

Structure, Stratigraphy and Petroleum Potential of the Central Officer Basin, South Australia*

Peter Boulton¹, Paul J. Bennett², and Annelise Freeman²

Search and Discovery Article #10469 (2012)**

Posted December 31, 2012

*Adapted from oral presentation at AAPG International Conference and Exhibition, Singapore, September 16-19, 2012

**AAPG © 2012 Serial rights given by author. For all other rights contact author directly.

¹Ginkgo Resources, Npsp, SA, Australia (pboulton@ginkgoresources.com.au)

²Rodina Oil Corp, Calgary, AB, Canada

Abstract

Recent wildcat exploration drilling (2 wells) by Rodinia Oil has found the thickest section of Neoproterozoic aged rocks of any wells in the central and eastern parts of the Officer Basin. Thick sections of Neoproterozoic aged rocks are seen in Officer Basin wells in Western Australia, but these do not appear to have as complete a section as the two most recent wells in South Australia.

The Officer Basin was formed as part of the early Neoproterozoic Centralian Super Basin. An initial basin fill of coarse clastics and evaporates was followed by the deposition of finer mixed clastics and carbonates, glacial sediments and finally carbonates during the Cryogenian period. Latest Neoproterozoic sediments of finer clastics, incised canyon fill and mudstones are overlain in the recent wells by Cambrian clastics and Quaternary aeolian deposits.

The central Officer Basin was deformed by several major tectonic events since the early Neoproterozoic. The oldest of these events is manifested by the major Sturtian angular unconformity at the top of the Burra Group and may be equivalent in age to the Areyonga Movement as reported in Western Australia by Apak and Moors (2001). The second major structure forming event in the Central Officer Basin relates to the latest Neoproterozoic Petermann Orogeny that involved canyon formation and decollement on a thick salt layer near the base of the section. This major tectonic event was later amplified by similarly oriented movement during a third major event, the Devonian/Carboniferous aged Alice Springs Orogeny. Evidence of these tectonic events can be seen in the recent wells and seismic gathered by Rodinia Oil.

The two recent wells have added considerable knowledge to the understanding of the petroleum potential of the Officer Basin. In the Mulyawara-1 well continuous gas and oil shows were recorded throughout the middle and lower parts of the Neoproterozoic section, particularly in the Burra Group. In the Kutjara-1 well, gas shows with "heavies" were recorded throughout the entire mid Neoproterozoic in similar setting to the Mulyawara-1 well. Although commercial deposits were not encountered in the two recent wells, the presence of an active Neoproterozoic petroleum system has been convincingly demonstrated. Excellent reservoir properties were also established for the Murnaroo, the informally named Mulyawarra and the Pindyin sandstones, and the predicted continuous thick salt seal within the Callana Group was confirmed.

Reference

Apak, S.N., H.T. Moors, and K.A.R. Ghorri, (eds.), 2001, Basin development and petroleum exploration potential of the Lennis area, Officer Basin, Western Australia: Geological Survey of Western Australia, Report #77, 42 p.



Structure, Stratigraphy & Petroleum Potential of the Central Officer Basin, South Australia.

By

Peter Boulton, *Ginkgo ENP GNG, Adelaide, Australia, Badley Geoscience LTD, UK*

Paul Bennett, *Rodinia Oil Corp Calgary, Alberta, Canada*

Annelise Freeman, *Rodinia Oil Corp Calgary, Alberta, Canada*



Rodinia's Exploration Program

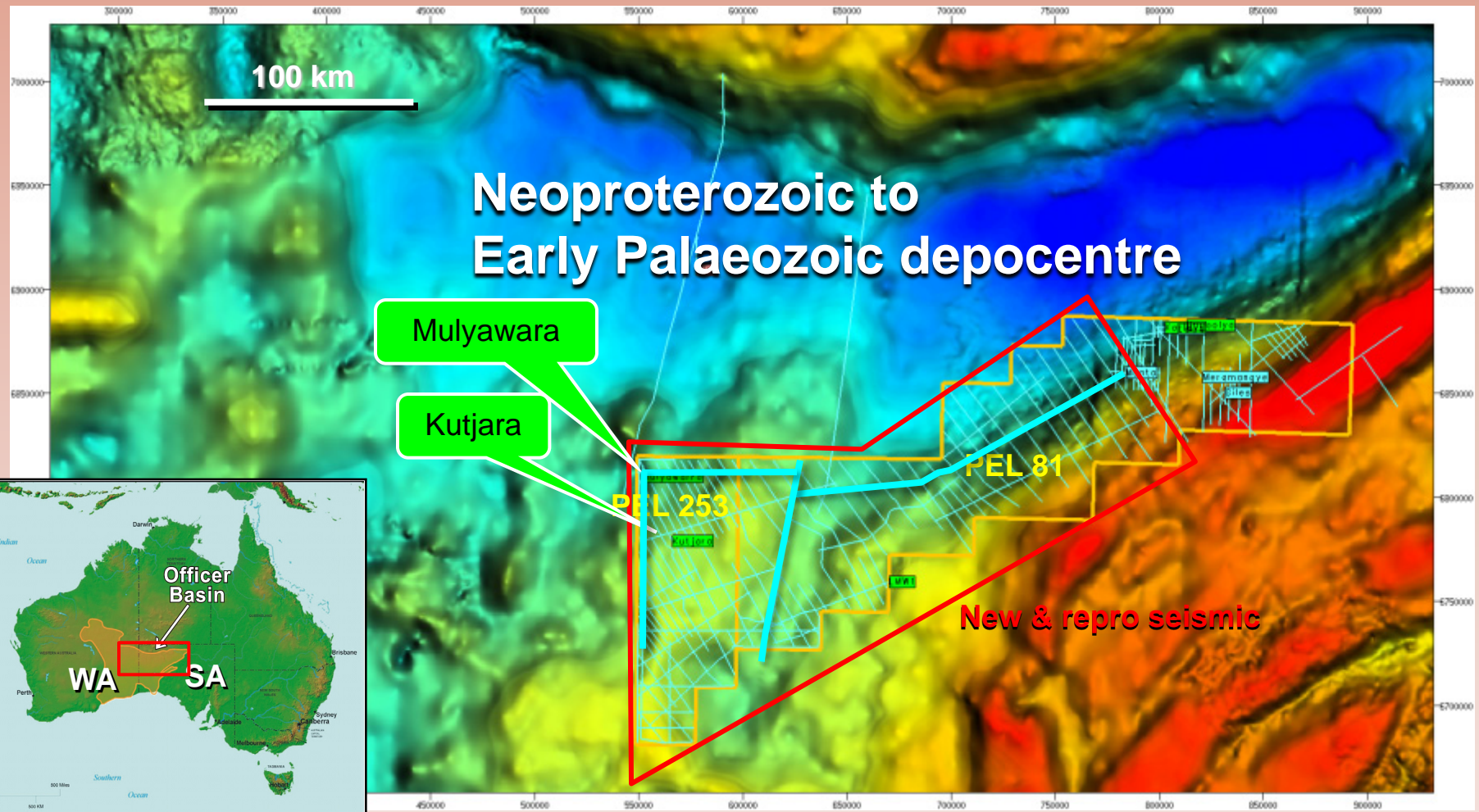
- 4045 km new seismic (2007-2011)
- 1363 km reprocessing (2011)
- 6153 km seismic interpreted
- 2 wells

Mulyawarra-1 – TD 2691.3 m
P & A with oil and gas shows

Kutjara-1 – TD 2453.7 m
P & A with oil and gas shows

Location – Rodinia's permits

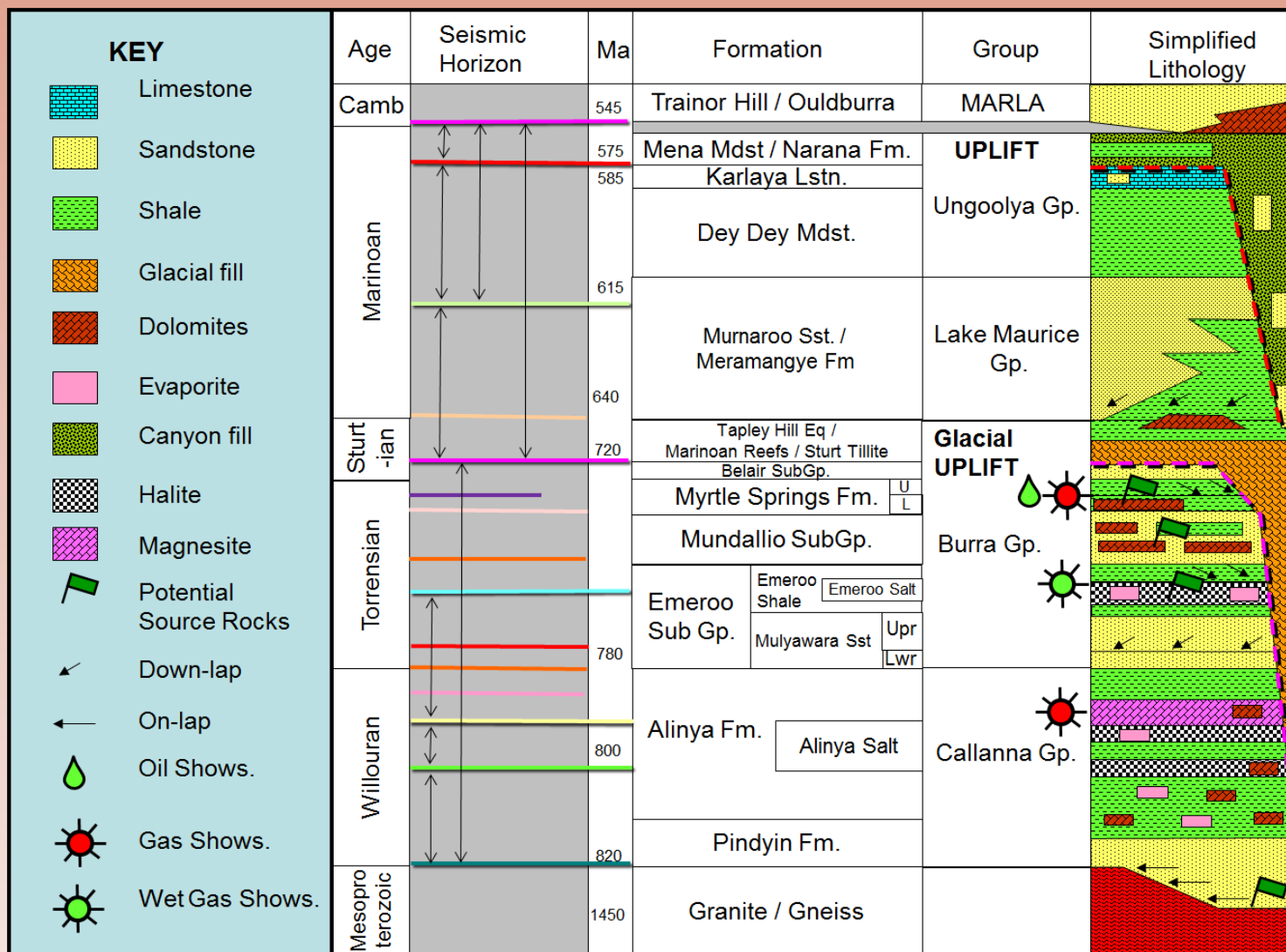
- over Bouguer Gravity



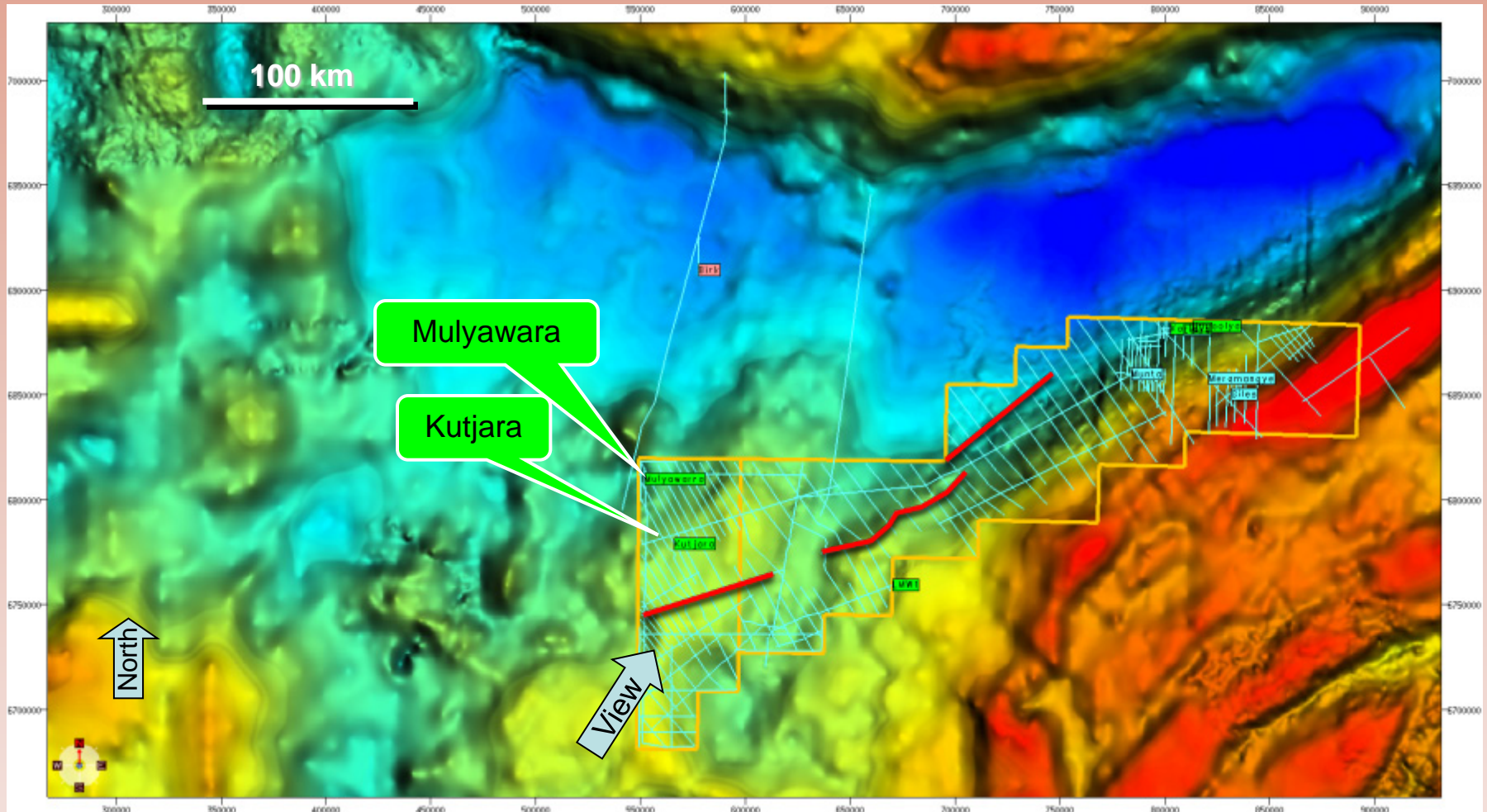
Western Officer Basin (SA) Stratigraphic Column

Bold horizons = Key modelled / mapped horizon
Minor horizons = partially picked

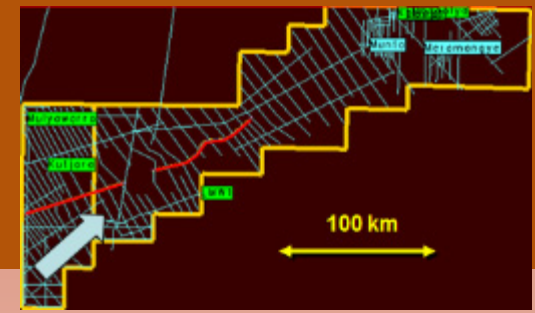
Isochrons 



Location – over Bouguer Gravity

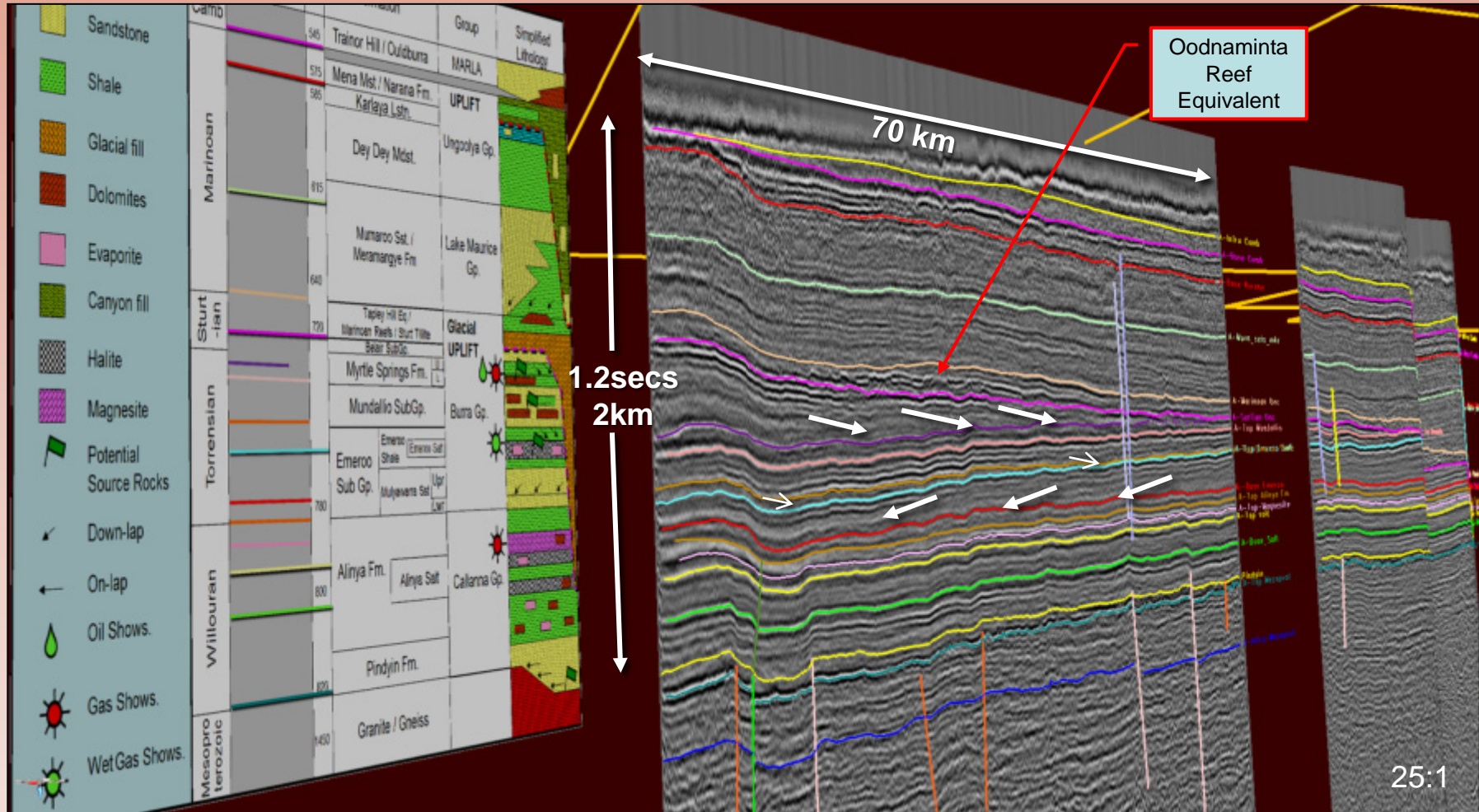


Western Officer Basin (SA) Stratigraphy & Strike Section (OBE-07-01)

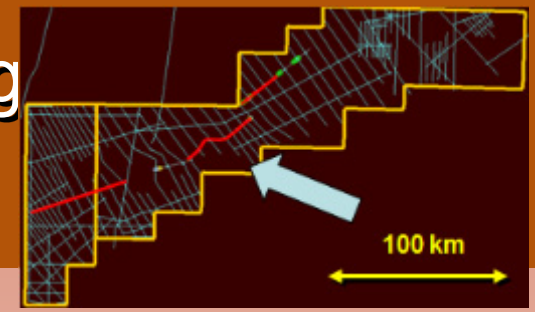


WEST

EAST



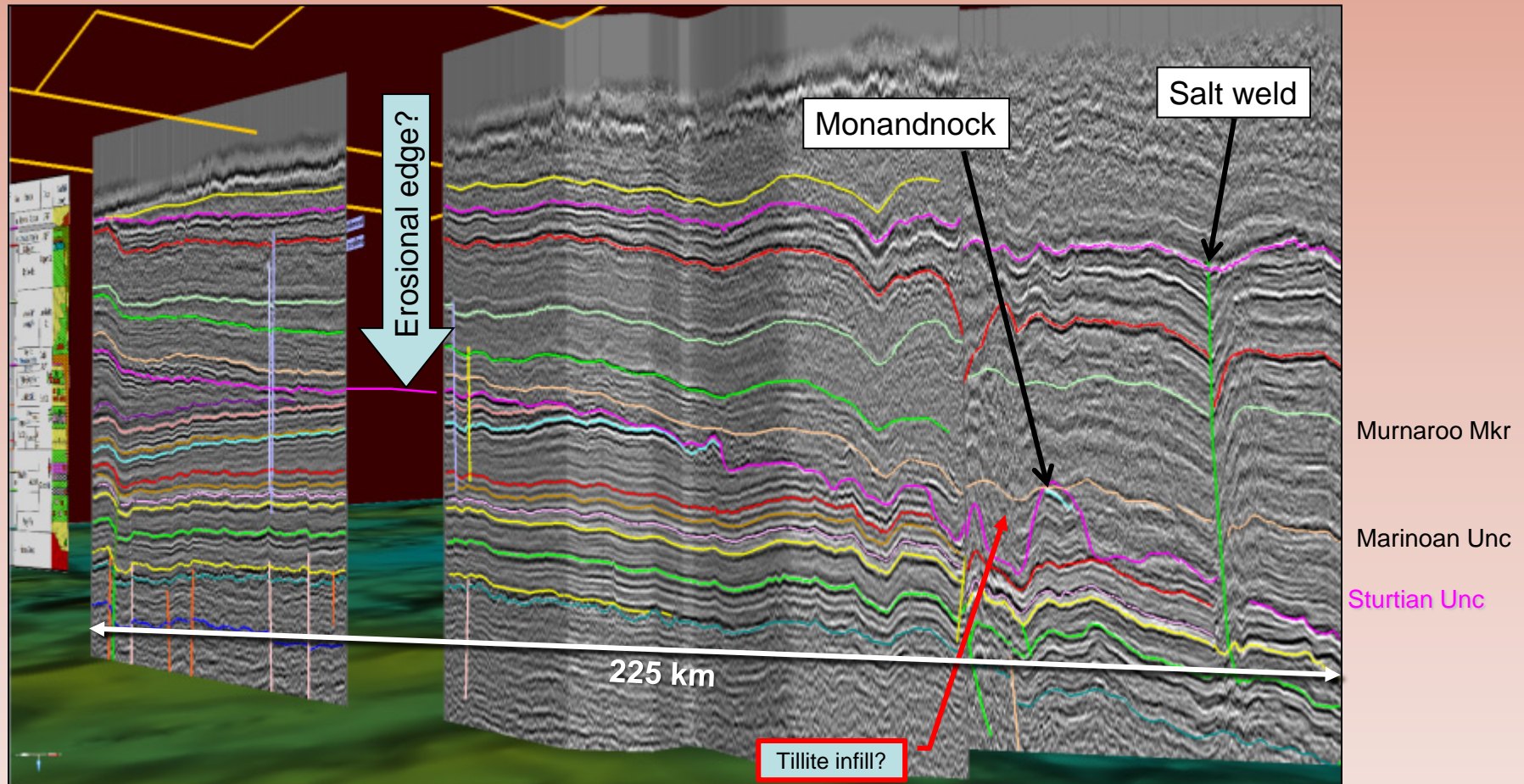
West – East strike section highlighting the Sturtian Unconformity



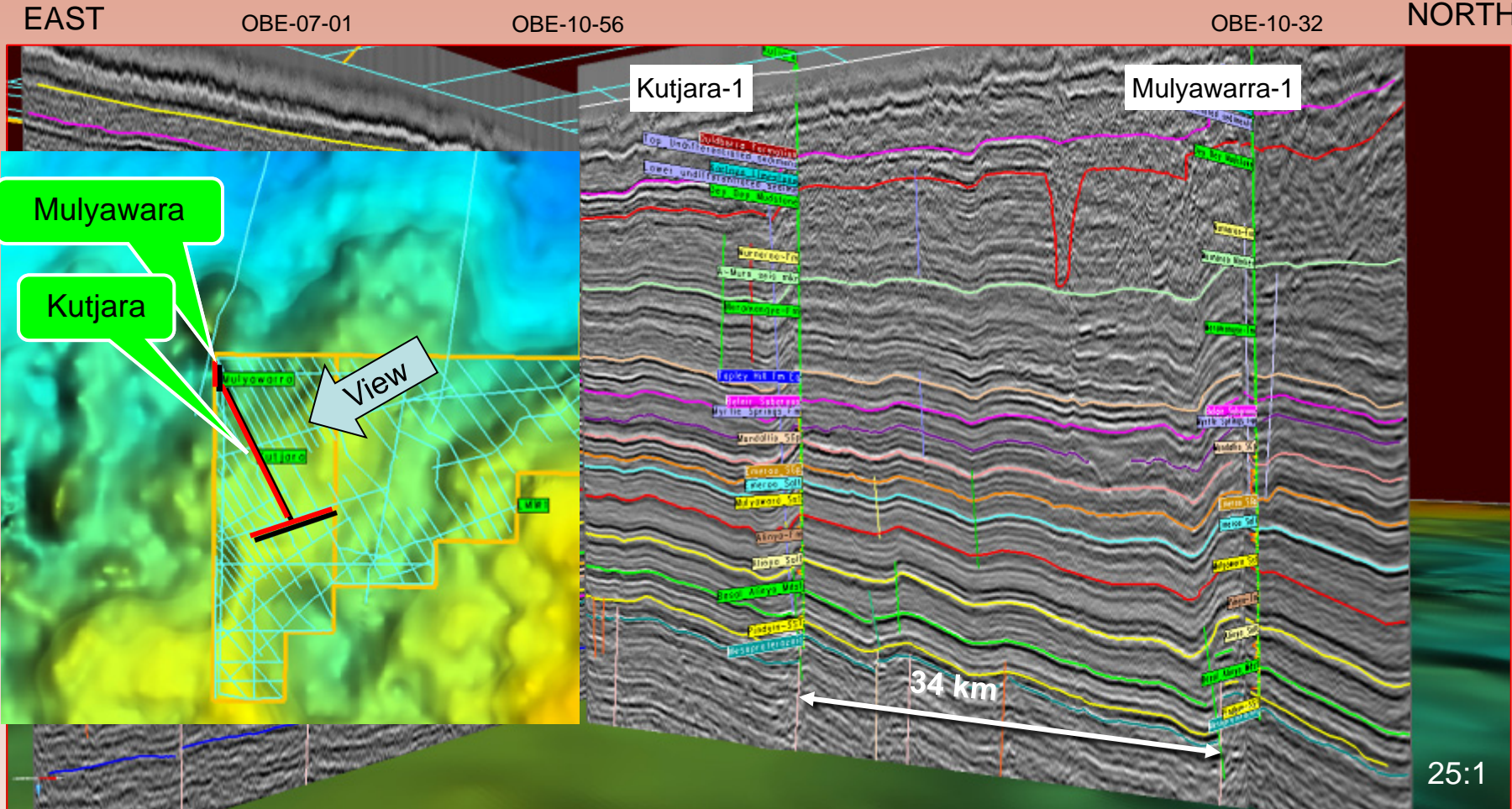
West OBE-07-01

OBE-07-01B

OBE-10-19 East



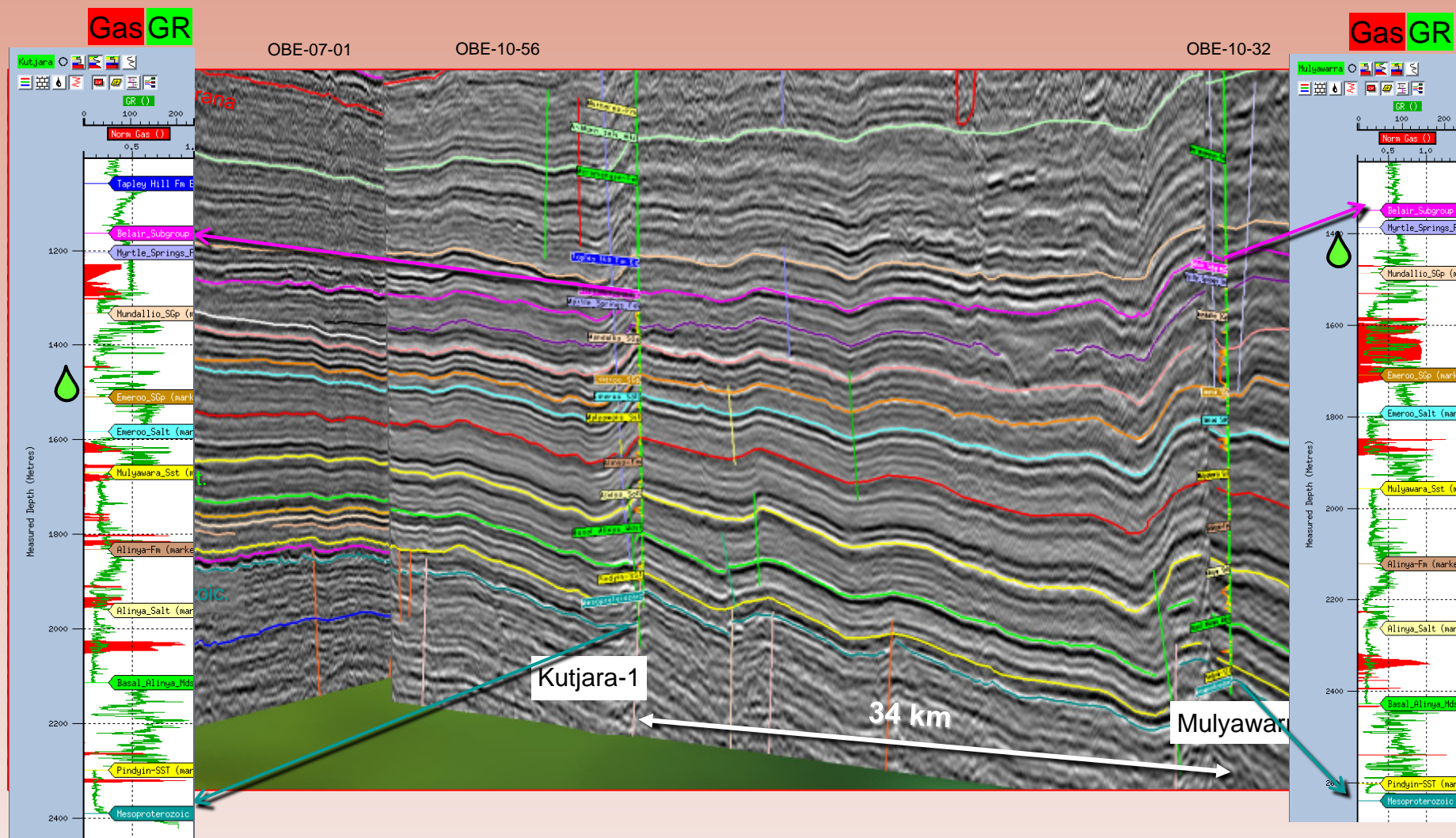
Drilling results 2011



Drilling results 2011

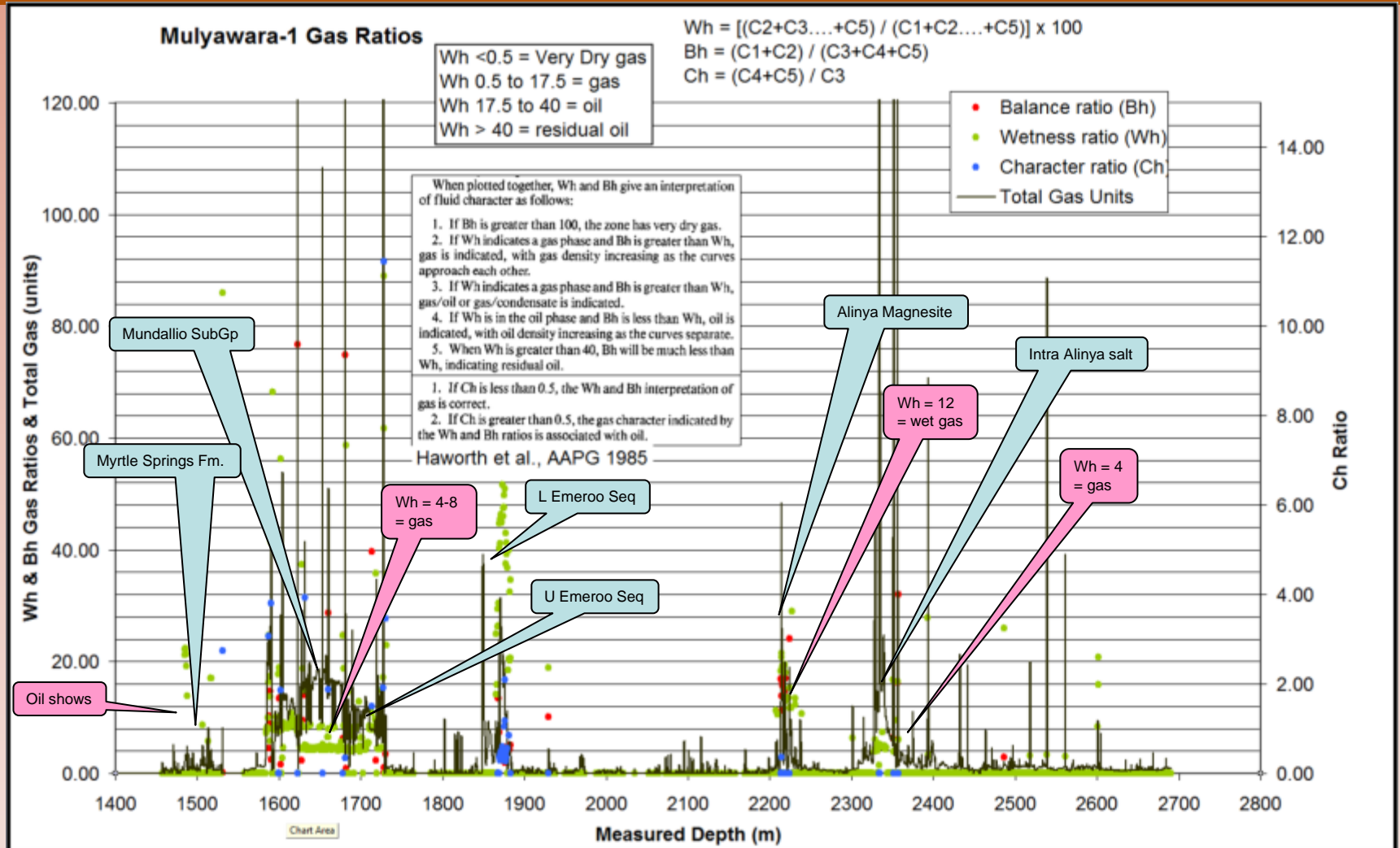
EAST

NORTH



Mulyawara-1 gas ratio logs

Drilled with Air / then air and water / then mud



Air drill to 1589m
Gas to 8.8%
Air and water to 1727 m

Western Officer Basin (SA) Stratigraphic Column

Bold horizons = Key modelled / mapped horizon

Minor horizons = partially picked

Targets

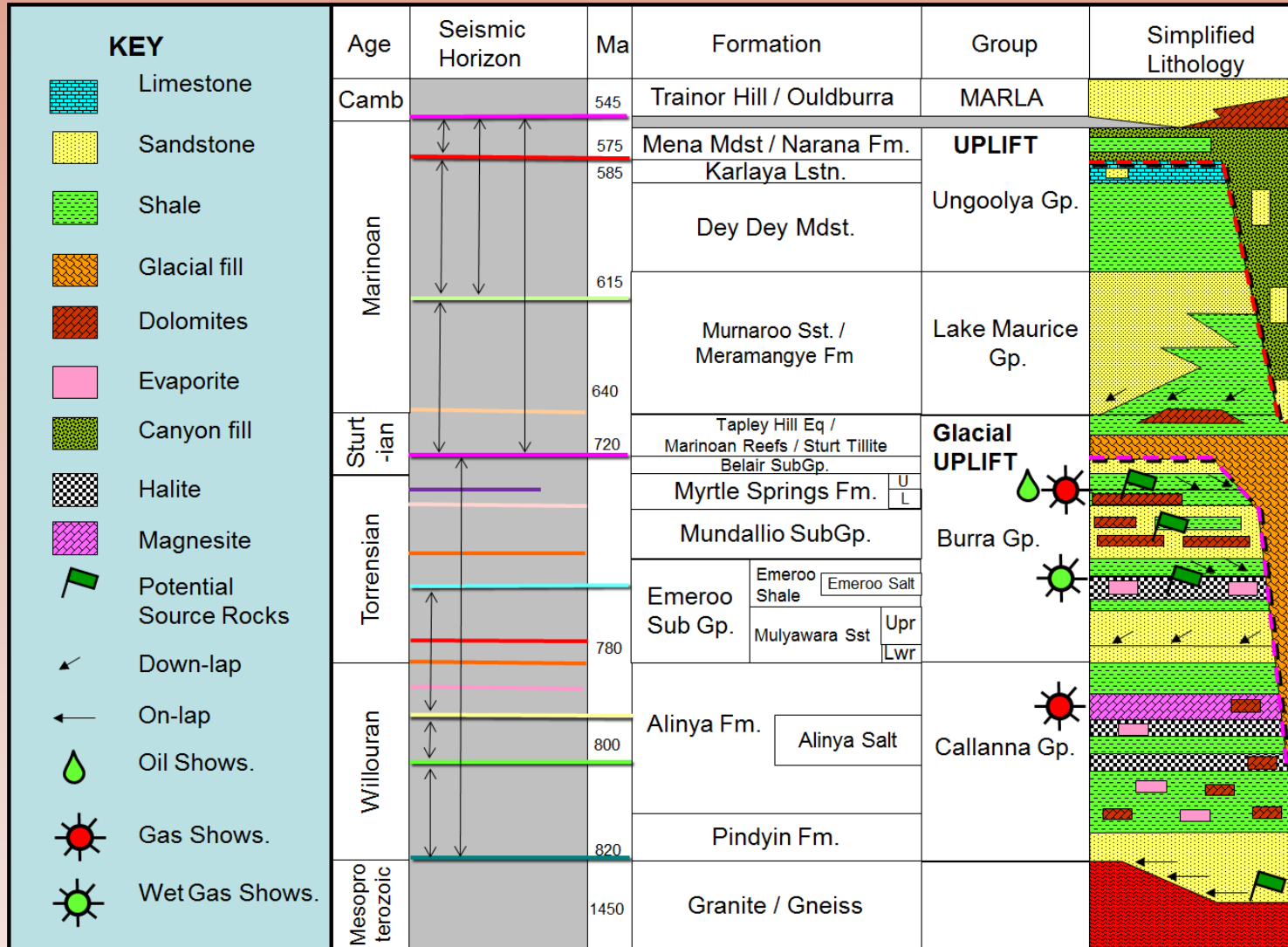


Conventional



Unconventional

Isochrons

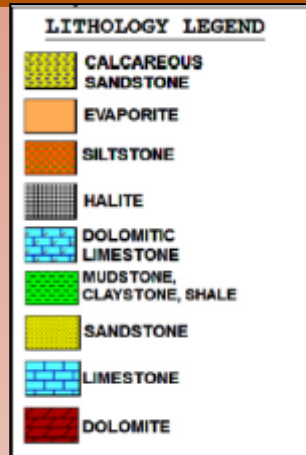
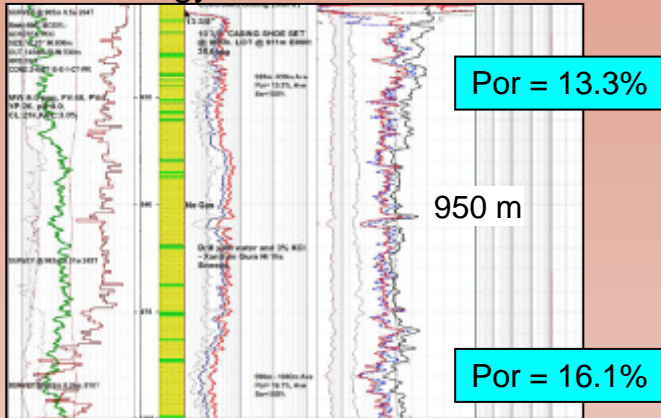


Targets

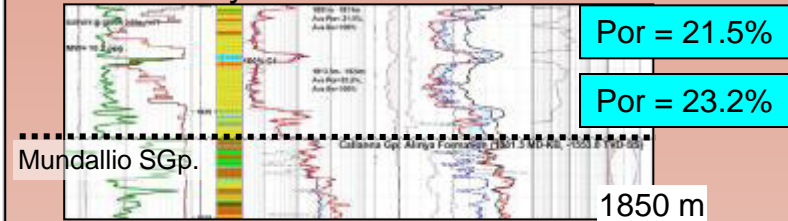


Kutjara-1 – highlighted reservoirs

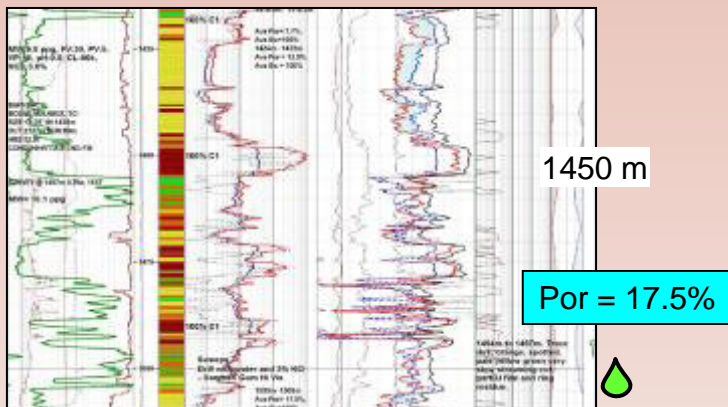
Meramangye Fm.



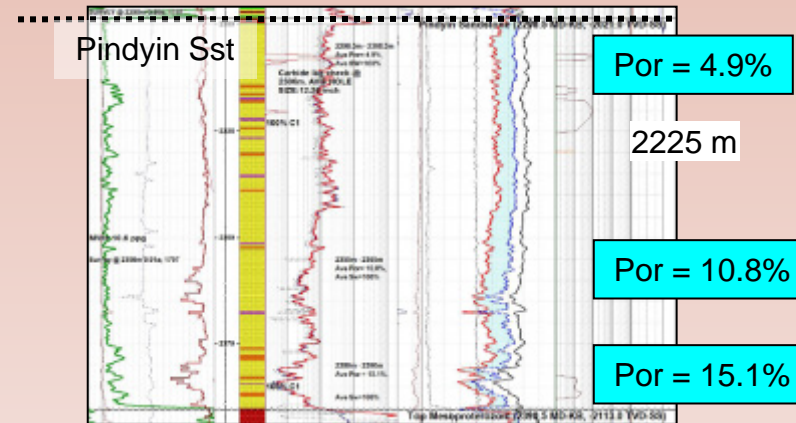
Base Mulyawara Sst.



Mundallio Fm.



Pindyin Sst



Seismic mapping

- 16+ horizons (7 modelled)
- 9 Isochores (TWT)
- Surface attributes
 - Dip
 - Azimuth
 - Maximum curvature
- Faults
 - Predominantly thrust
 - Common strike-slip releasing (keystone)
 - Minor strike-slip restricting (pop-up)
 - Minor normal – mainly basement graben

Western Officer Basin (SA) Stratigraphic Column

Bold horizons = Key modelled / mapped horizon

Minor horizons = partially picked

Targets

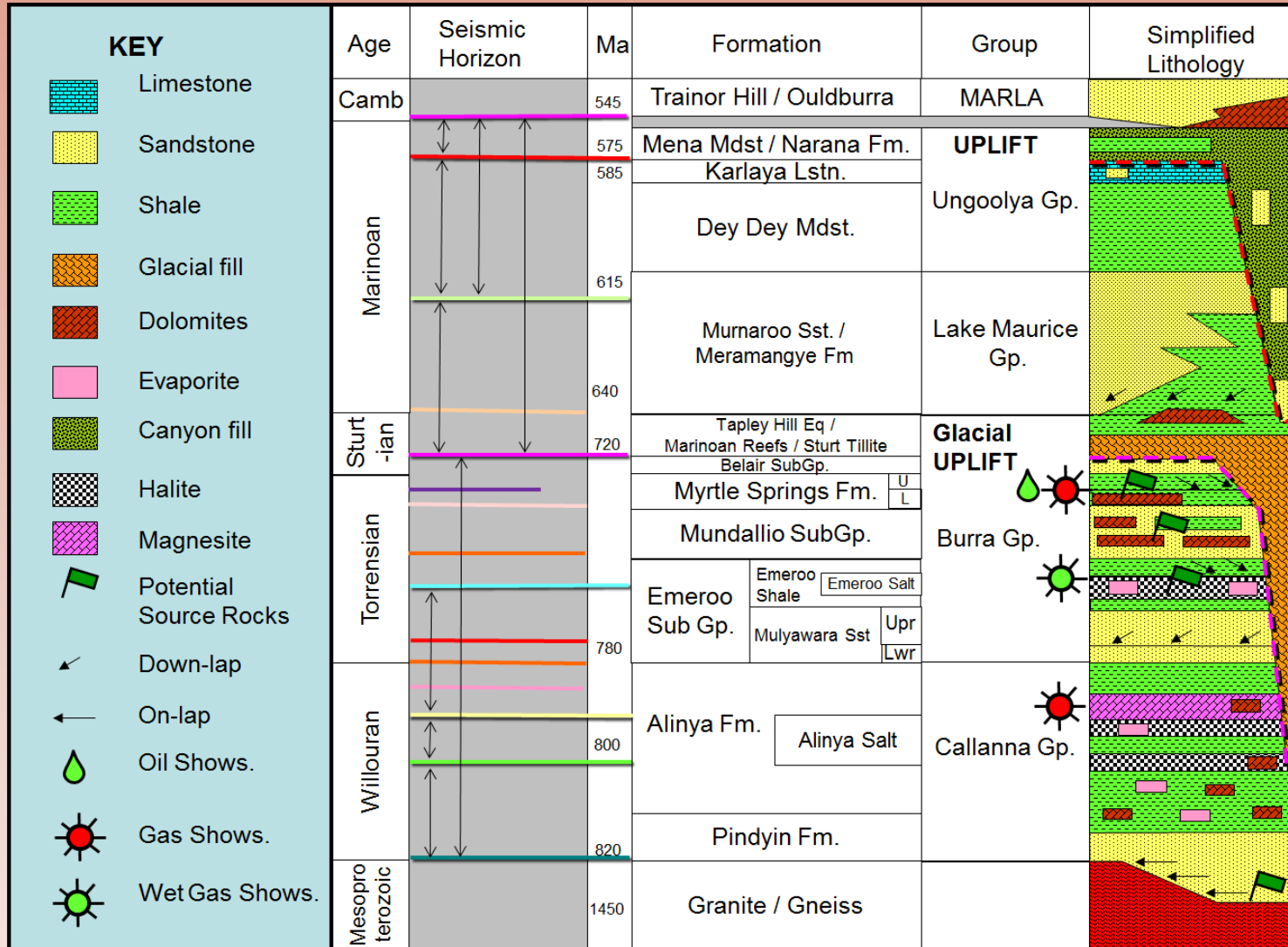


Conventional



Unconventional

Isochrons

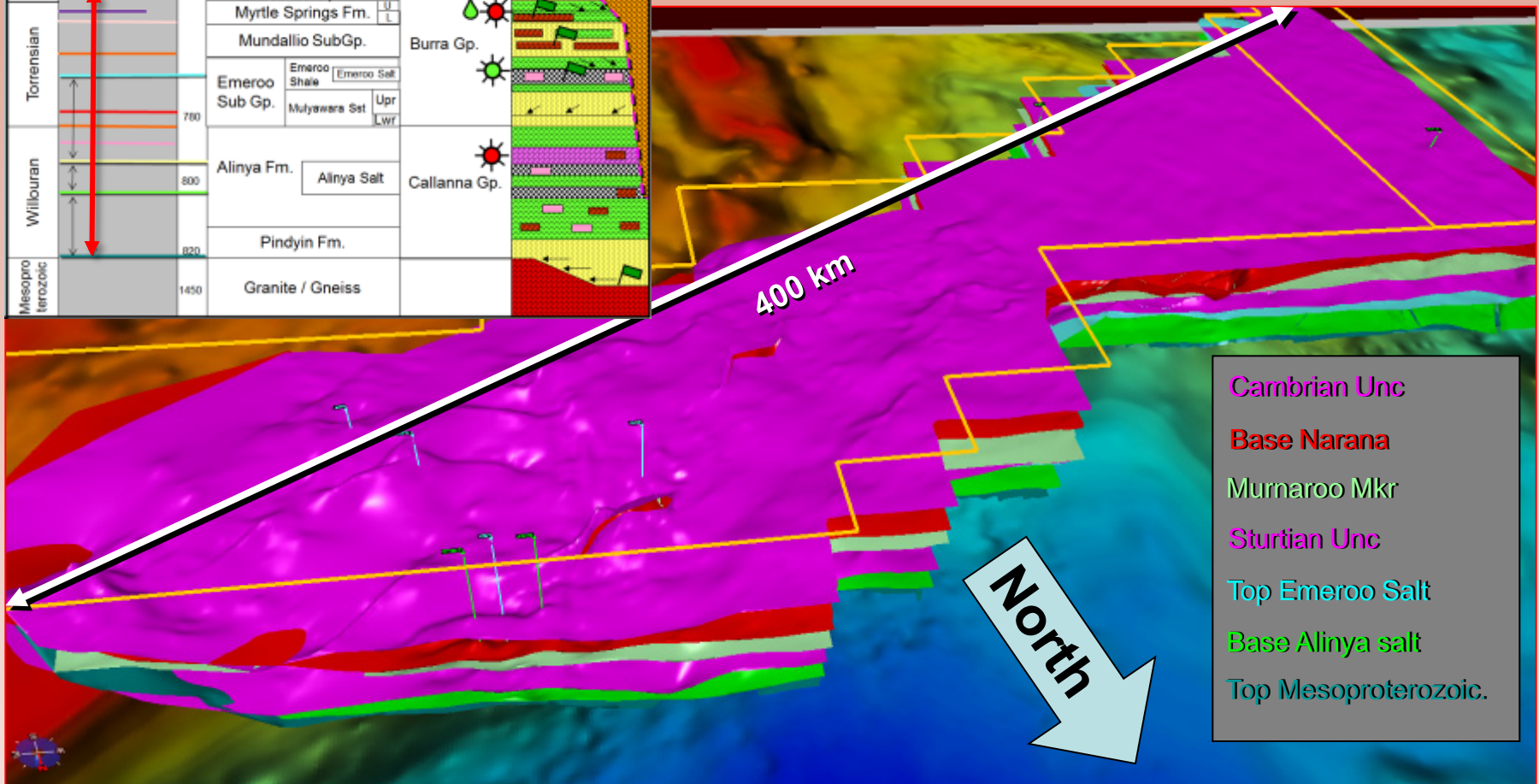


Targets



Seven horizons gridded in detail

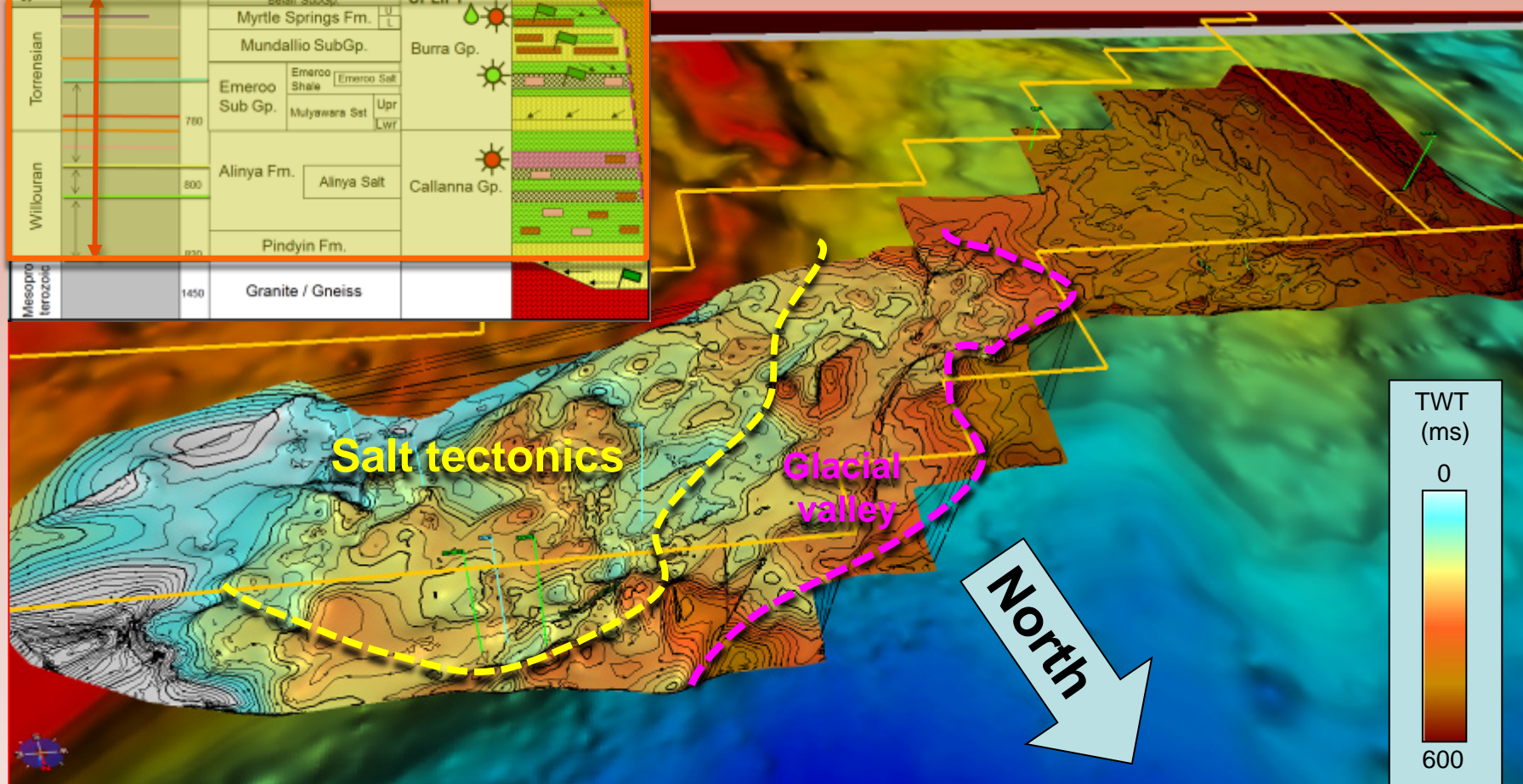
Age	Seismic Horizon	Ma	Formation	Group	Simplified Lithology
Camb		545	Trainer Hill / Ouldburra	MARLA	
Marinoan		575	Mena Mdst / Narana Fm.	UPLIFT	
		585	Karlaya Lstn.		
			Dey Dey Mdst.	Ungoolya Gp.	
		615			
Sturtian		640	Murnaroo Sst. / Meramangye Fm	Lake Maurice Gp.	
		720	Tapley Hill Eq / Marinoan Reefs / Sturt Tillite	Glacial UPLIFT	
			Belair SubGp.		
			Myrtle Springs Fm.		
Torrensian			Mundallio SubGp.	Burra Gp.	
			Emeroo Shale		
		780	Emeroo Sub Gp.		
			Mulyawana Sst		
Willouran		800	Alinya Fm.	Callanna Gp.	
			Alinya Salt		
		820	Pindyin Fm.		
Mesoproterozoic		1450	Granite / Gneiss		



Age	Seismic Horizon	Ma	Formation	Group	Simplified Lithology	
Camb		545	Trainer Hill / Ouldburra	MARLA		
Marinoan		575	Mena Mdst / Narana Fm.	UPLIFT		
		585	Karlaya Lstn.			
			Dey Dey Mdst.	Ungoolya Gp.		
		615				
Sturtian		640	Mumaroo Sst. / Meramangye Fm	Lake Maurice Gp.		
		720	Tapley Hill Eq / Marinoan Reefs / Sturt Tillite	Glacial		
Torrensian			Myrtle Springs Fm.	Burra Gp.		
			Mundallio SubGp.			
			Emeroo Sub Gp.	Emeroo Shale / Emeroo Salt		Callanna Gp.
		780	Mulyawara Sst.	Upr Lwr		
Willouran		800	Alinya Fm.	Callanna Gp.		
			Alinya Salt			
Mesoproterozoic		930	Pindiyin Fm.			
		1450	Granite / Gneiss			

Sturtian Unc. – Mesoproterozoic

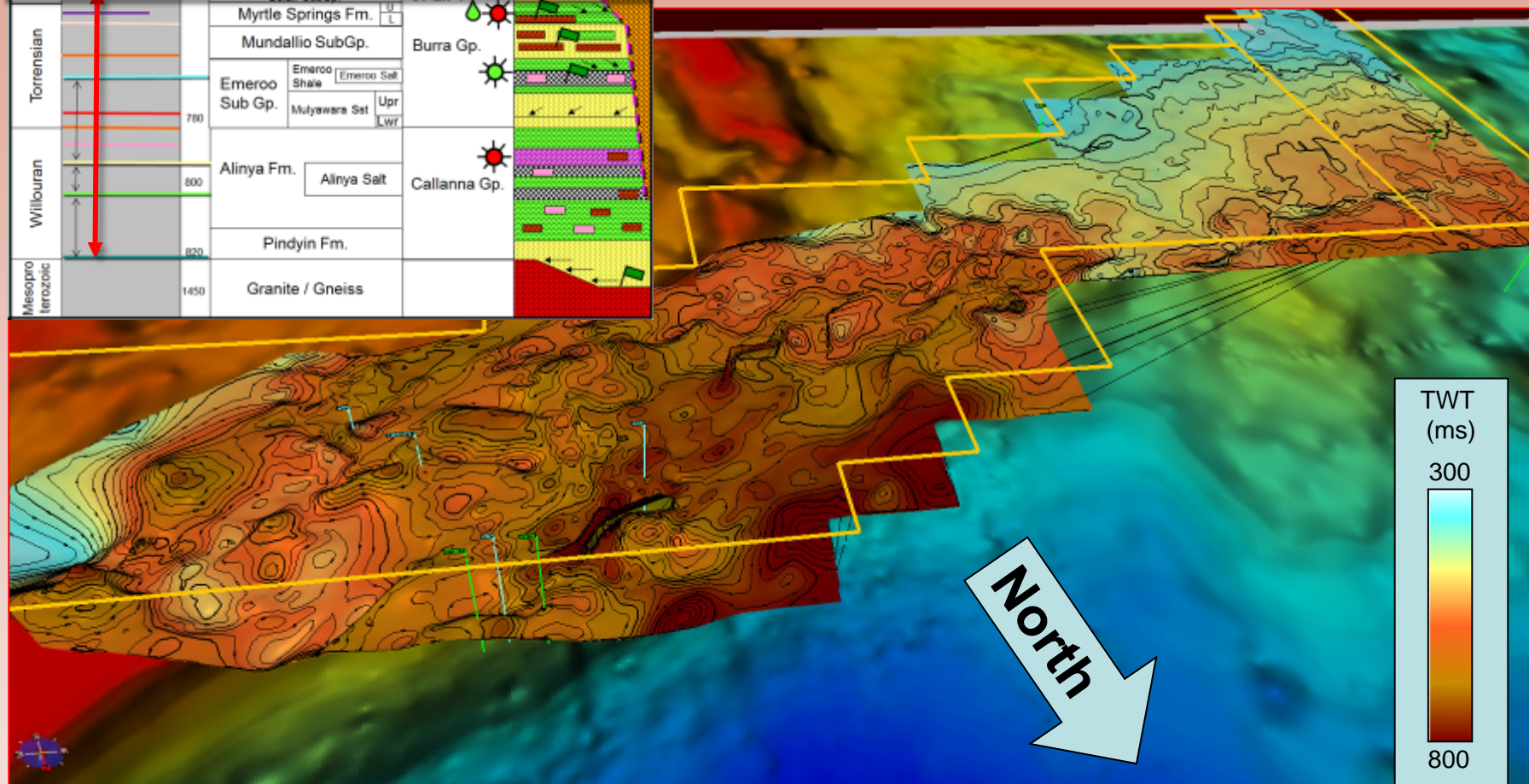
General thickening to west – unconformity cuts down to east



Age	Seismic Horizon	Ma	Formation	Group	Simplified Lithology	
Camb		545	Trainer Hill / Ouldburra	MARLA		
Marinoan		575	Mena Mdst / Narana Fm.	UPLIFT		
		585	Karlaya Lstn.			
			Dey Dey Mdst.	Ungoolya Gp.		
		615	Mumaroo Sst. / Meramangye Fm	Lake Maurice Gp.		
Sturtian		640				
		720	Tapley Hill Eq / Marinoan Reefs / Sturt Tillite	Glacial		
Torrensian			Myrtle Springs Fm.	Burra Gp.		
			Mundallio SubGp.			
			Emeroo Sub Gp.	Emeroo Shale Emeroo Salt Mulyawara Sst Upr Lwr		Callanna Gp.
		780				
Willouran		800	Alinya Fm.	Callanna Gp.		
			Alinya Salt			
		820	Pindyin Fm.			
Mesoproterozoic		1450	Granite / Gneiss			

Base Cambrian – Sturtian Unc.

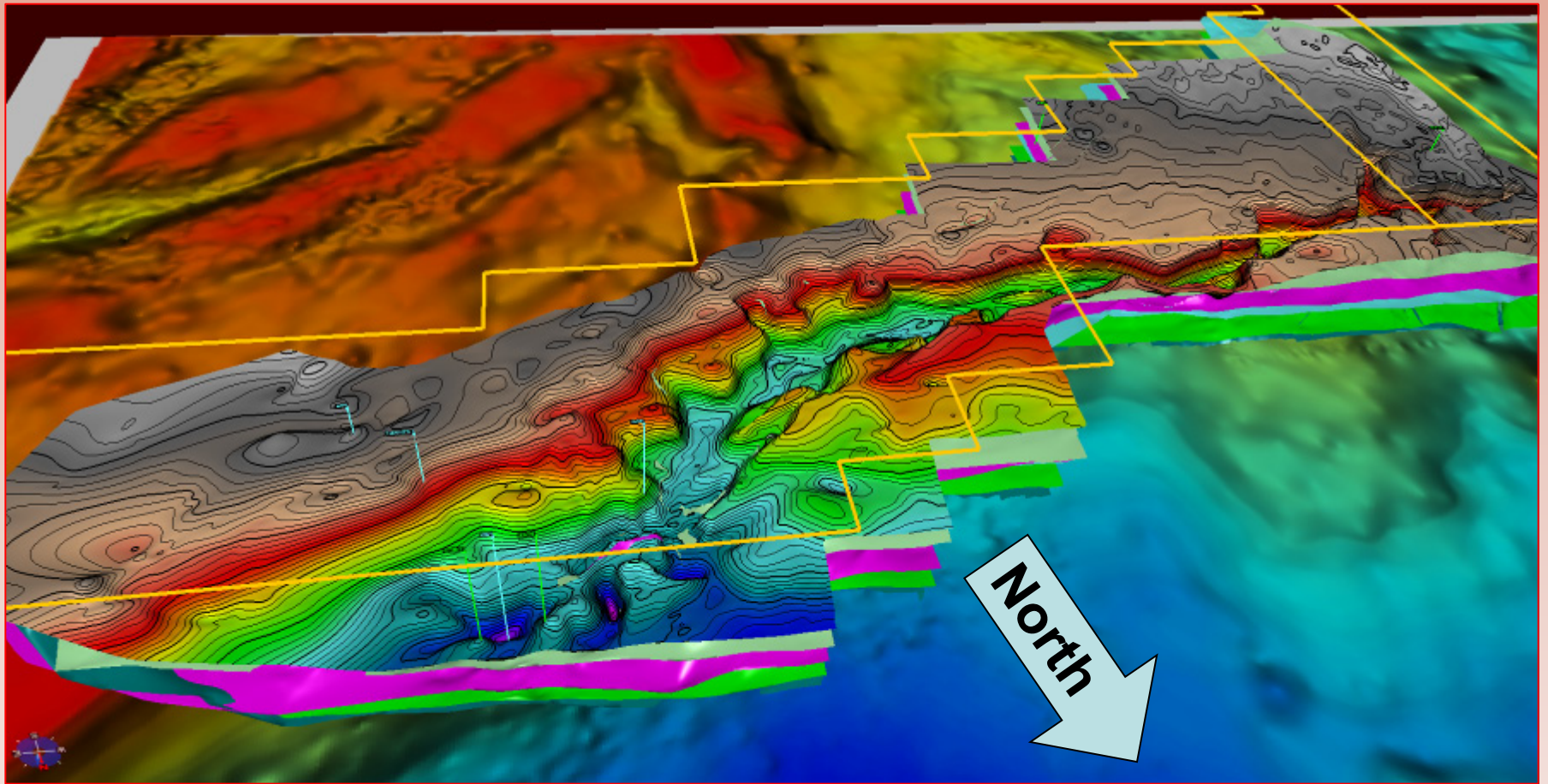
General thickening to north



15:1 20ms contours ~ 45m

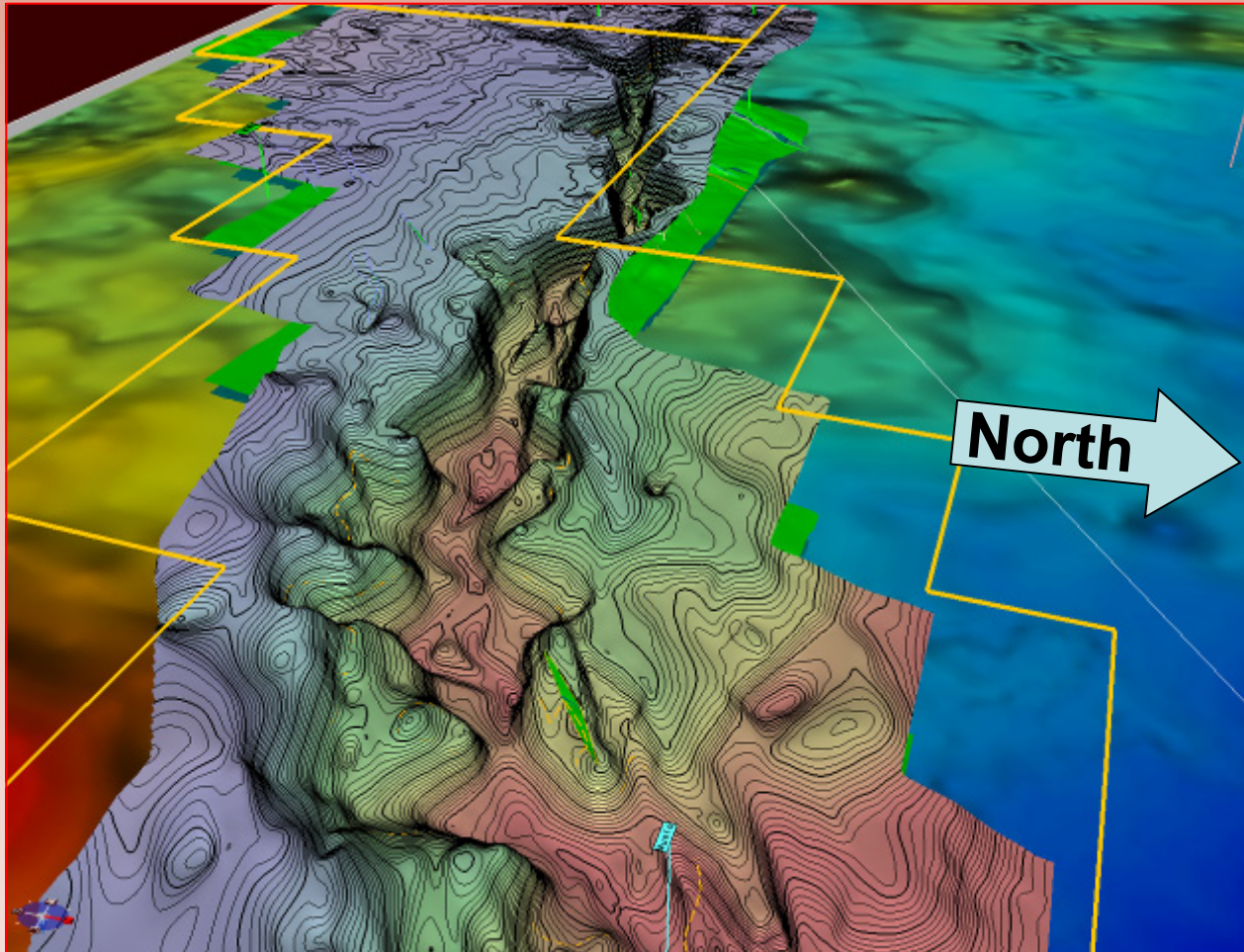
Base Narana

20ms contours ~ 45m



Base Narana

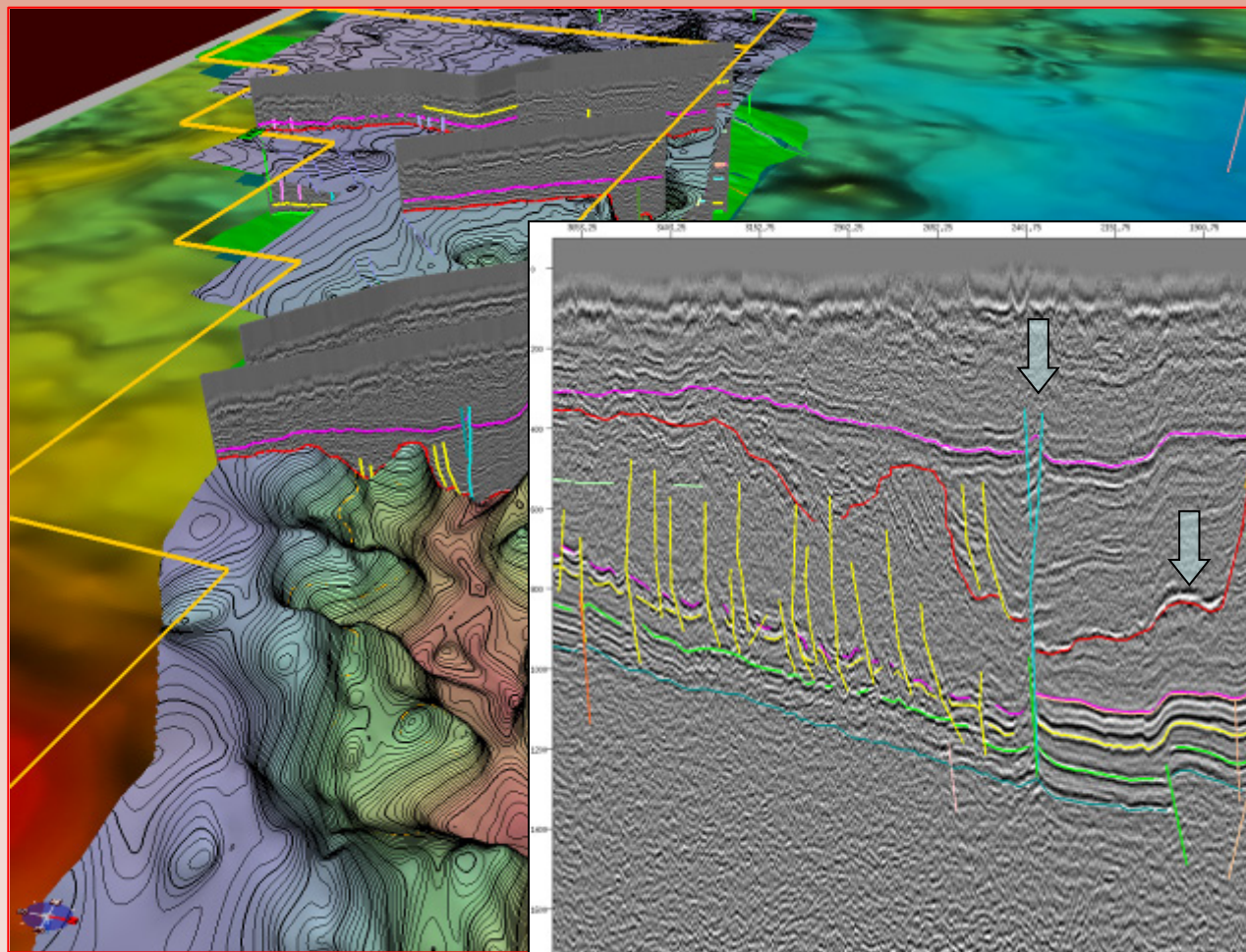
10ms contours ~ 22m



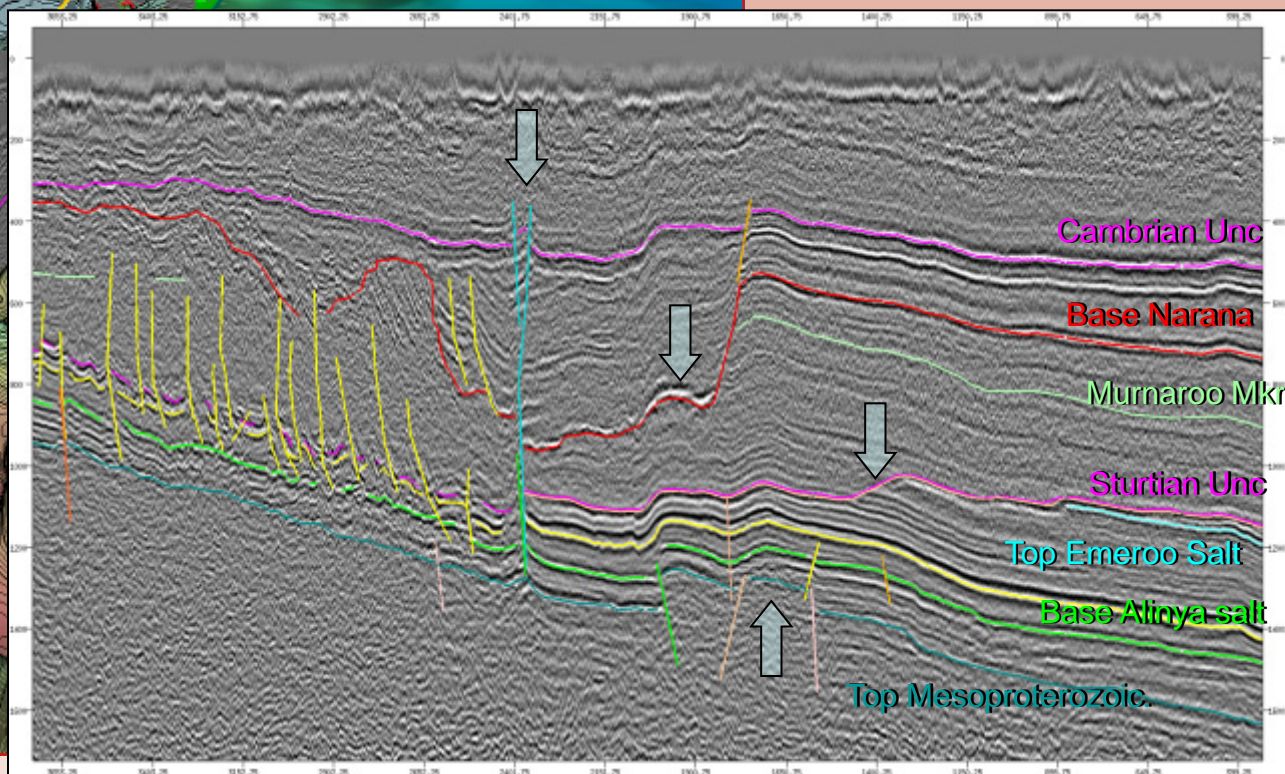
Maggi Canyon.
Correlates to Wonaka
Fm. canyons in the
Flinders Ranges

Base Narana

10ms contours ~ 22m



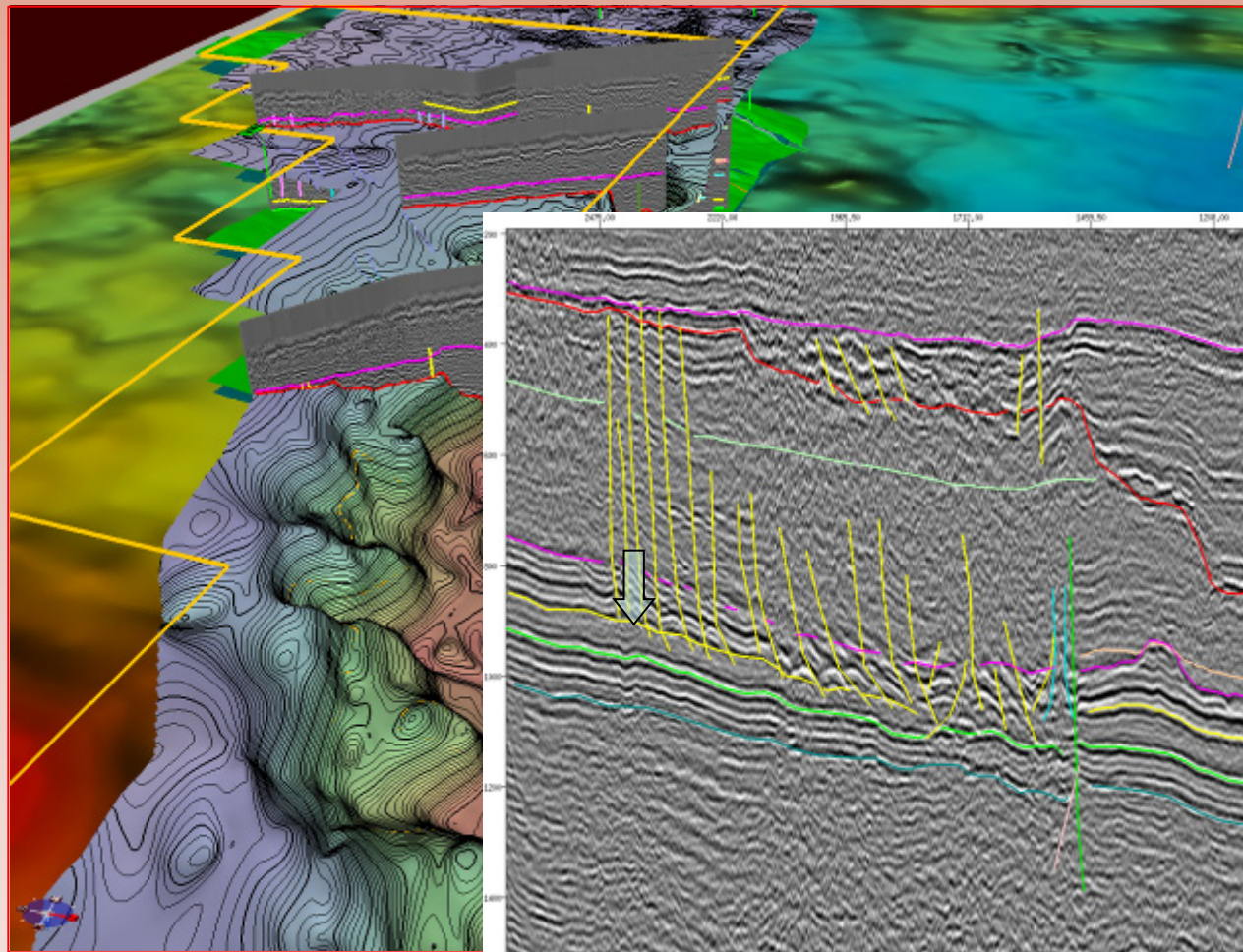
OBE-07-11 15:1



15:1

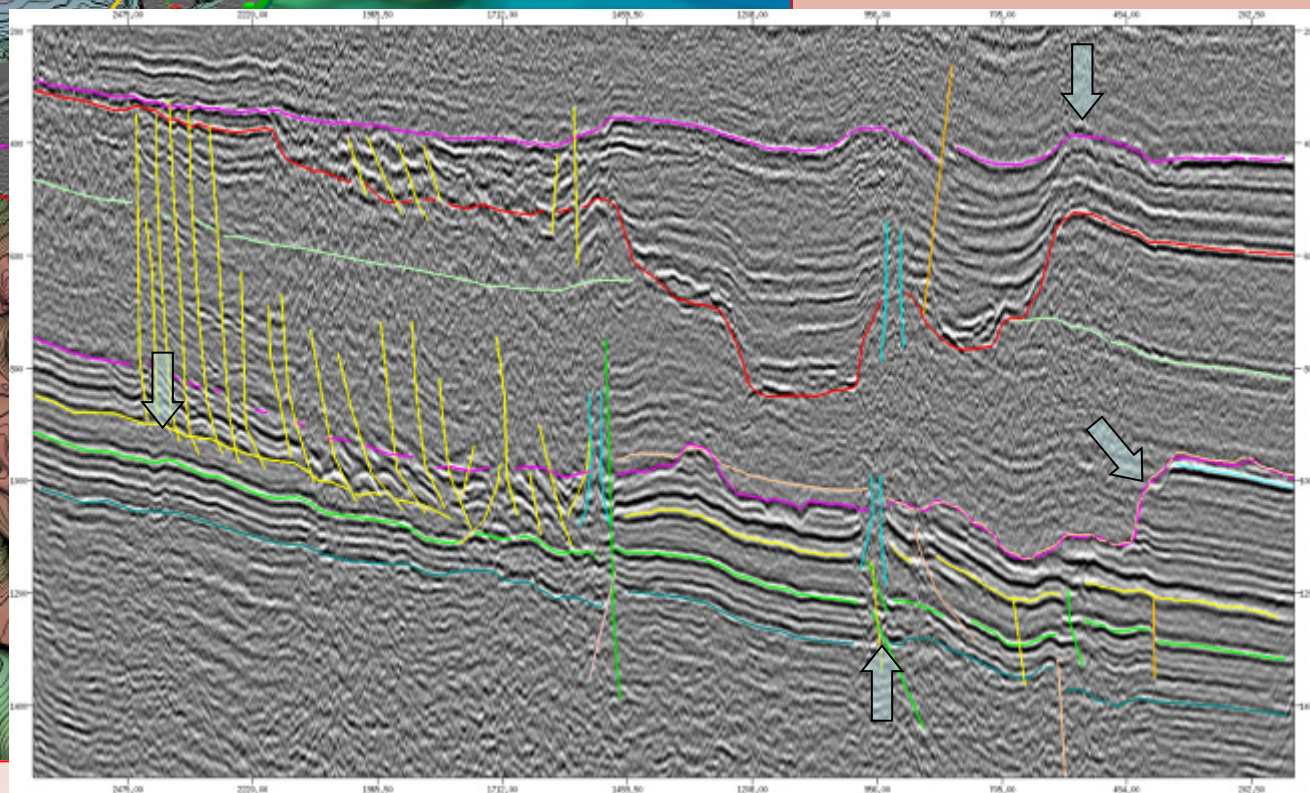
Base Narana

10ms contours ~ 22m



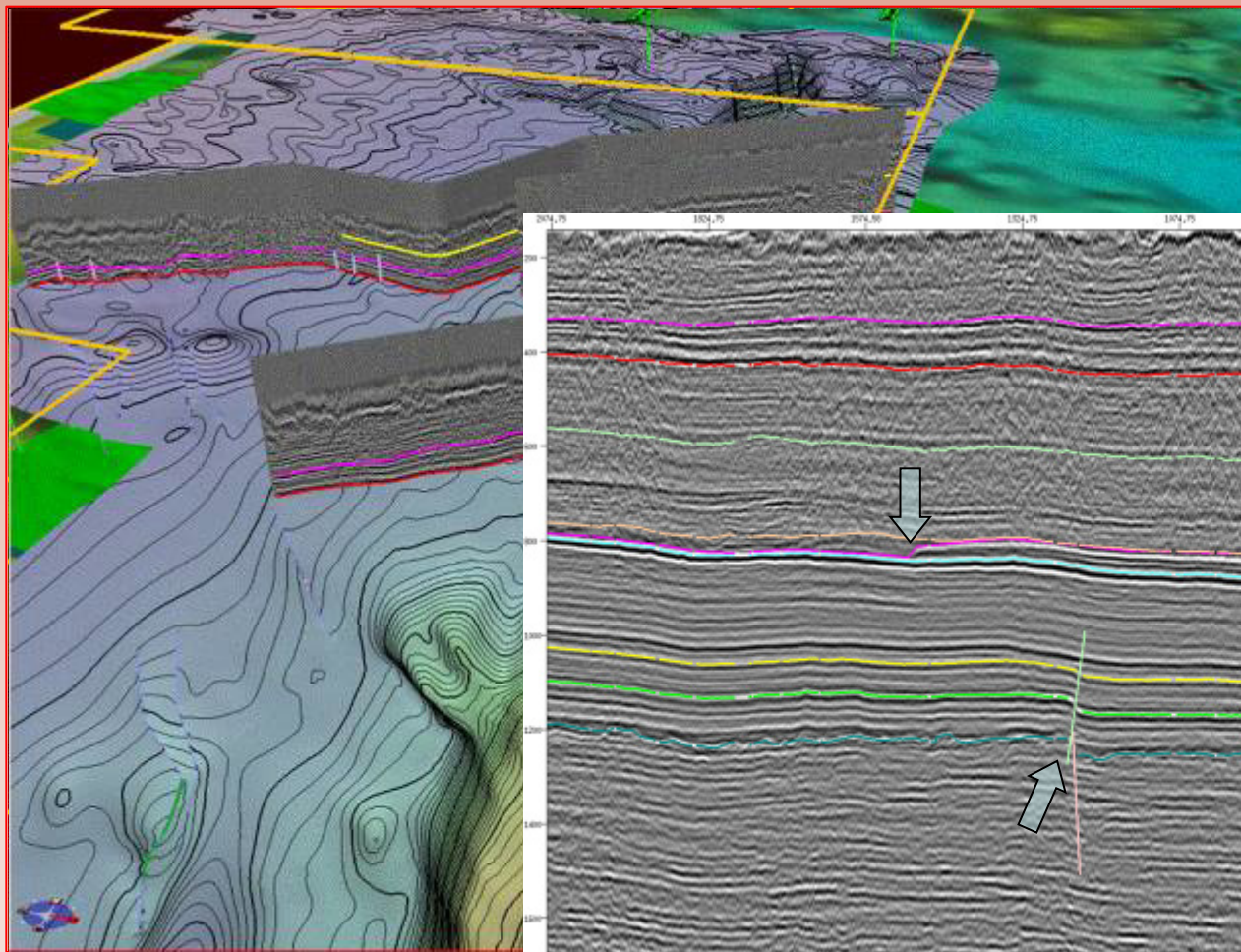
15:1

07-14 15:1



Base Narana

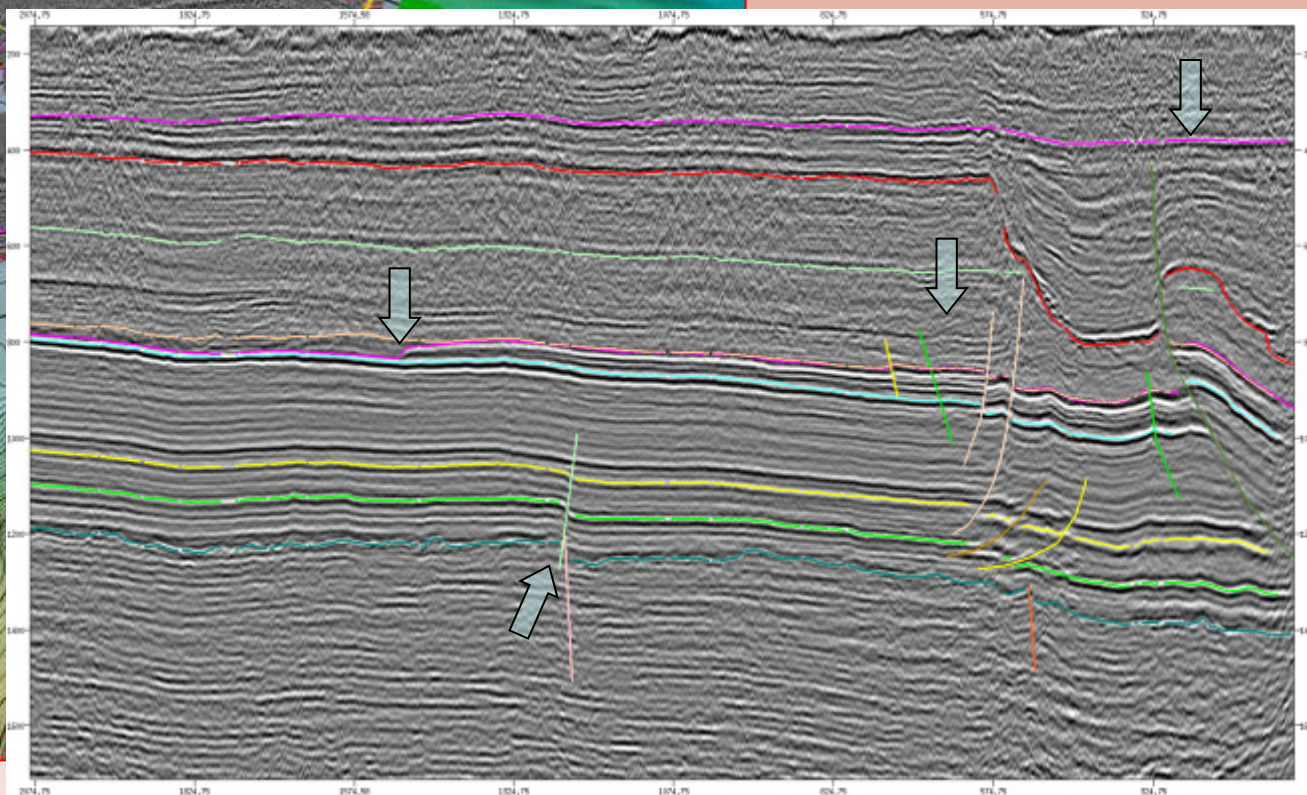
10ms contours ~ 22m



15:1

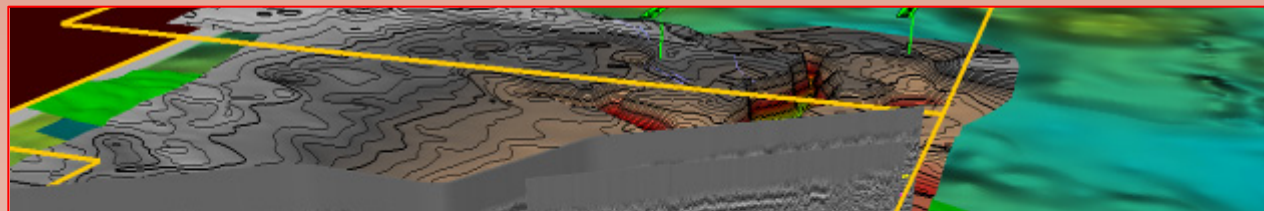
Animated

OBE-07-08 10:1

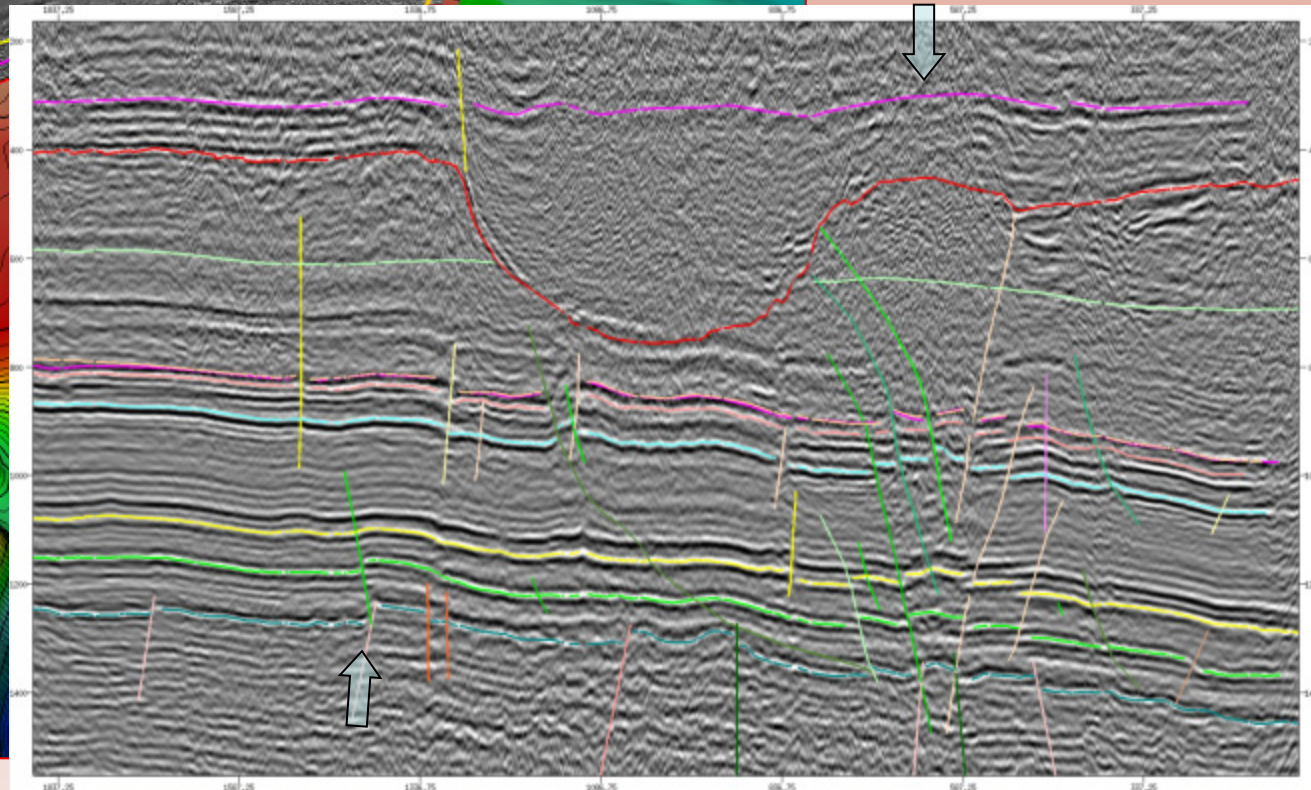
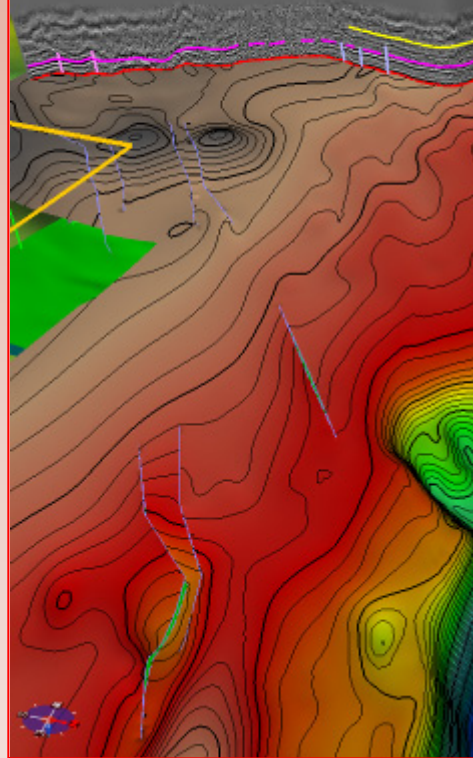


Base Narana

10ms contours ~ 22m



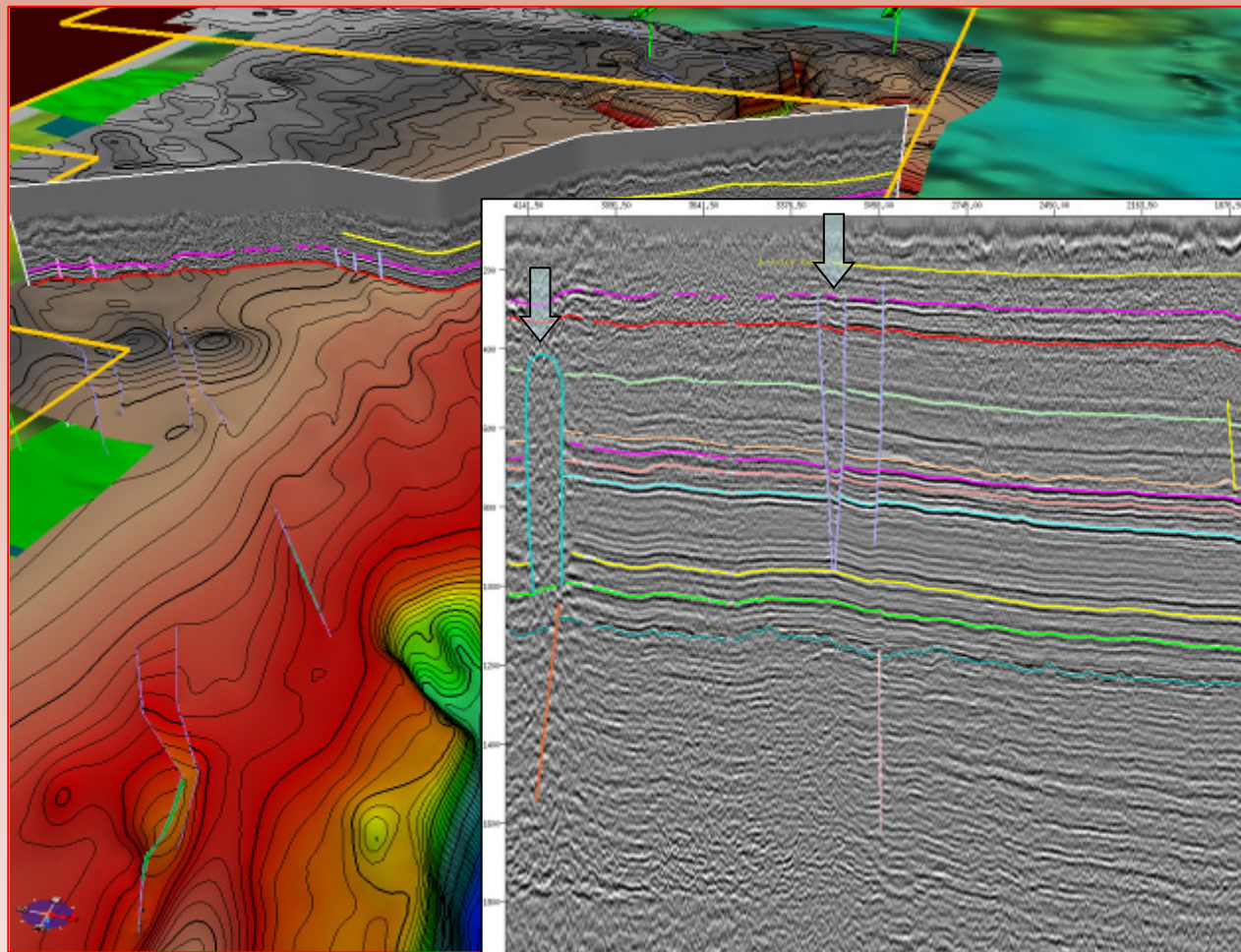
OBE-08-29 10:1



15:1

Base Narana

10ms contours ~ 22m

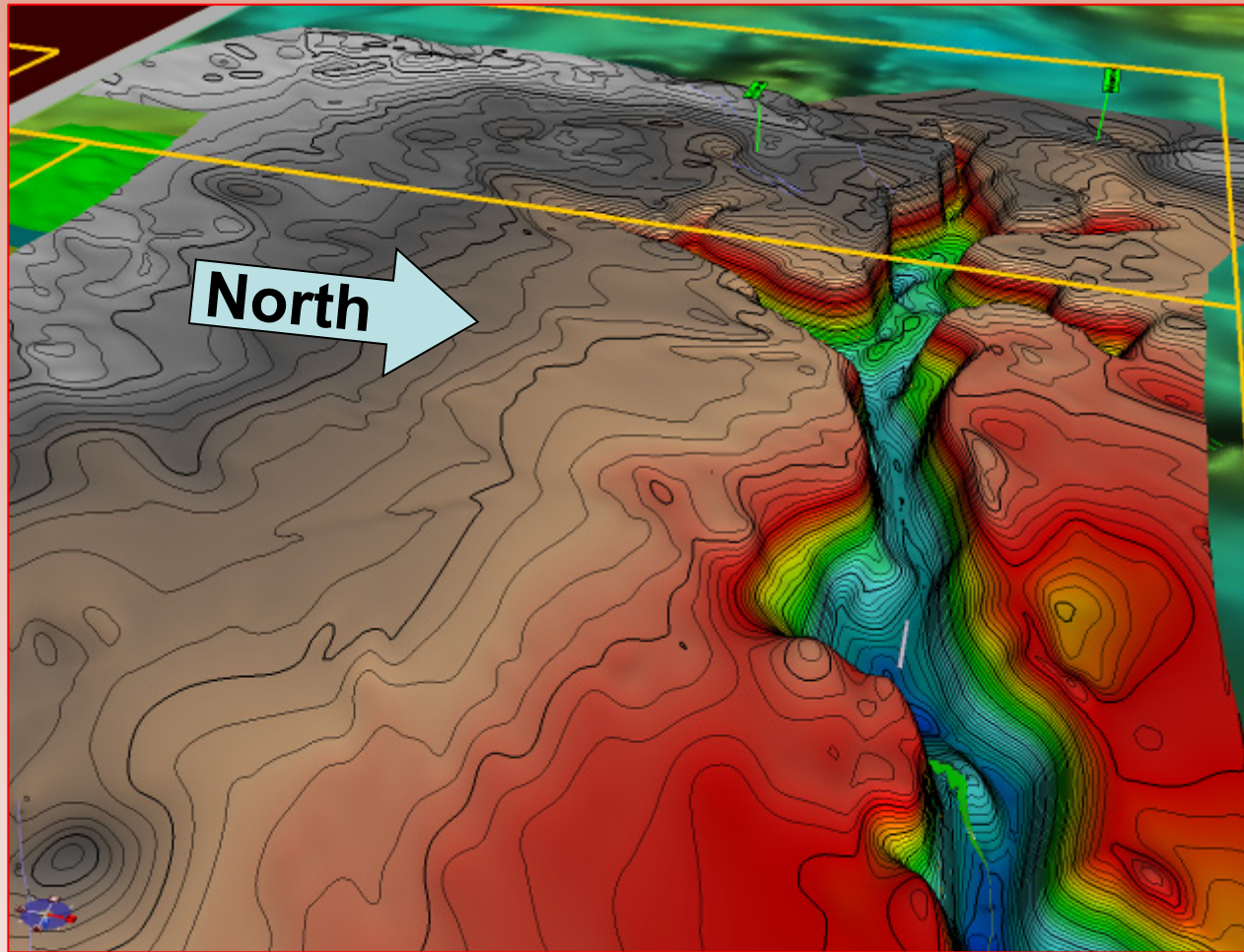


OBE-07-06 15:1

15:1

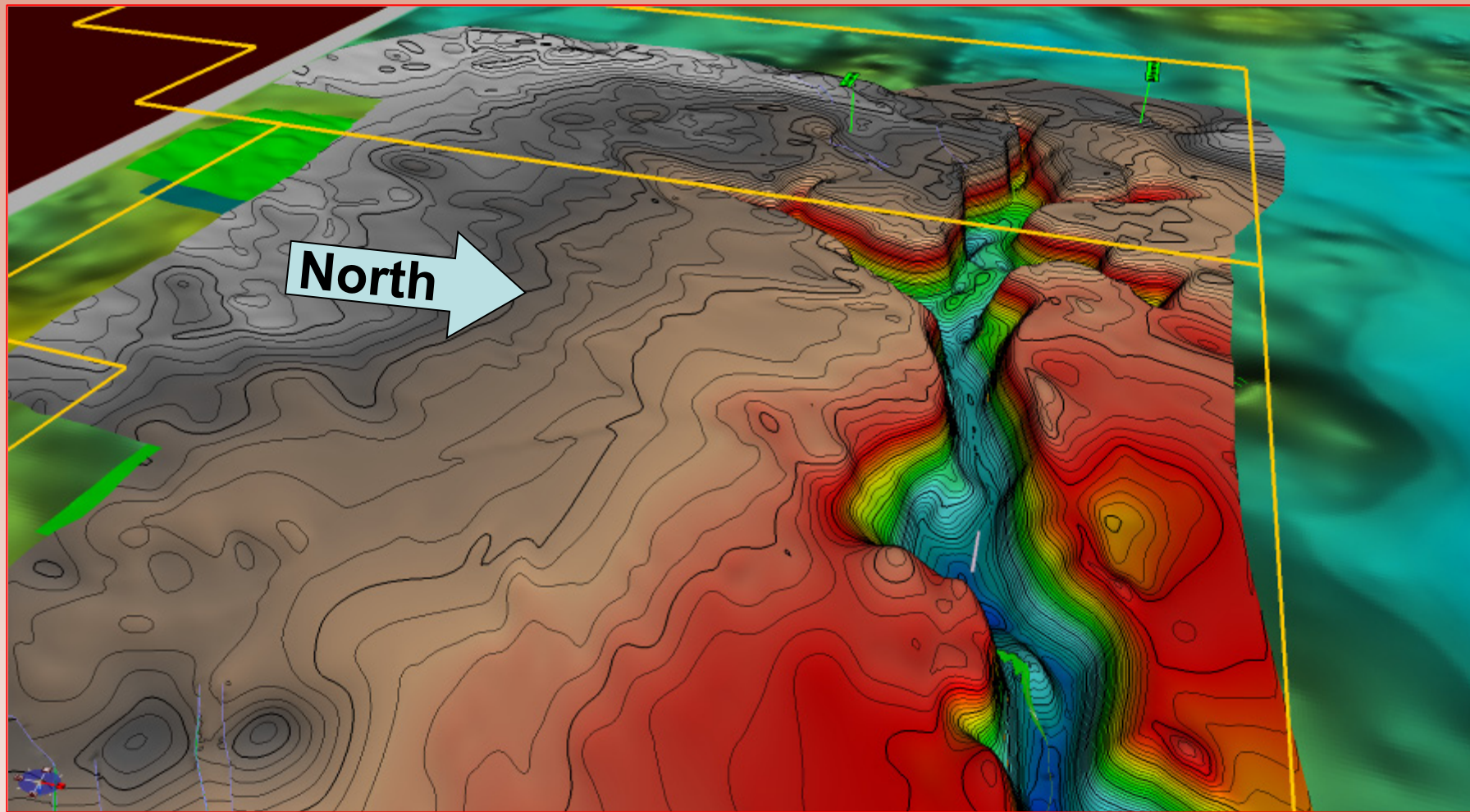
Base Narana

10ms contours ~ 22m

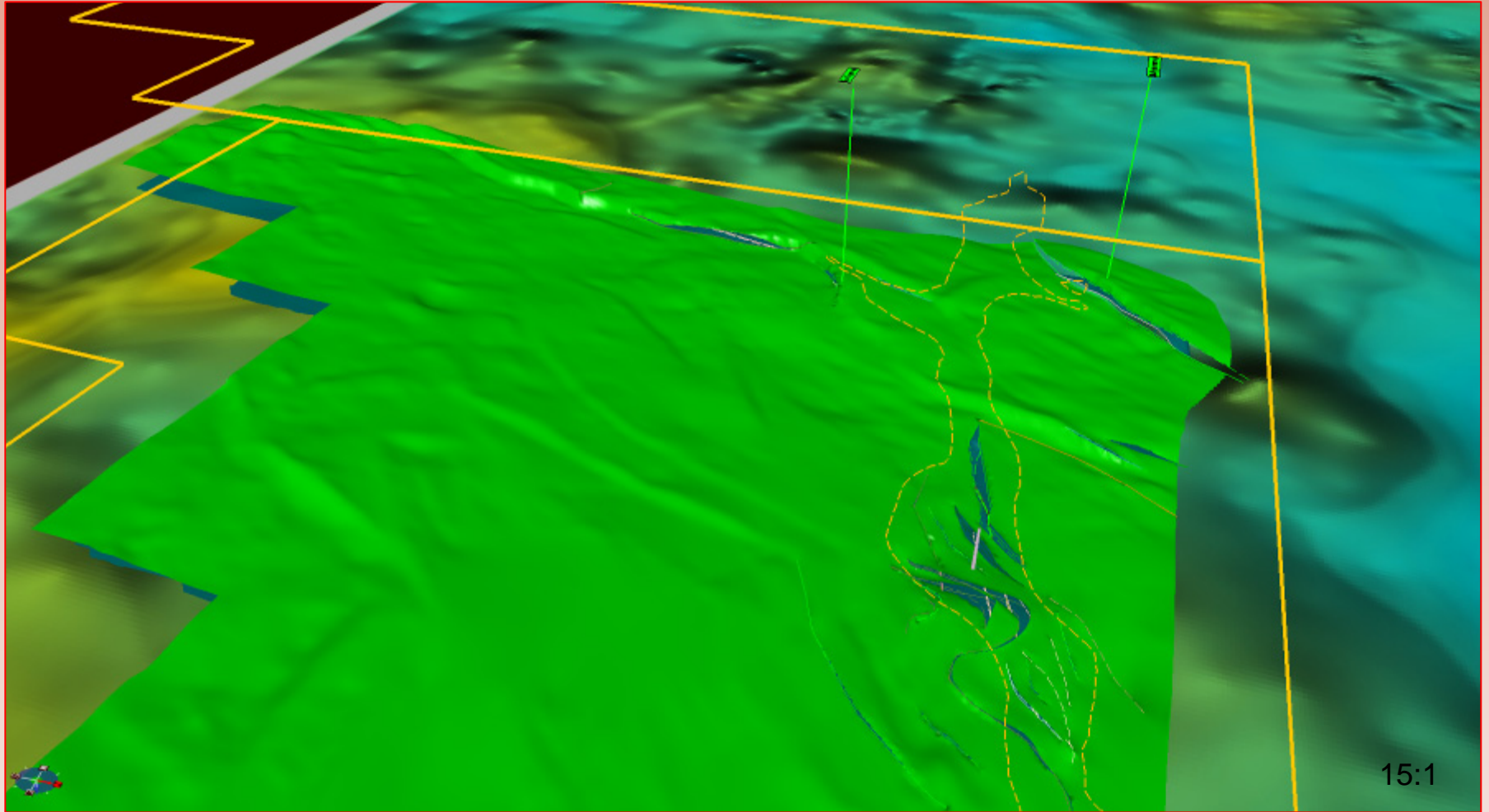


Base Narana

10ms contours ~ 22m

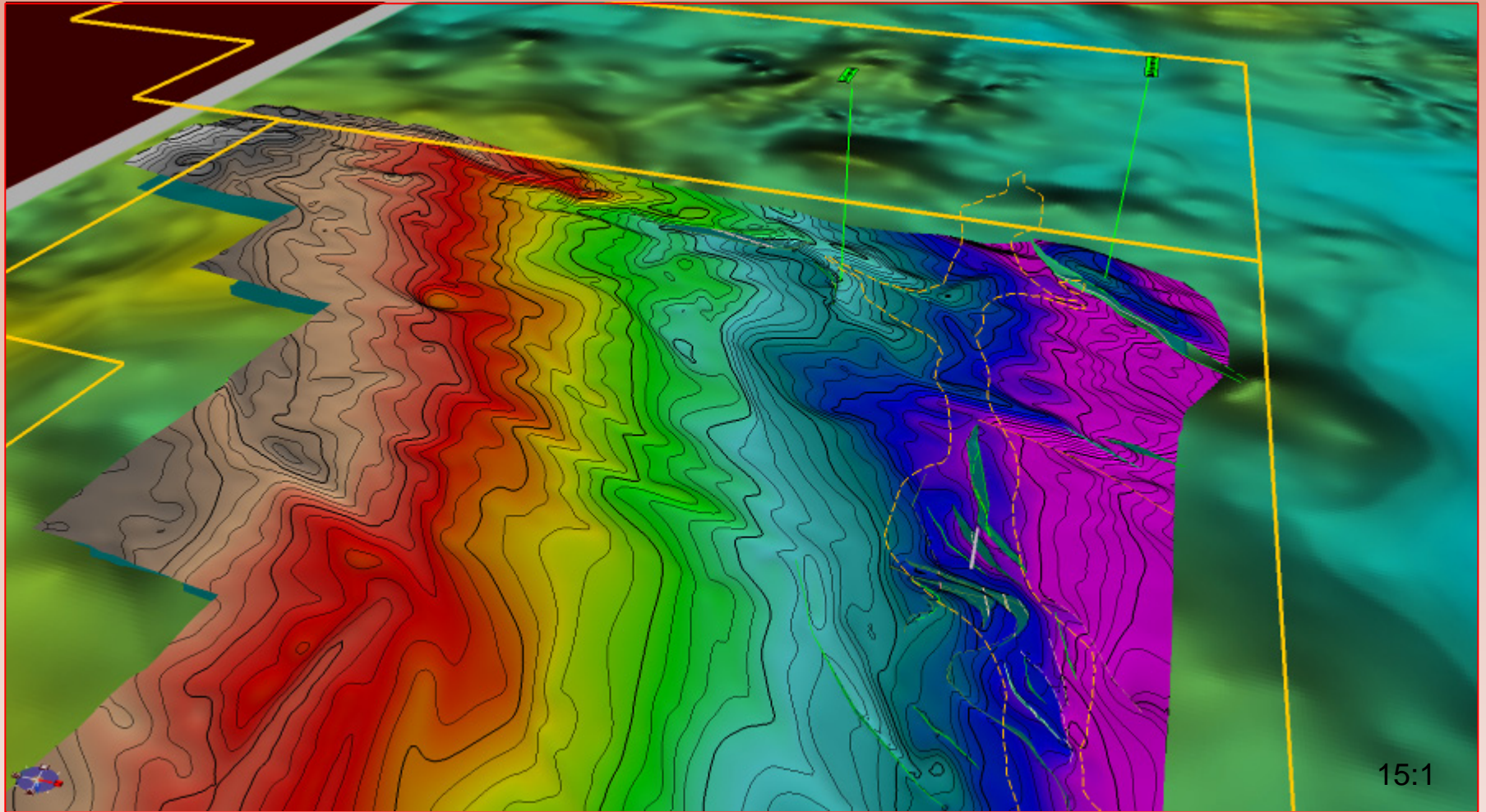


Base Alinya Salt



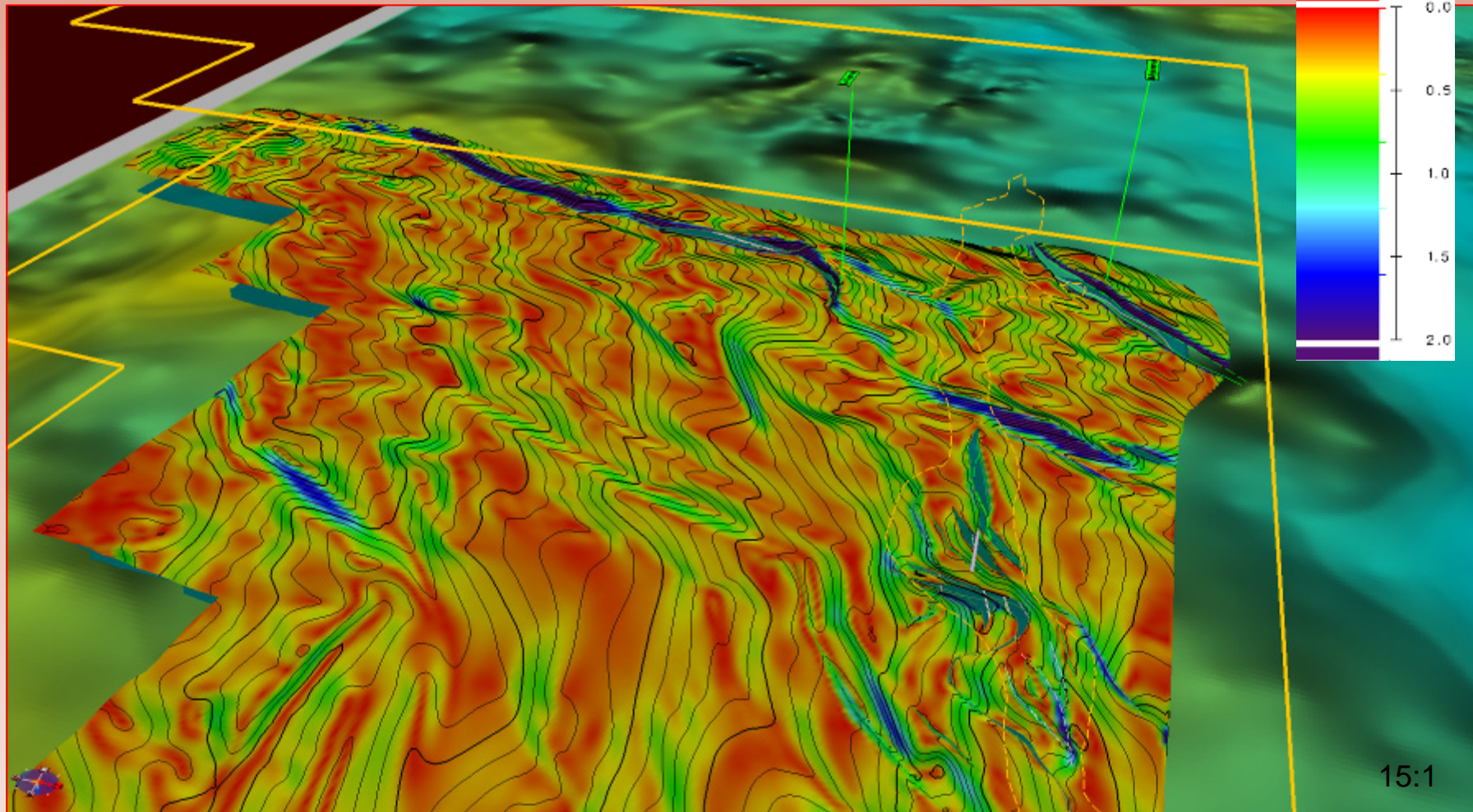
Base Alinya Salt - TWT

10ms contours ~ 22m



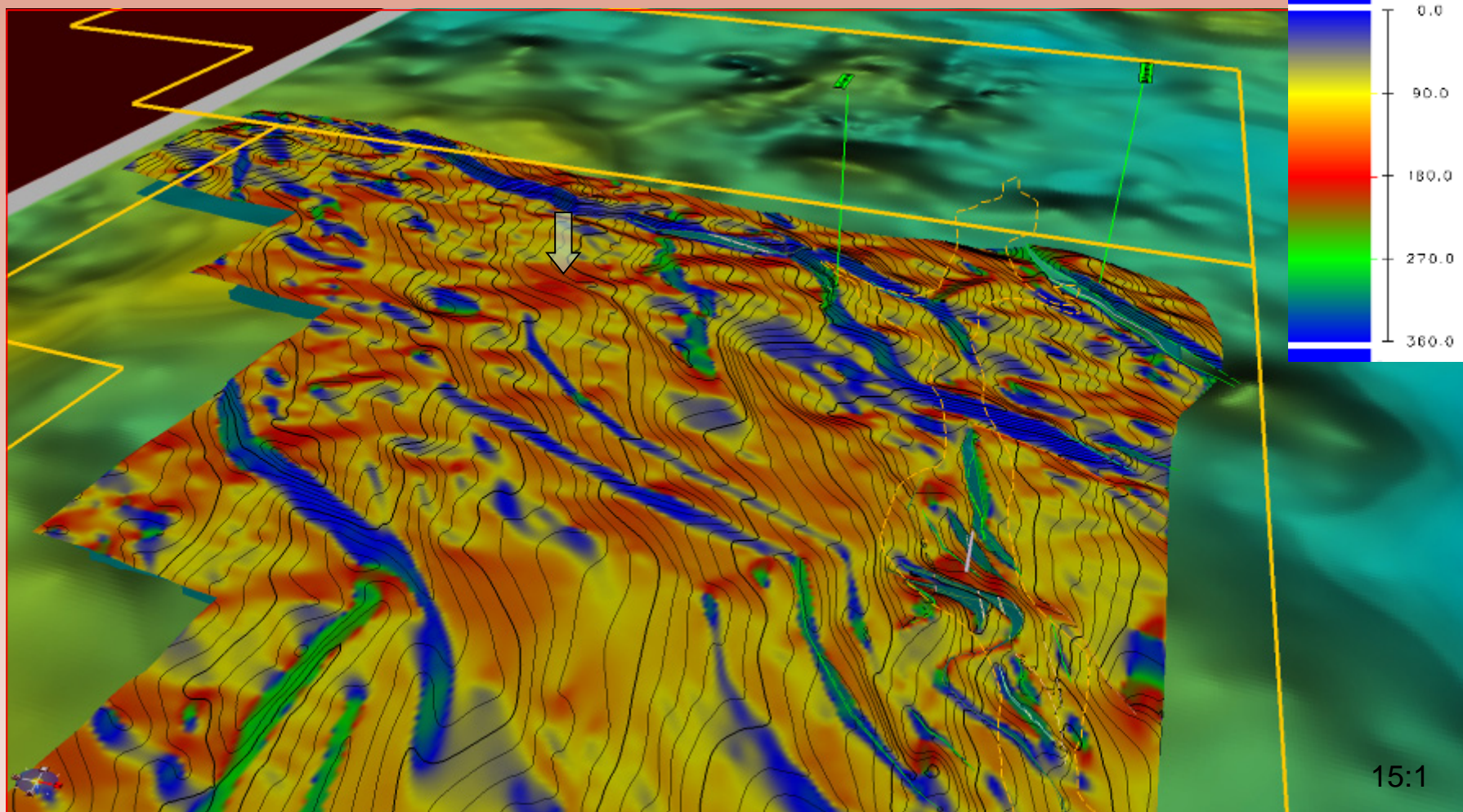
Base Alinya Salt - dip attribute

10ms contours ~ 22m

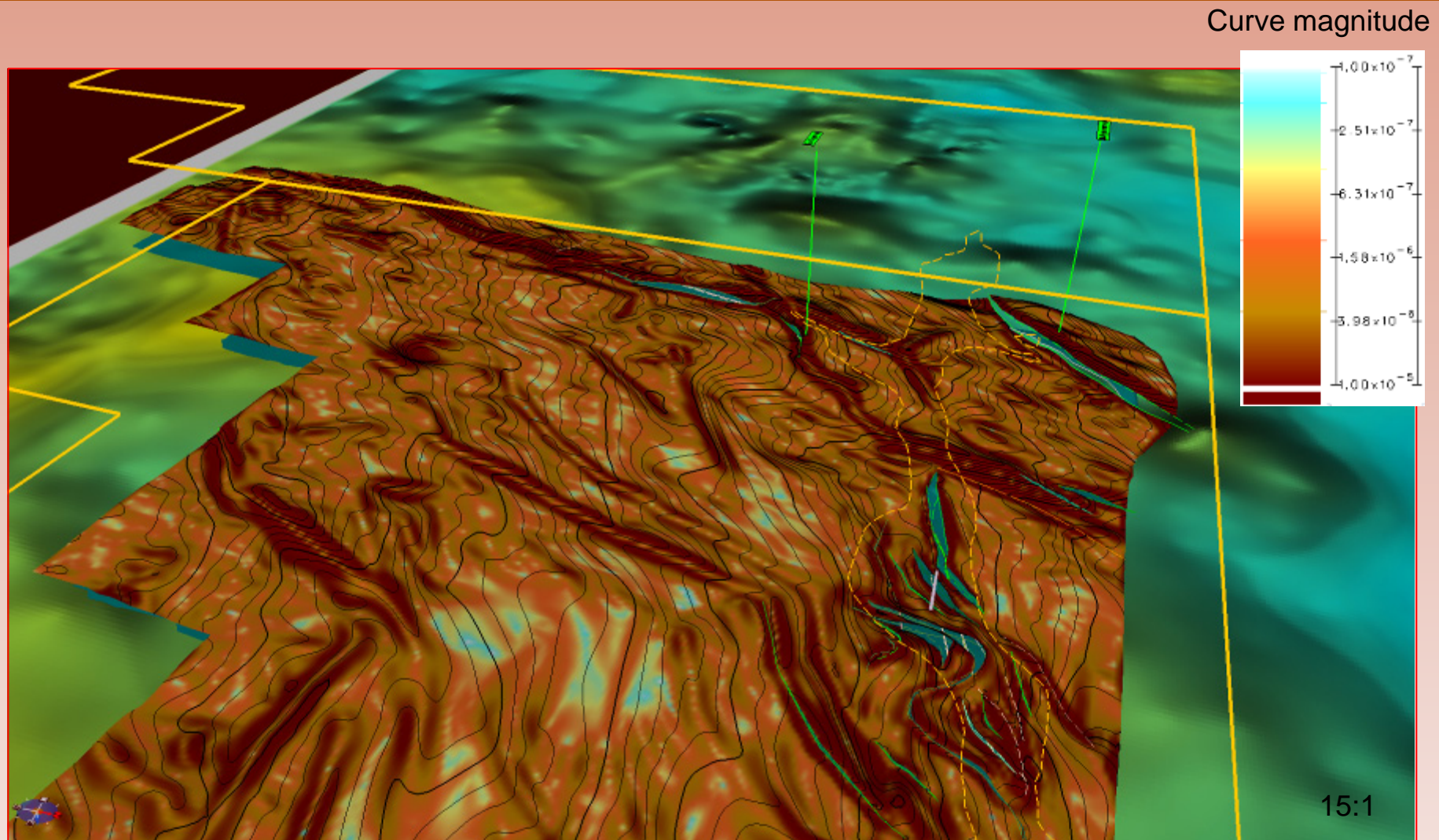


Base Alinya Salt - azimuth attribute

10ms contours ~ 22m

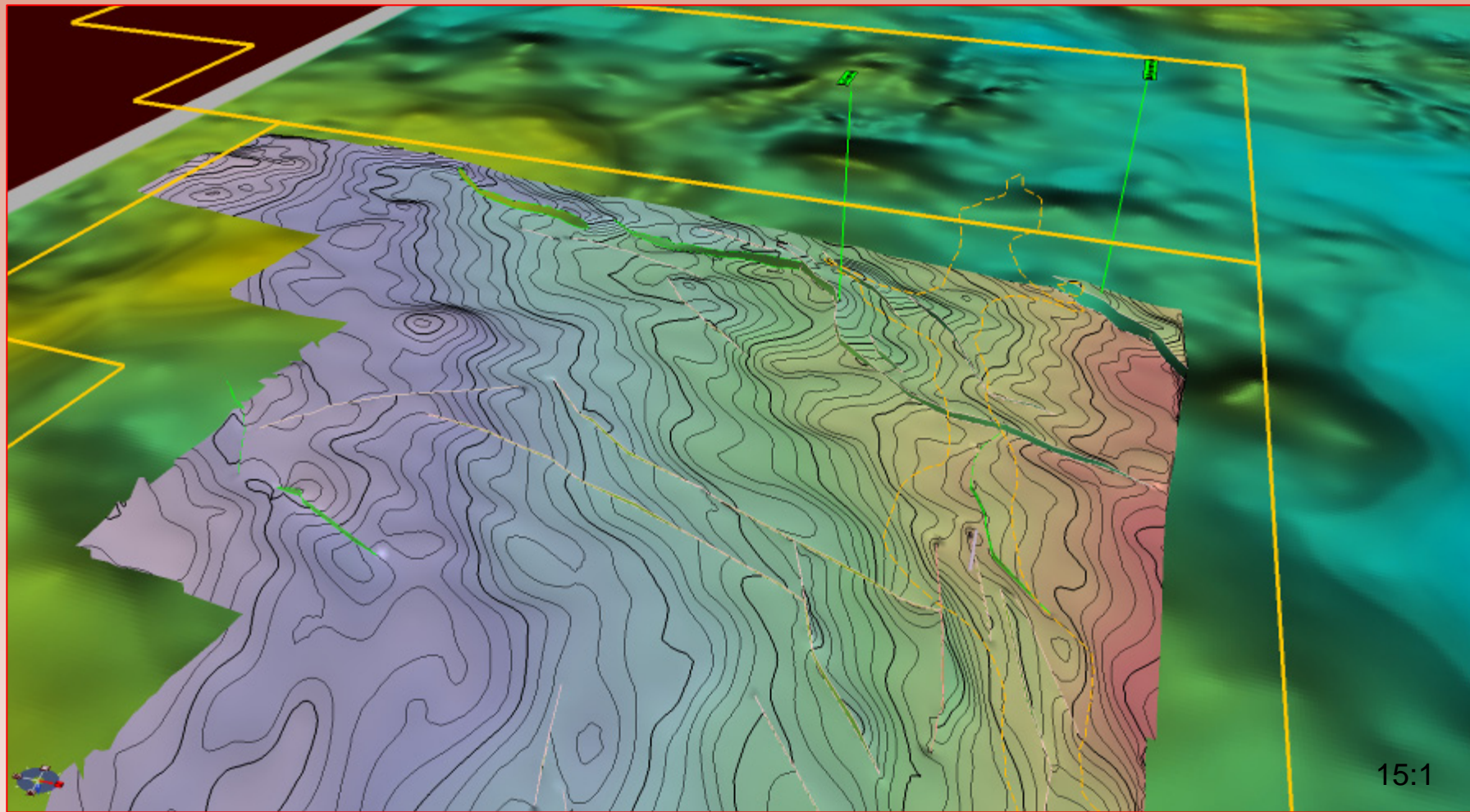


Base Alinya Salt - curvature attribute



Top Mesoproterozoic

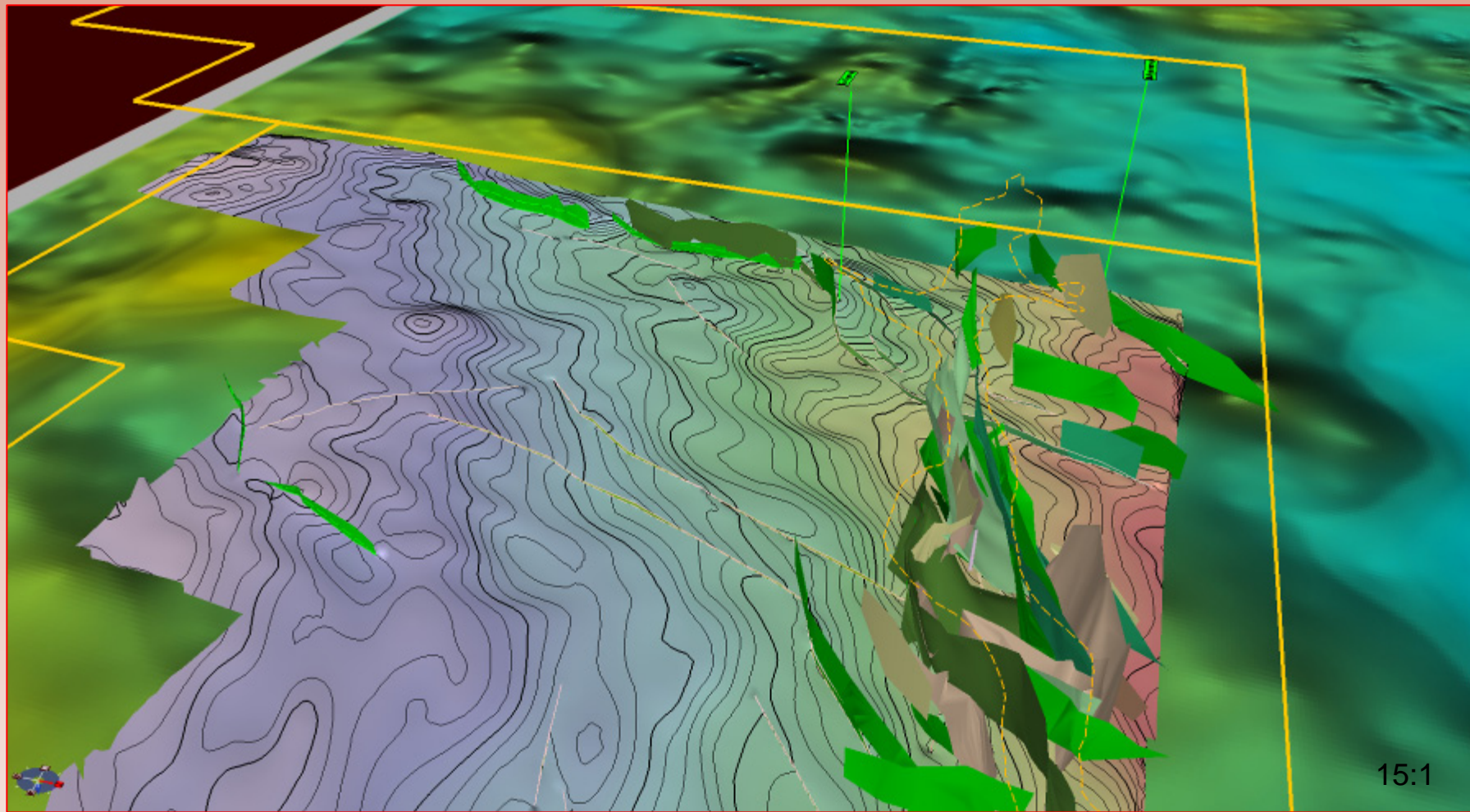
10ms contours ~ 22m



Thrust faults

Top Mesoproterozoic

10ms contours ~ 22m

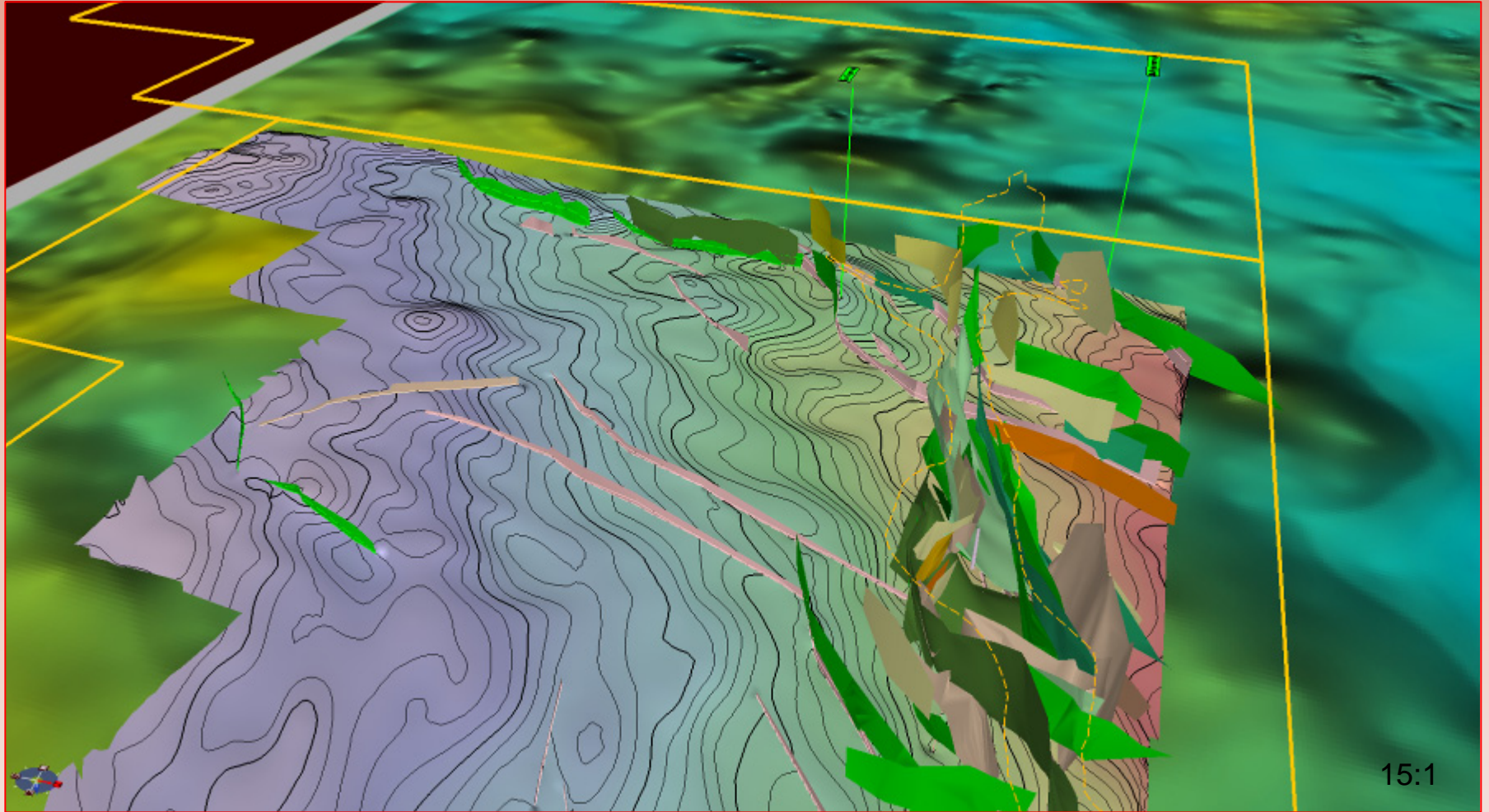


15:1

Top Mesoproterozoic

Thrust faults
Normal faults

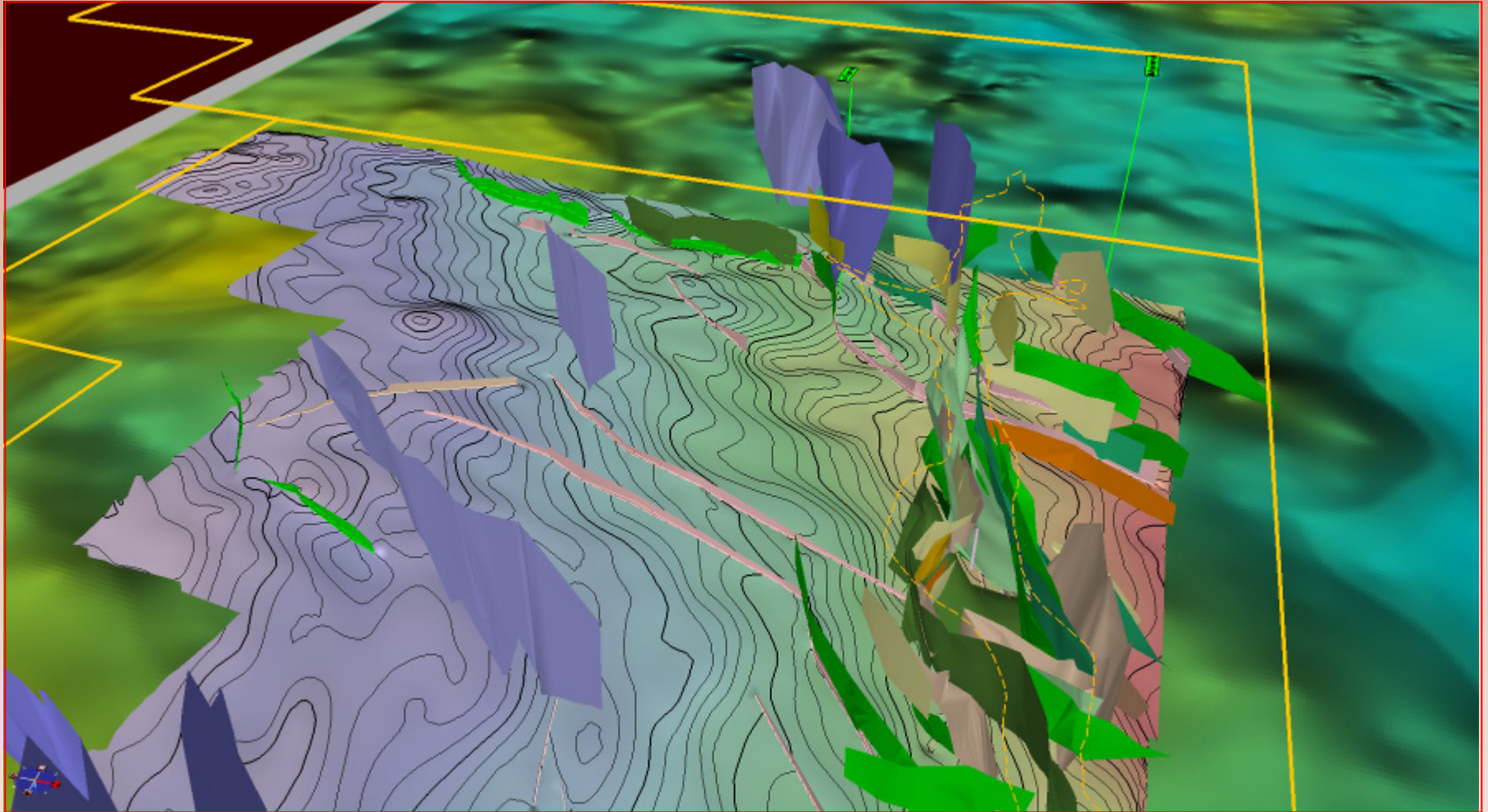
10ms contours ~ 22m



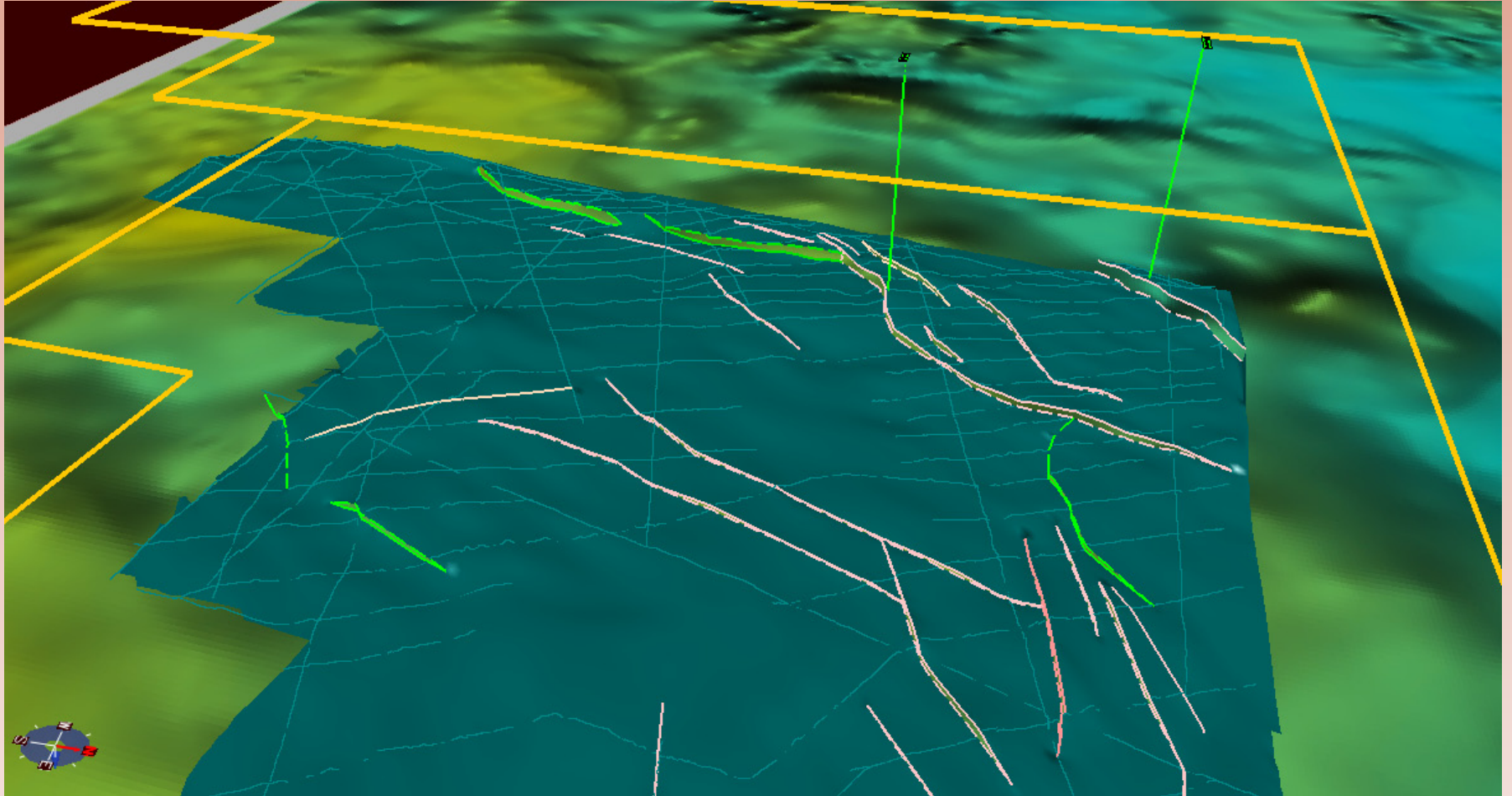
Top Mesoproterozoic

Thrust faults
Normal faults
Keystone faults

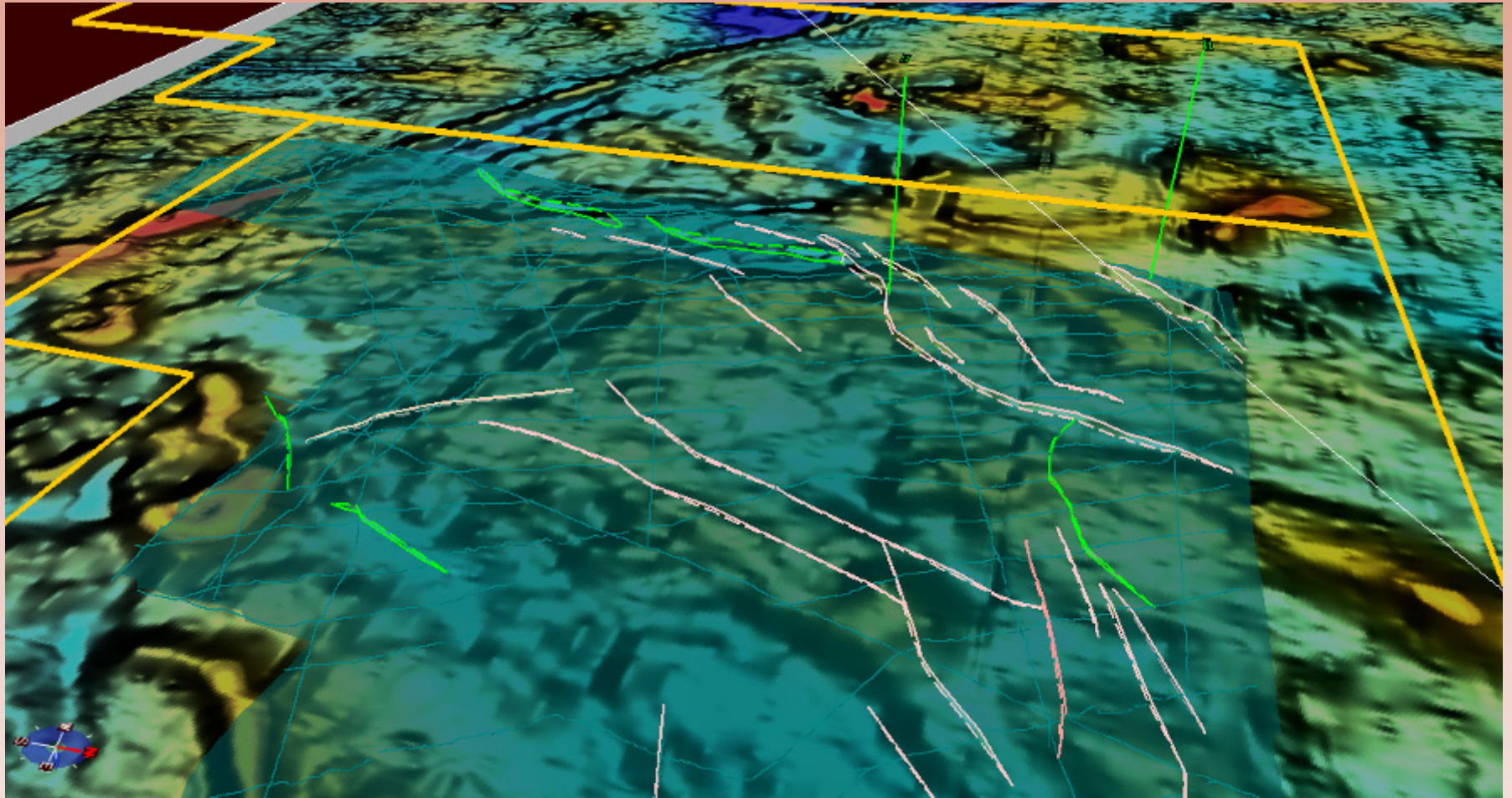
10ms contours ~ 22m



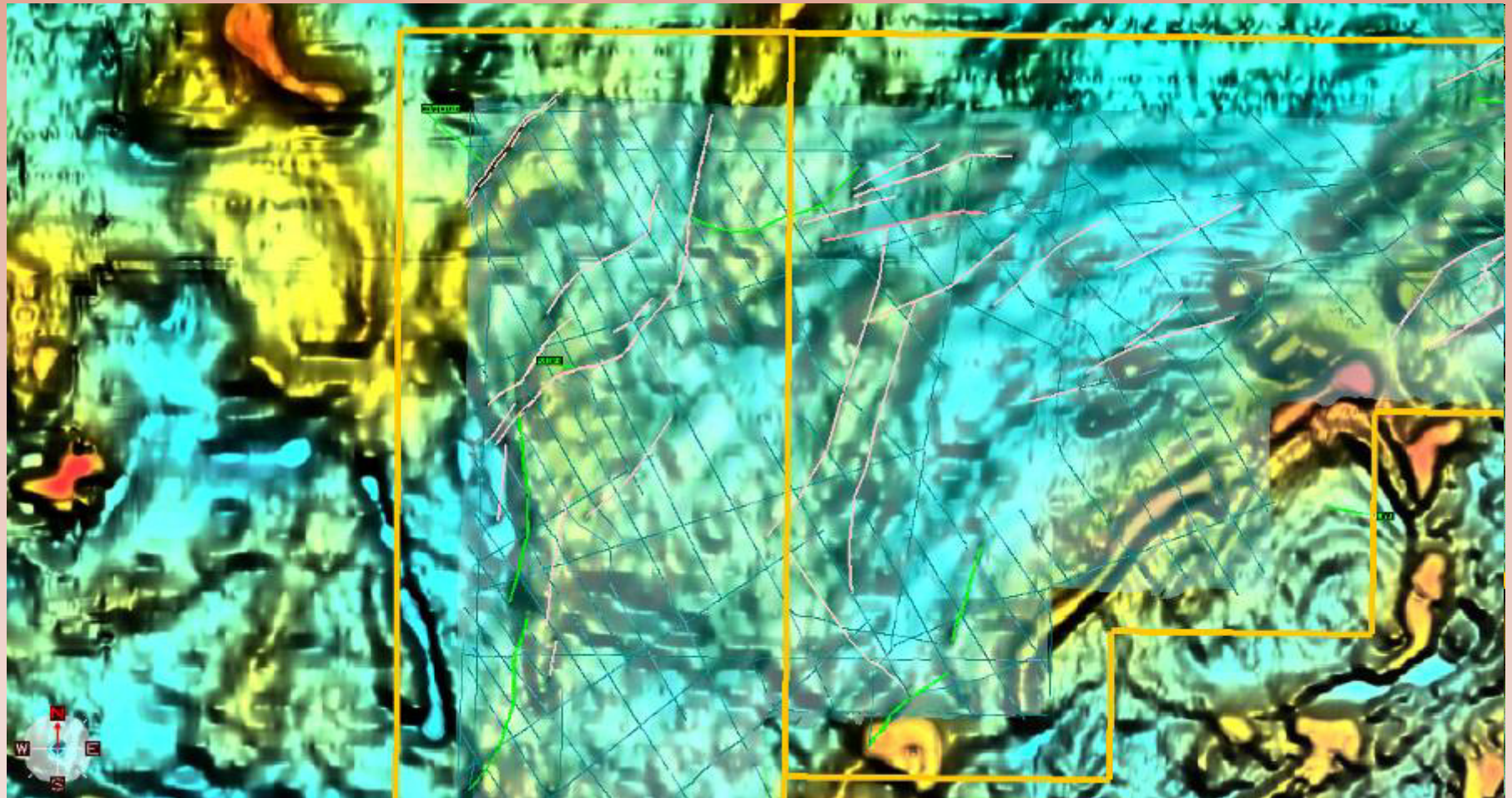
Top Mesoproterozoic + Bouguer Gravity



Top Mesoproterozoic + RTP TMI 1VD

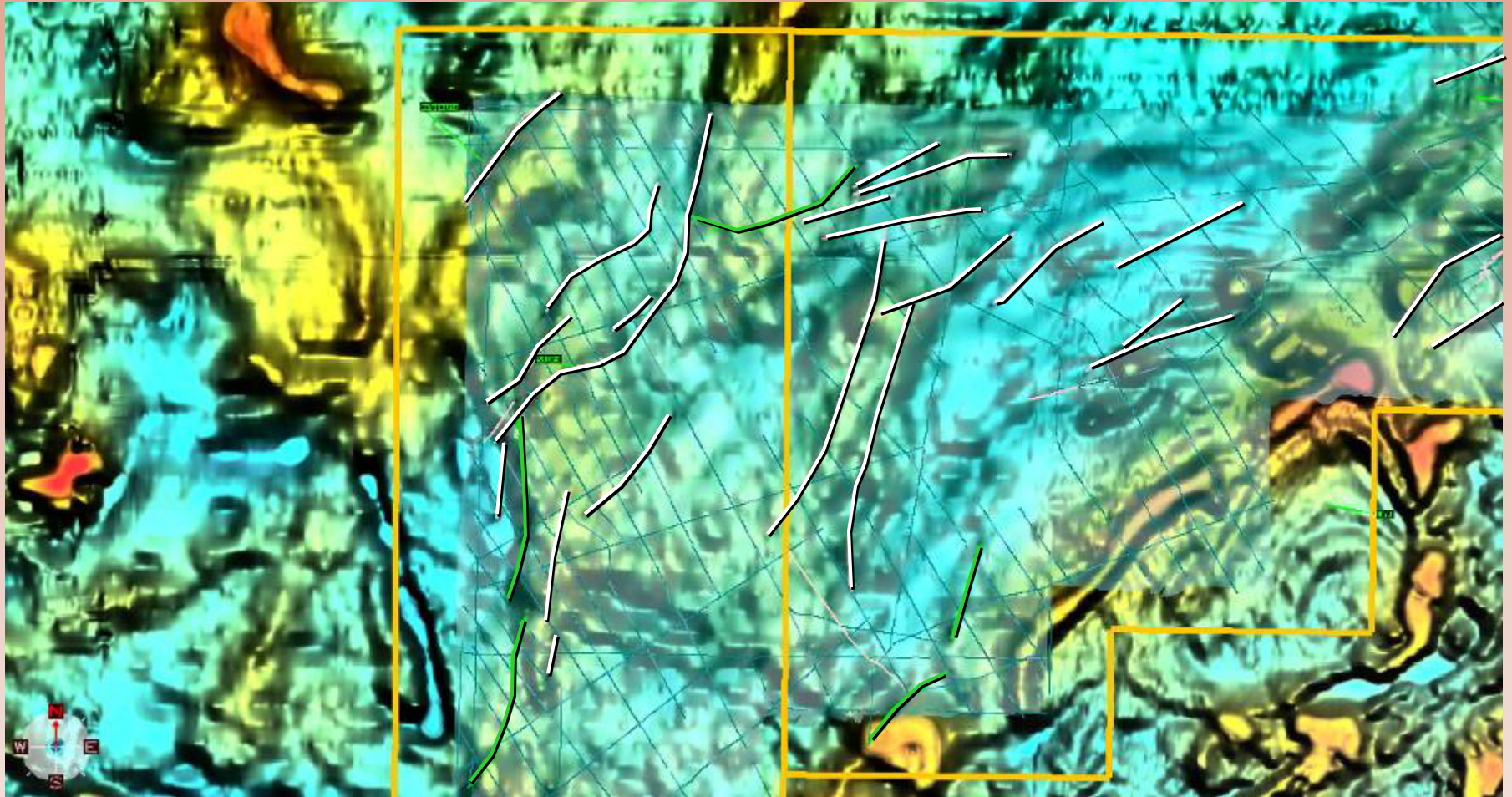


Top Mesoproterozoic + RTP 1VD TMI



Animated

Top Mesoproterozoic + RTP 1VD TMI



Top Mesoproterozoic + overlying structural interpretation

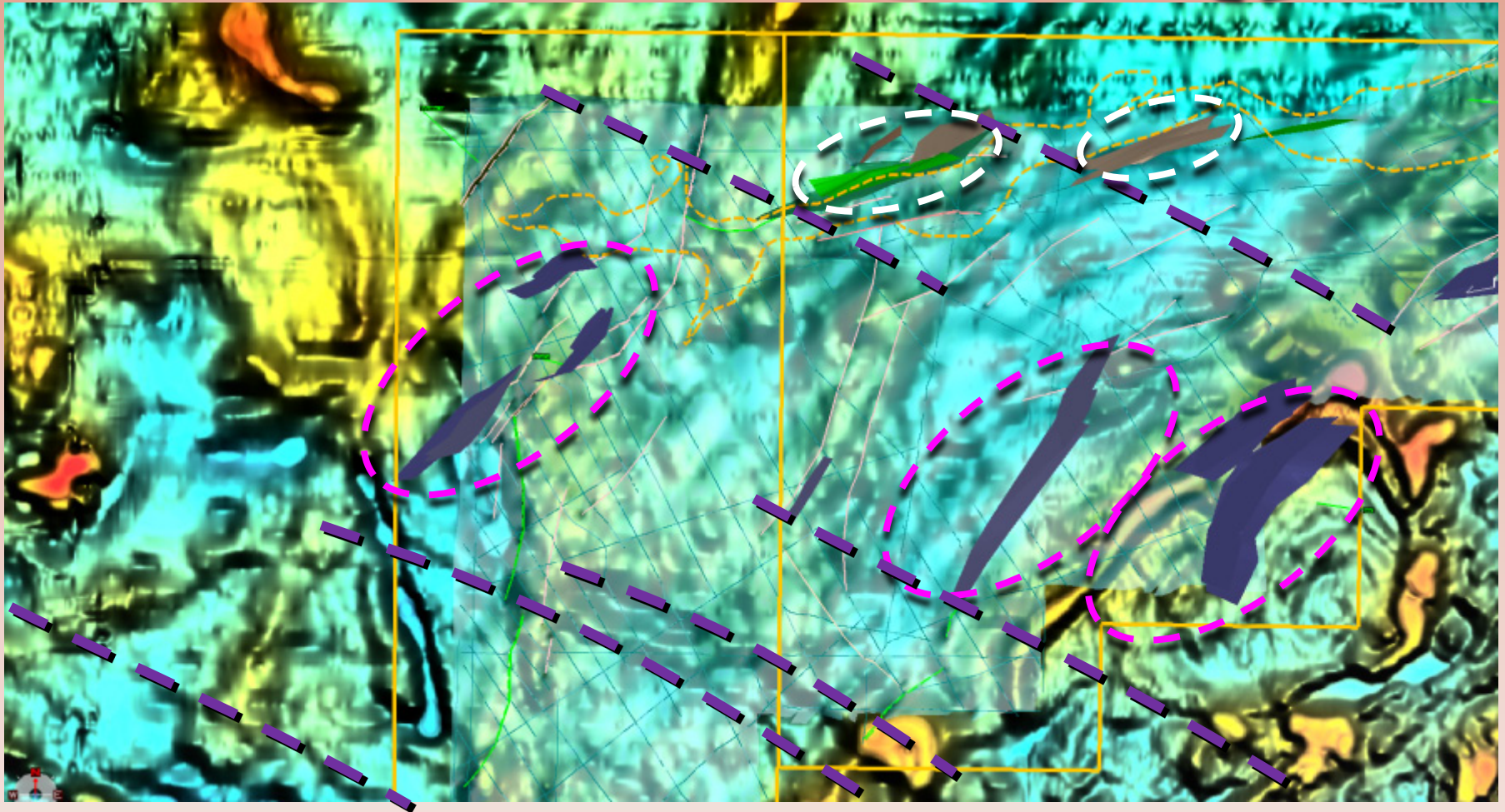
Strike-slip lineaments



Keystone features



Pop-ups



Conclusions (1)

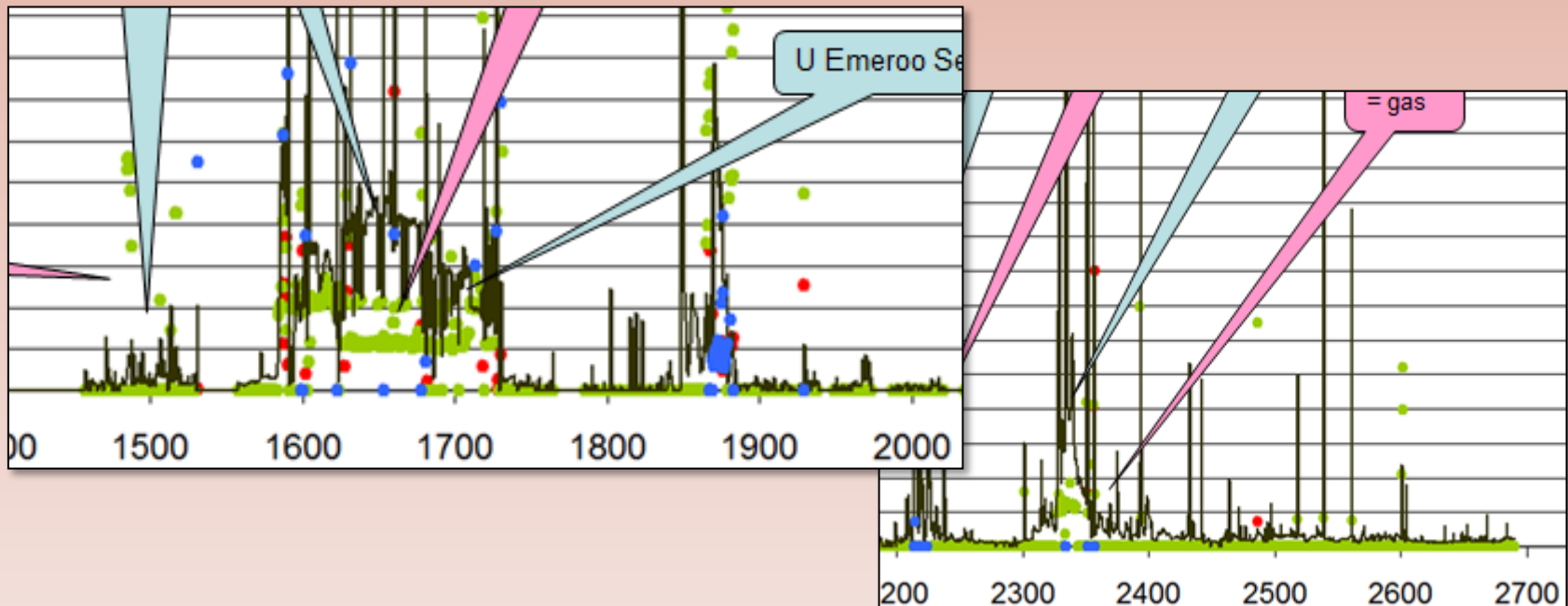
- A working petroleum system exists in the Callana / Burra Gps of the central Officer Basin.
 - Good reservoirs & excellent seals
 - Shows
- Main risk is charge & trap integrity
 - Understanding timing & structure

Conclusions (2)

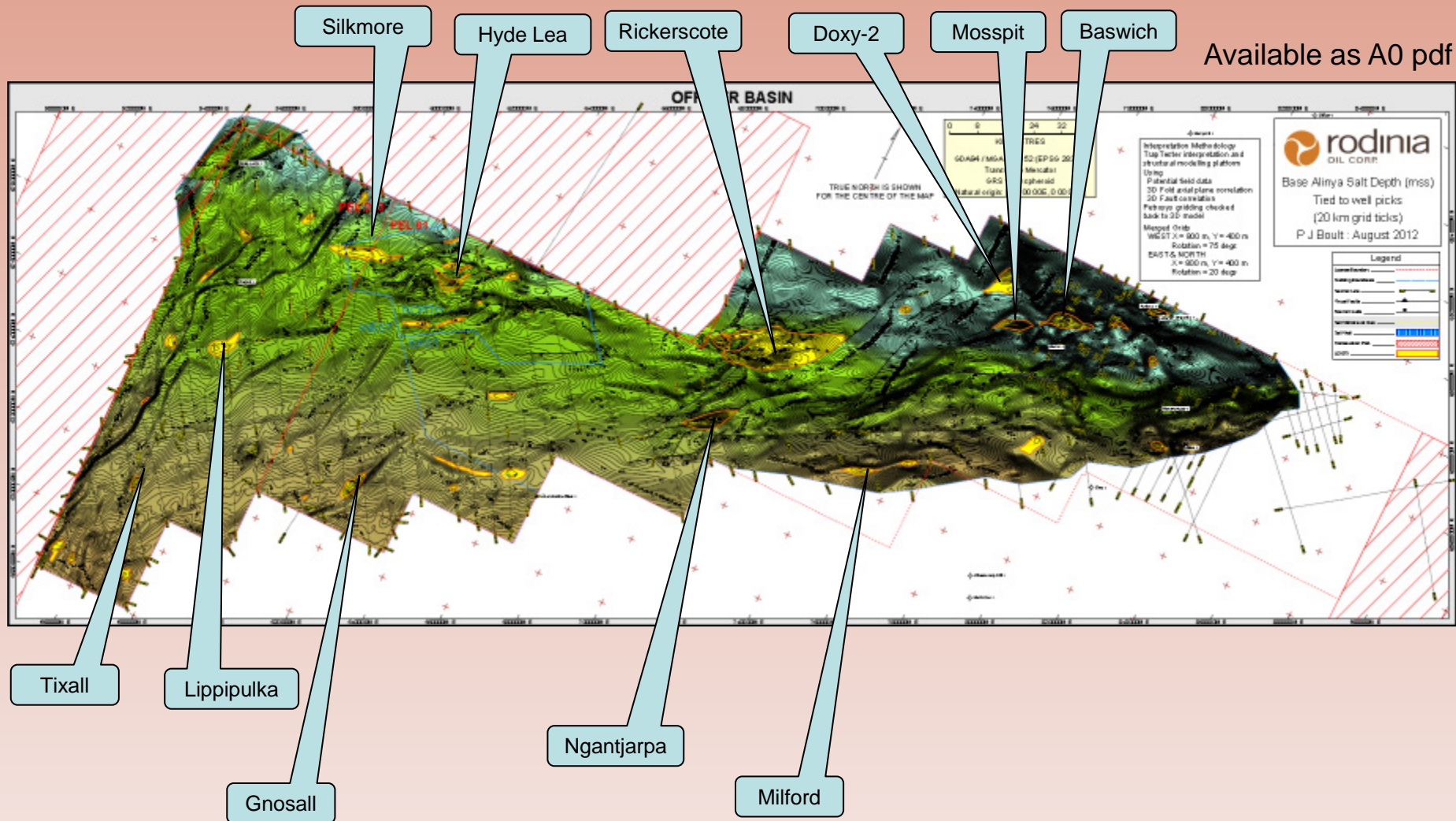
- Charge
 - Marinoan – Early Palaeozoic
- Structure
 - Early extension (Willouran grabens)
 - Willouran aggradation
 - Torrensian progradations (two directions)
 - Sturtian uplift & glaciation
 - Early Marinoan SAG
 - Late Marinoan uplift and canyoning
 - Peterman uplift & thrusting > Cambrian unconformity
 - Cambrian extension – main depocentre to north
 - Alice springs orogeny – strike slip kestones and pop-ups

Where to now?

- Coventional
 - Many more structures to drill
- Unconventional?



Depth SS: Base Alinya Salt horizon



Detailed Depth SS Top Murnaroo Sandstone Map – Enclosure 11

Available as A0 pdf

OFFICER BASIN

Scale: 0 16 32 40 KILOMETRES

TRUE NORTH IS SHOWN THE CENTRE OF THE MAP

Interpretation Methodology
Trap/Tester interpretation and structural modelling platform Using
Potential field data
3D Fault axial plane correlation
3D Fault correlation
Petrology gridding checked back to 3D model
Merged Grids
WEST X = 600 m, Y = 400 m
Rotation = 75 degs
EAST X = 600 m, Y = 400 m
Rotation = 30 degs

rodinia OIL CORP

Murnaroo Sandstone Depth (mss)
Tied to Well picks
(20 km grid ticks)
P J Boul: August 2012

Legend

Source Boundary
Seismic Line
Fault Trace
Normal Fault
Well Location
Well Depth
Well Type
Well Status

Callouts: Rickerscote, Doxy, Ngantjarpa, Milford, Walton, Brocton



Thankyou.

from

Peter Boulton, *Ginkgo ENP GNG, Adelaide, Australia, Badley Geoscience LTD, UK*

Paul Bennett, *Rodinia Oil Corp Calgary, Alberta, Canada*

Annelise Freeman, *Rodinia Oil Corp Calgary, Alberta, Canada*



GINKGO
ENP GNG



rodinia
OIL CORP.

