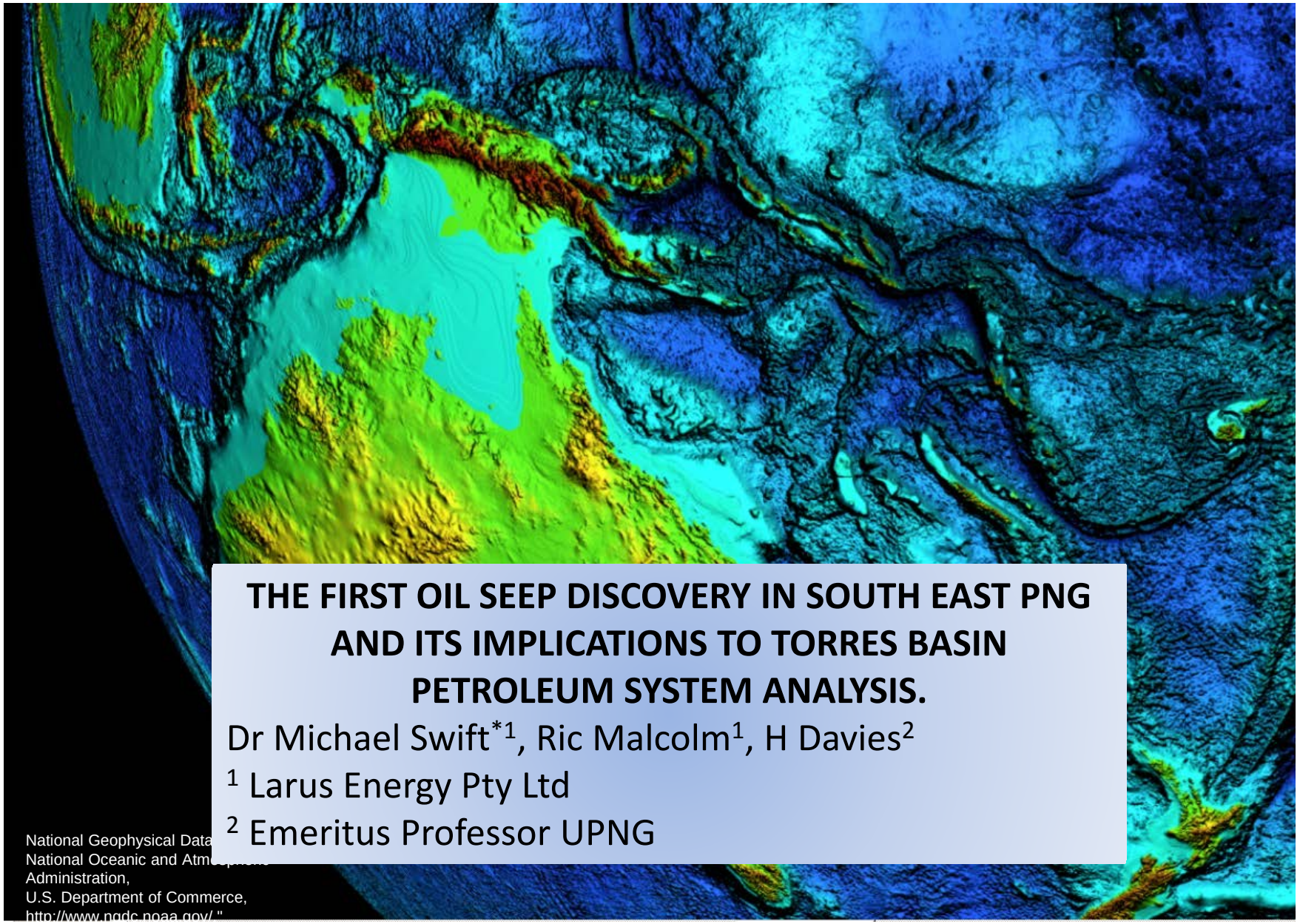

THE FIRST OIL SEEP DISCOVERY IN SOUTH EAST PNG AND ITS IMPLICATIONS TO TORRES BASIN PETROLEUM SYSTEM ANALYSIS.

Dr Michael Swift*[1], Ric Malcolm[1], H Davies[2]
[1] Larus Energy Pty Ltd
[2] Emeritus Professor UPNG

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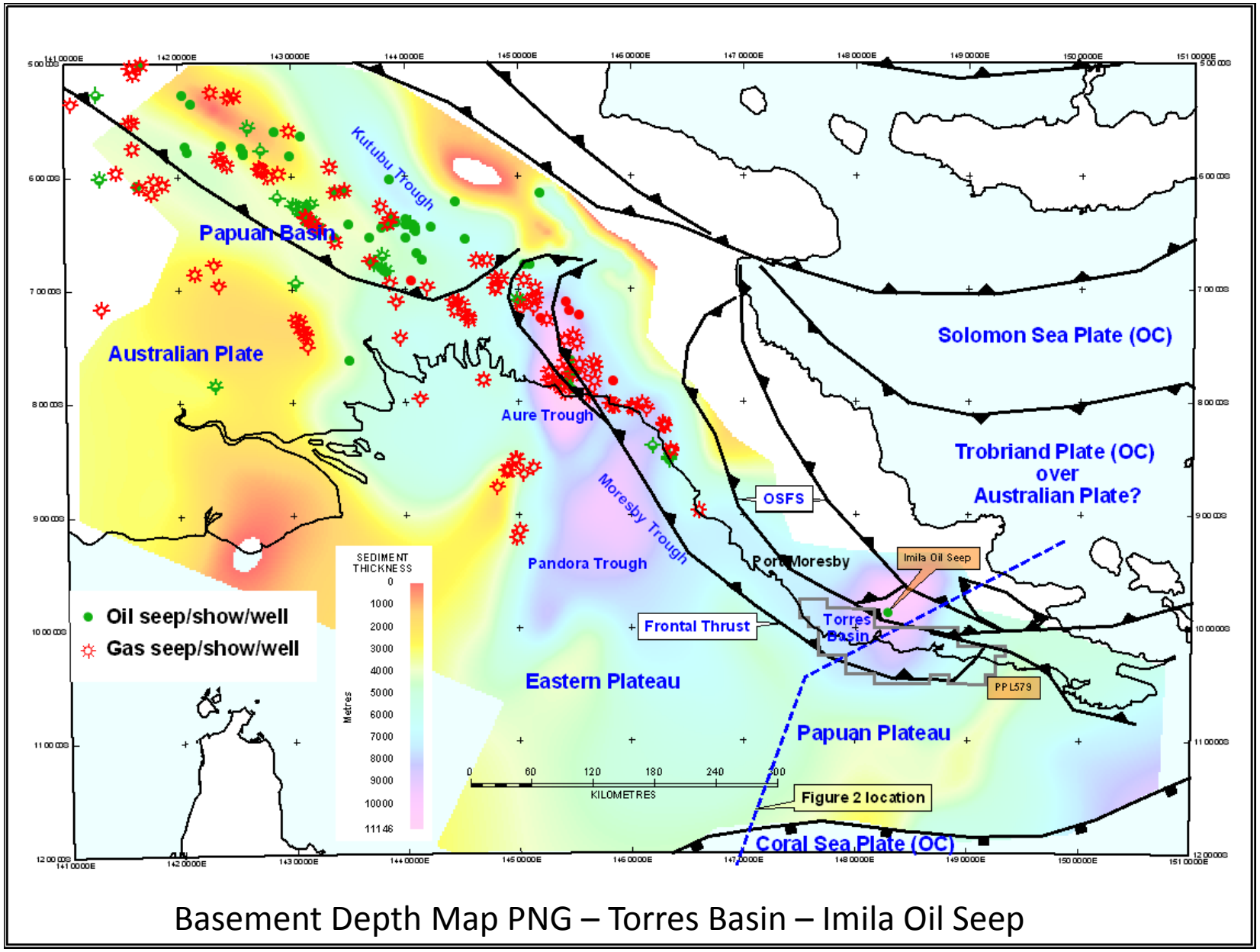
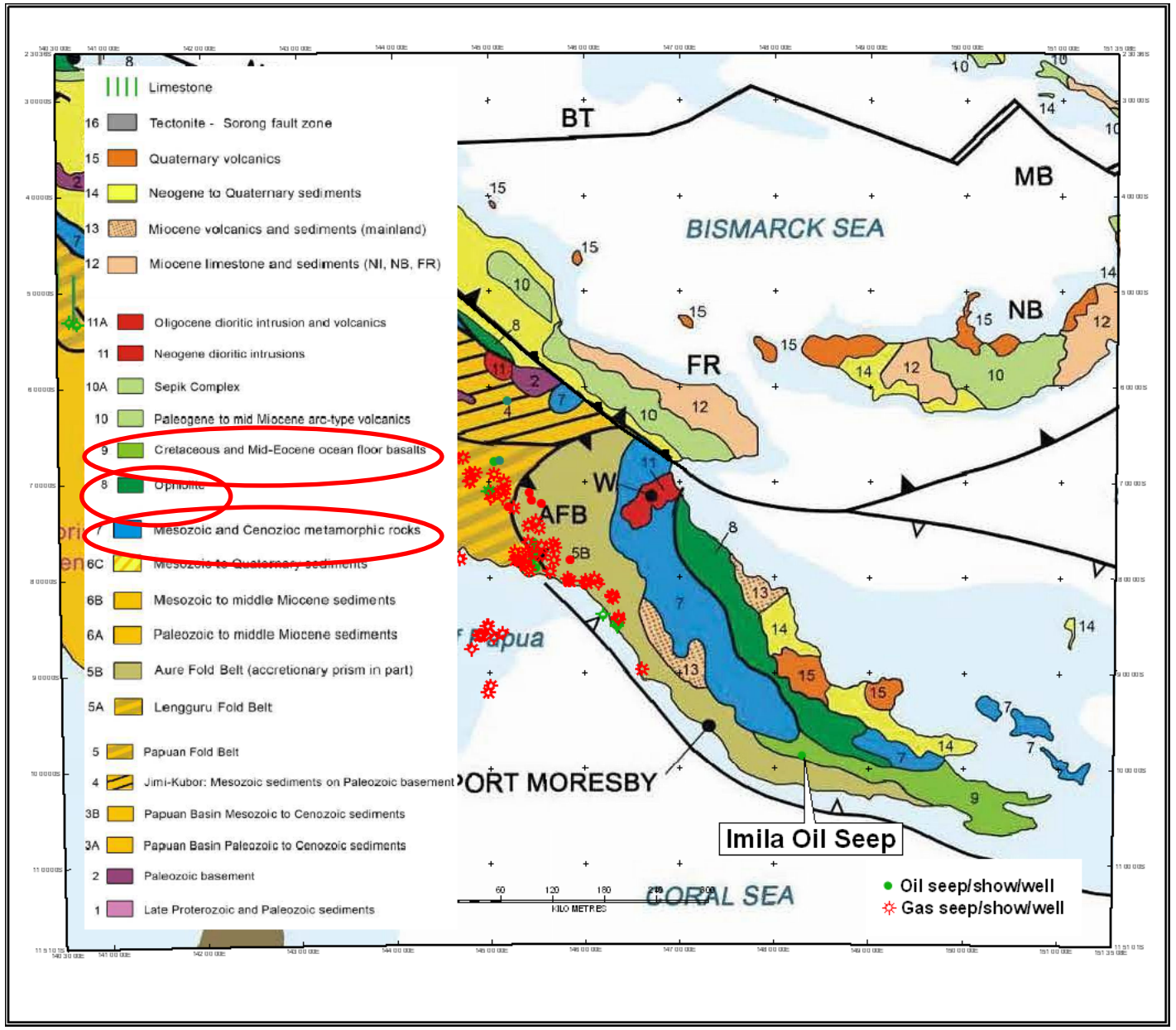
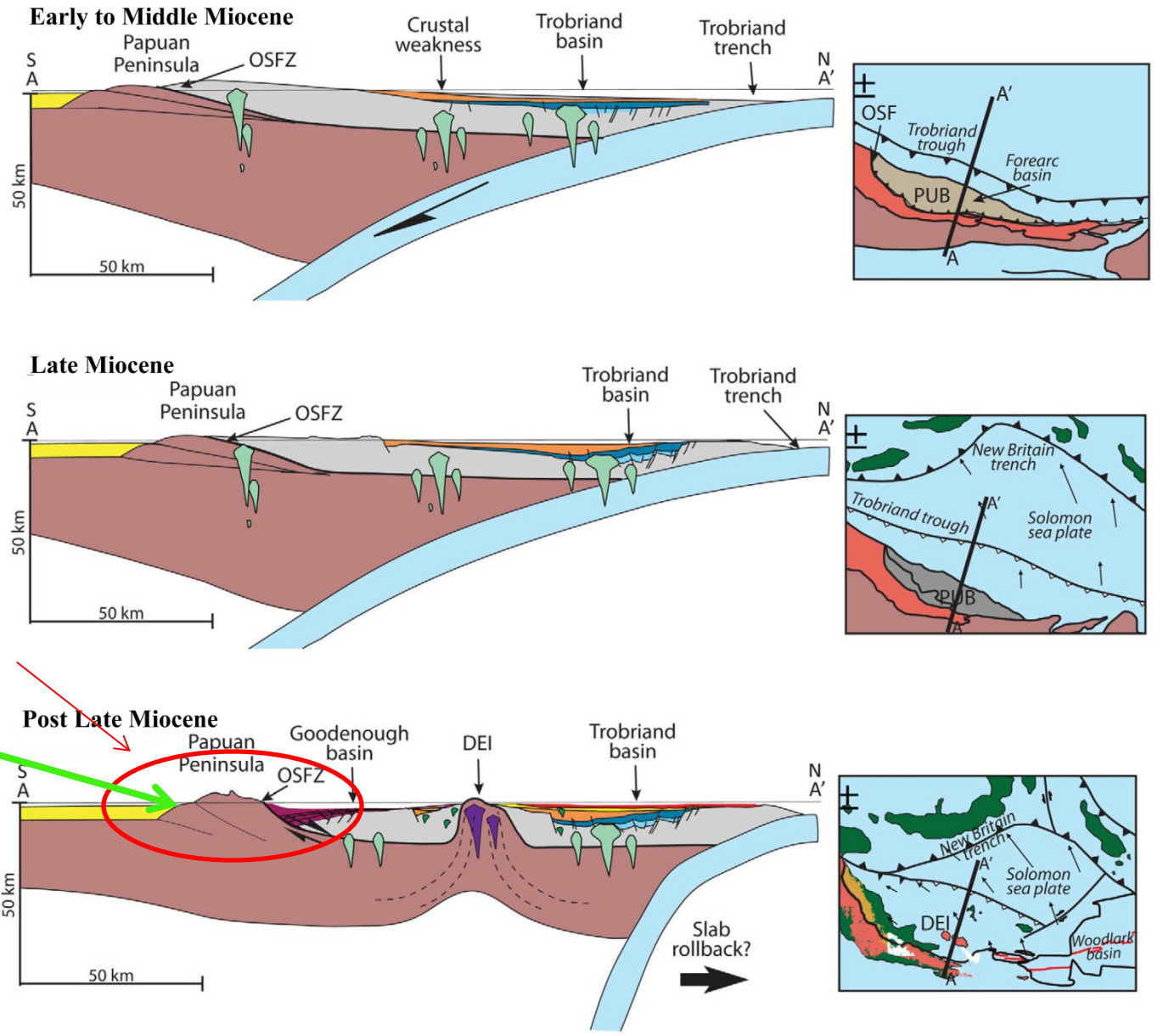


Basement Depth Map PNG – Torres Basin – Imila Oil Seep



Surface Geology – oil/gas occurrences



Area of Interest

Seep

Guy Fitz and Paul Mann, 2013, Evaluating upper versus lower crustal extension through structural reconstructions and subsidence analysis of basins adjacent to the D'Entrecasteaux Islands, eastern Papua New Guinea. Geochemistry Geophysics Geosystems ,Volume 14, Number 6 pp 1800 - 1818.

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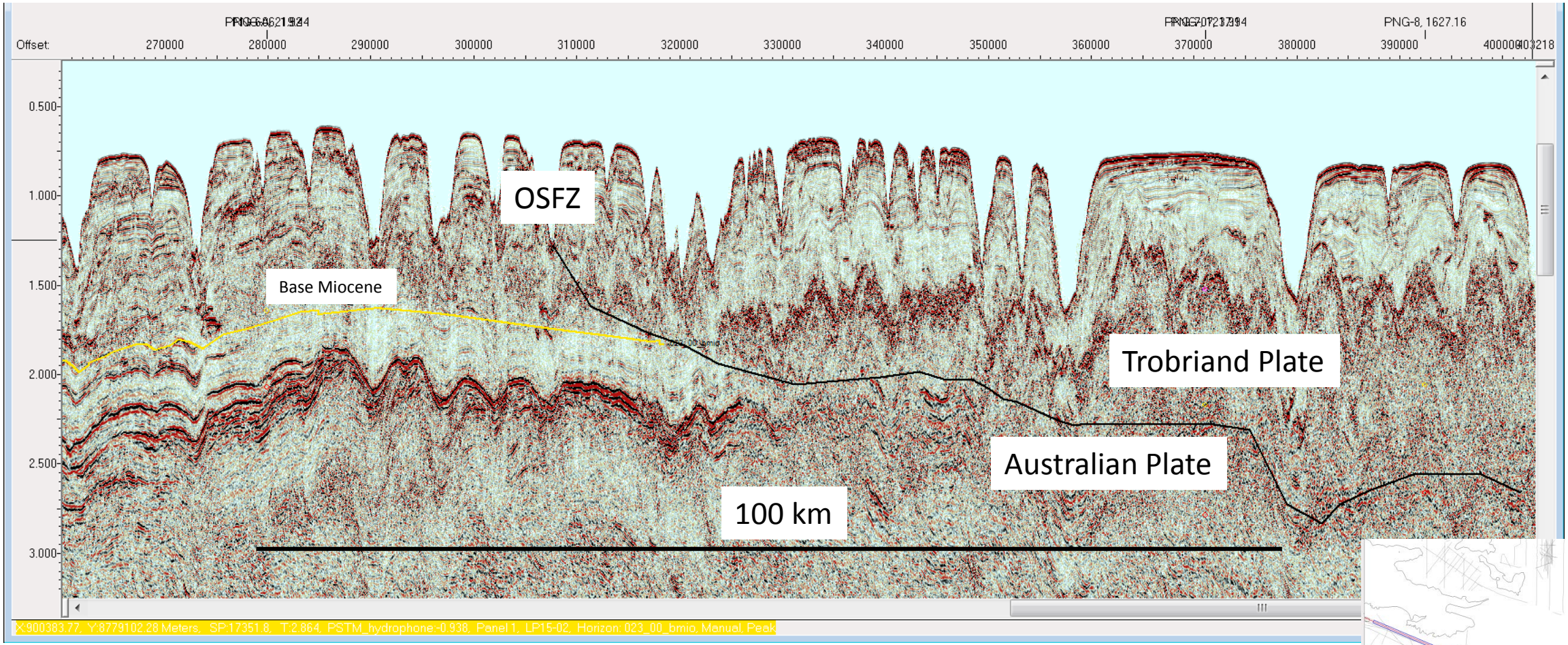
Understanding the Papuan Ultramafic Story



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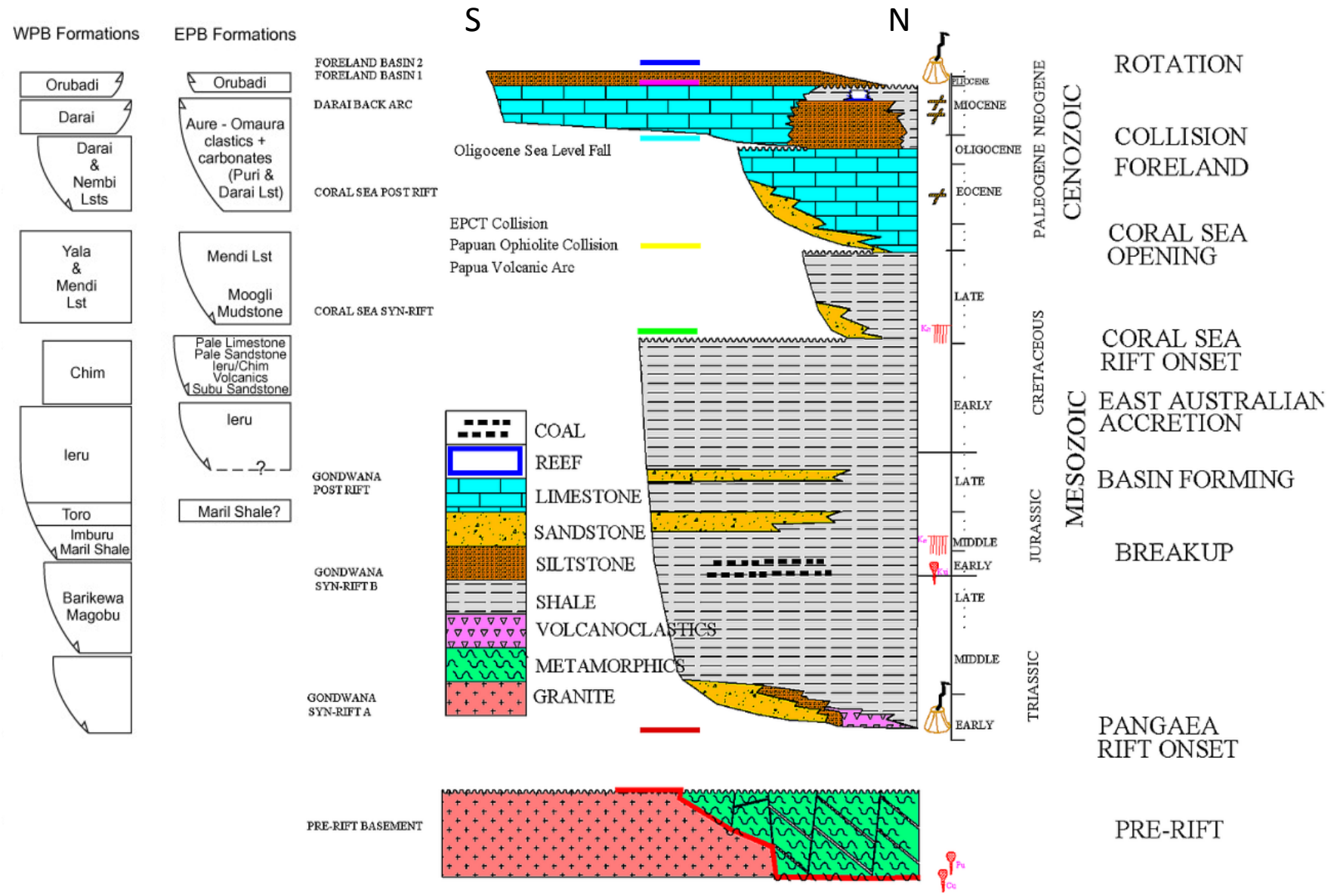
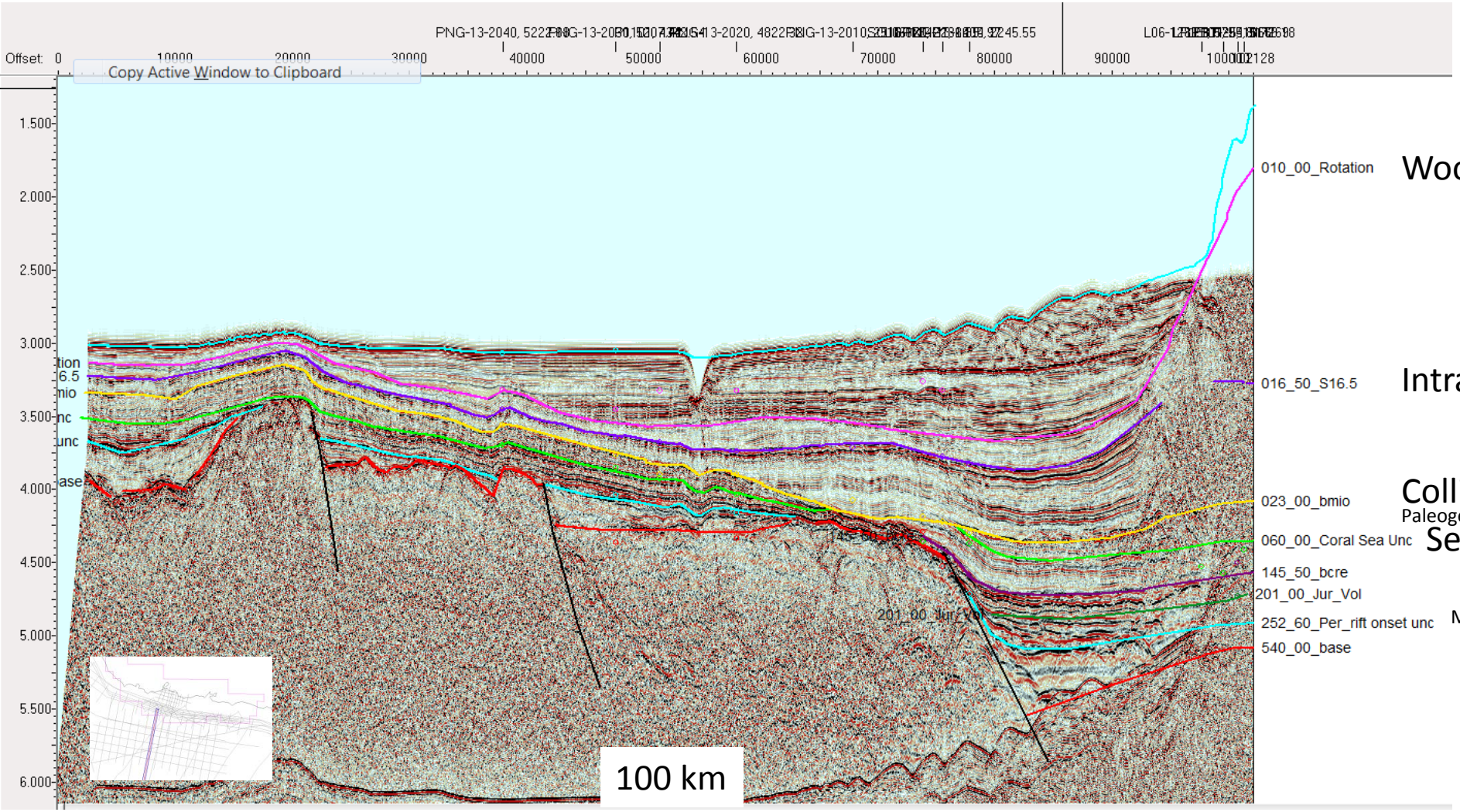
Seismic Image – Regional Cross Section



Stratigraphy Model for Torres Basin

S N



Woodlark Basin opening

Intra Darai eqv.

Collision Unc

Paleogene Section

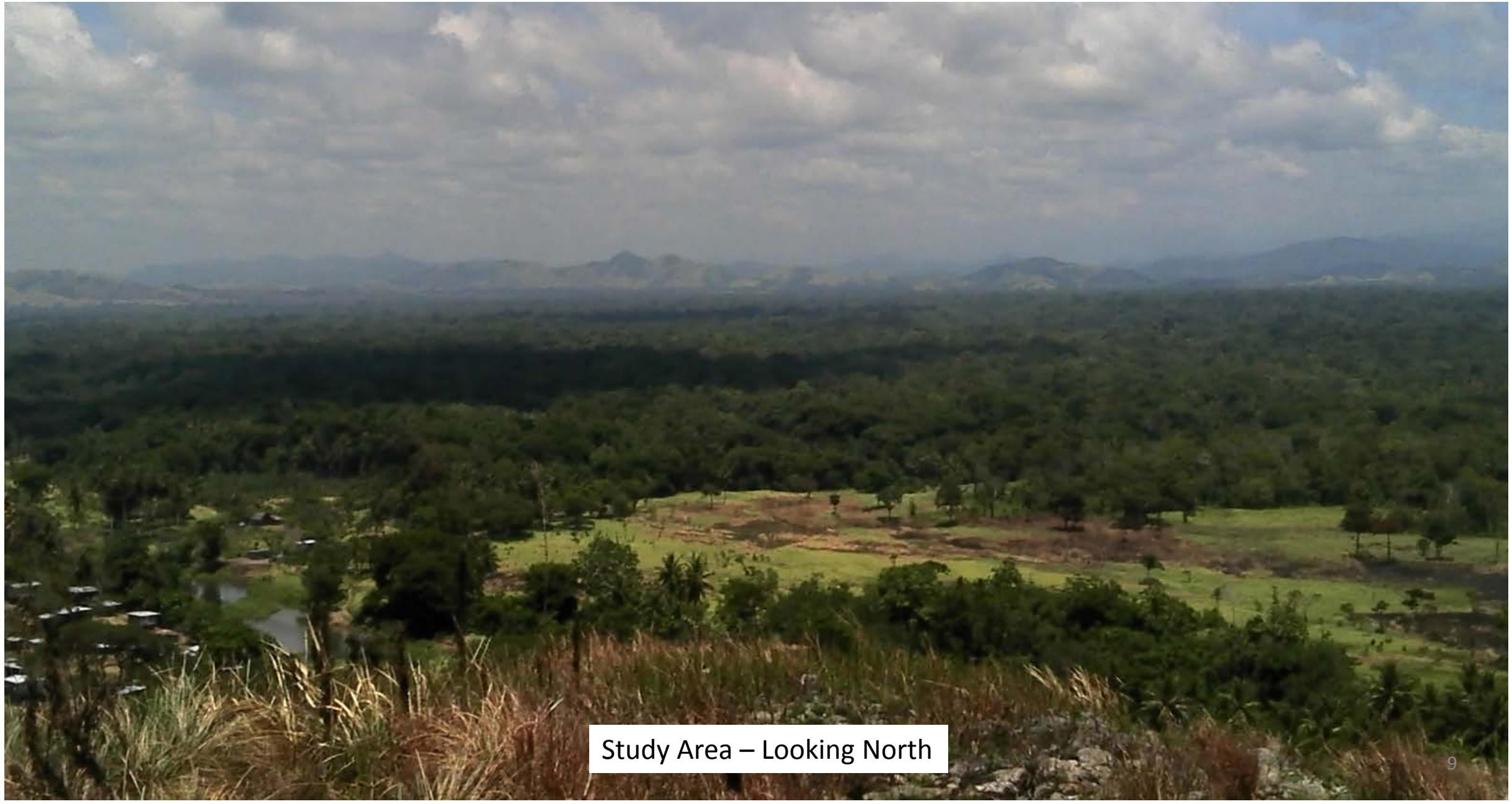
Sedimentation resumes

Mesozoic Section

Seismic Stratigraphy over the Papuan Plateau

Study Area – Looking South

LARUS ENERGY

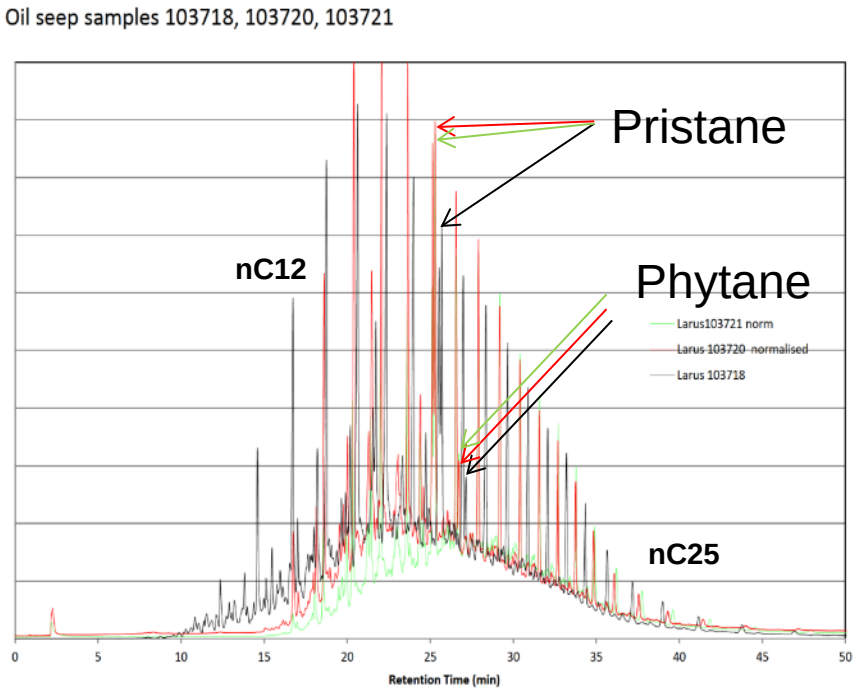


Study Area – Looking North

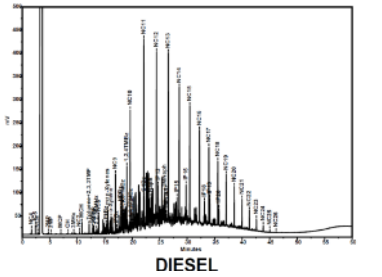
Seep Site - Panorama

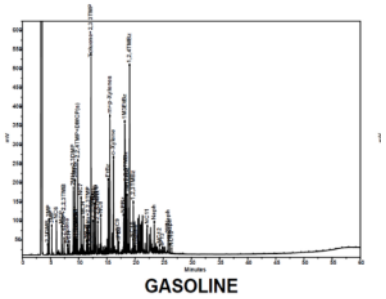

Seep Site

n-Hexane	nC_{10}
2,4-DMP	nC_{11}
Benzene	nC_{12}
Cyclohexane	nC_{13}
2-Mhexane	nC_{14}
2,3-DMP	nC_{15}
1,1-DMP	nC_{16}
3-Mhexane	nC_{17}
1-c-3-DMCP	nC_{18}
Phytane	ph
1-t-2-DMCP	nC_{19}
2,2,4-TMP	nC_{20}
n-Heptane	nC_{21}
McycloHexa	nC_{22}
2,5DMHexa	nC_{23}
2,3,4-TMP	nC_{24}
Toluene	nC_{25}
3-Mheptane	nC_{26}
2,2,5-TMP	nC_{27}
Cycloheptane	nC_{28}
n-Octane	nC_{29}
Ethylbenzene	nC_{30}
m-Xyle/pXyl	nC_{21}
o-Xylene	nC_{32}
n-Nonane	nC_{33}



Seep Sections

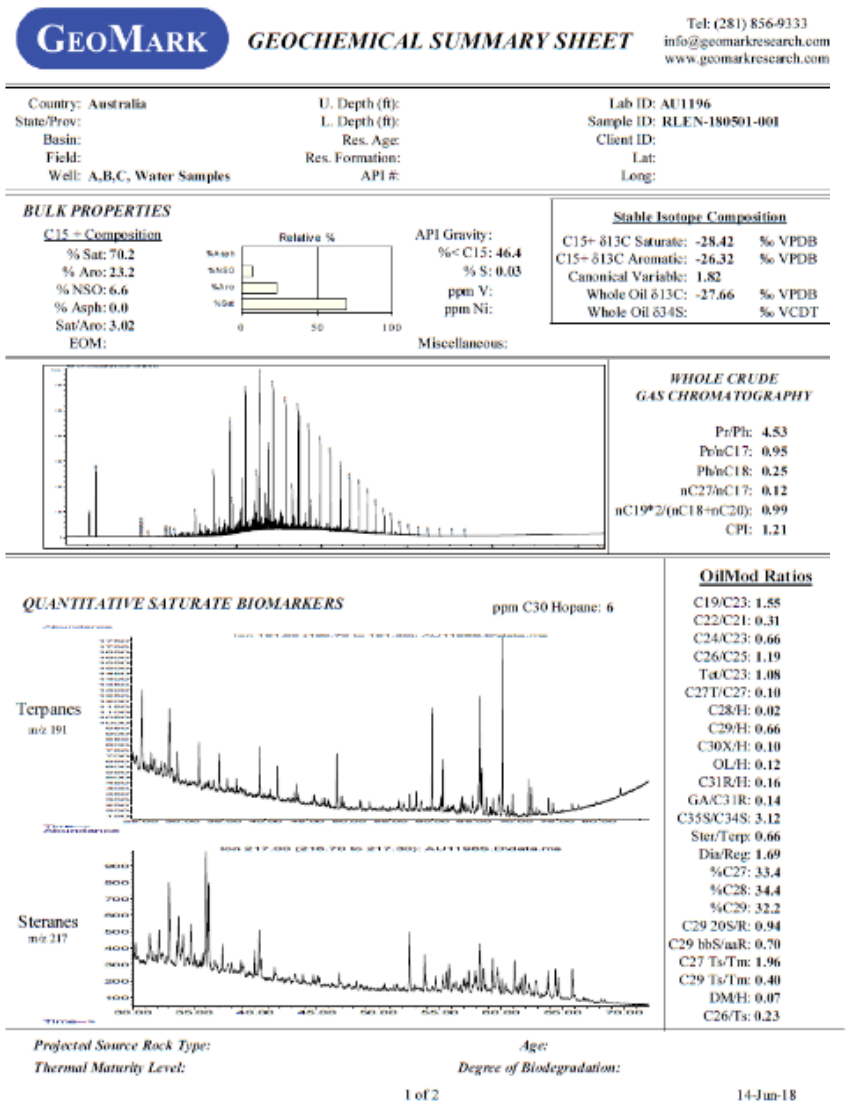




Type Sections

Gas chromatography

The Pr/Ph is 4.9 . Very high Pr/Ph ratios (more than 3) are associated with terrestrial sediments, fluvio-marine and coastal swamp environments. High values (4 to 10) are related to peat swamp depositional environments (oxidizing conditions).



GeoMark GEOCHEMICAL SUMMARY SHEET

Tel: (281) 856-9333
info@geomarkresearch.com
www.geomarkresearch.com

Country: Australia
State/Prov:
Basin:
Field:
Well: A,B,C, Water Samples

U. Depth (ft):
L. Depth (ft):
Res. Age:
Res. Formation:
API #:

Lab ID: AU1196
Sample ID: RLEN-180501-001
Client ID:
Lat:
Long:

BULK PROPERTIES

C15 + Composition
% Sat: 70.2
% Aro: 23.2
% NSO: 6.6
% Asph: 0.0
Sat/Aro: 3.02
EOM:

Relative %

API Gravity:
%<C15: 46.4
% S: 0.03
ppm V:
ppm Ni:
Miscellaneous:

Stable Isotope Composition

C15+ δ13C Saturate:	-28.42	‰ VPDB
C15+ δ13C Aromatic:	-26.32	‰ VPDB
Canonical Variable:	1.82	
Whole Oil δ13C:	-27.66	‰ VPDB
Whole Oil δ34S:		‰ VCDT

WHOLE CRUDE GAS CHROMATOGRAPHY

Pr/Ph: 4.53
Pr/nC17: 0.95
Ph/nC18: 0.25
nC27/nC17: 0.12
nC19*2/(nC18+nC20): 0.99
CPI: 1.21

QUANTITATIVE SATURATE BIOMARKERS

ppm C30 Hopane: 6

Terpanes m/z 191

Steranes m/z 217

OilMod Ratios

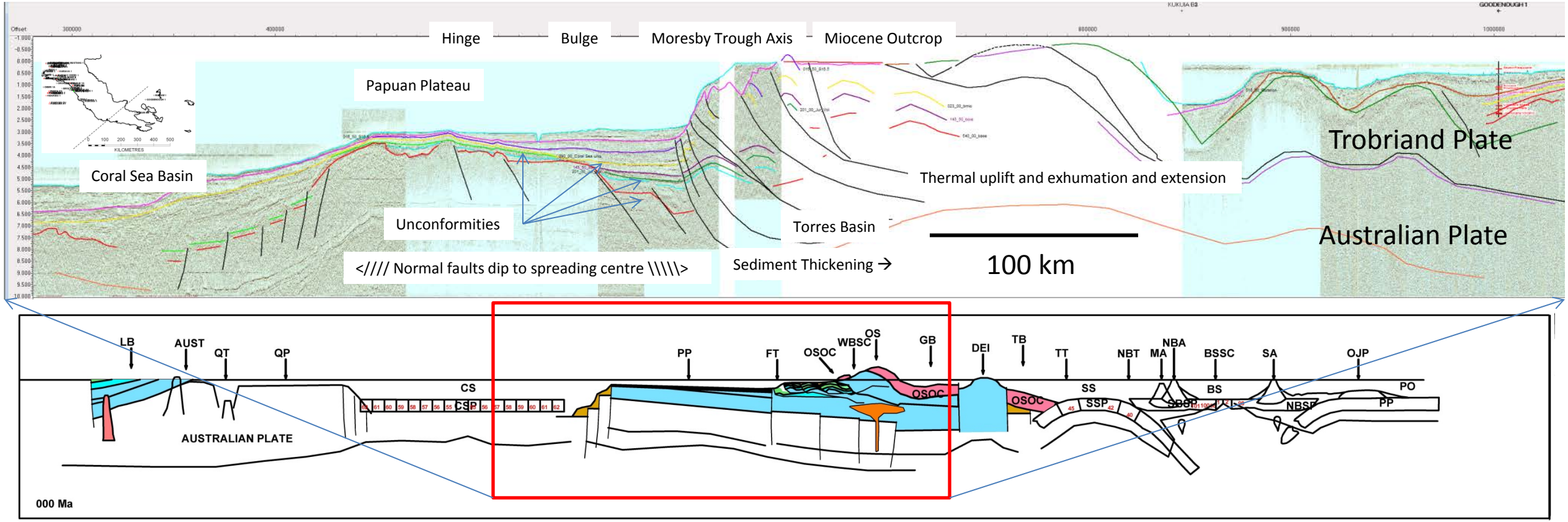
C19/C23: 1.55
C22/C21: 0.31
C24/C23: 0.66
C26/C25: 1.19
Tet/C23: 1.08
C27T/C27: 0.10
C28/H: 0.02
C29/H: 0.66
C30X/H: 0.10
OL/H: 0.12
C31R/H: 0.16
GA/C31R: 0.14
C35S/C34S: 3.12
Ster/Terp: 0.66
Dia/Reg: 1.69
%C27: 33.4
%C28: 34.4
%C29: 32.2
C29 20S/R: 0.94
C29 bbS/aaR: 0.70
C27 Ts/Tm: 1.96
C29 Ts/Tm: 0.40
DM/H: 0.07
C26/Ts: 0.23

Projected Source Rock Type:
Thermal Maturity Level:
Age:
Degree of Biodegradation:

1 of 2 14-Jun-18

1. **The oil is a very light oil (46 API) at the surface but was probably in the gas phase in the sub-surface (i.e. a gas condensate).**
2. **The oil has experienced no significant liquids to gas cracking in the reservoir *maturation indicates 4 km deep source*?**
3. **The oil was formed from a clastic (clay rich) source rock of late Cretaceous to *Paleogene age* containing a mixture of marine algal and land-plant organic matter.**
4. **The likely depositional environment is a paralic-marine deltaic setting with transported land-plant organic matter deposited under open-water (sub-oxic to oxic) marine conditions.**
5. **The geochemistry of the oil does not place it among any previously identified fluid family.**
6. **The molecular composition of the oil indicates a source rock with a tendency to produce mixed oil and gas, with a slight bias towards gas-condensates.**
7. **Source rocks of this type would be expected to lead to *both oil and gas resources.***

Oil seep analysis GCMSMS QQQ



AUST - AUSTRALIAN PLATE
(BSP) - EARLY BISMARK SEA PLATE
BSP - BISMARK SEA PLATE
BSSC - BISMARK SEA SPREADING CENTRE
BS - BISMARK SEA
CIMMERIA
CS - CORAL SEA
CSP - CORAL SEA PLATE
DEI -D'E ISLANDS

GB - GOODENOUGH BASIN
HINGE LINE
LB - LAURA BASIN
MA - MELANISIAN ARC
NBT - NEW BRITIAN TROUGH
NBA - NEW BRITIAN ARC
NBSP - NORTH BISMARK SEA PLATE
OSFS - OWEN STANLEY FAULT SYSTEM
OSOC - OWEN STANLEY OPIOLITE COMPLEX
OJP - PLATEAU

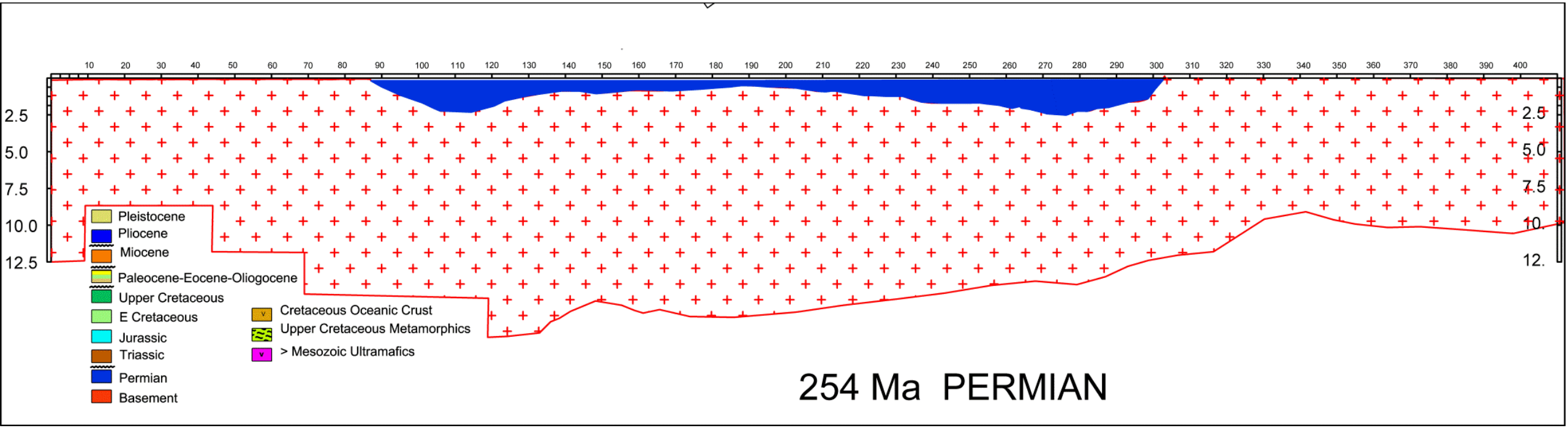
PO - PACIFIC OCEAN
PP - PACIFIC PLATE
QT - QUEENSLAND TROUGH
QP - QUEENSLAND PLATEAU
SEPNG PLATE
SS - SOLOMON SEA
SSP - SOLOMON SEA PLATE
SA - SOLOMON ARC
SBSP - SOUTH BISMARK SEA PLATE
TT - TORIBAND TROUGH

TORRES BASIN
TETHYAN
WBSC - WOODLARK BASIN SPREADING CENTRE

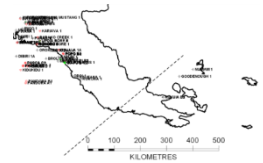
BOUNDARY
SPREADING CENTRE
SUBDUCTION LINE
ARC
OCEANIC CRUST
FAULTS

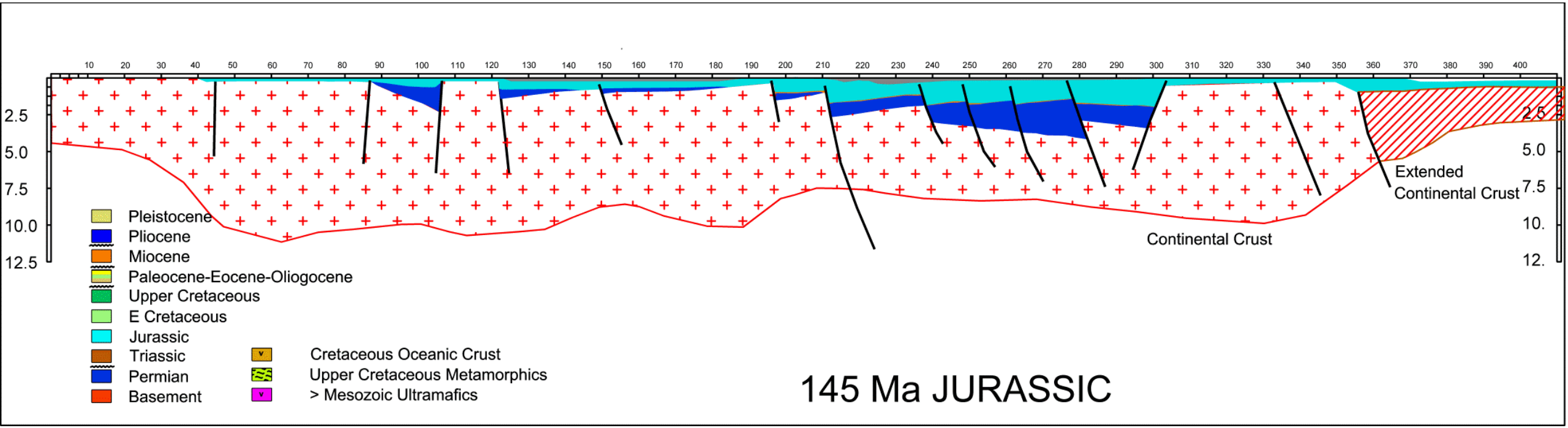
LARUS ENERGY

Seismic Image – Regional Cross Section

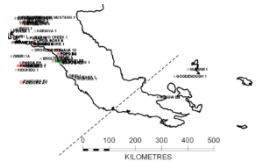


Permian Intracratonic basin formed within Australian Plate.





Jurassic Triassic rifting and then Jurassic sedimentation forms Torres Basin. Location of suspected horst block defining northern margin of Torres Basin derived from gravity modelling. Rift faulting dip is to the north. The basin may be a restricted basin; the extended crust would indicate a failed rift. Otherwise it may be oceanic crust with a more open rift system.



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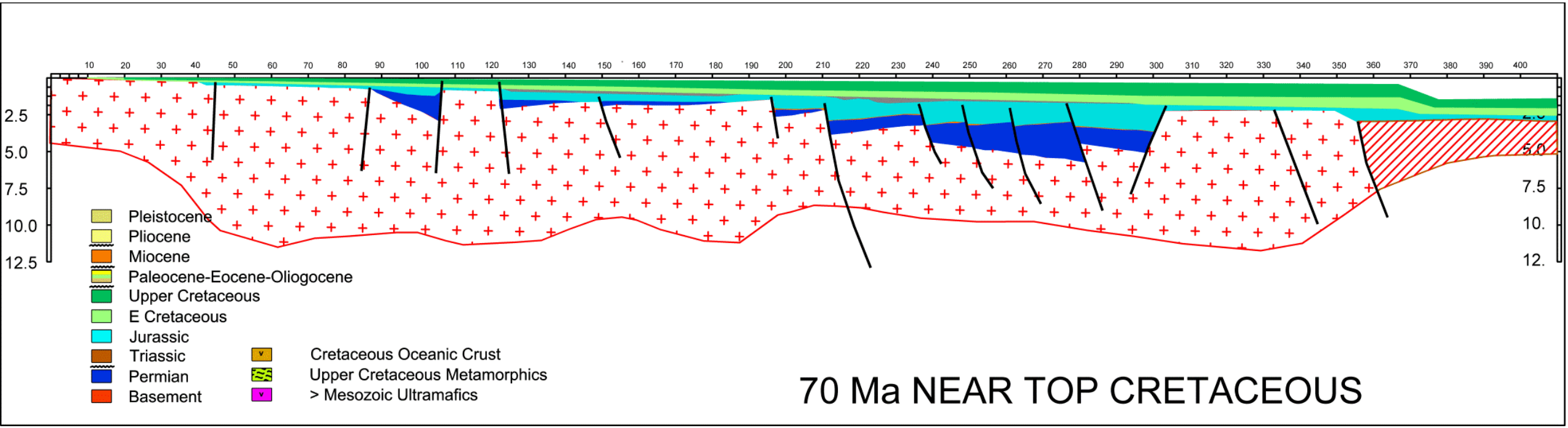
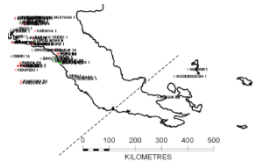
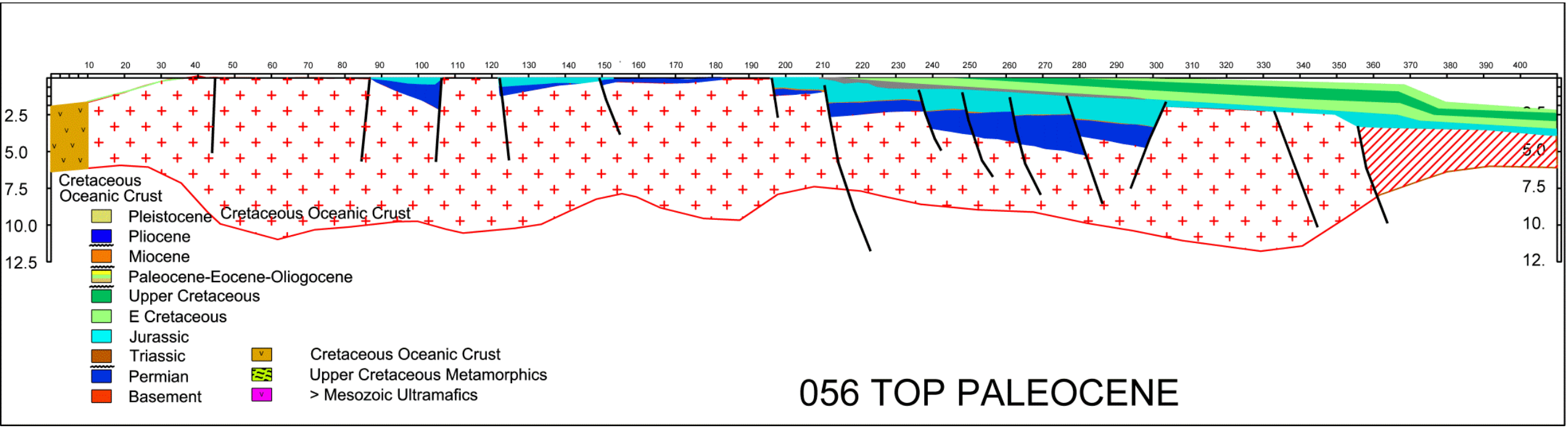


Cretaceous To the end of the Cretaceous there would have been a rift margin setting (syn and post rift) with sediment derived from the Australian Craton, sediment flow is south to north.

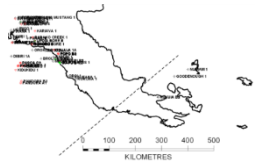


Coral Sea Basin

Hinge Zone



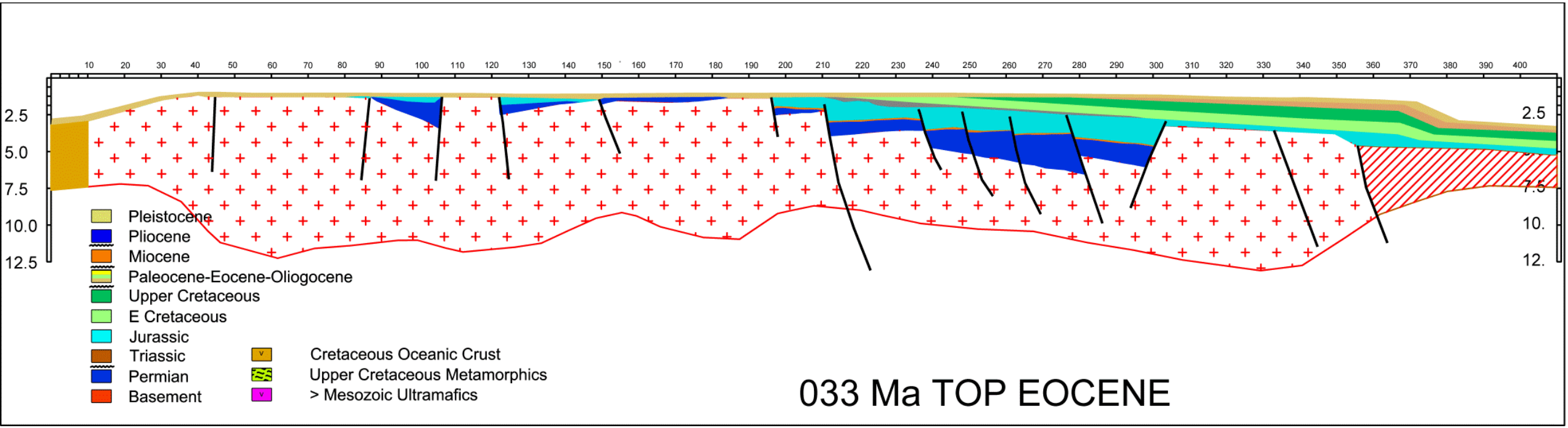
Paleocene By this time the Coral Sea Oceanic Crust has formed; this isolates and moves the Papuan Plateau from the Australian Plate. The extent of south dipping faults defines hinge zone of this latest rift system. There is erosion and a major unconformity in the south, at the hinge line the Mesozoic section begins to be preserved and thickens to the north. Further north there is continuous sedimentation.



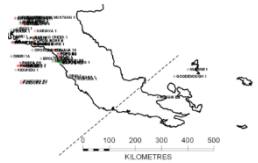
LARUS ENERGY

Coral Sea Basin

Hinge Zone



Eocene Continuous sedimentation in deeper water with no clastic input, sedimentation is largely carbonate.

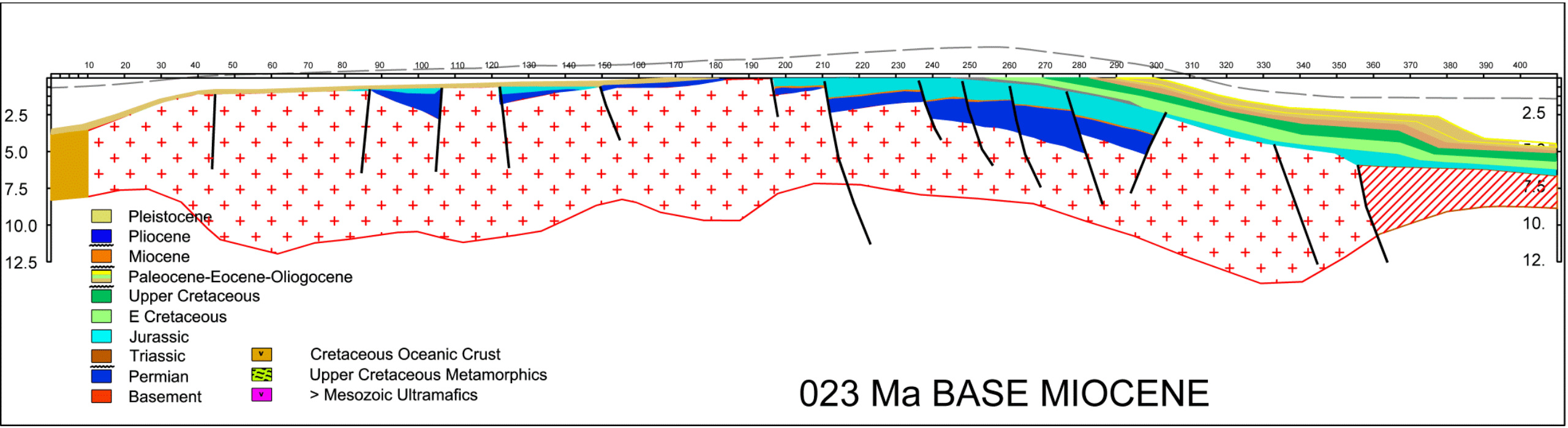


Coral Sea Basin

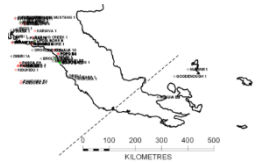
Hinge Zone

Peripheral Bulge

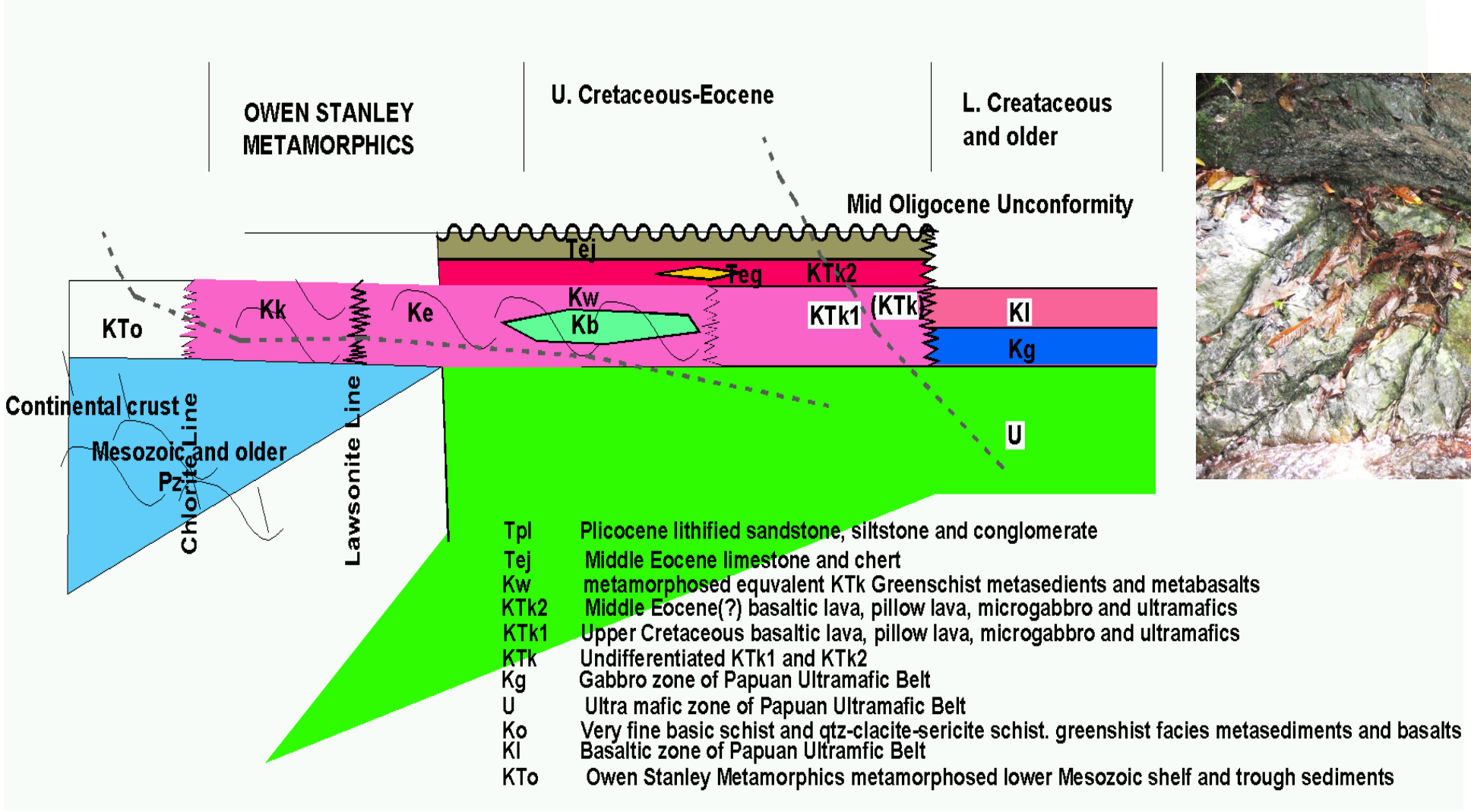
Foreland Deep



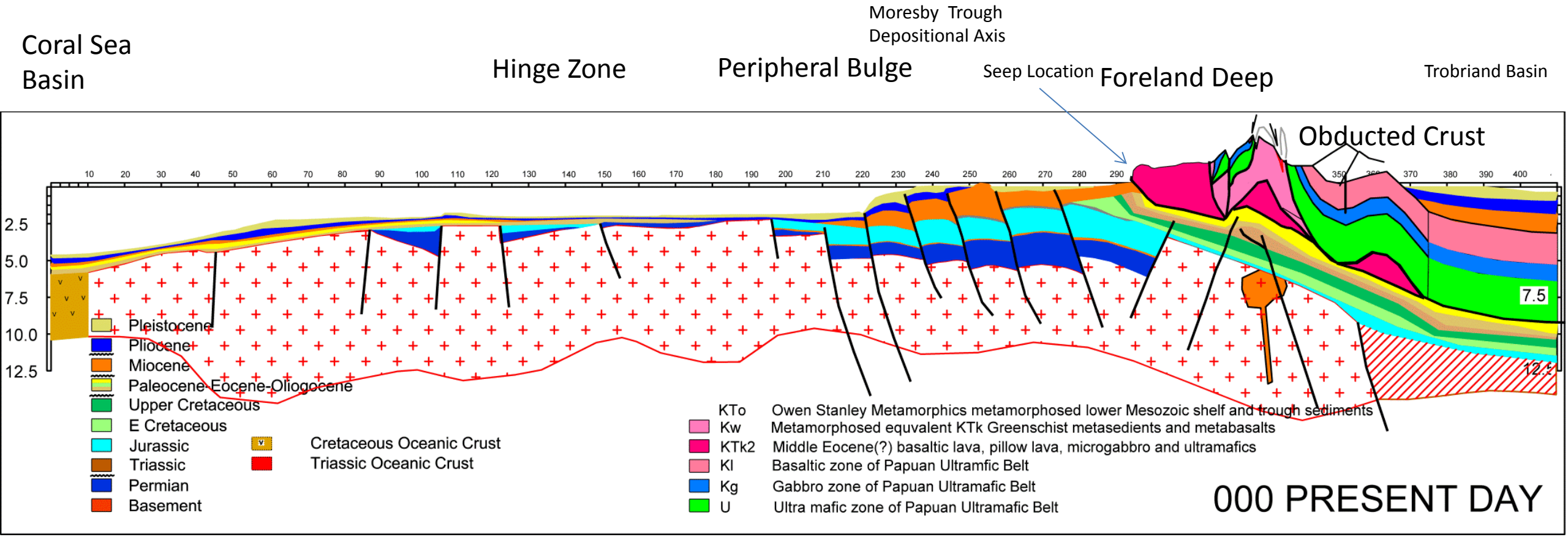
Base Miocene Obduction of the Solomon Sea plate starts to the north, the obducted ultramafic crust segment is now known as the Trobriand Plate. This event sets up foreland basin and peripheral bulge over the Papuan Plateau. There is a major erosional unconformity associated with the peripheral bulge (in parts it cuts deeper than the Coral Sea Unconformity), but the fore-deep allows for a complete Paleogene section to be preserved to the north.



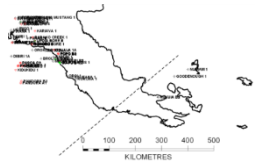
LARUS ENERGY



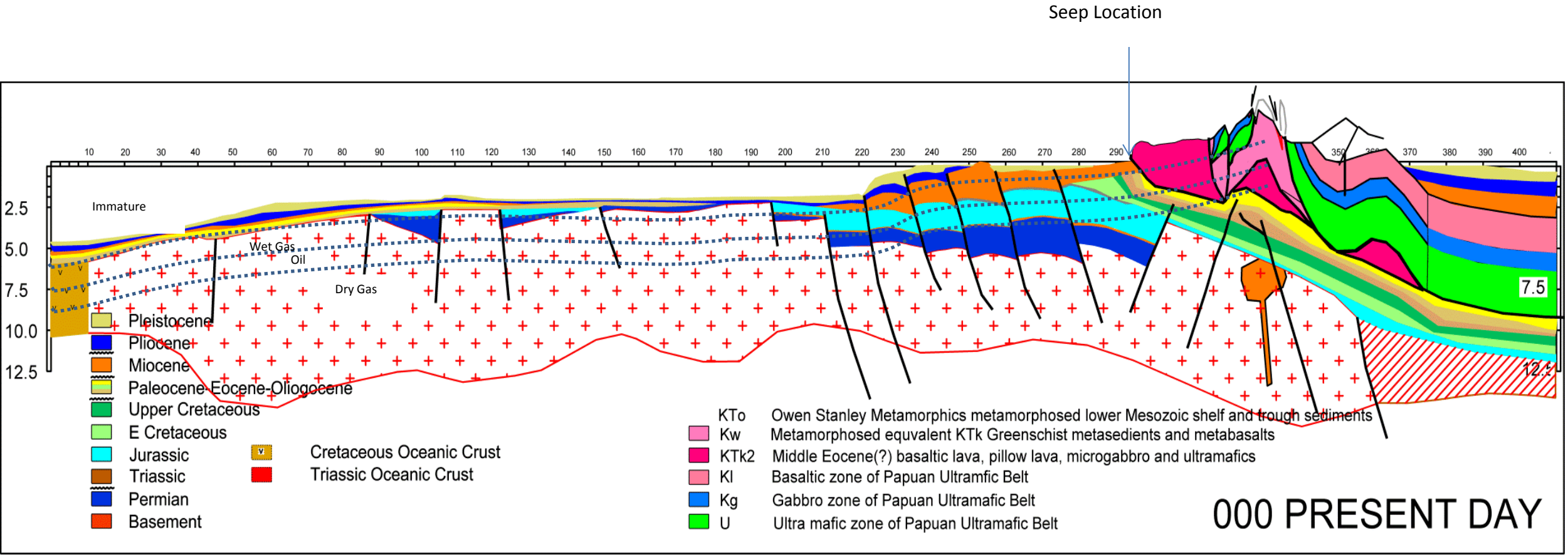
Coming in from the north- Obduction geology – the Trobriand Plate (Arc volcanics and more) .
Dashed lines constitute what will become the Owen Stanley Fault System



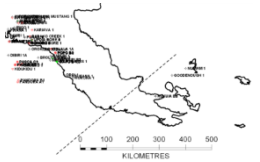
Post Miocene Obduction of over 150 km of the Trobriand Plate (Fitz and Mann, 2013) (can be referred to as the EPCT, Solomon Sea Plate, and Melanesian Arc) dominated the structuring and creates a regional foreland basin (often referred to as the Aure-Moresby Trough). There has been significant mountain building and crustal thickening due to the over thrust of oceanic crust and ophiolite. The southern Papuan Plateau is now under deep water in a foreland basin setting.

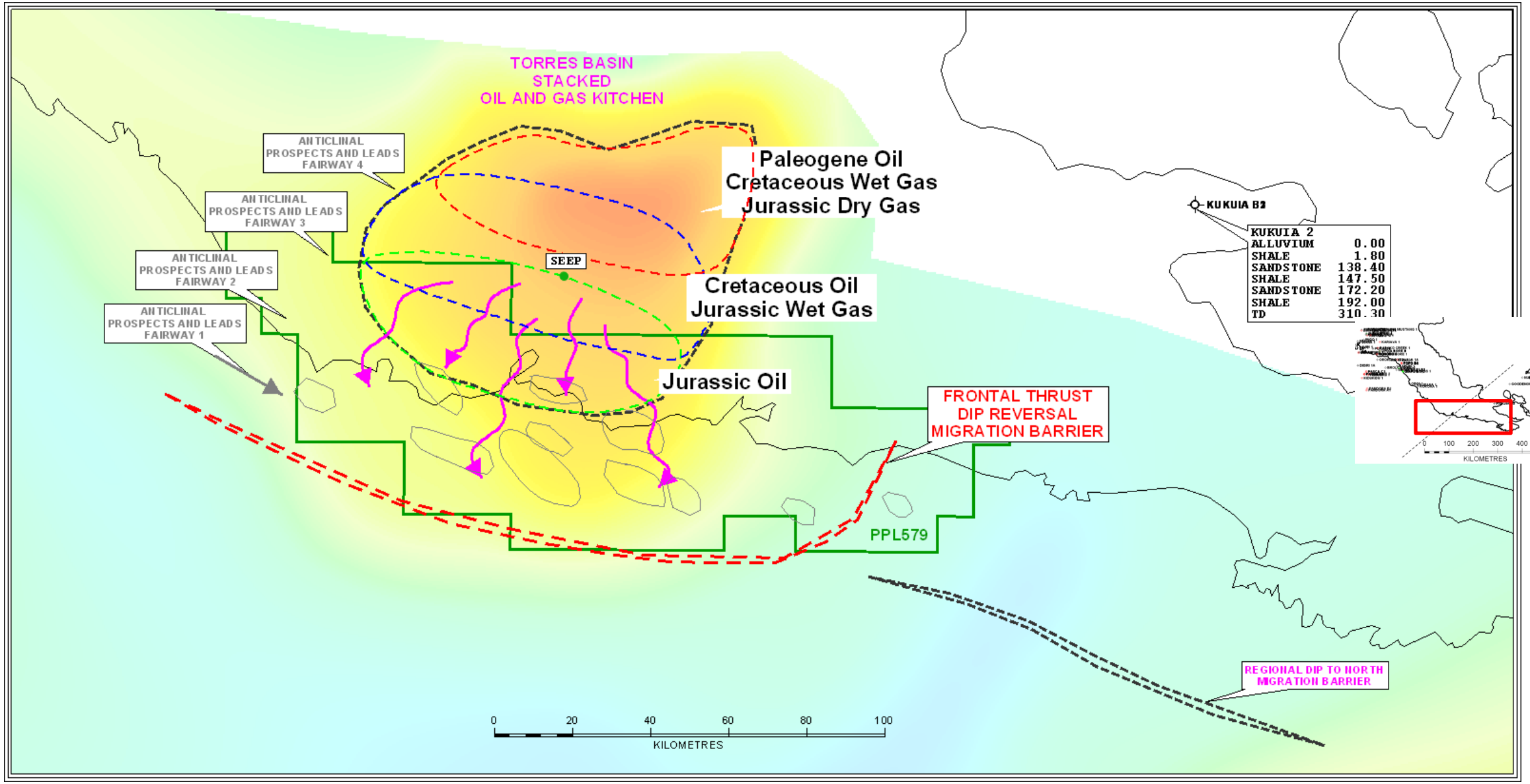


LARUS ENERGY



Petroleum system: The Paleogene is oil mature and feeding the seep.
Depending on source rock the Mesozoic is also oil and gas mature.





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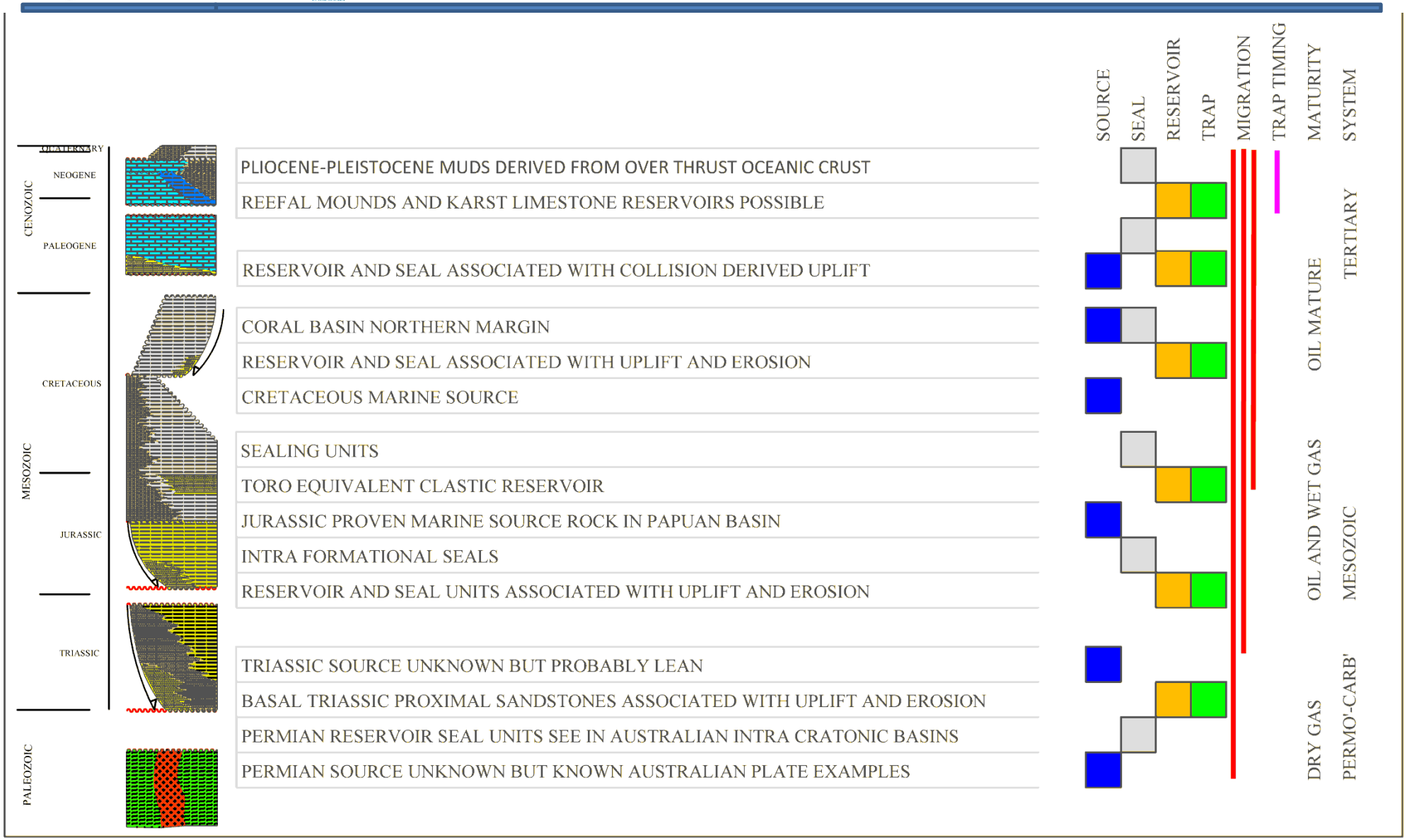
Kitchens – migration - traps



LARUS ENERGY

Petroleum Systems - Oil and Gas of the Torres Basin

THE FIRST OIL SEEP DISCOVERY IN SOUTH EAST PNG AND ITS IMPLICATIONS TO TORRES BASIN PETROLEUM SYSTEM ANALYSIS.

Dr Michael Swift*[1], Ric Malcolm[1], H Davies[2]
[1] Larus Energy Pty Ltd
[2] Emeritus Professor UPNG

A little oil goes a long way

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