North Soldado, Trinidad and Tobago: An Examination of the Remaining Exploration Potential within the Field*

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Abstract

The prolific North Soldado Field discovered in 1961, has proven to date to be the only large oilfield found in the Caroni sub-basin, having produced over 250 million barrels of oil. Development of the field, whose reservoirs are the Telemaque and the Lower Springvale sands of Late Miocene to Pliocene age, has been achieved by a combination of single wells, clusters, and platforms. The stratigraphy of the Telemaque sands consists of at least four transgressive-regressive cycles with environments of deposition varying from the middle neritic in the Lower Telemaque section to the lower delta plain in the Upper Telemaque section. Structurally the field is bounded to the south by the locally east west trending Los Bajos Fault Zone (LBFZ) which is a Miocene to Pliocene age strike slip fault cutting deep into the crust and allowing migration of large volumes of hydrocarbons across it. The field is also segmented into two parts by the east-west trending North Soldado Transtensional Fault Zone (NSTFZ). This fault zone is kinematically linked to the transtensional horse tailing of the Los Bajos Fault and is mapped here as linking with the LBFZ at depth. This presentation tries to shed some new structural and stratigraphic insight on the deeper "Lower Telemaque stratigraphy" which has proven prolific in the past. This was done to highlight the remaining exploration opportunities within the field. There has been a re-examination of the structural model and new traps and potential reservoirs have been realised. Further examination of the model reveals a well imaged flower structure (NSTFZ) which created heavily segmented compartments within the "Upper Telemaque", but has preserved larger compartments at depth within the "Lower Telemaque".

This Lower Telemaque section is believed to have potential in the neritic sands which are heavily interbedded with shales, but exhibit high oil saturations. Successful drilling of these targets can substantially increase proven reserves in the North Soldado Field. Furthermore, two additional exploration opportunities have been realised. These are the under-drilled Nariva reservoirs (which exist below a regionally extensive Early to Mid-Miocene age unconformity, EMMU) and the northern segment, down-dip extension, of the field which has a beautifully imaged prograding delta system believed to have large remaining exploration potential. These three opportunities have excited the geoscientists working the block and are believed to have large volumes of hydrocarbons.

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Petroleum Company
of Trinidad and Tobago Limited

North Soldado, Trinidad and Tobago:

An examination of the remaining exploration potential within the field

By Adrian Thomas

PRESENTATION OUTLINE

- Acknowledgements
- Objective
- Study area
- Structural evolution of the Trinidad area
- North Soldado stratigraphy & structural geology
- Three exploration play types
- Something interesting- Evolution of a flower structure
- Summary

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- Mr. Philip Farfan (AGES)
- The Geological Society of Trinidad and Tobago (GSTT)
- All of the G&G staff at Petrotrin

Abbreviations Used

FF- Fault Family

LBFZ- Los Bajos Fault Zone

MMU- Mid Miocene Unconformity

NSM_FS1 – North Soldado Manzanilla Fm_Flooding Surface 1

NSM_FS2 – North Soldado Manzanilla Fm _Flooding Surface 2 etc.

NSTFZ- North Soldado Transtensional Fault Zone

TR Cycle - Transgressive – Regressive Cycle

Objective

- To delineate the main remaining exploration play types within the North Soldado field by looking at the available seismic and well data.

STUDY AREA

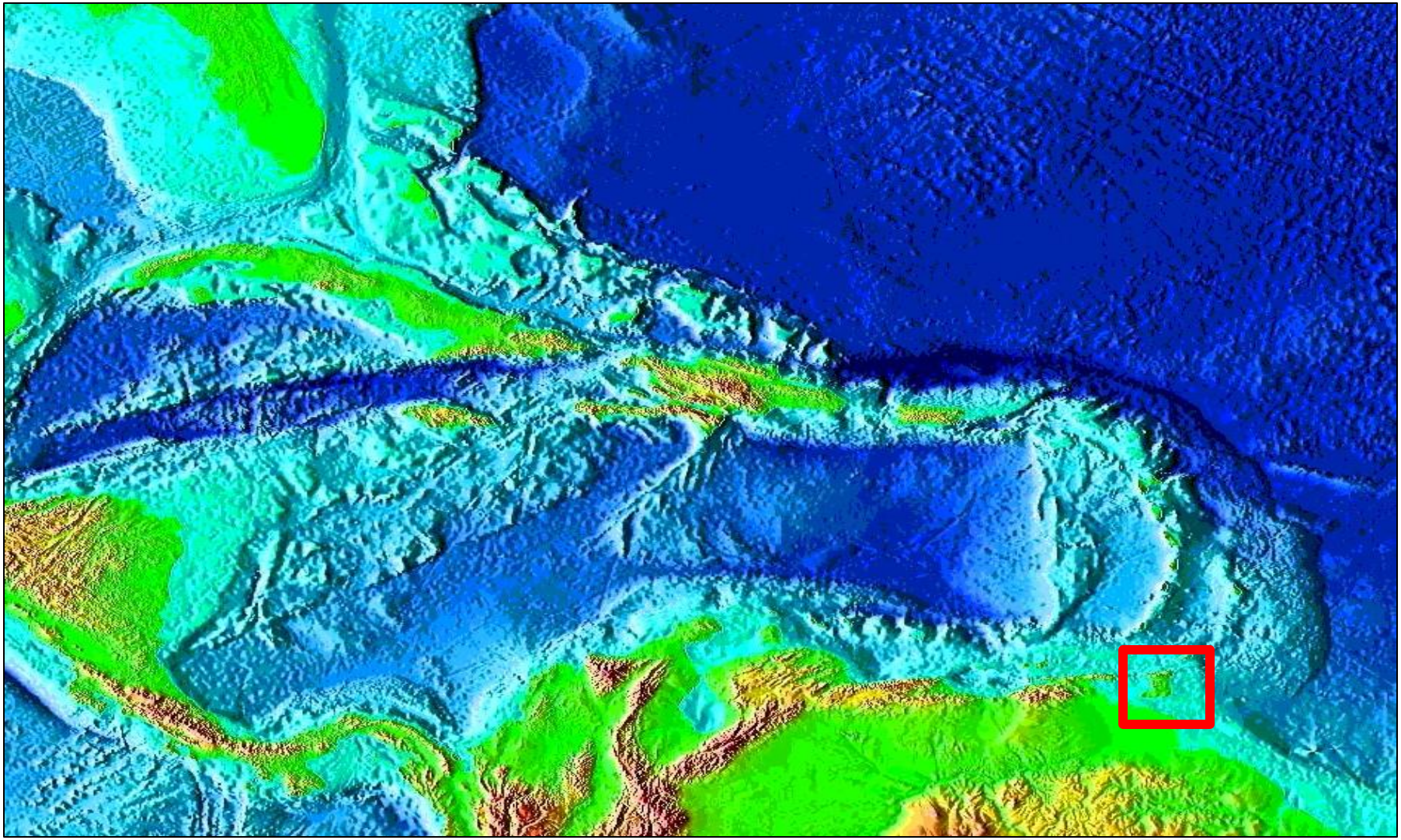


Image courtesy internal Petrotrin report

STUDY AREA

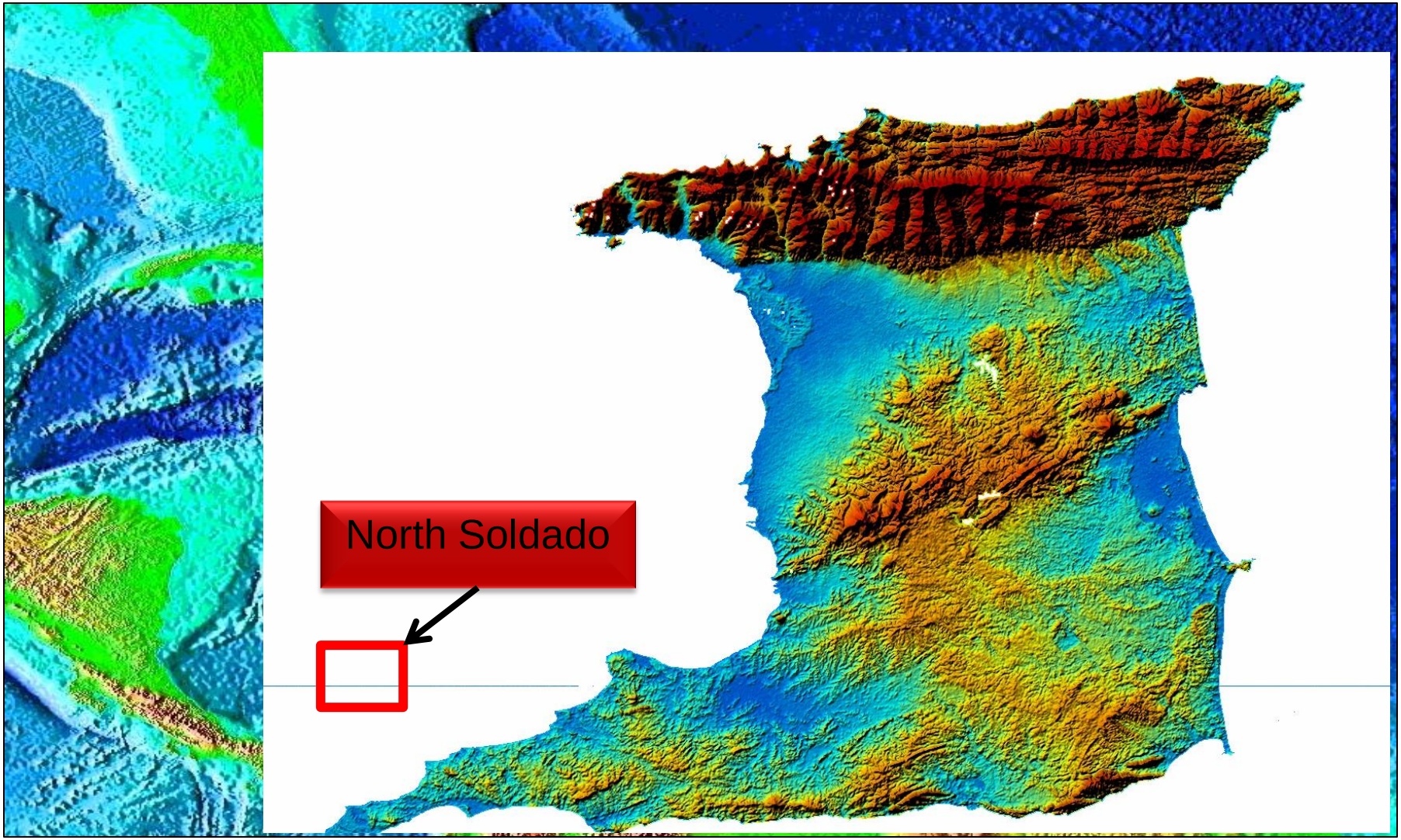


Image courtesy internal Petrotrin report

STRUCTURAL EVOLUTION OF THE CARIBBEAN PLATE

Cenozoic structural history: Evolution of the Caribbean Plate

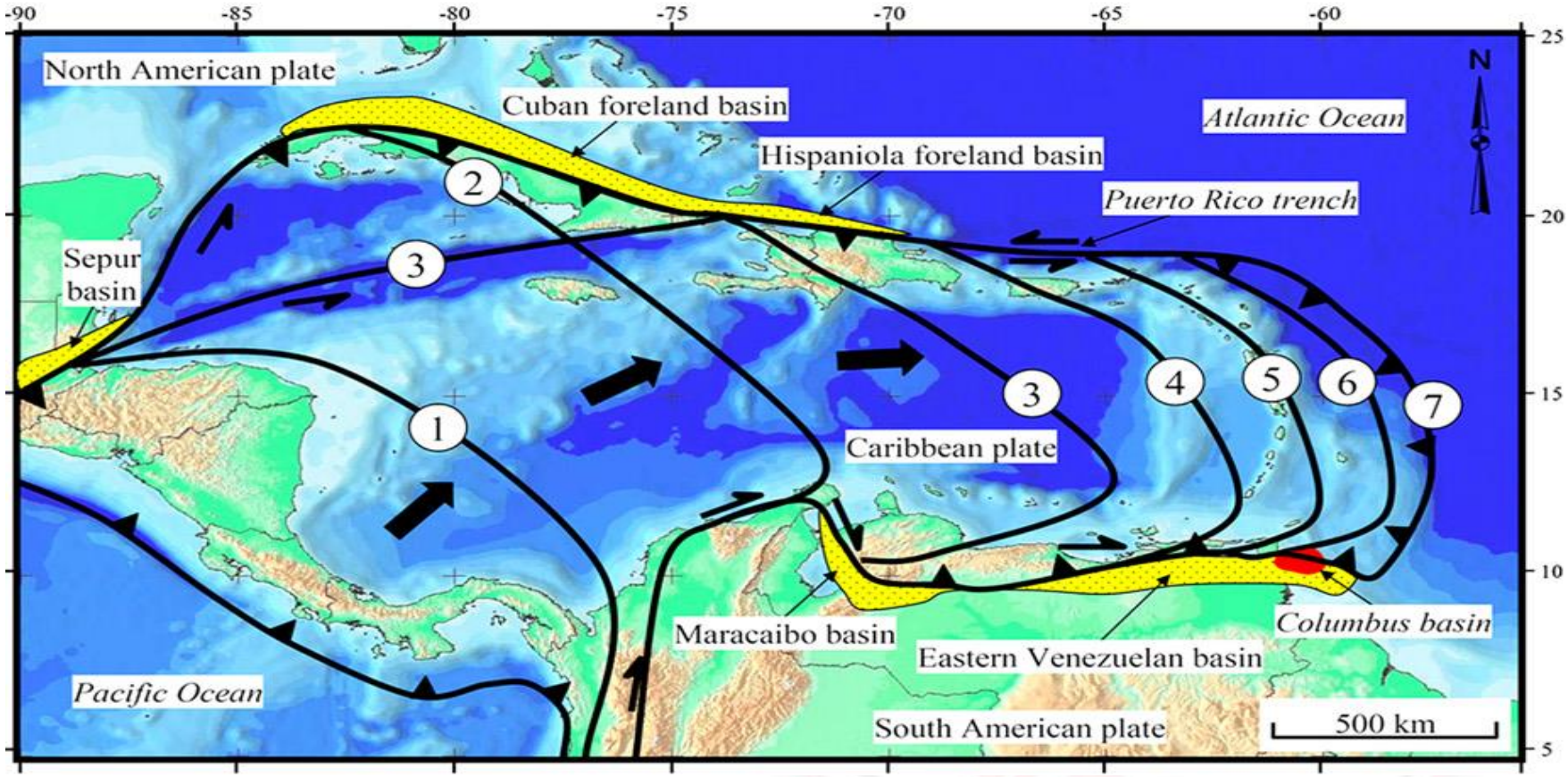
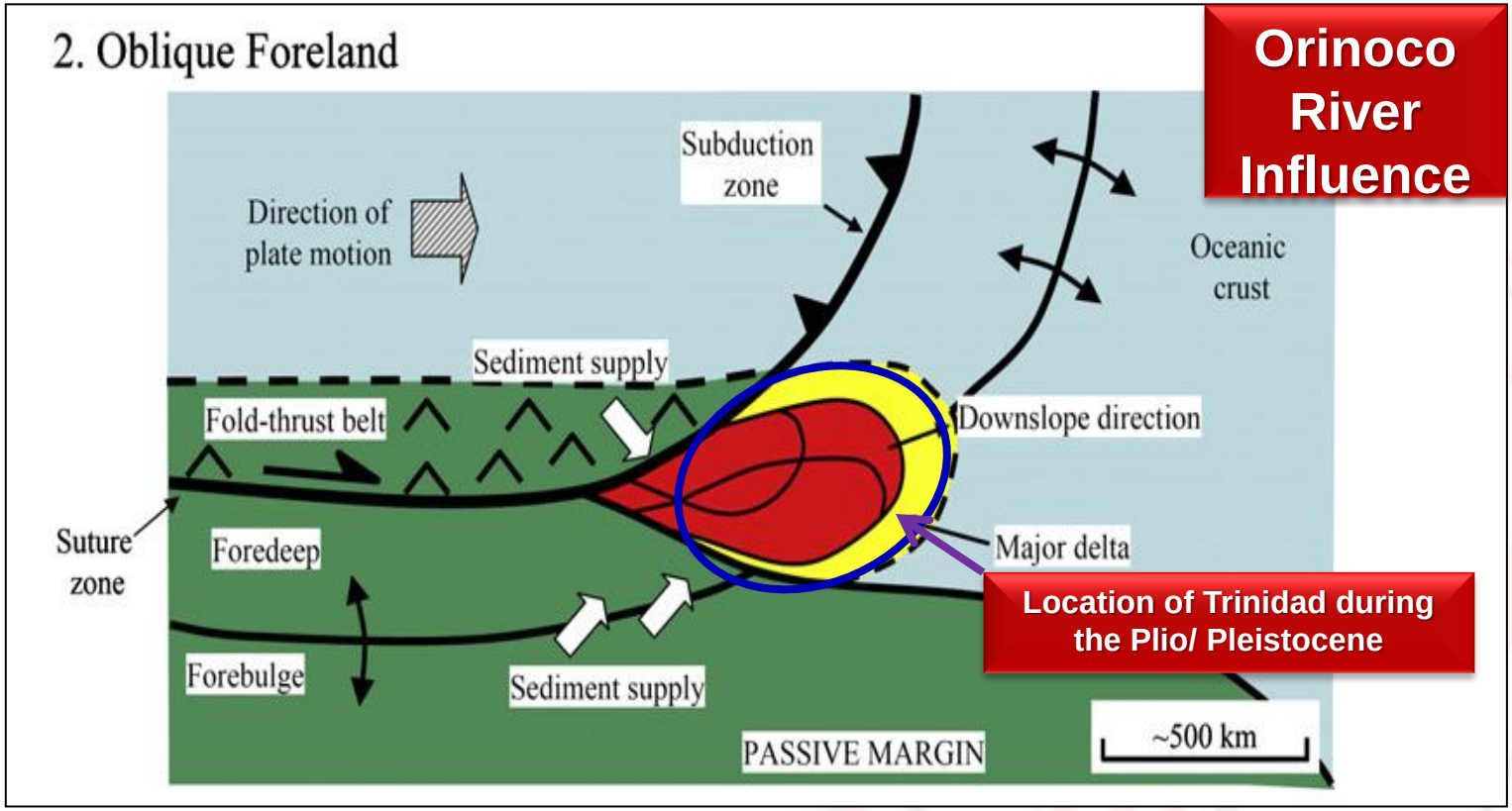


Plate reconstruction of the Caribbean plate relative to North and South America showing successive positions of the leading edge of the Caribbean plate based on ages of foreland basins (yellow) deposited on the North and South American plates: 1 = Late Cretaceous (80 Ma); 2 =Paleocene (60 Ma); 3 =middle Eocene (44 Ma); 4 = Oligocene (30 Ma); 5 = middle Miocene (14 Ma); 6 =Pliocene (5 Ma); 7 =Recent. The Columbus foreland basin in the southeastern Caribbean near Trinidad is highlighted in red.

Garciacaro et al. 2011

Cenozoic structural history: Late Miocene to Pliocene Evolution

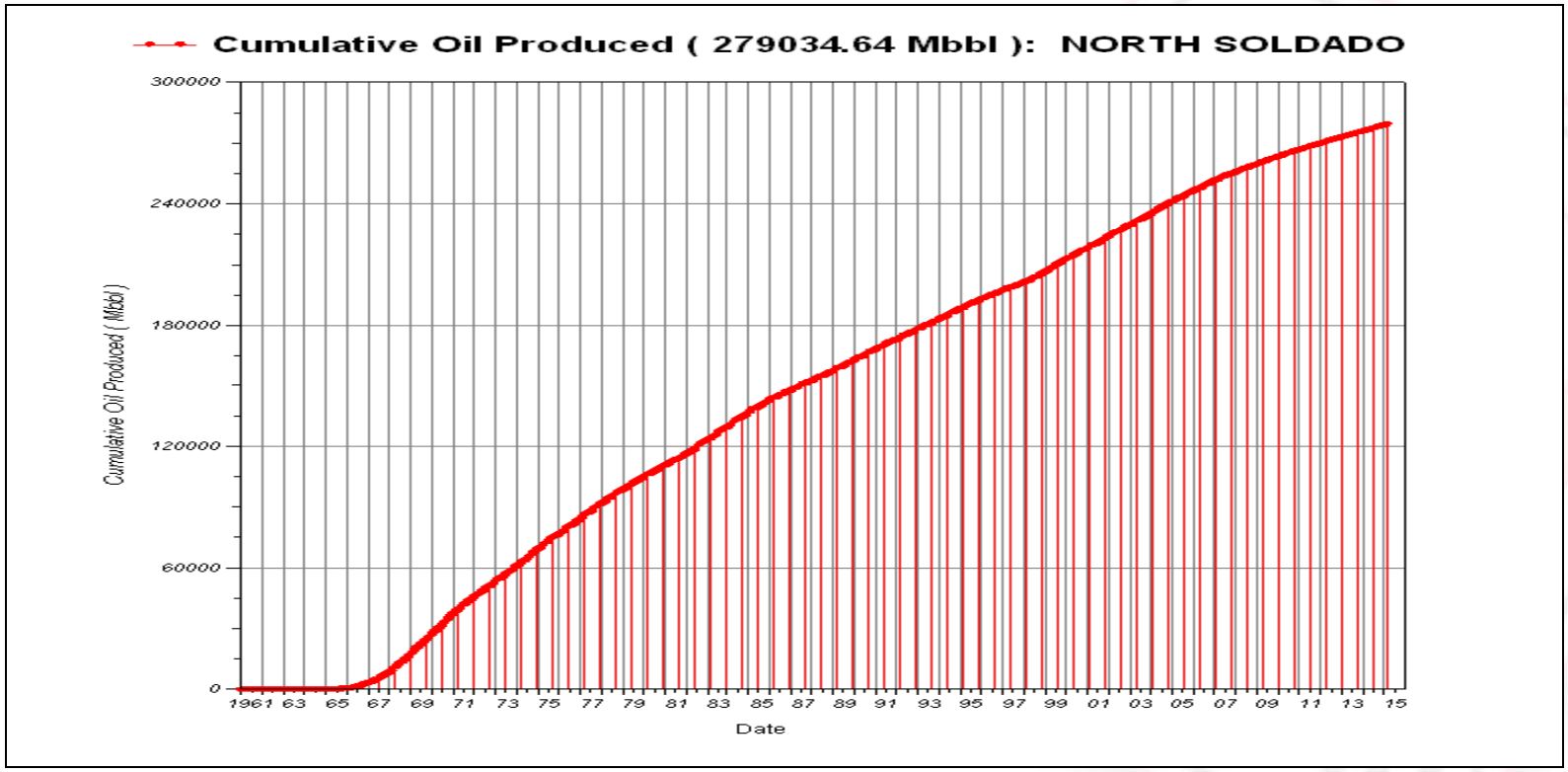


Garciacaro, et al. 2011

NORTH SOLDADO

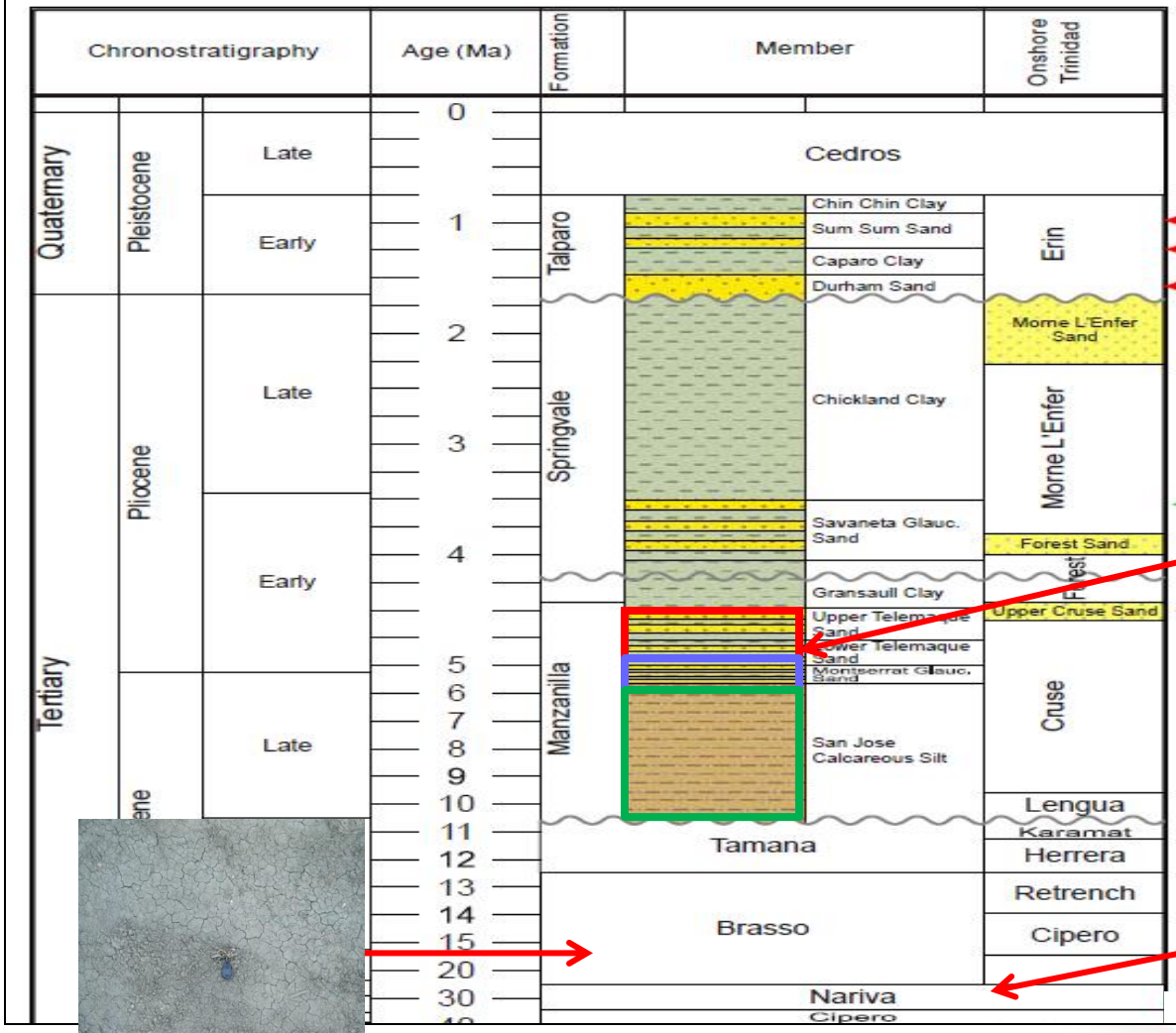
FIELD HISTORY

The prolific North Soldado Field ,discovered in 1961, has proven to be an extremely prolific field having produced over 250 million barrels of oil to date.



FIELD STRATIGRAPHY

Daniel et al. 2007



Fluvial to braided streams

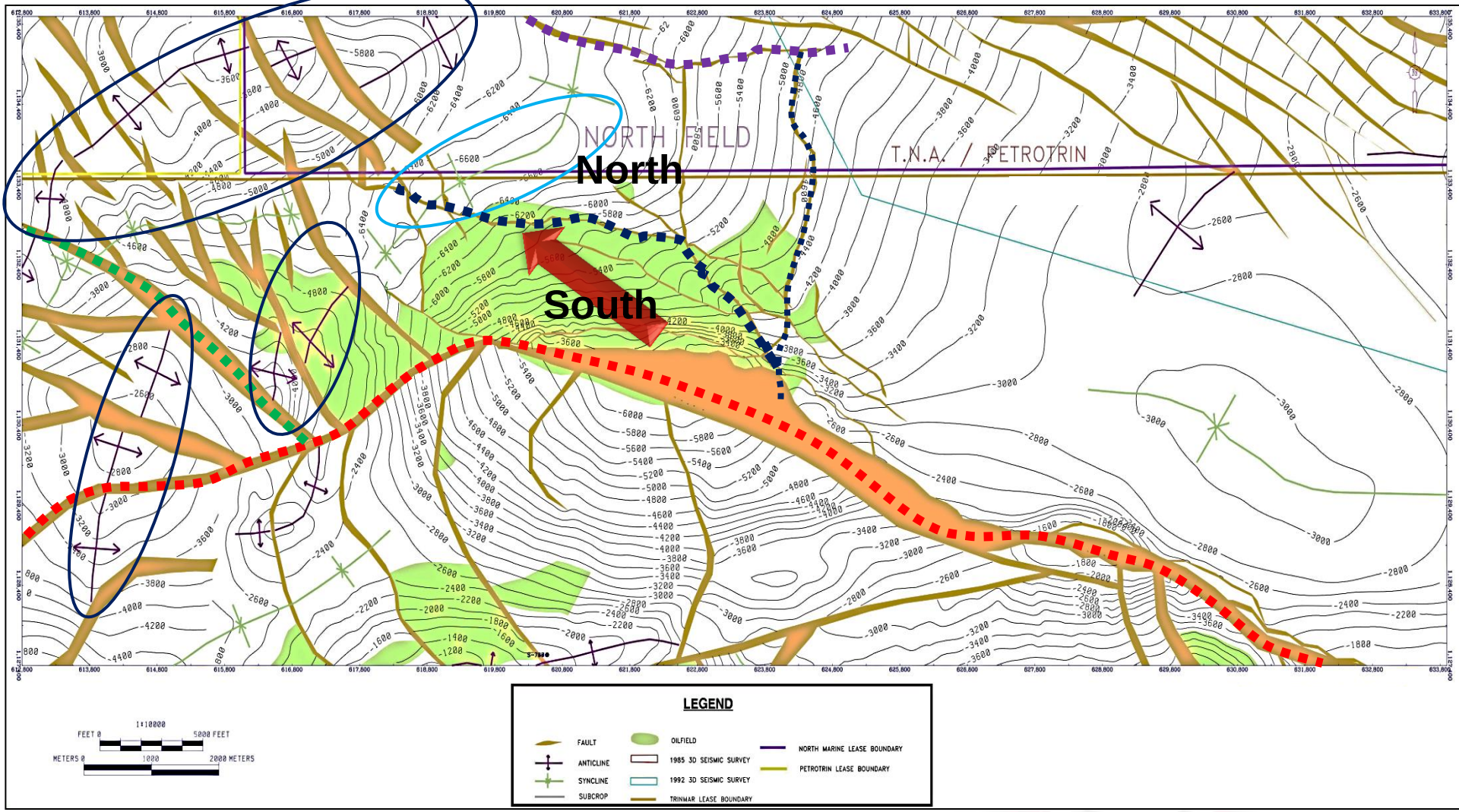
Fluvial to shallow neritic

Huggins, 2012

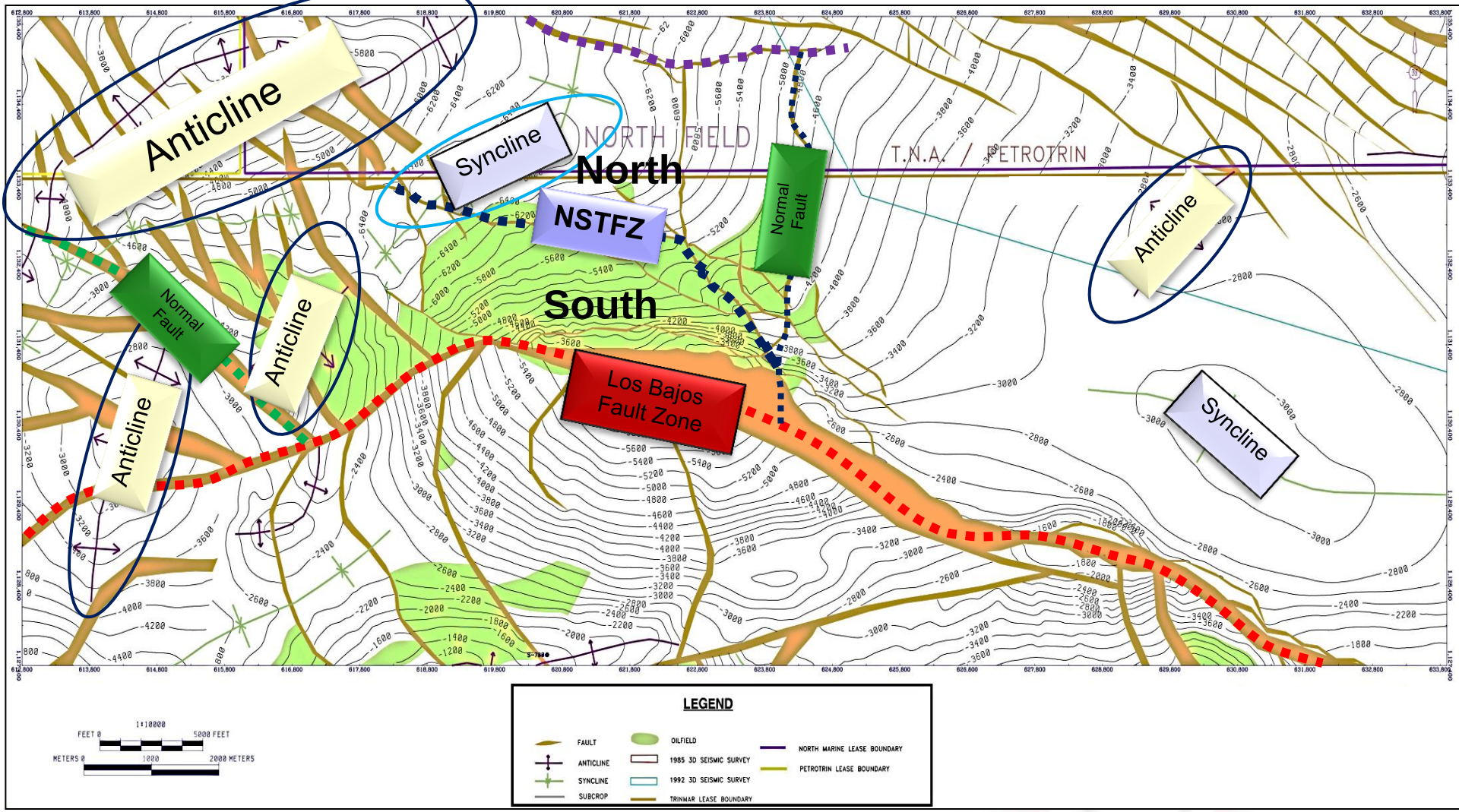
Target sands (Middle Neritic to Marginal Marine)

Vincent, 2008

NORTH SOLDADO- Top Manzanilla Structure Map



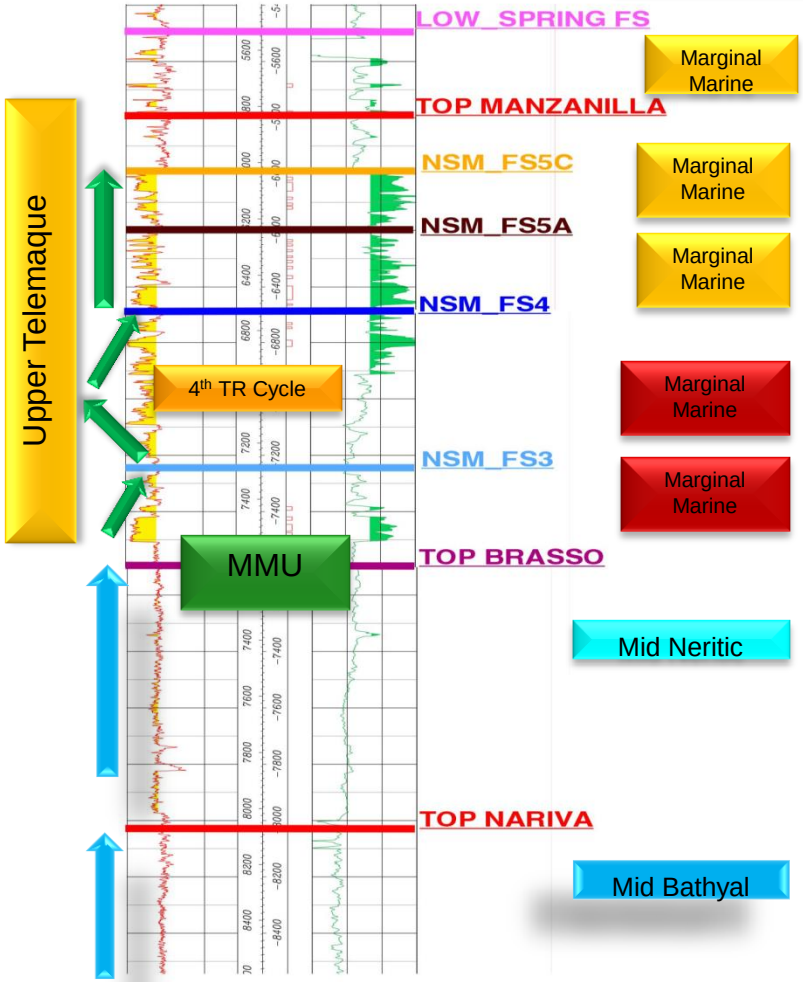
NORTH SOLDADO- Top Manzanilla Structure Map



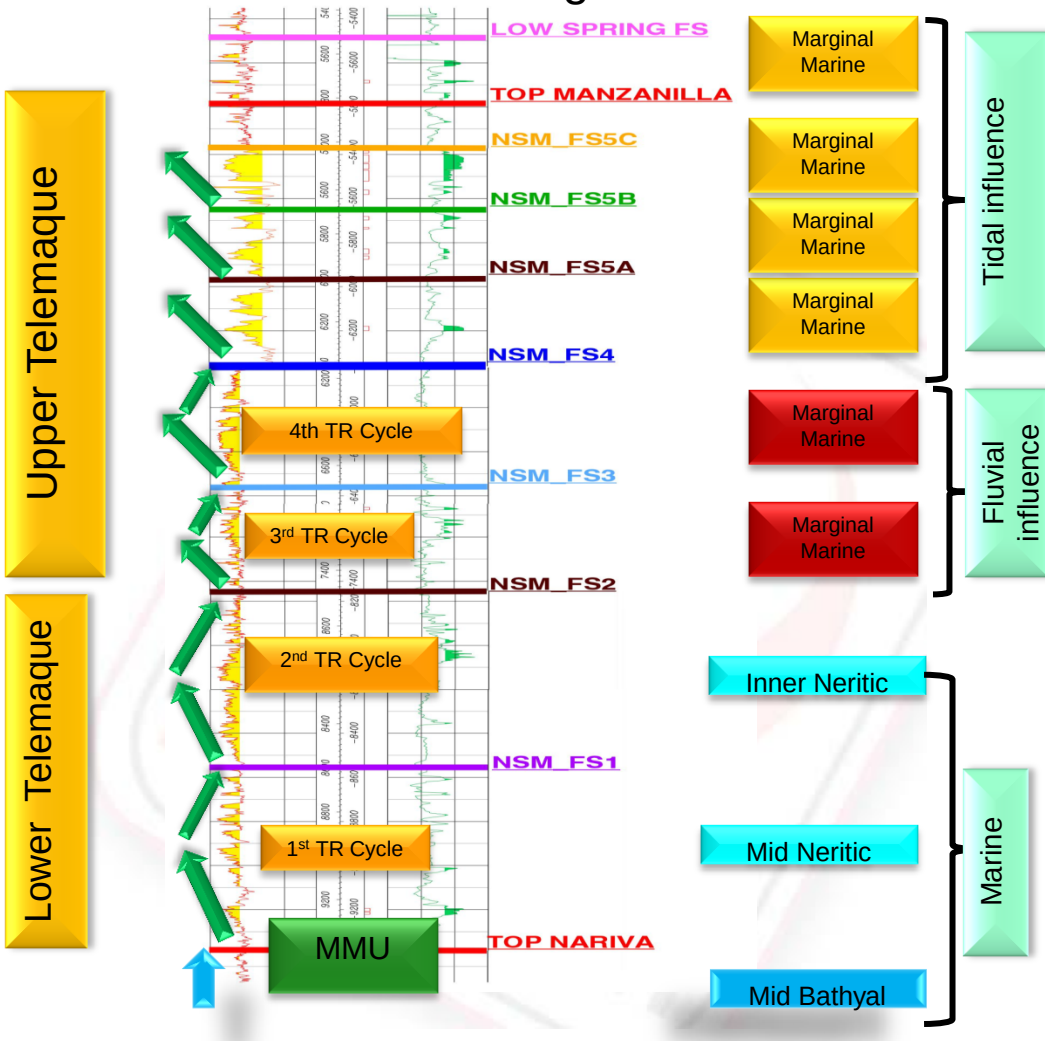
Type logs and Environments of Deposition

Segments separated by the NSTFZ

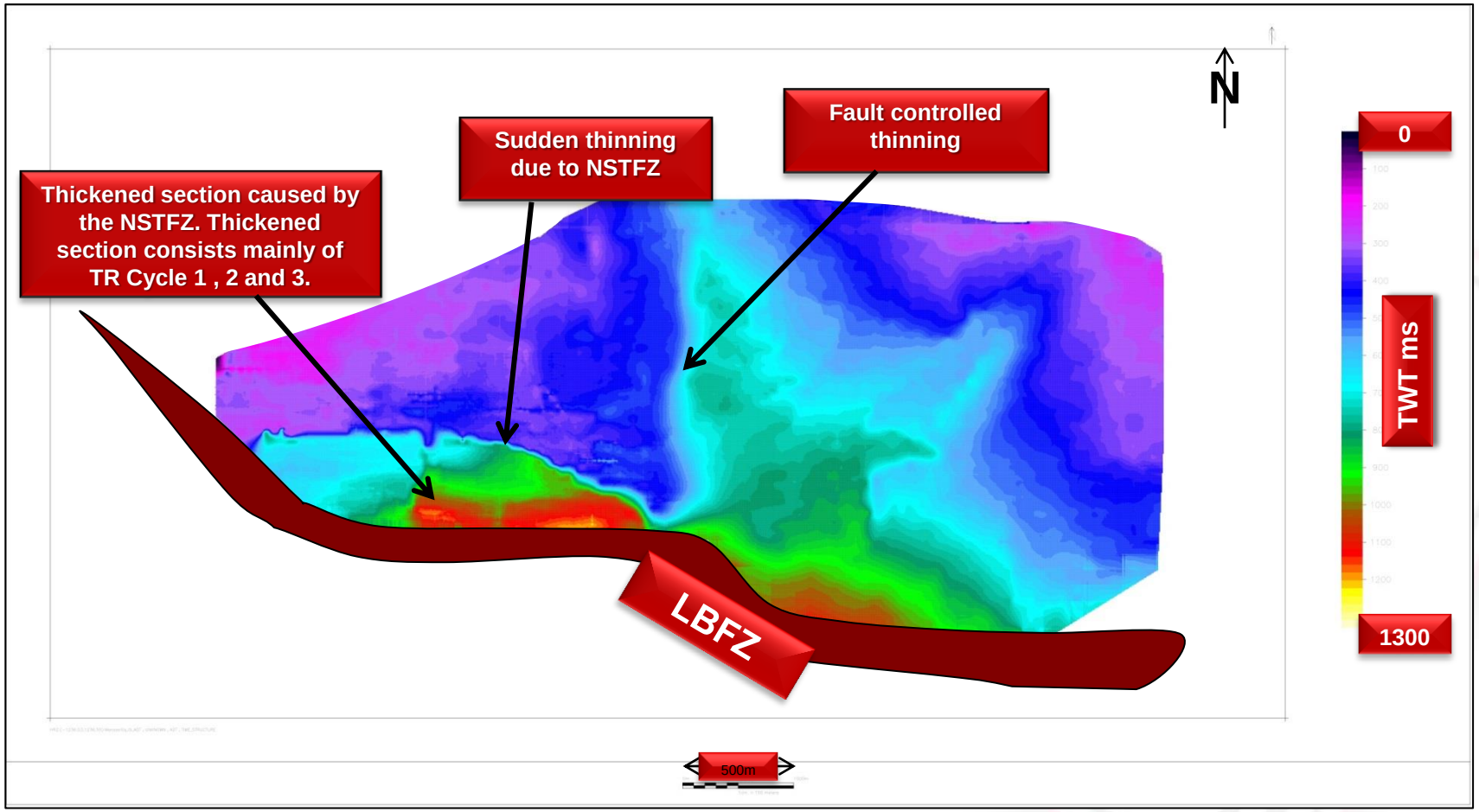
Northern Segment



Southern Segment

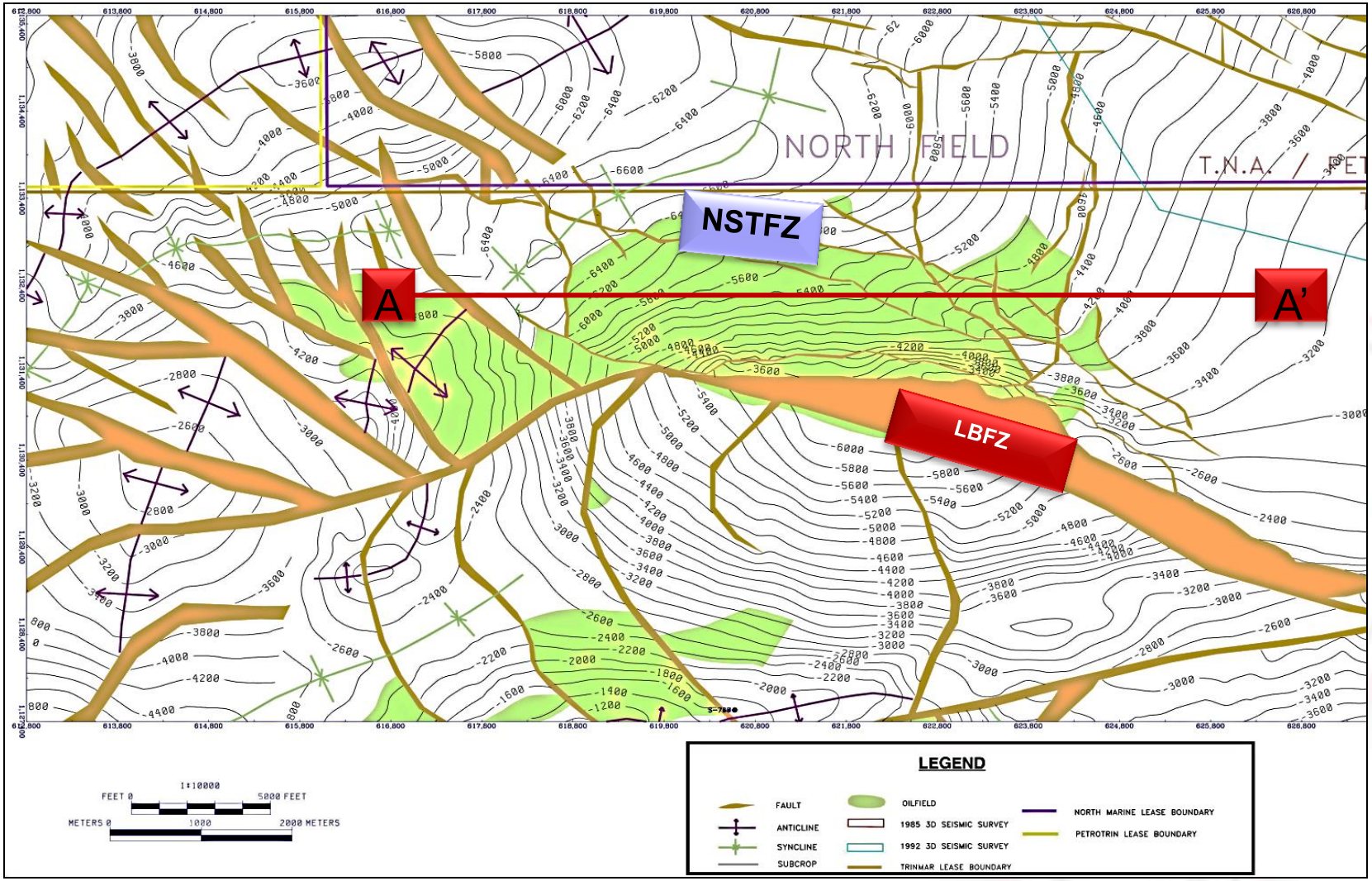


Manzanilla Formation Isochore

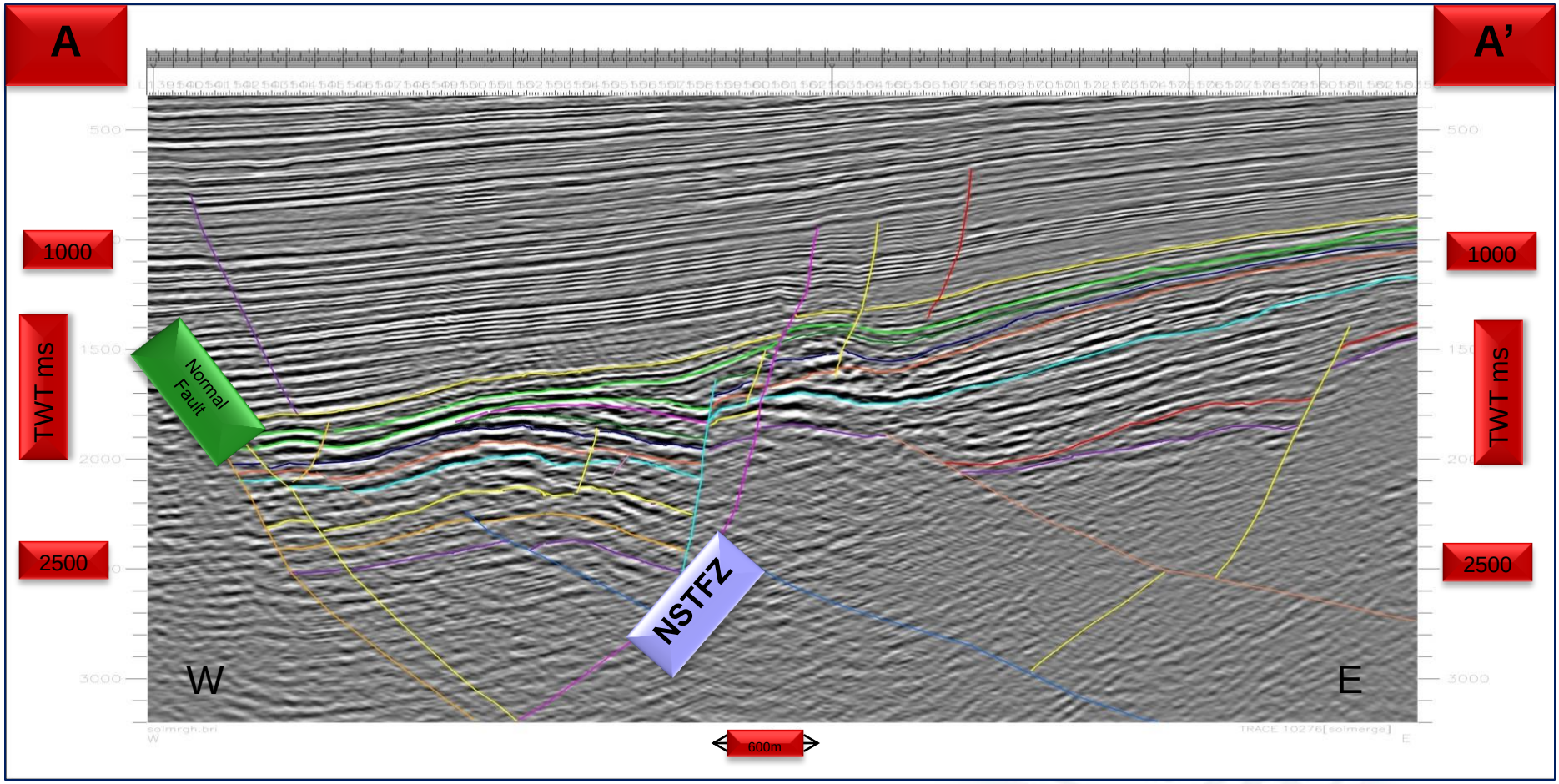


PLAY TYPE 1: UNDER-DRILLED SUB-MMU STRATIGRAPHY – NARIVA RESERVOIRS

NORTH SOLDADO TRANSECT

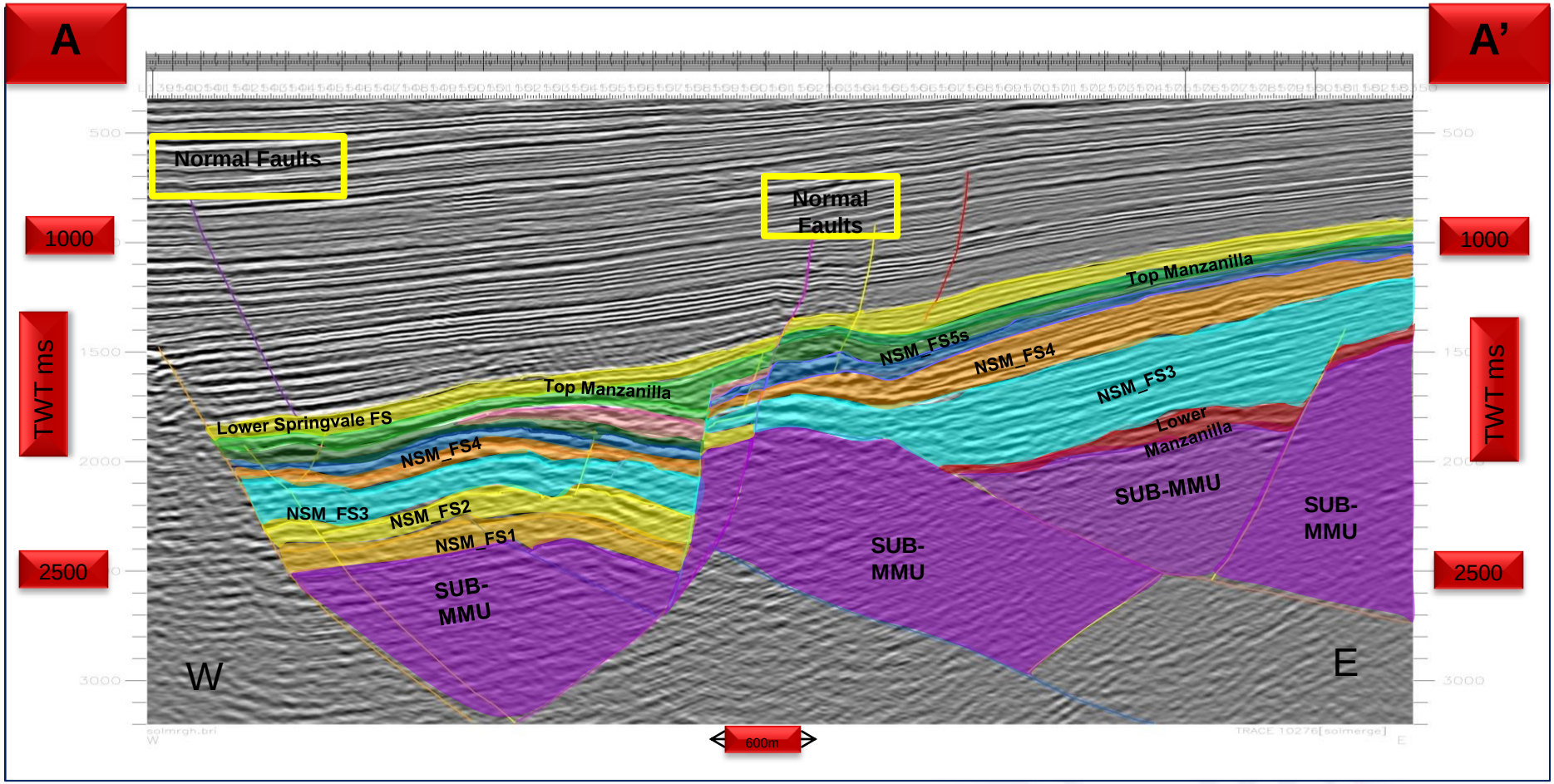


Regional Seismic line (Southern Block)



Vertical exaggeration 1:3

Regional Seismic line (Southern Block)



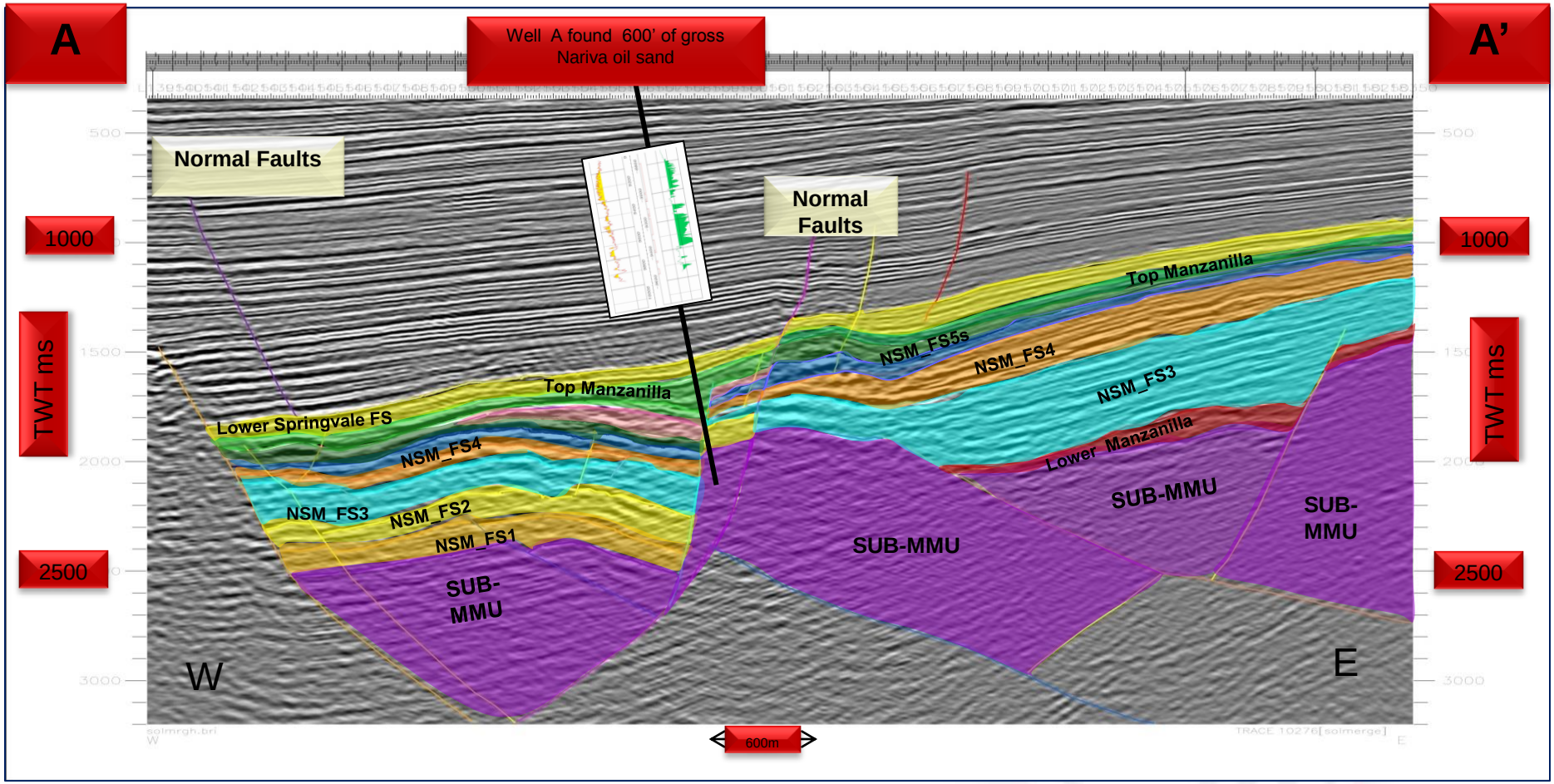
Vertical exaggeration 1:3

NARIVA TARGET RESERVOIRS

Approximately 20 years ago , one of the deep North Soldado wells drilled across the NSTFZ and encountered approximately 600’ of gross Nariva oil sand. The Narivas are interpreted to be a deep water turbidite deposit of Oligocene to Mid Miocene age. The reservoir sand had a low permeability , but the well proved a working petroleum system in the North Soldado acreage.

The Nariva oil sands produce approximately 20 km to the east in the Brighton Marine Field. This field has produced relatively large volumes of hydrocarbons within the last 30 years.

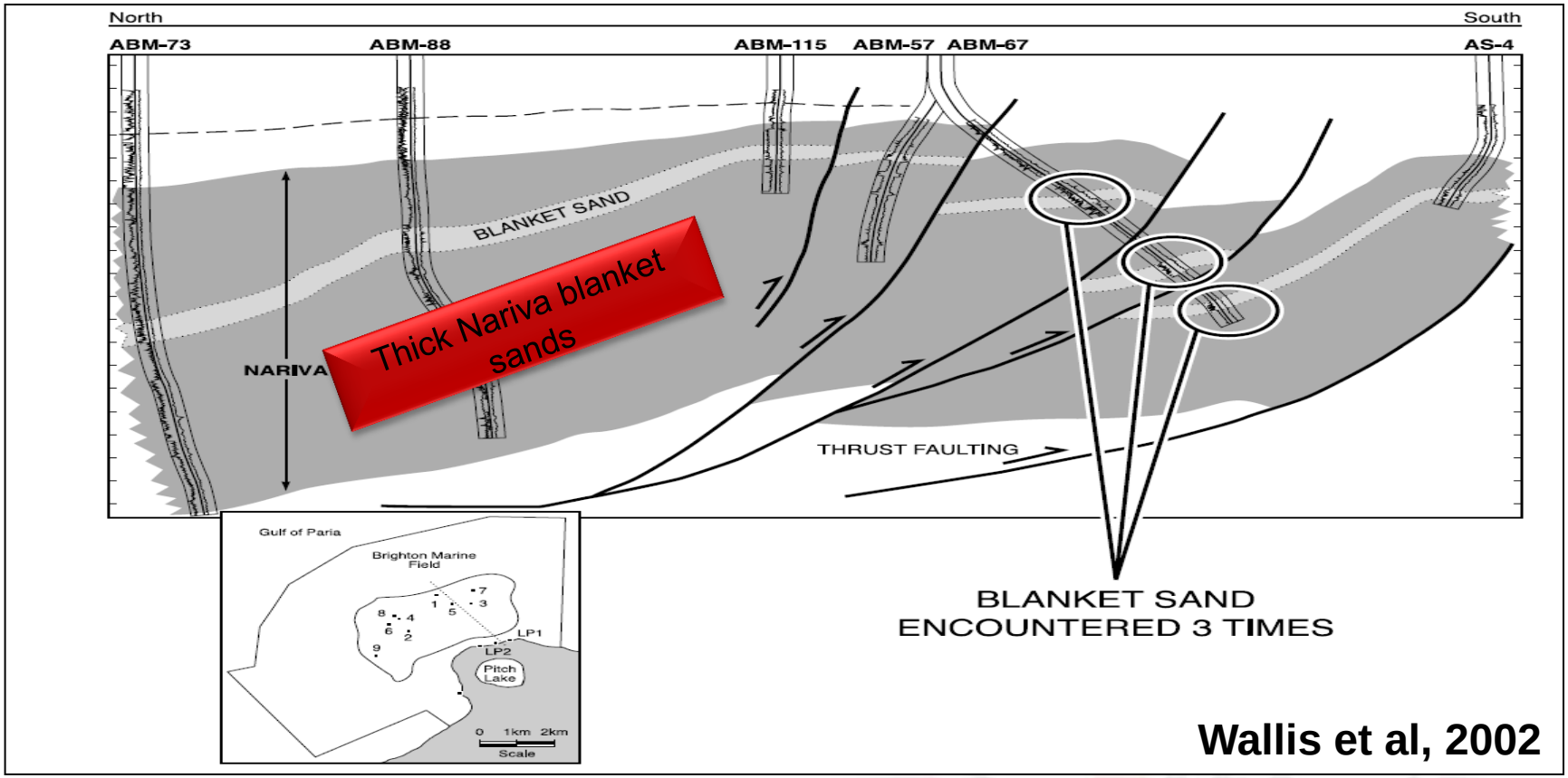
Regional Seismic line (Southern Block)



Vertical exaggeration 1:3

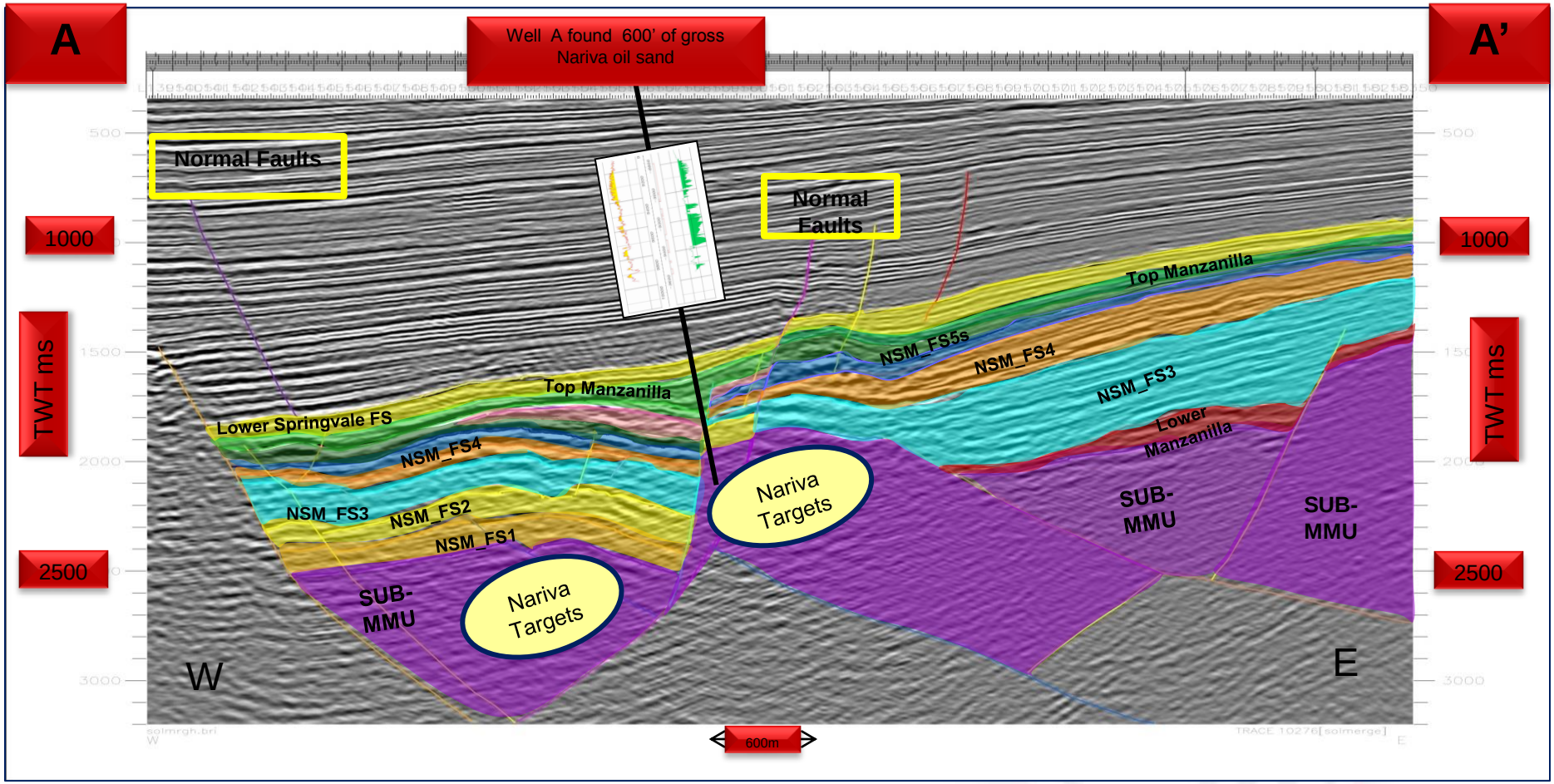
Nariva Analogue:

Brighton Marine Field, Trinidad



Wallis et al, 2002

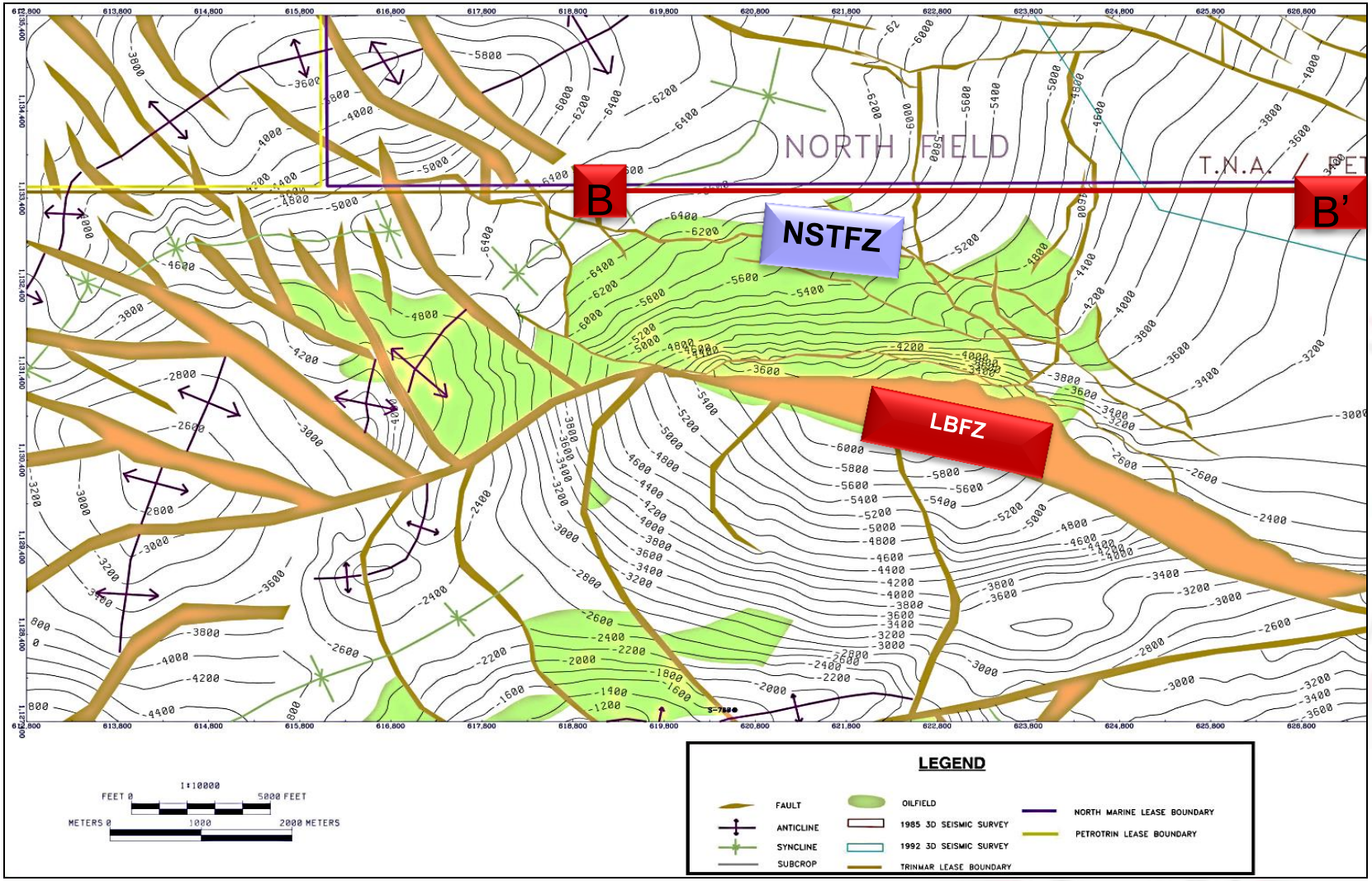
Regional Seismic line (Southern Block)



Vertical exaggeration 1:3

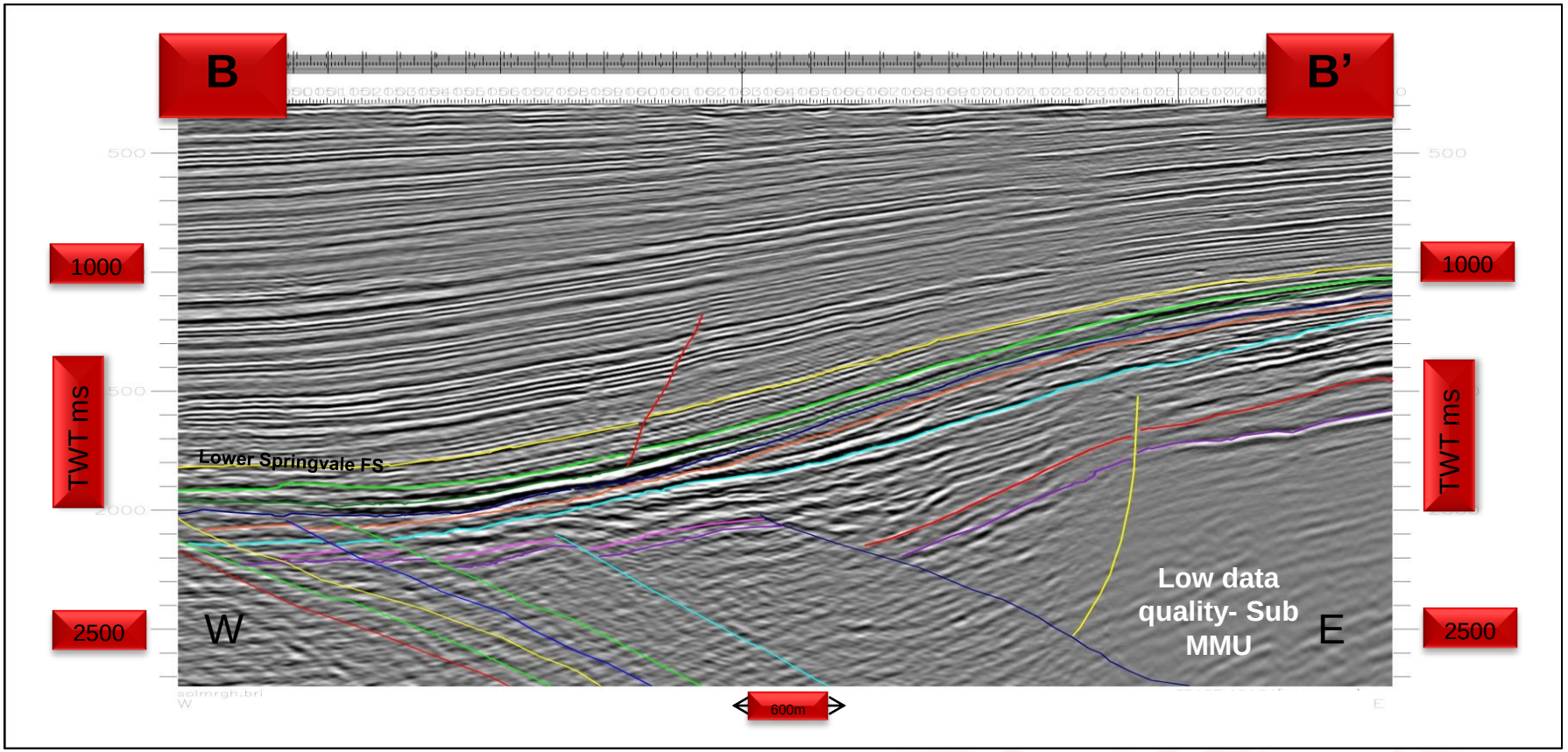
PLAY TYPE 2: UNDER-DRILLED DELTA FRONT STRATIGRAPHY – MANZANILLA RESERVOIRS

NORTH SOLDADO TRANSECT



Seismic Cross Section

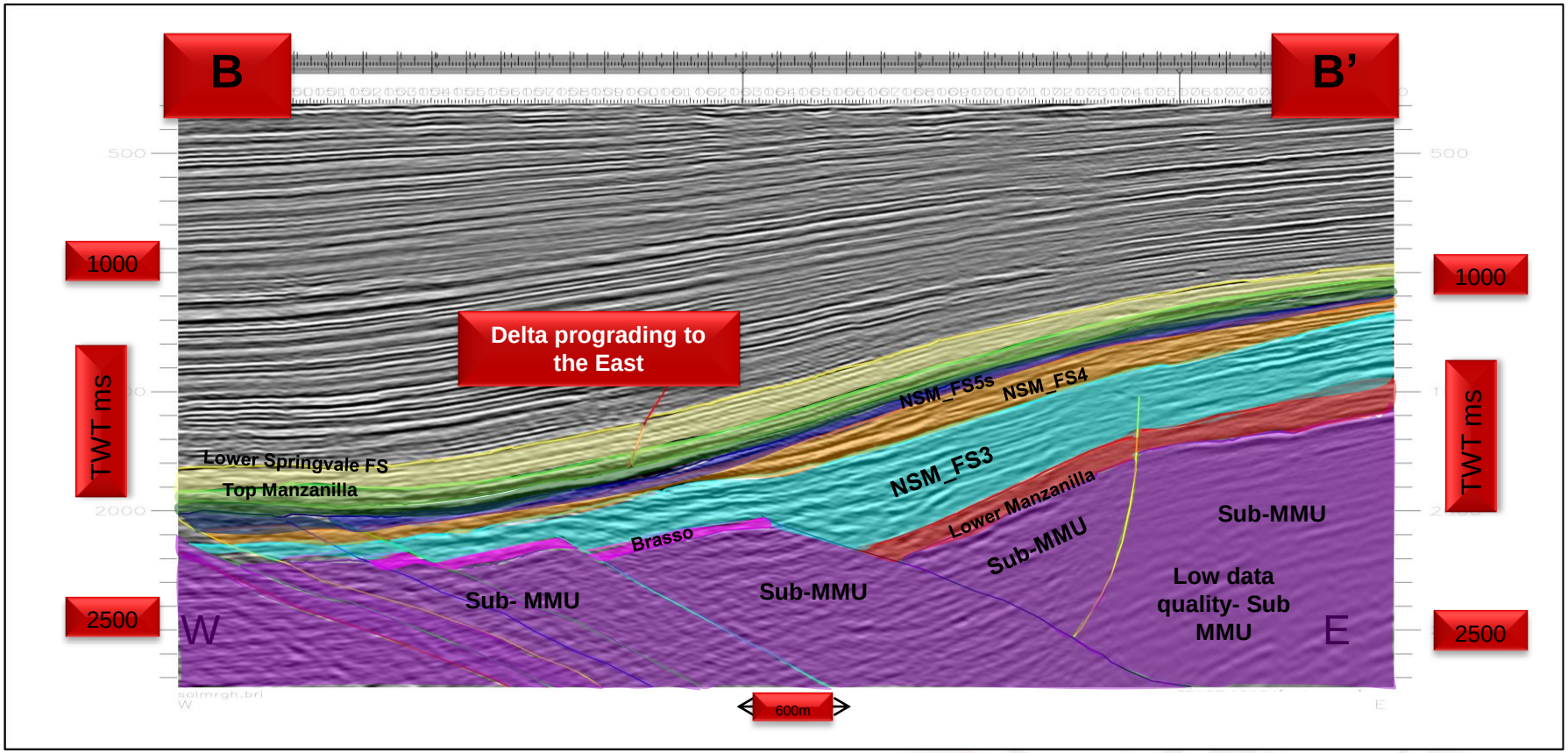
Northern block- Uninterpreted



Vertical exaggeration 1:3

Seismic Cross Section

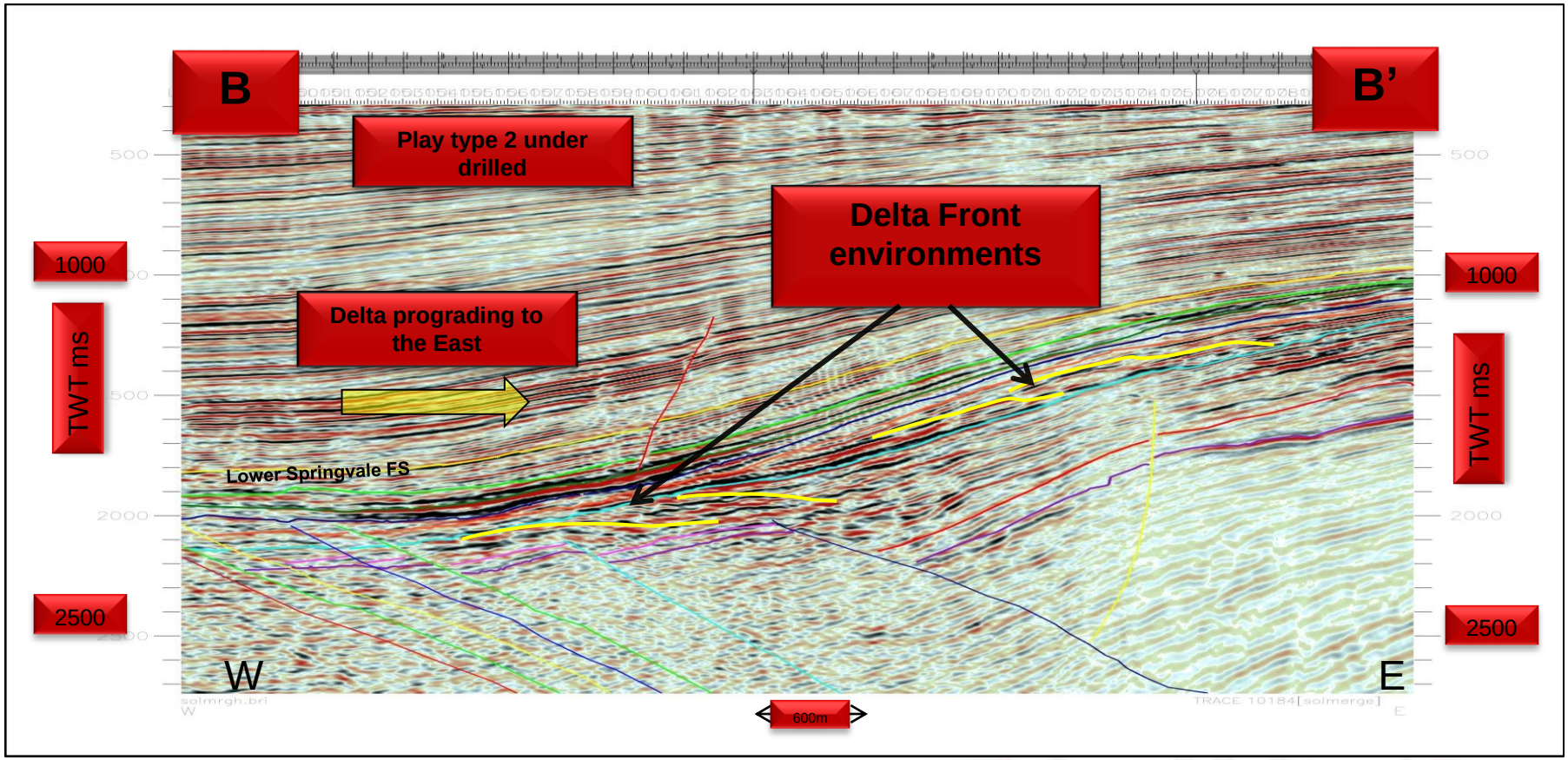
Northern block (Stratigraphic Play)



Vertical exaggeration 1:3

Seismic Cross Section

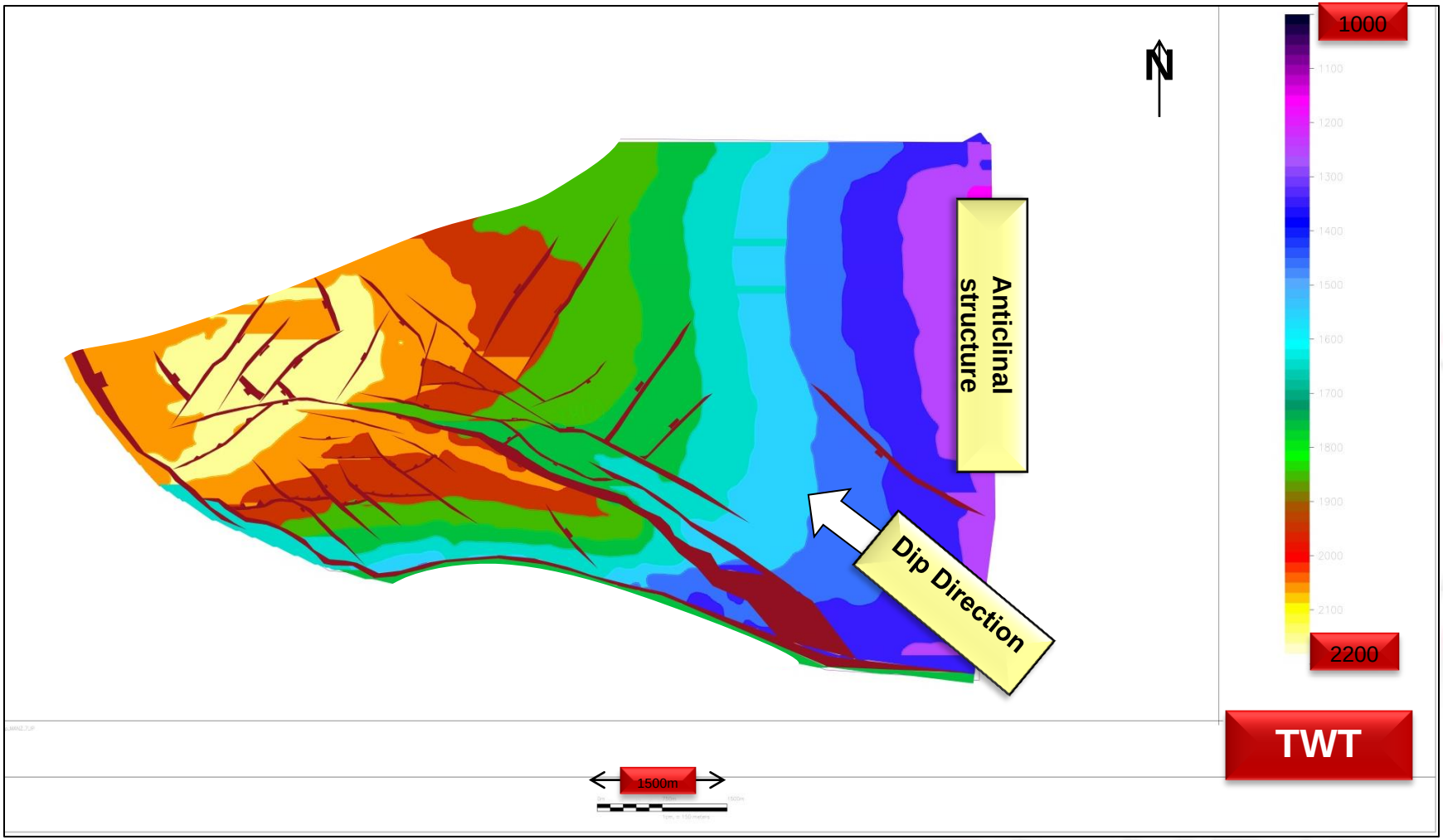
(Northern block) Stratigraphy Play



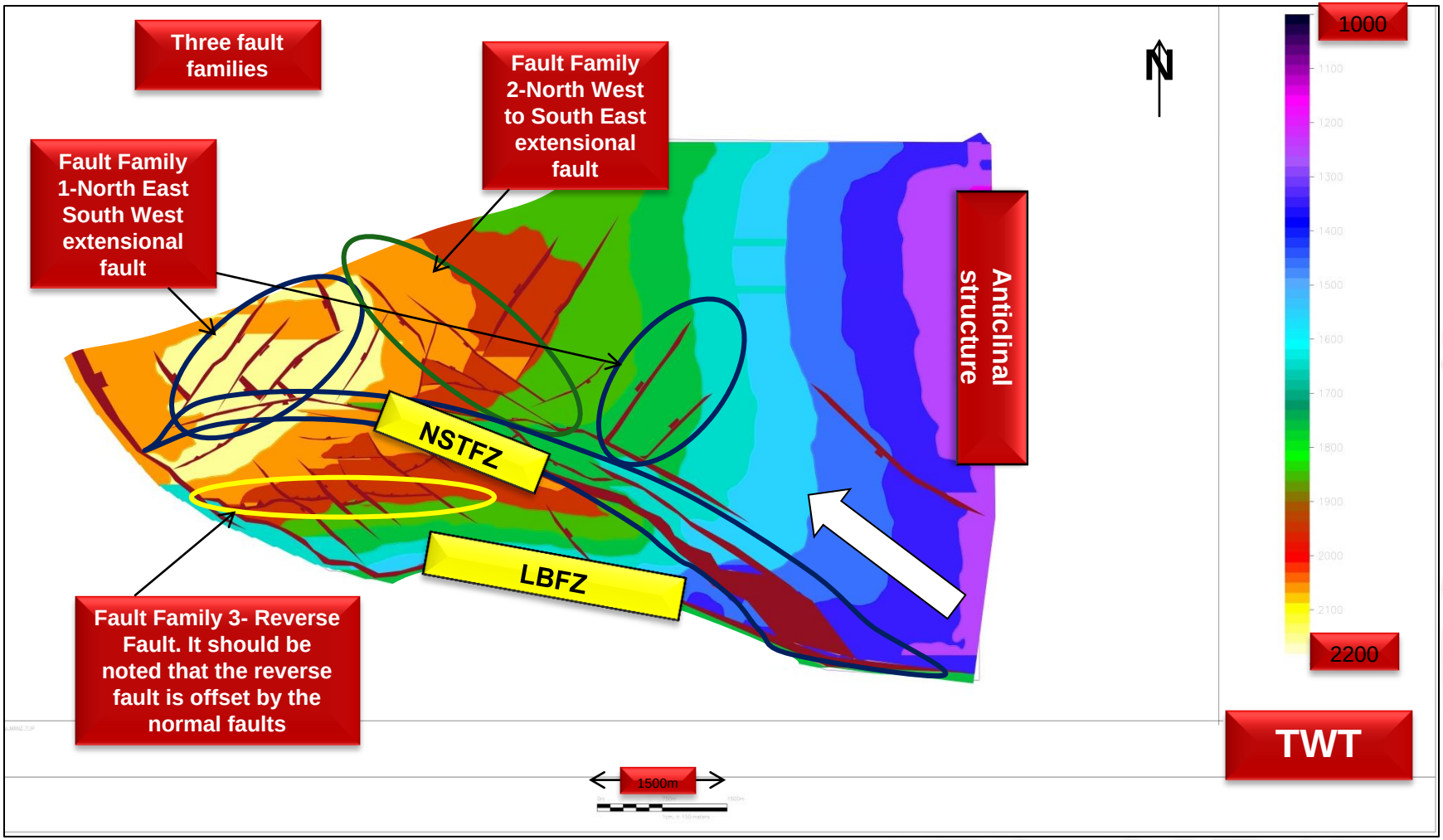
Vertical exaggeration 1:3

PLAY TYPE 3: UNDER-DRILLED LOWER TELEMAQUE (NSM_FS3) RESERVOIRS

NSM_FS3 Structure Map

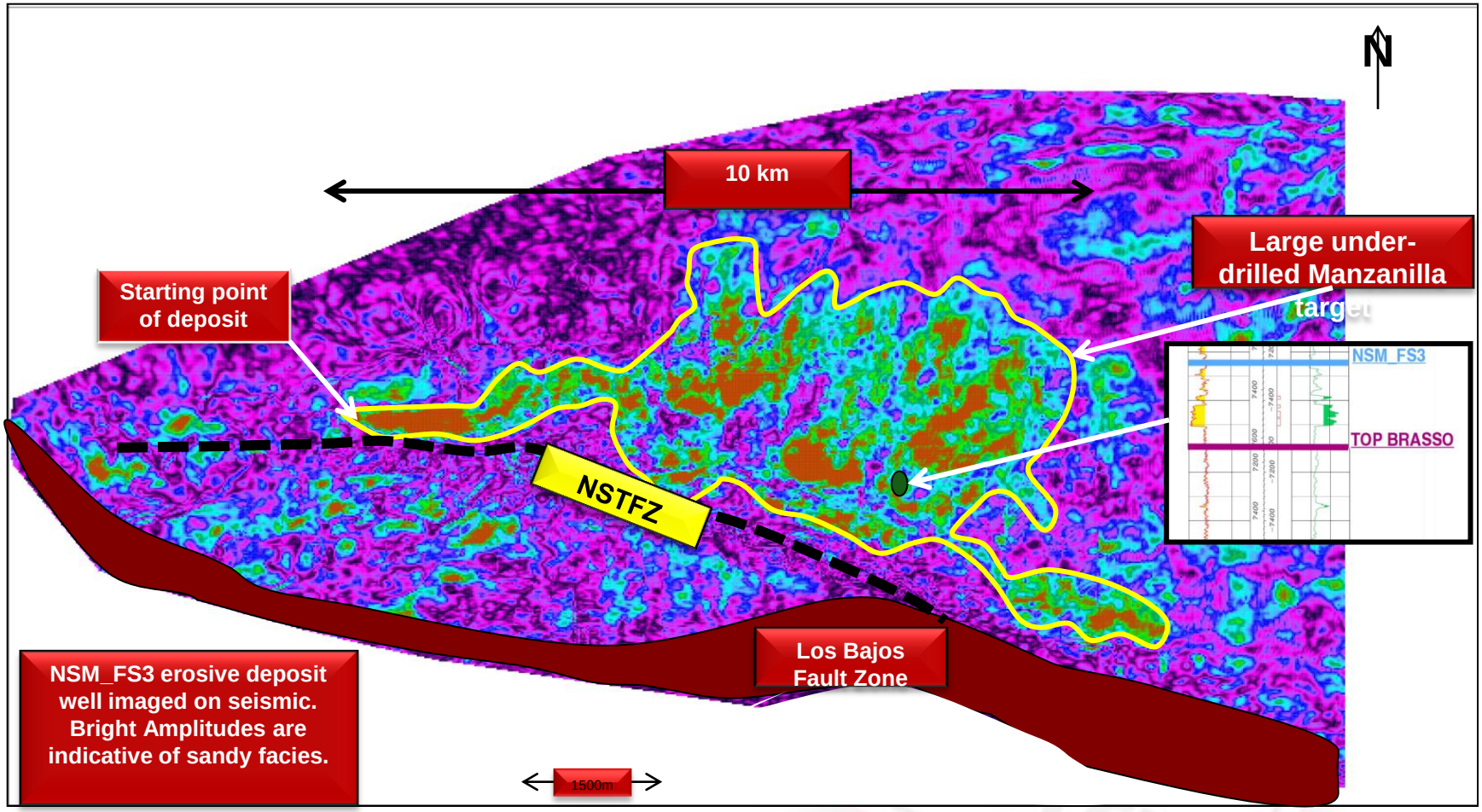


NSM_FS3 Structure Map



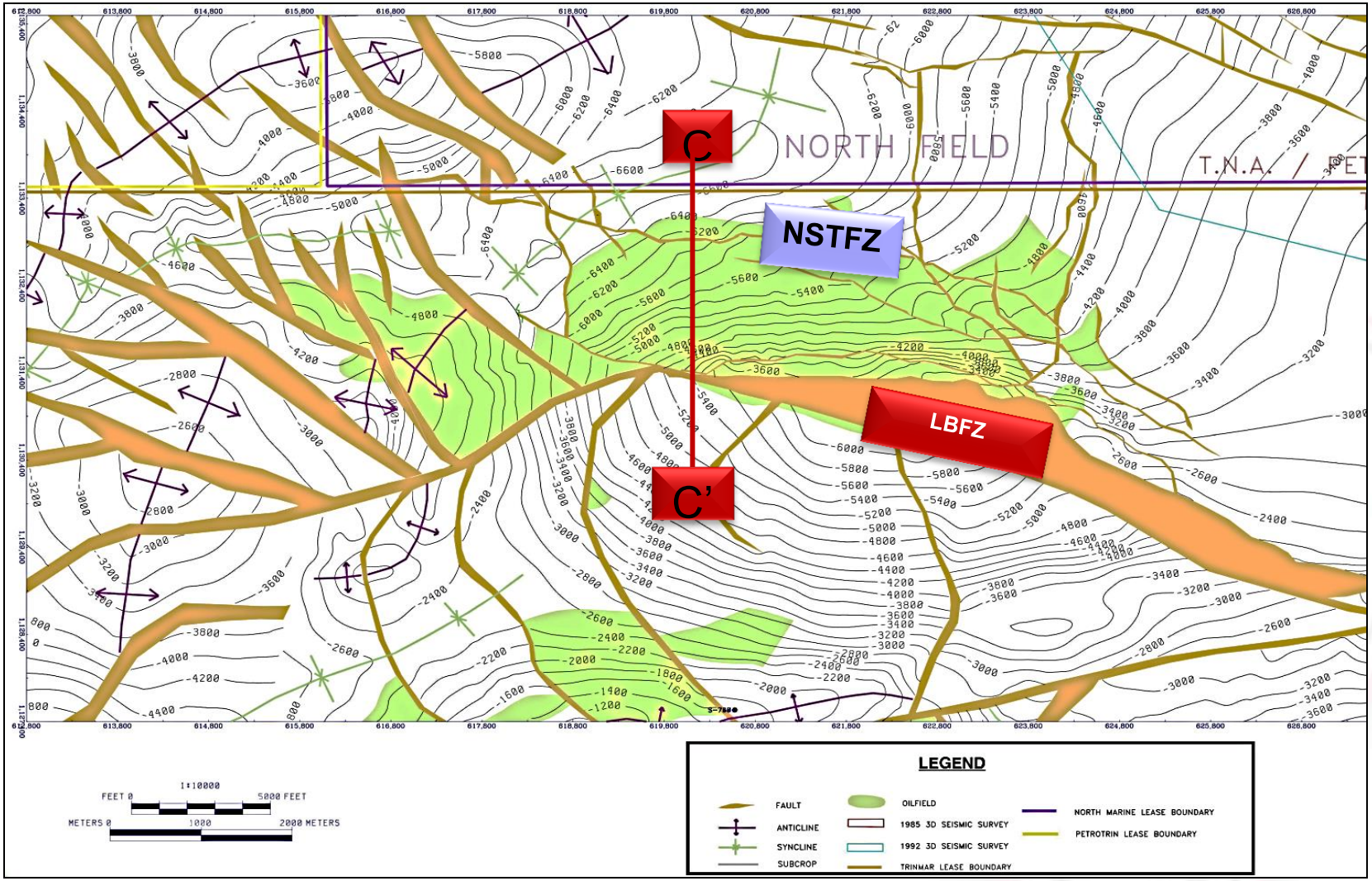
RMS- Extraction NSM_FS3

(8 ms window)- red colours are larger amplitude values and purple are the lowest

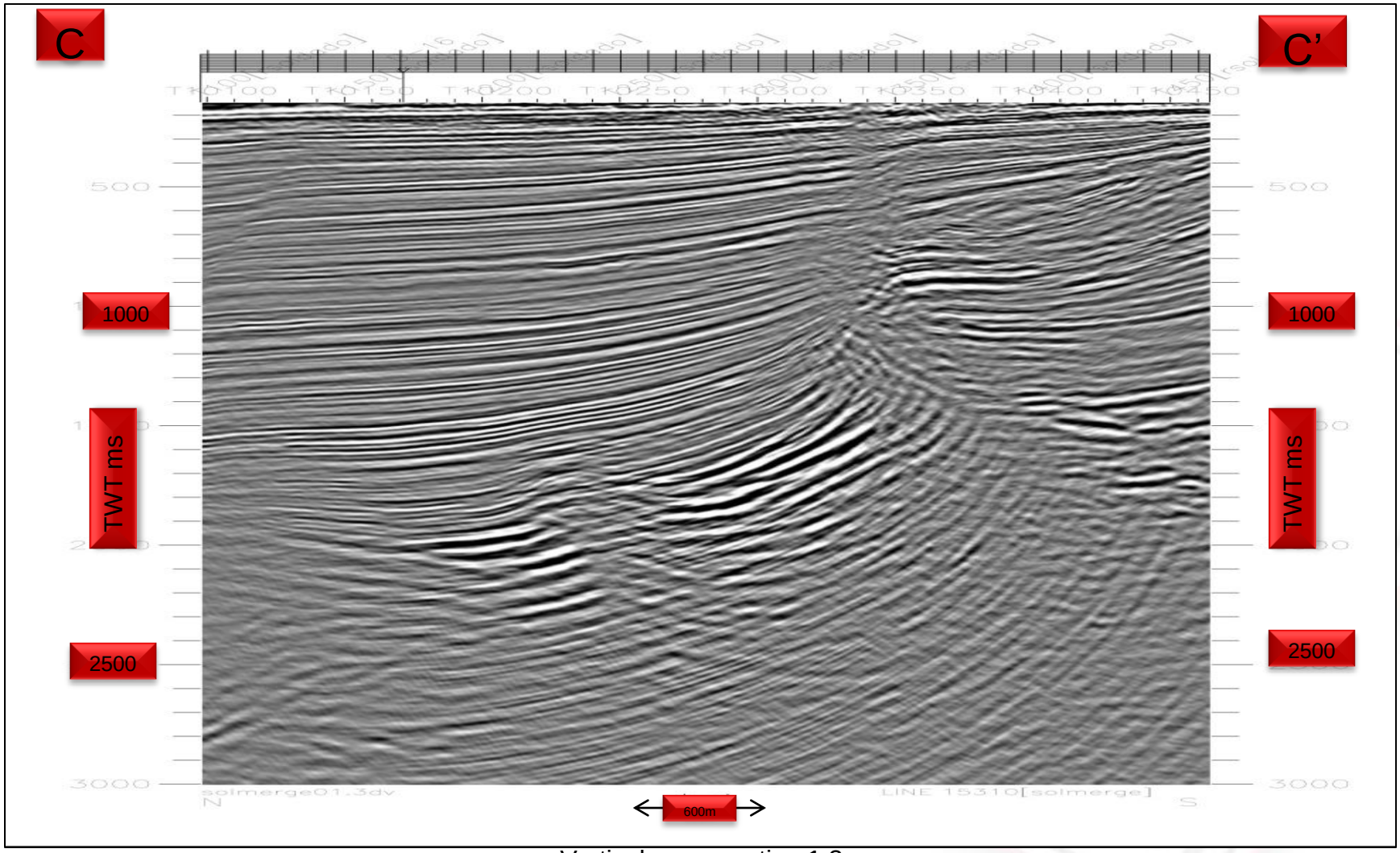


SOMETHING INTERSTING: FLOWER STRUCTURE (NSTFZ) EVOLUTION

North Soldado Transect

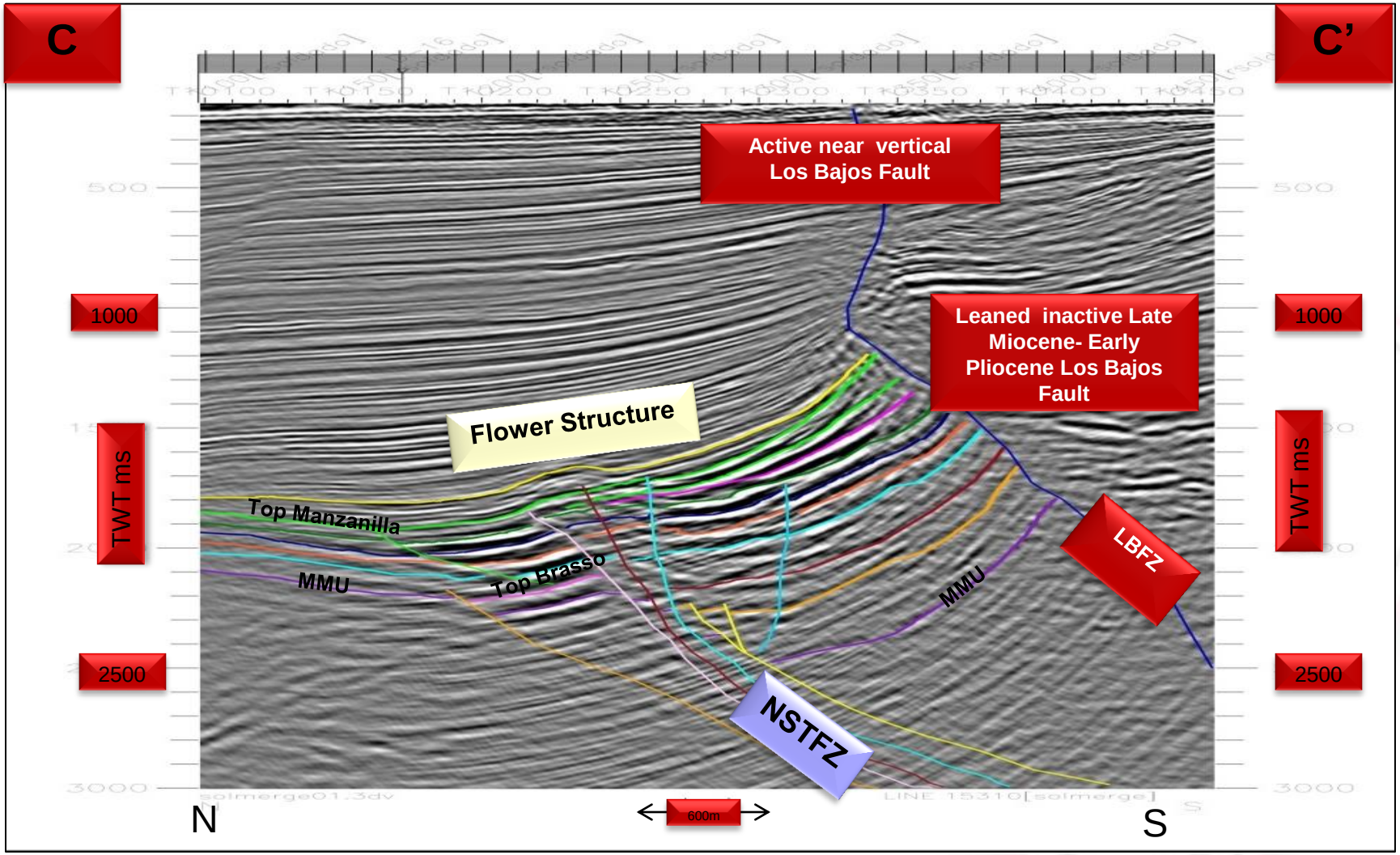


North Soldado – Uninterpreted line



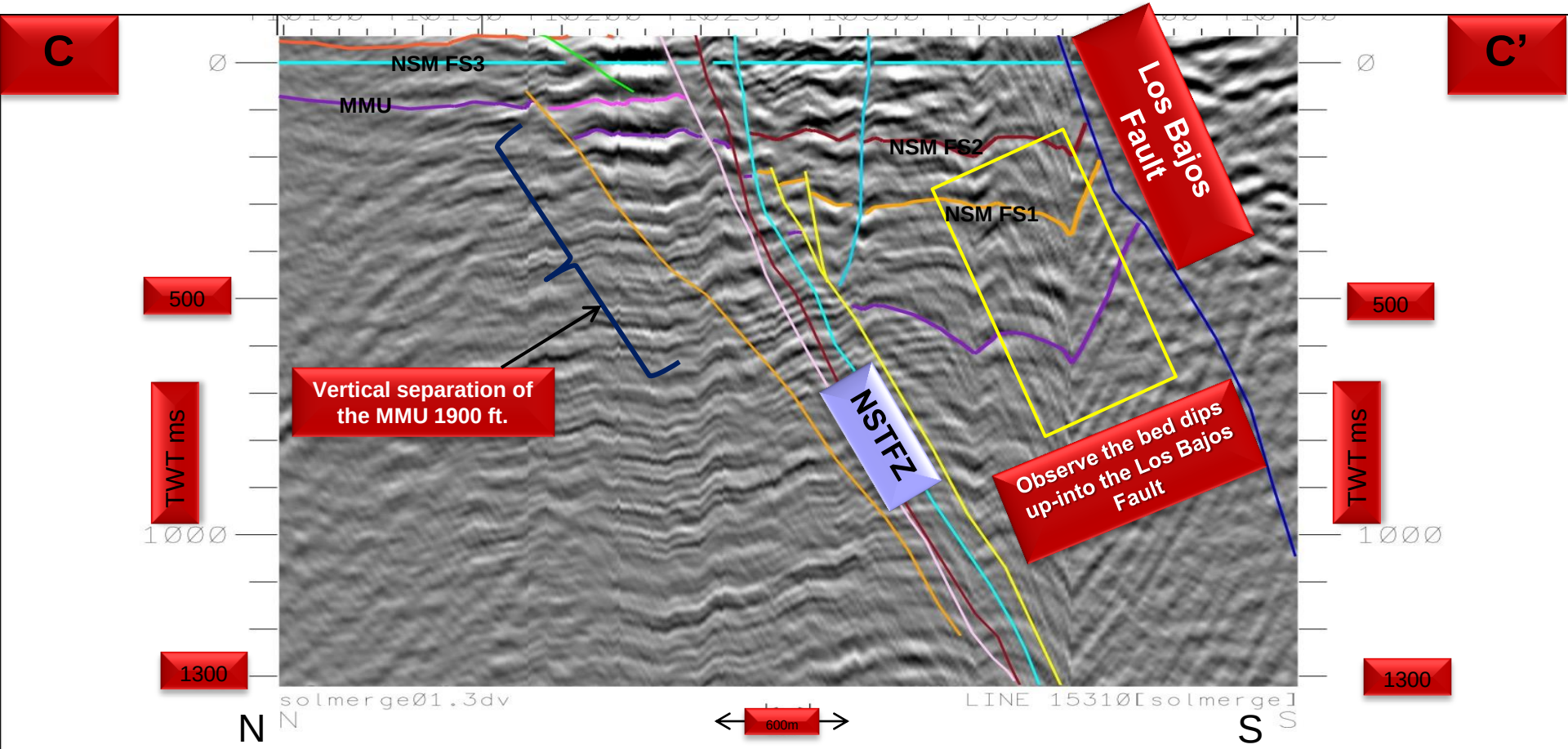
Vertical exaggeration 1:3

Miocene to Pliocene aged Flower Structure



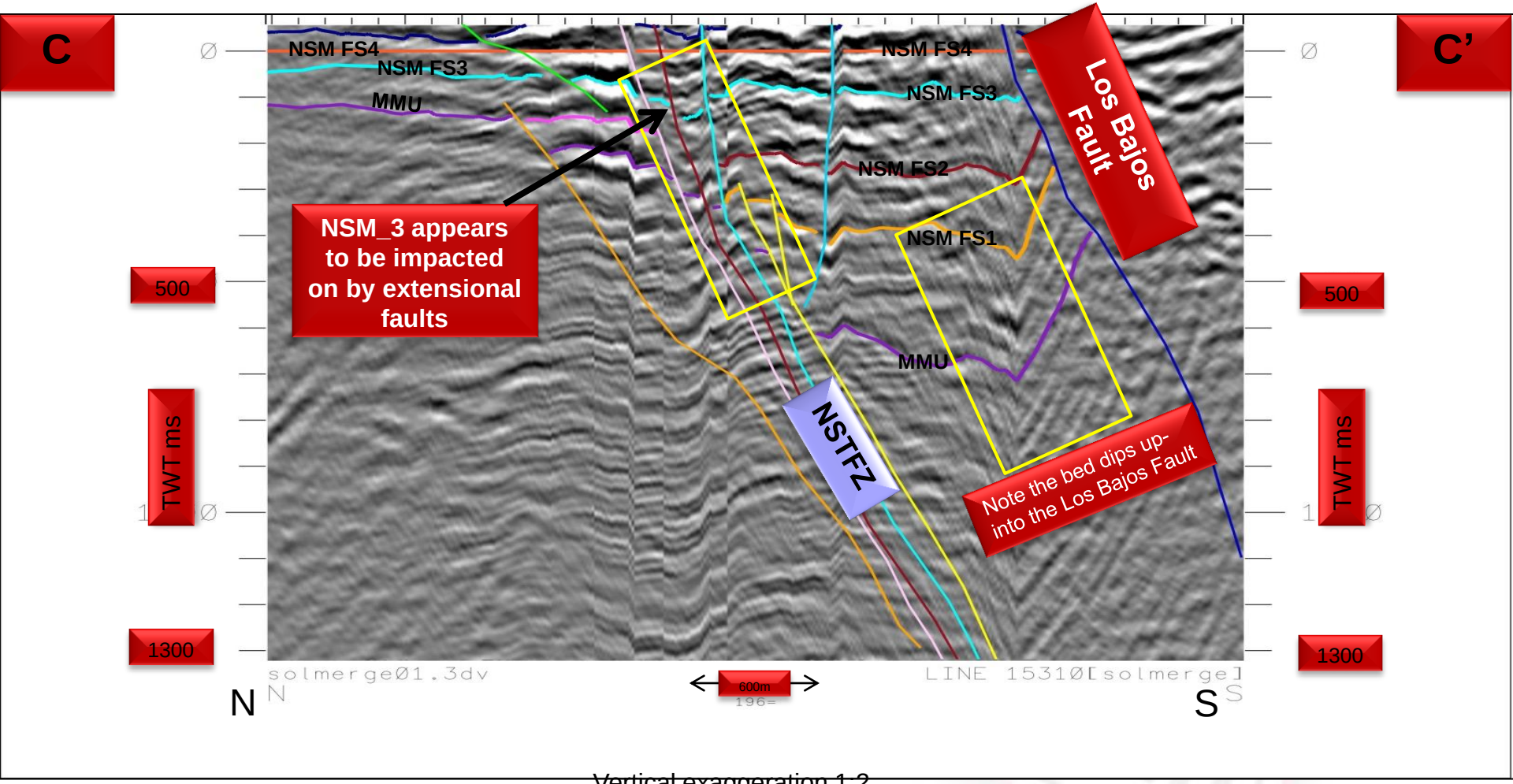
Vertical exaggeration 1:3

Flower Structure Evolution - Flattened on NSM FS3



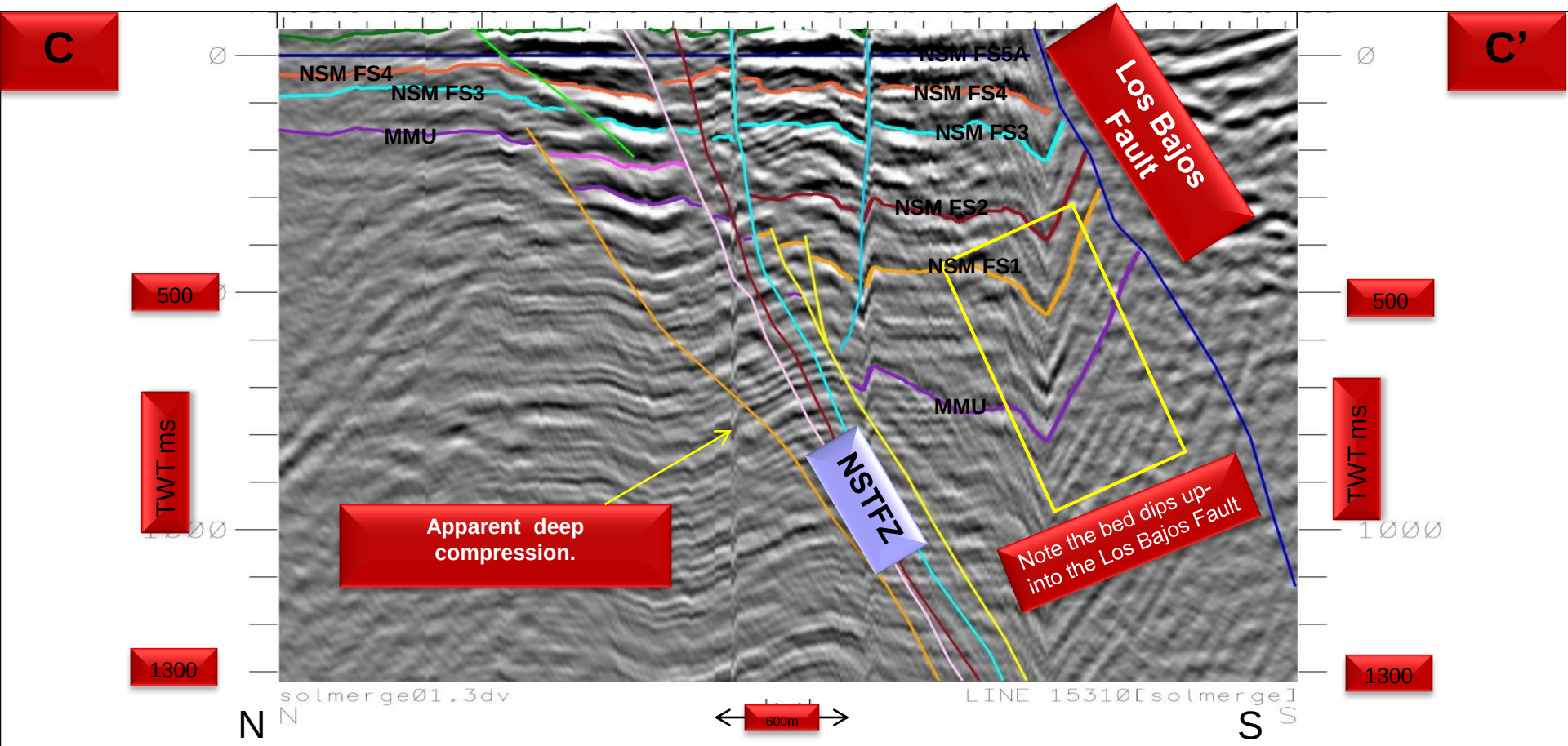
Vertical exaggeration 1:2

Flower Structure Evolution - Flattened on the NSM FS 4



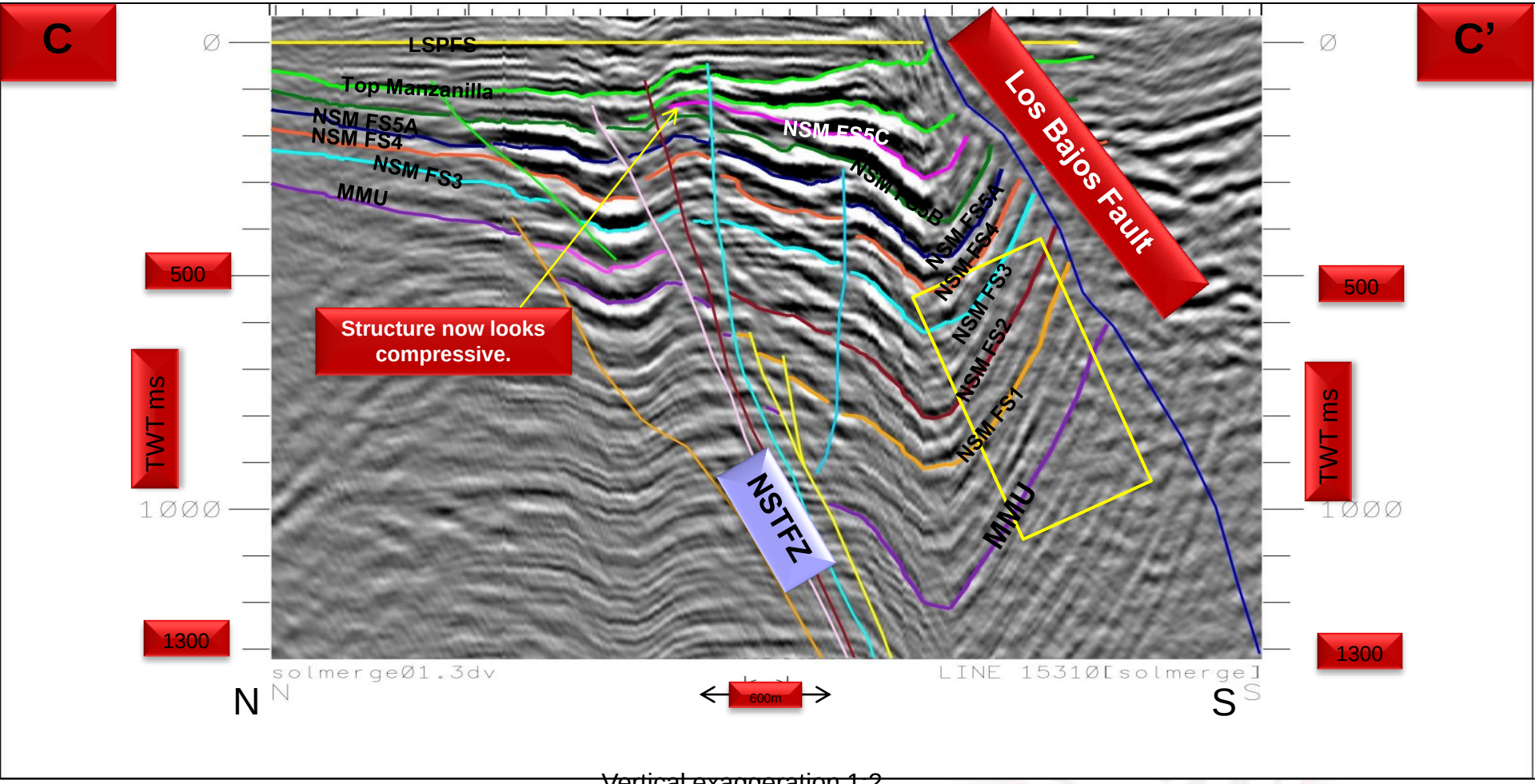
Vertical exaggeration 1.2

Flower Structure Evolution - Flattened on the NSM FS 5A



Vertical exaggeration 1.2

Flower Structure- Flattened on the Lower Springvale Flooding surface



Vertical exaggeration 1.2

SUMMARY

- The North Soldado Field, within the Gulf of Paria Trinidad and Tobago, contains the prolific Telemaque member of the Manzanilla Fm. which are Mio-Pliocene deposits ranging from neritic to marginal marine sandstones.

- The major structural elements within the field are the LBFZ (Los Bajos Fault Zone) to the south and the NSTFZ (North Soldado Transtensive Fault Zone) , which segments the field into two. A northern half and a southern half. Within the Northern half, the Manzanilla Fm. rests unconformable on the Brasso Fm. In the Southern half, the Manzanilla Fm. rest on the Nariva Fm. The NSTFZ ties into the LBFZ at depth. The NSTFZ is mapped here as flower structure impacting the Manzanilla Fm, but not the overlying Springvale Fm. indicating that its genesis and evolution is directly linked to the deposition of the Manzanilla Fm.

- The Field has three fault families. A pair of northwest – southeast and northeast-southwest (possibly conjugate) extensional faults and older, less common ,east – west reverse faults.

SUMMARY

- Seismically there appears to be a link between rms amplitude extractions and lithology assisting geoscientists with gross sand maps.

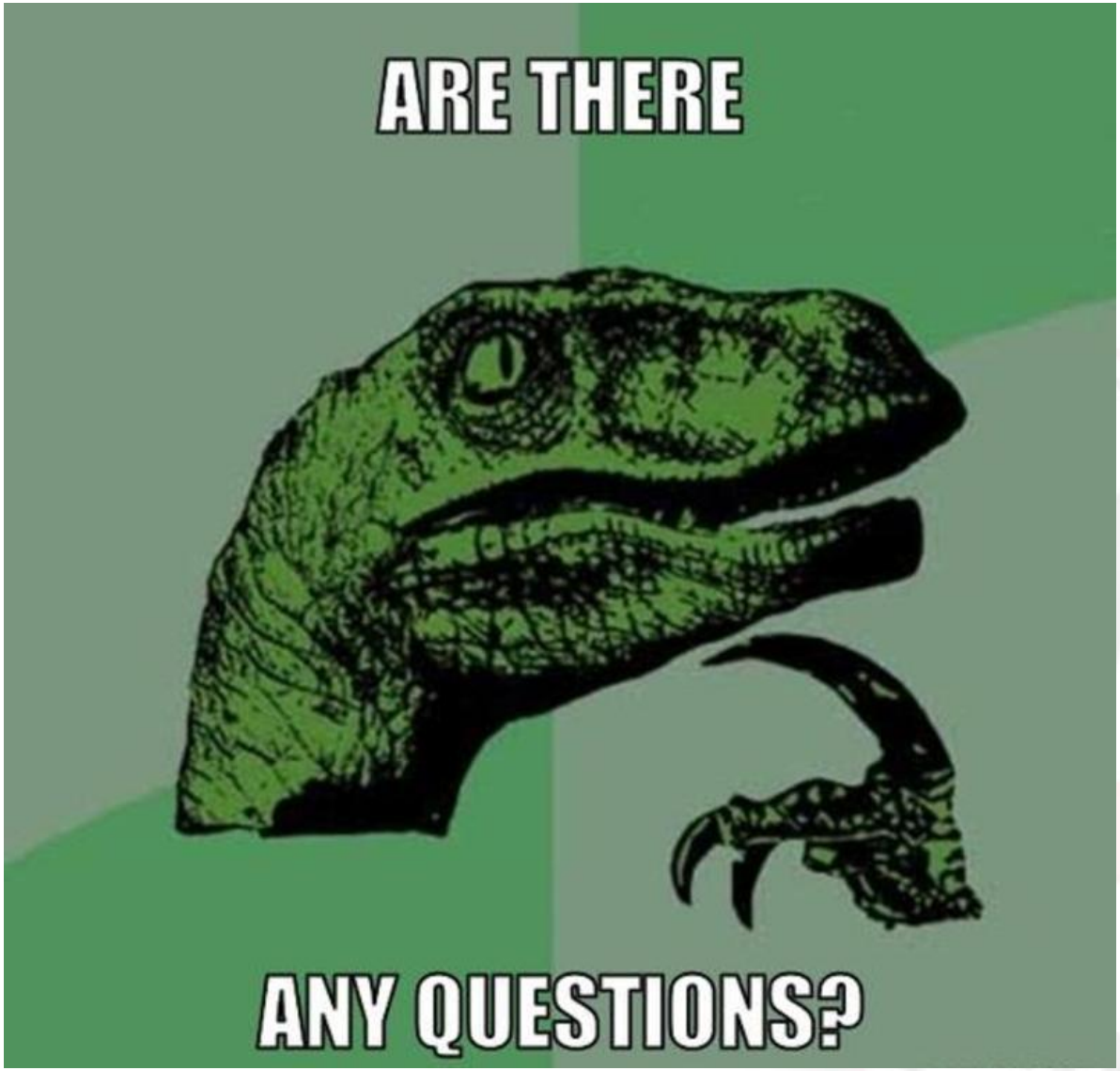
North Soldado has large remaining potential and three main exploration play types

These include

1) The under-exploited (sub MMU) Nariva submarine fan play producing nearby in the Brighton Field.

2) The neritic reservoir sands of the Lower Telemaque e.g. (NSM FS3) which are under-drilled.

3) The stratigraphically trapped prograding delta front sands , undrilled in areas to the North East extent of the Field.


ARE THERE
ANY QUESTIONS?