOUTH OF THE NORTH MARINE MASTER FAULT



- **Sediments thickest in low points and thin on the highs**
- **Units thinner**
- **No ‘Growth”**

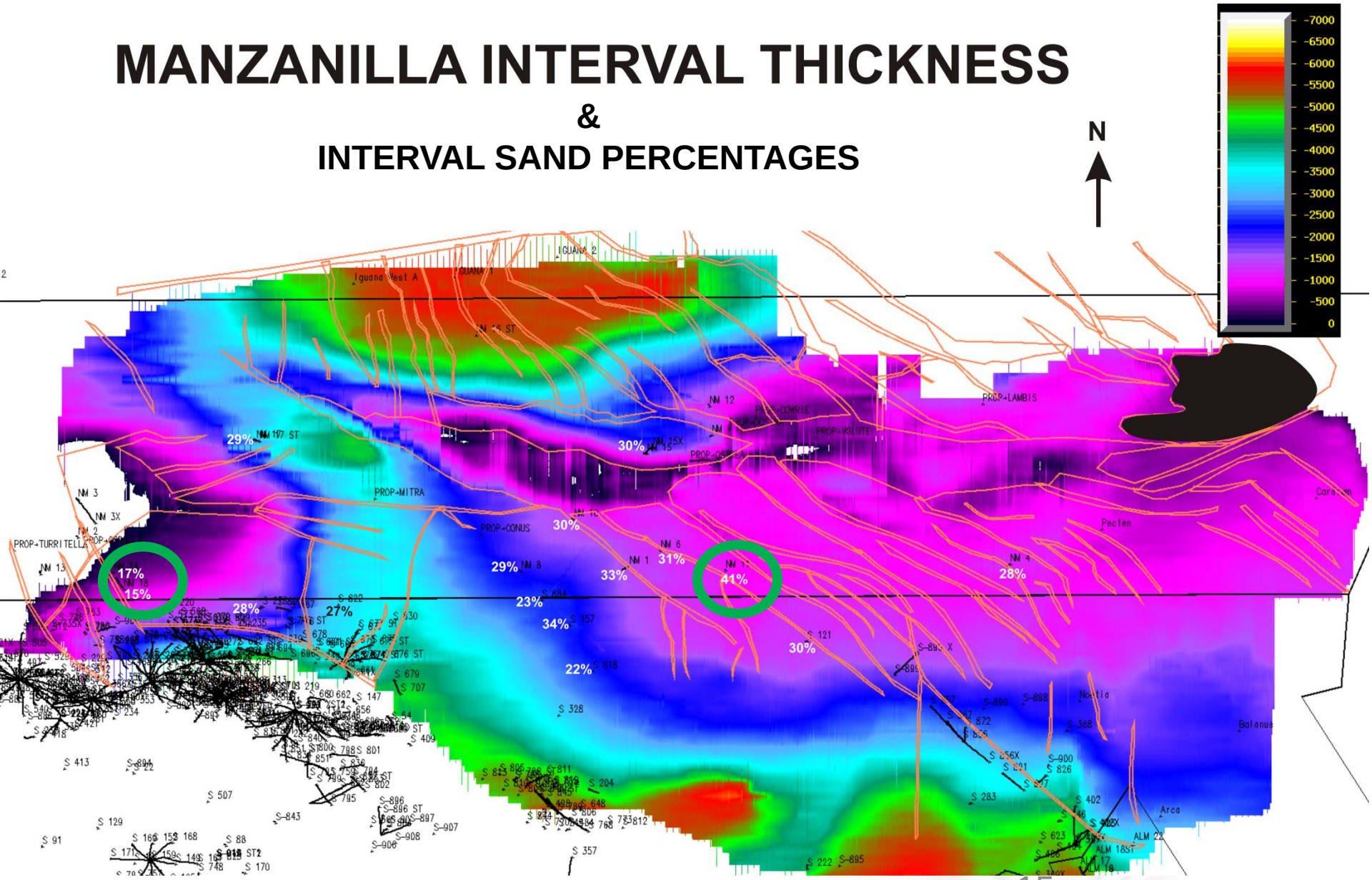


NORTH - SOUTH SEISMIC LINE BETWEEN THE WARM SPRINGS, NORTH MARINE MASTER AND LOS BAJOS FAULT

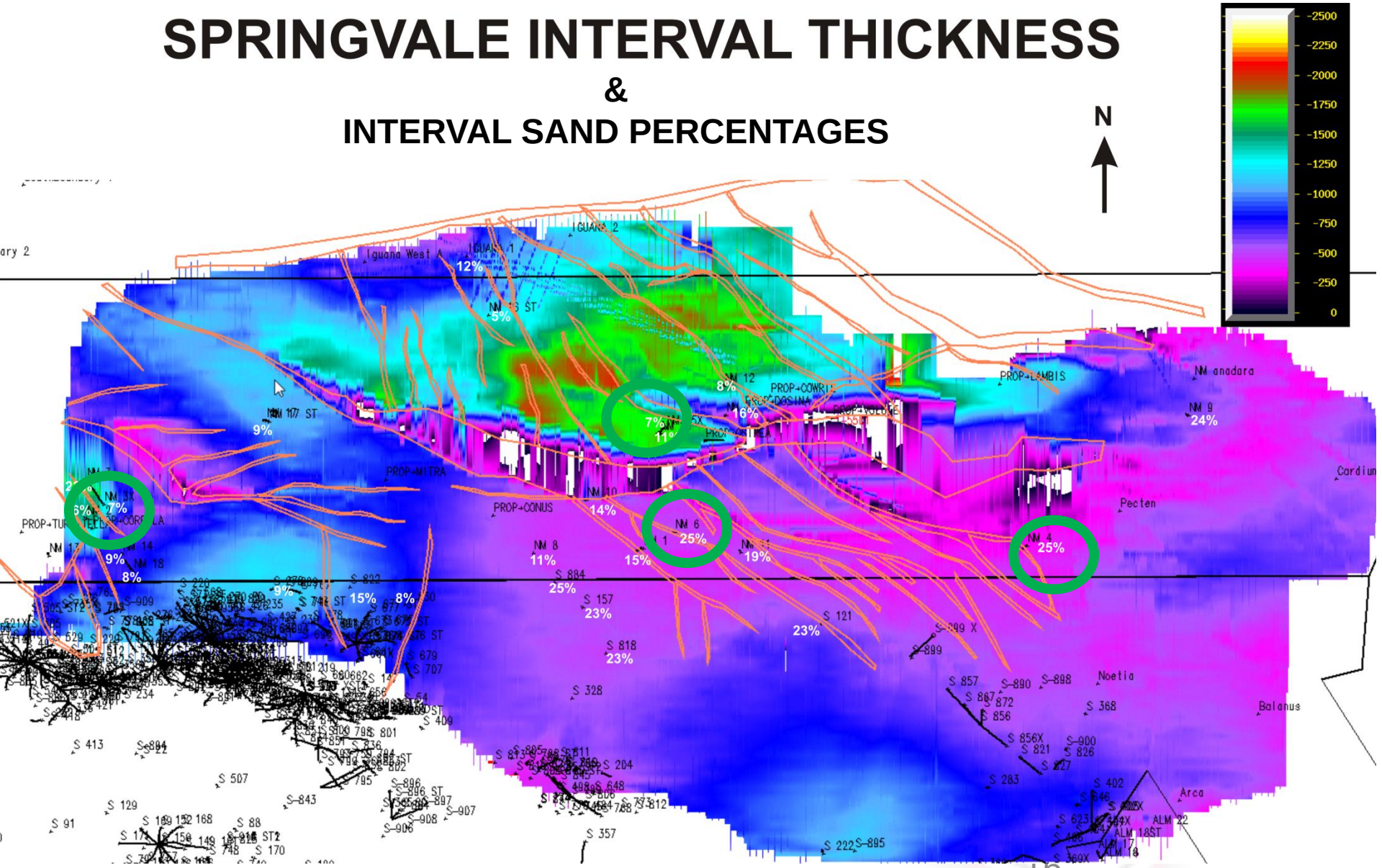


- Manz sediments thickest in low points and thin on the highs
- Manz & Springvale thicker on downthrown side of NNMF

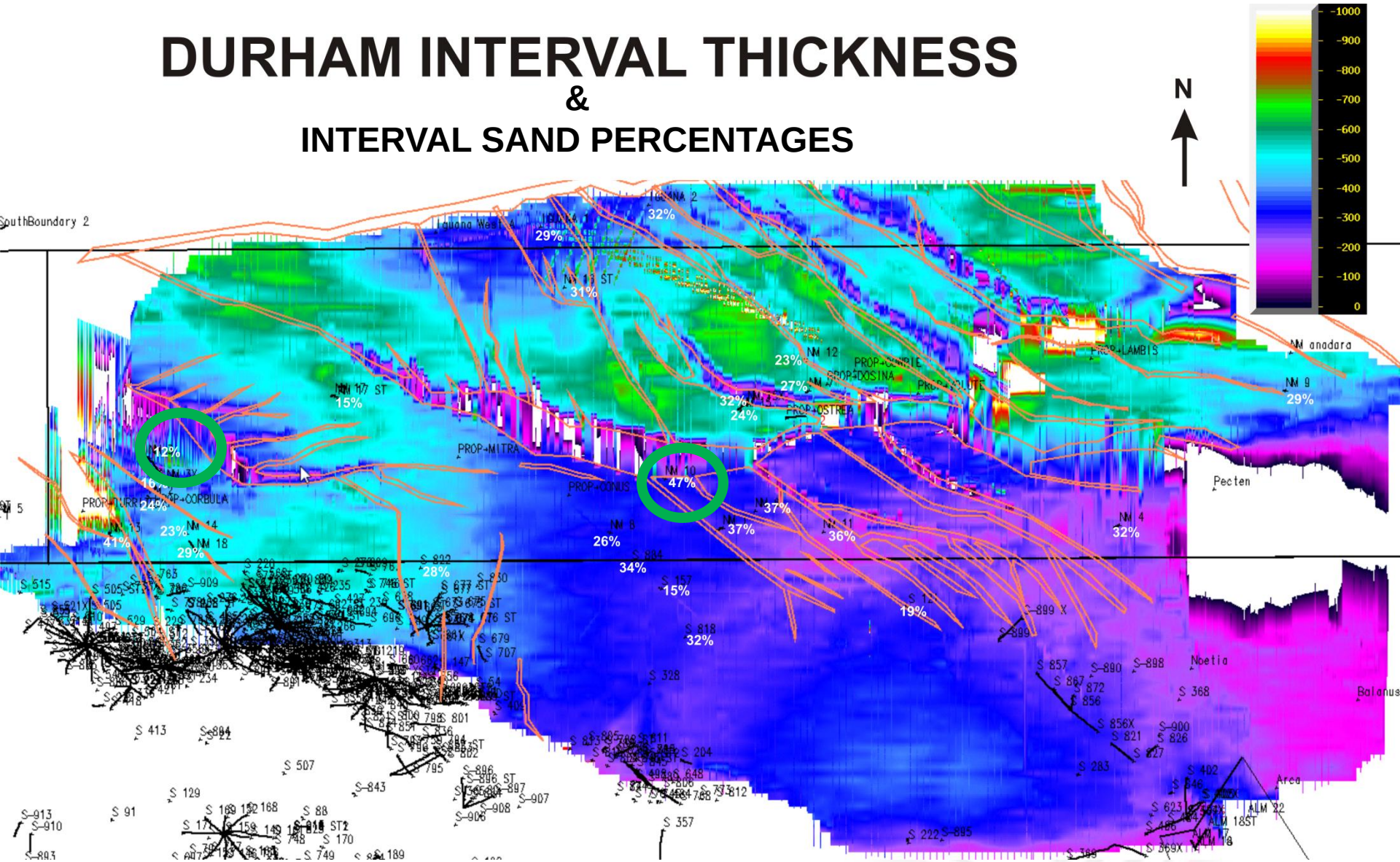
MANZANILLA INTERVAL THICKNESS
&
INTERVAL SAND PERCENTAGES

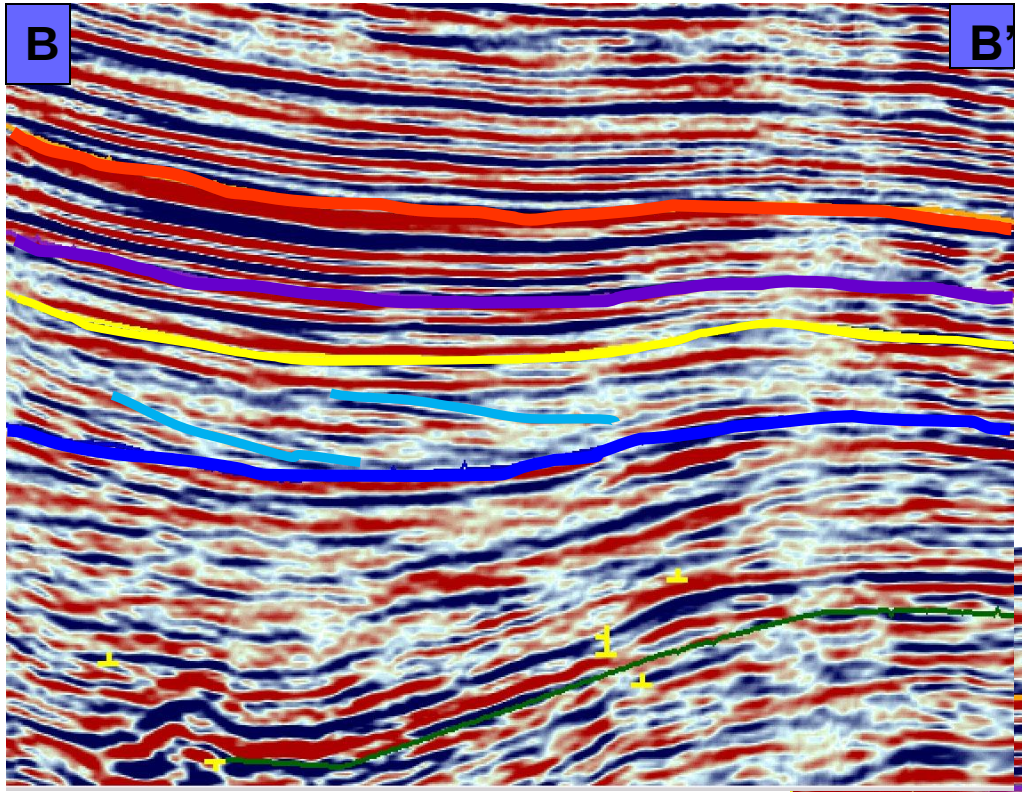


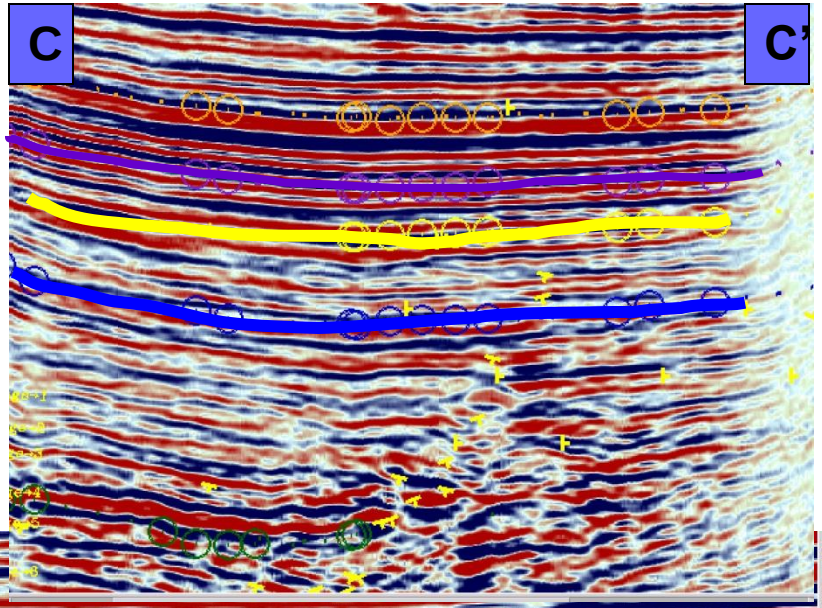
SPRINGVALE INTERVAL THICKNESS
&
INTERVAL SAND PERCENTAGES



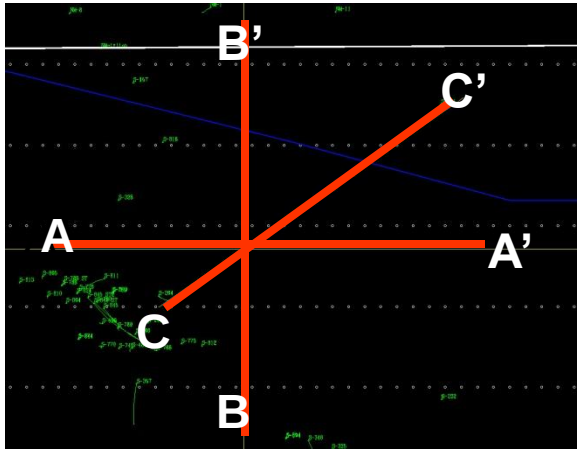
DURHAM INTERVAL THICKNESS
&
INTERVAL SAND PERCENTAGES

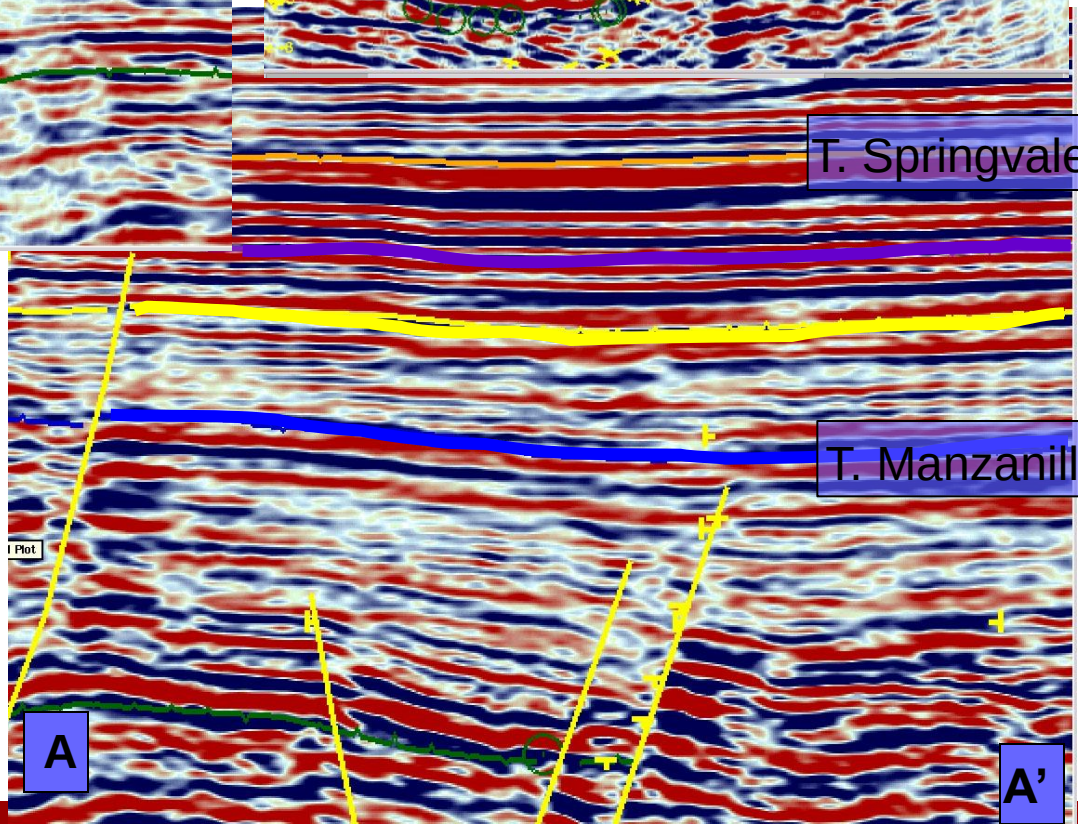


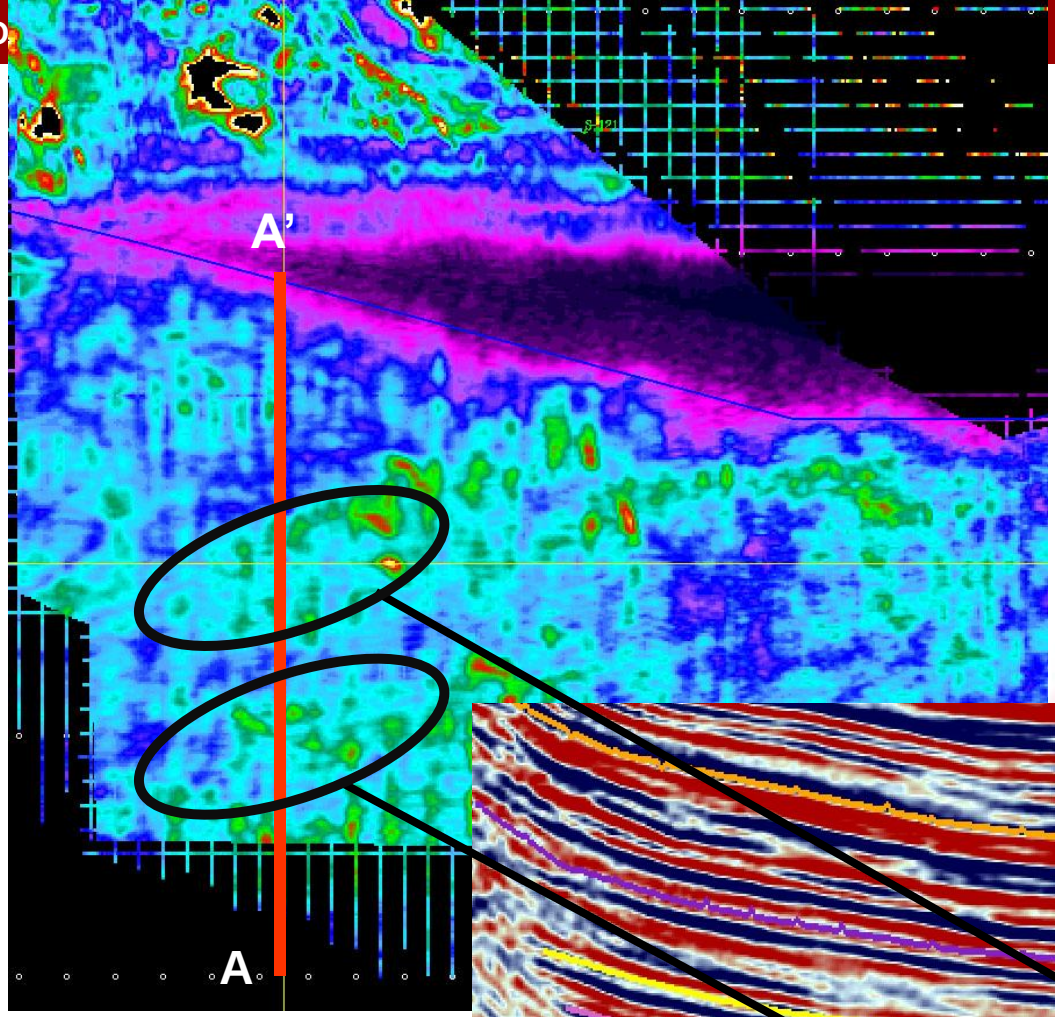




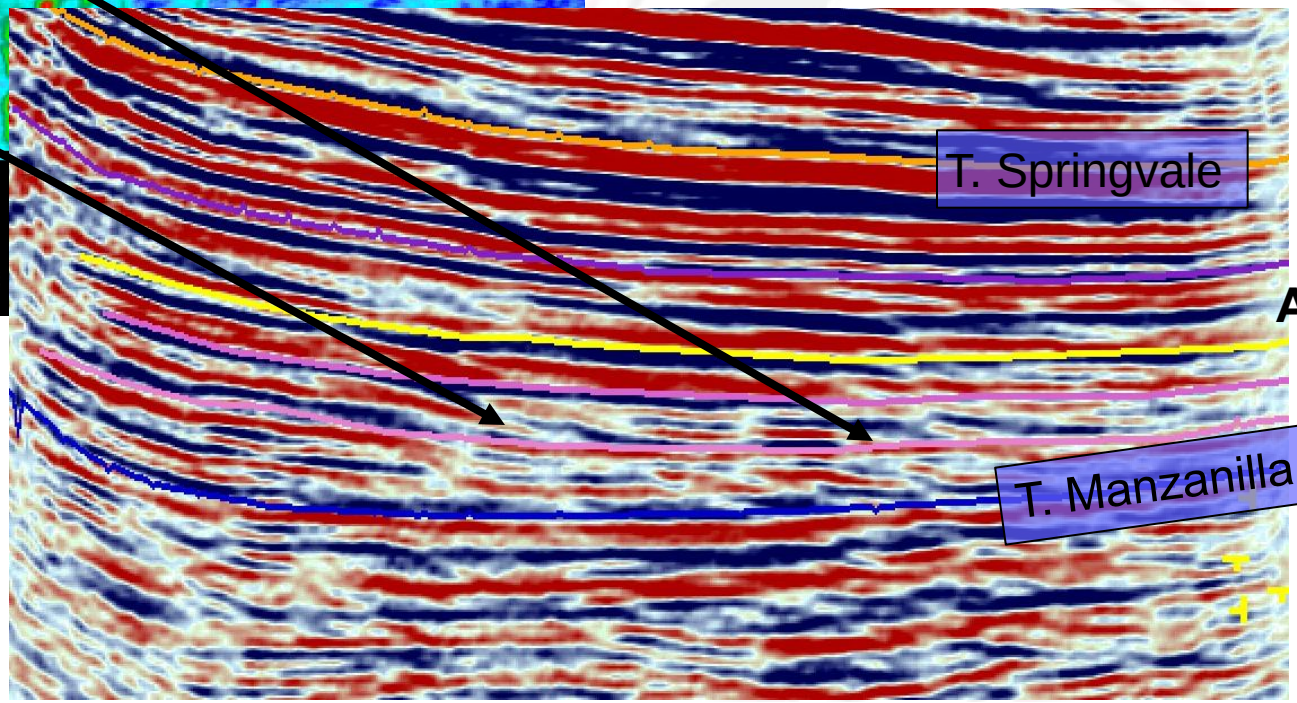
Springvale – Prograding events



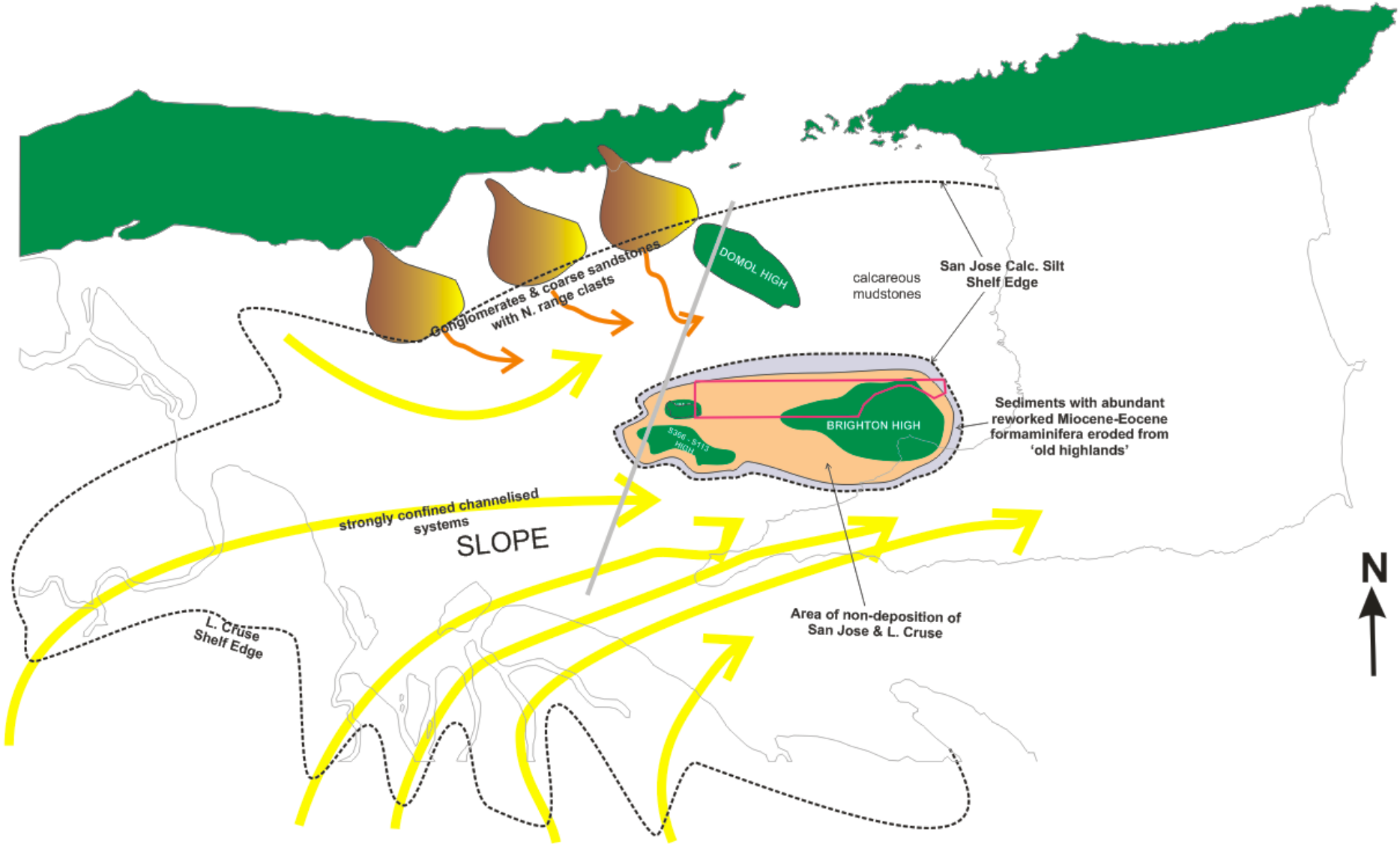




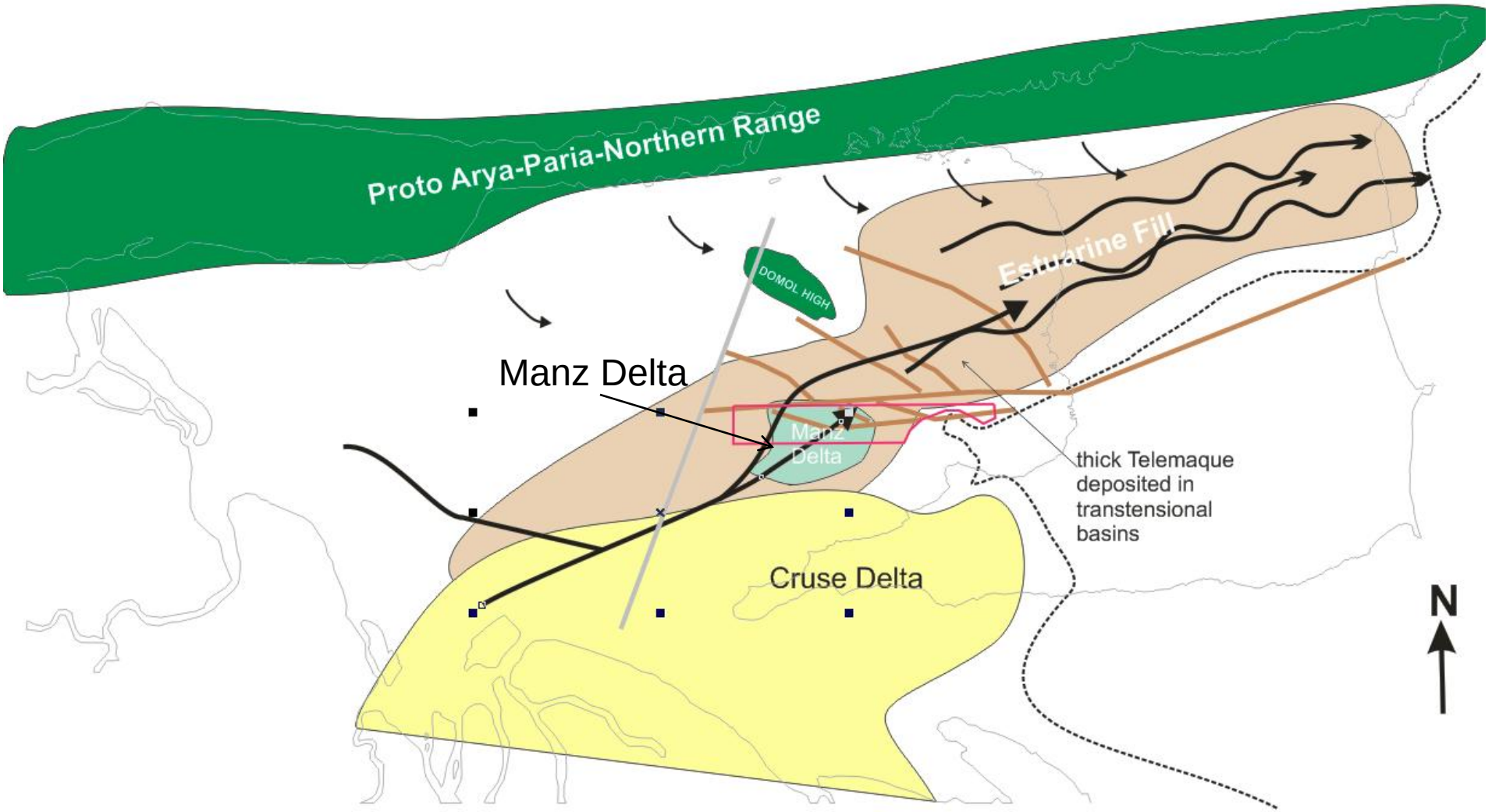
dipping reflectors that have been interpreted as sediments prograding from south – north, a WSW – ENE trending RMS amplitude may show the extent of deposition for each event



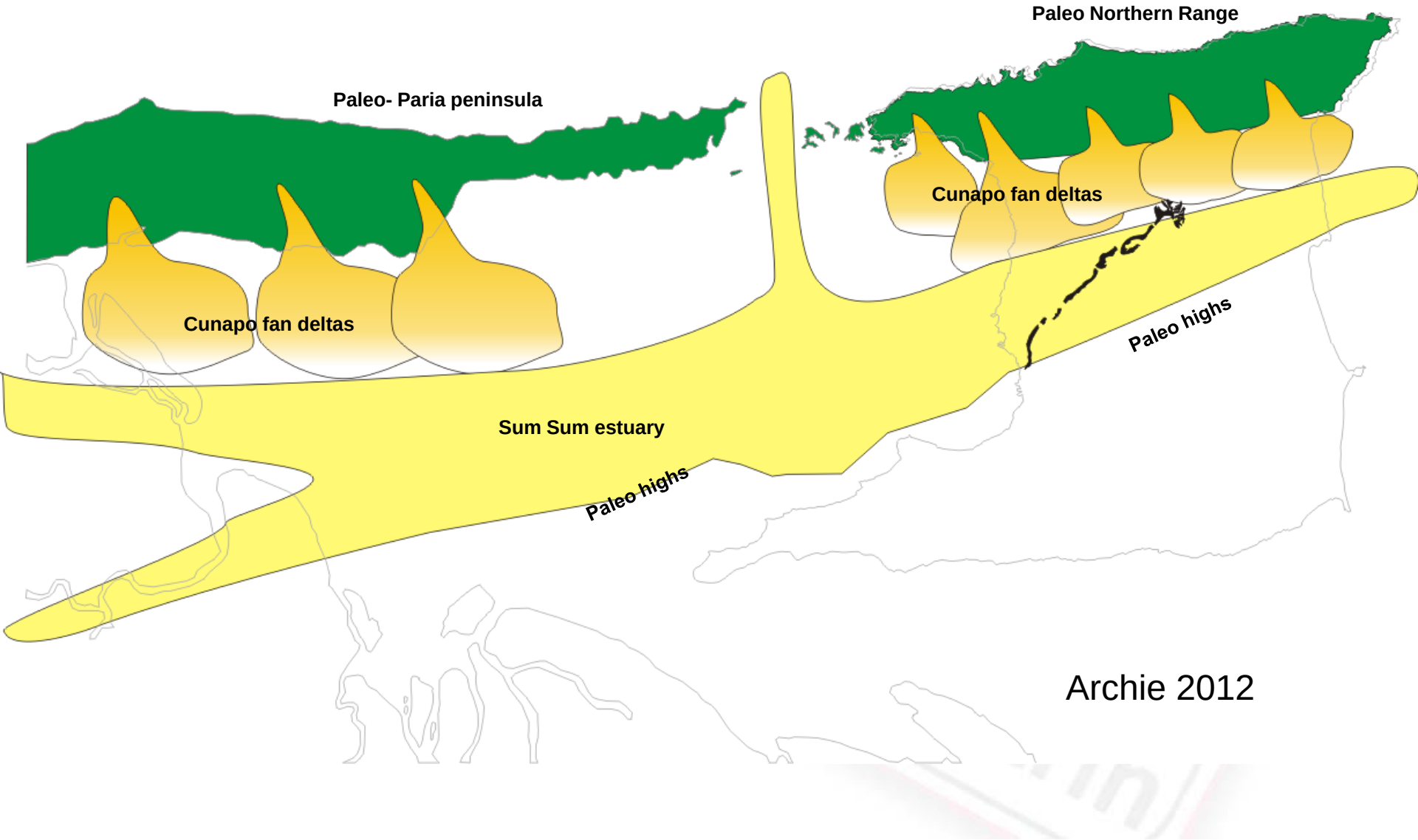
Lower Cruse / San Jose Cancareous Silt Paleogeography (U. Miocene)



Telemaque / Cruse Time



Paleogeographic reconstruction of Sum Sum Time



Archie 2012

CONCLUSIONS

- Transtensional stresses between the Warm Springs and Los Bajos faults created several normal faults that merged to form the North Marine Master Fault (NMMF).
- "Growth" obvious in Durham interval to the north of the NMMF.
- Topography created by the Mid-Miocene Unconformity strongly influences the deposition and interval thickness of the Manzanilla and less so the Springvale and Durham.
- No relationship between interval thickness and interval sand percentage.
- Source of sediments from the South – South west, very minor input from the North.

THE END

ANY QUESTIONS?

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