



Western Flank of the Papuan Basin, Indonesia

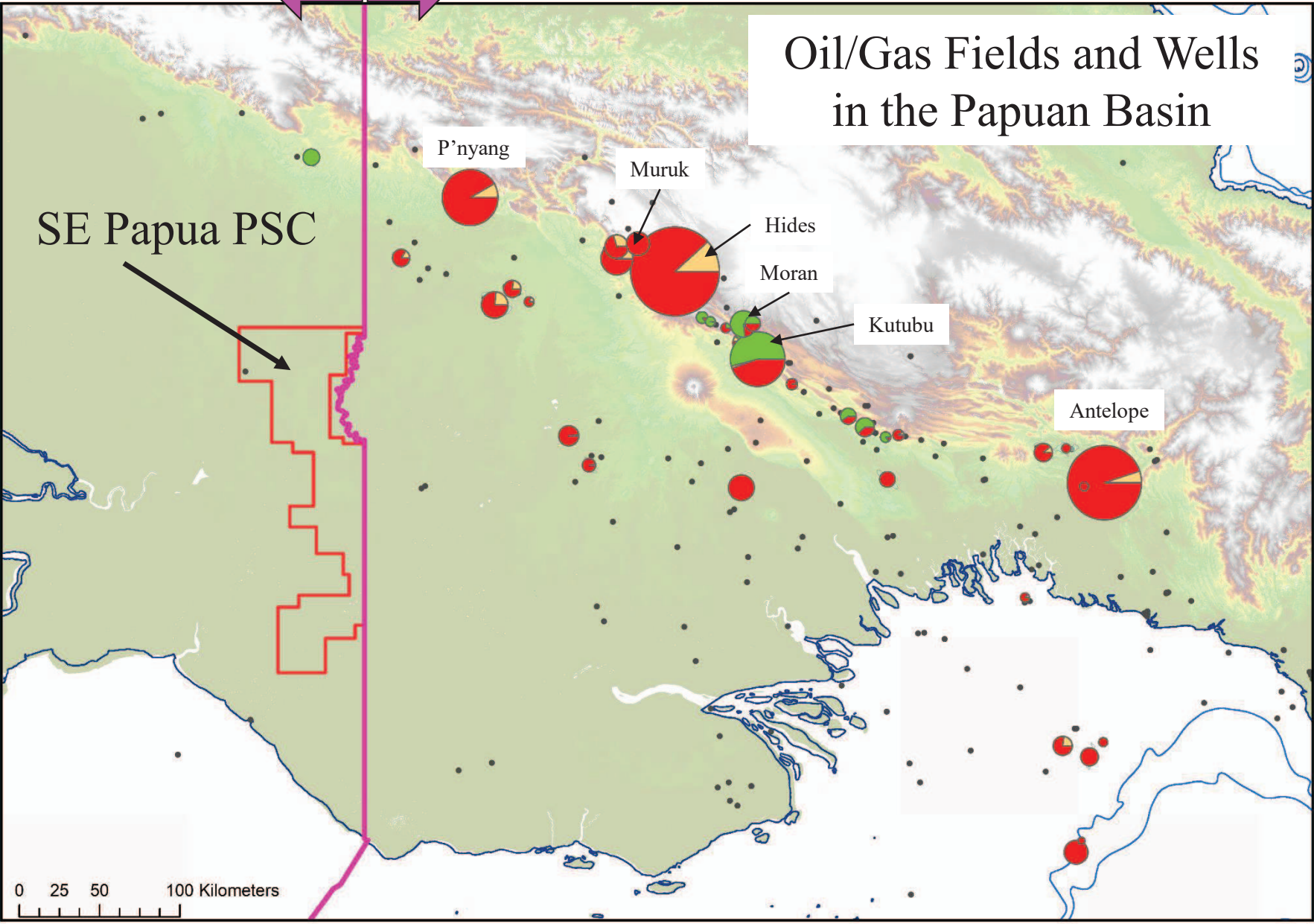
Agu Kantsler & Ian Longley

Outline

1. Intro/Why The Papuan Basin?
2. Geology & Exploration History of the Papuan Basin
3. The Toro/Base regional seal play
 - Reservoir
 - Seal
 - Charge
 - Trap
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5. Summary

INDONESIA ← → PNG

Oil/Gas Fields and Wells in the Papuan Basin



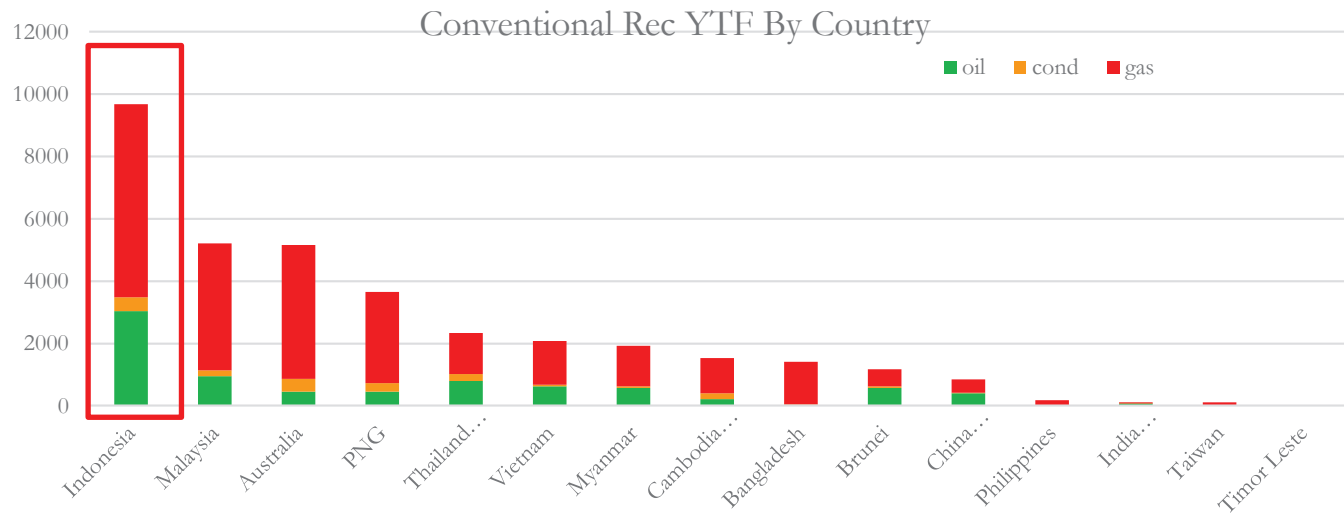
Why the Papuan Basin in Indonesia?

- **The Papuan Basin has delivered material exploration discoveries and is clearly not mature for exploration opportunities**
- **The Western extension of the basin into Indonesia is overlooked and very poorly explored and is well located to receive charge from source kitchens in PNG**

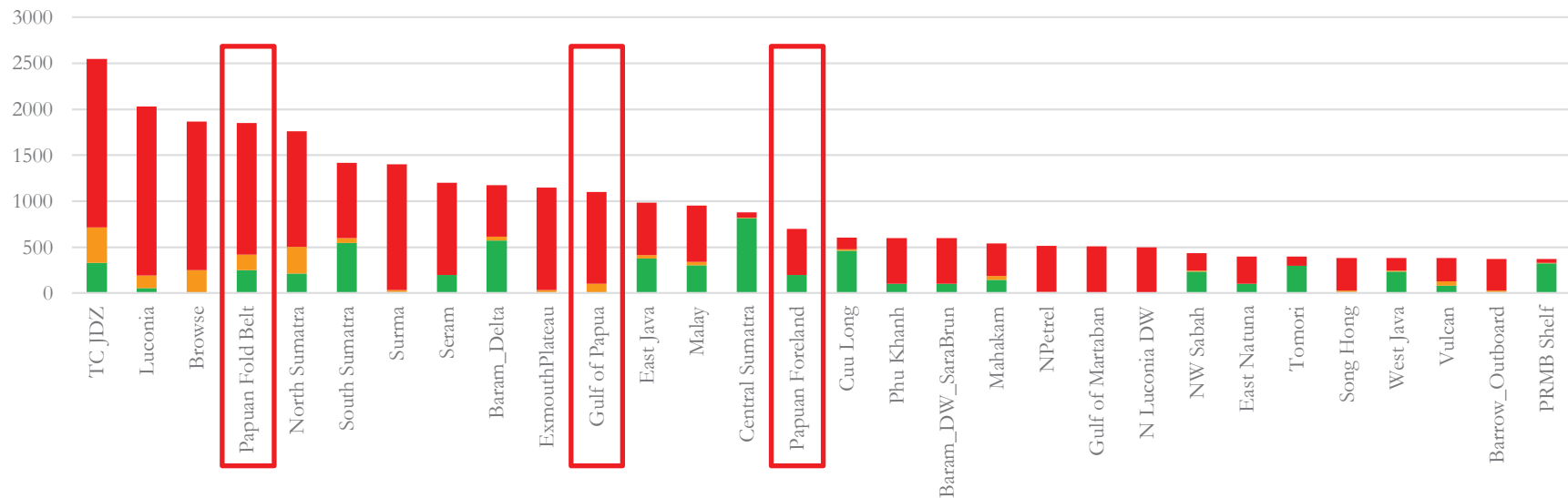


Country and Basin Rankings by YTF

SE Papua PSC is in the foreland basin of the Papuan Basin in Indonesia
 Indonesia has the region's largest yet-to-find volumes and the Papuan Basin has 3 sub basins in the top 20 Basins (#4 & #11 #15)



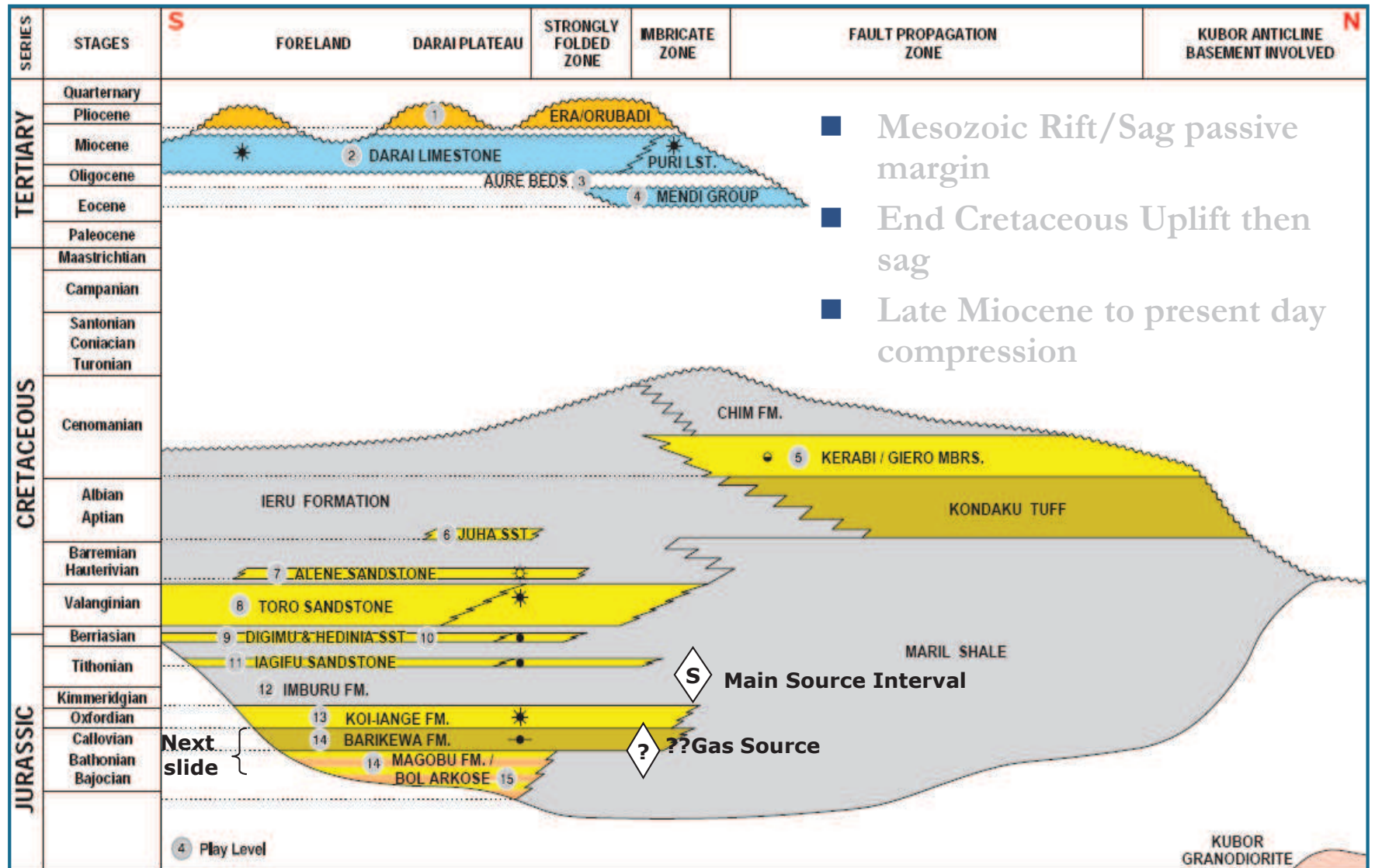
Top 30 Exploration "Basins"



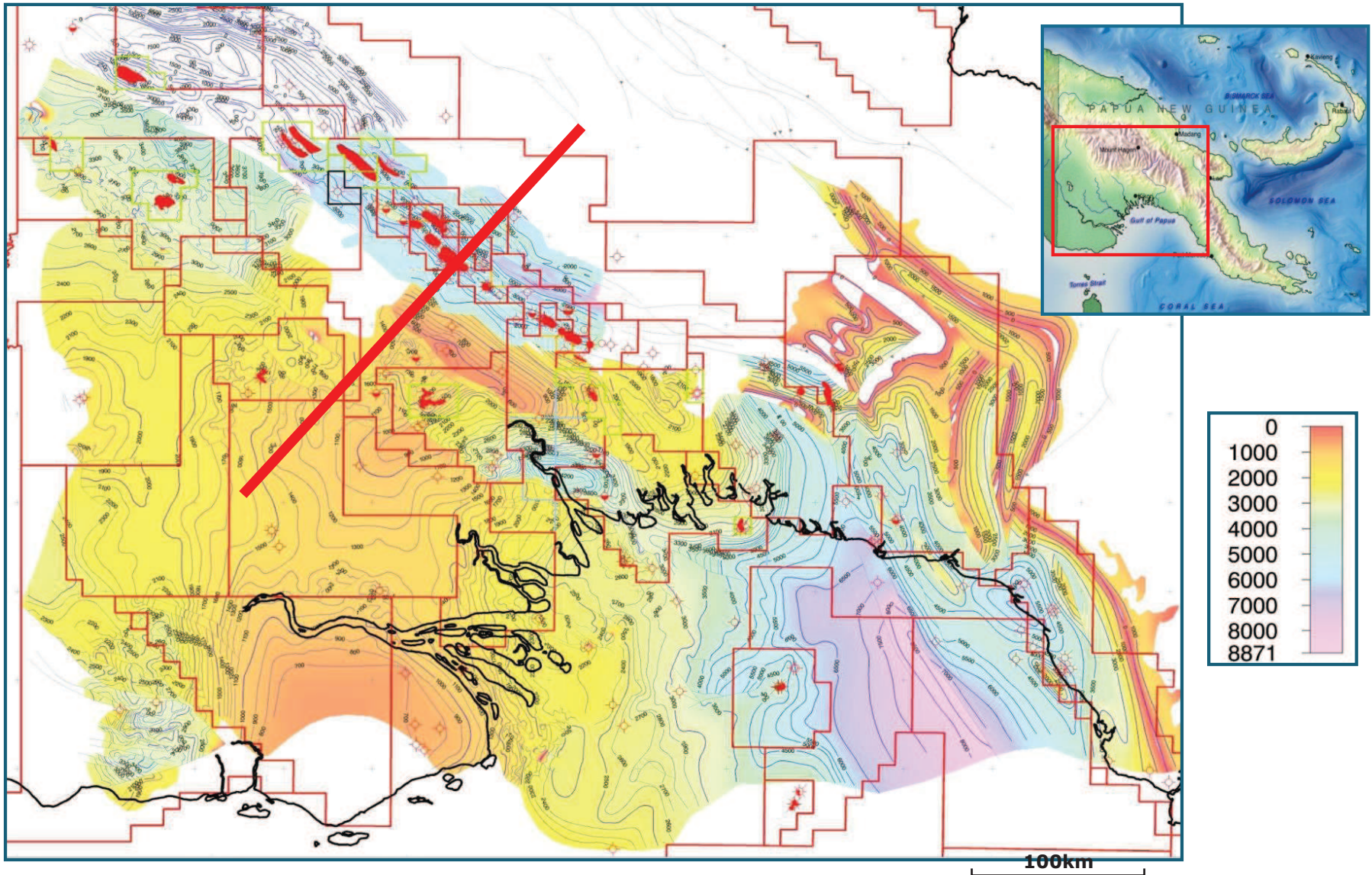
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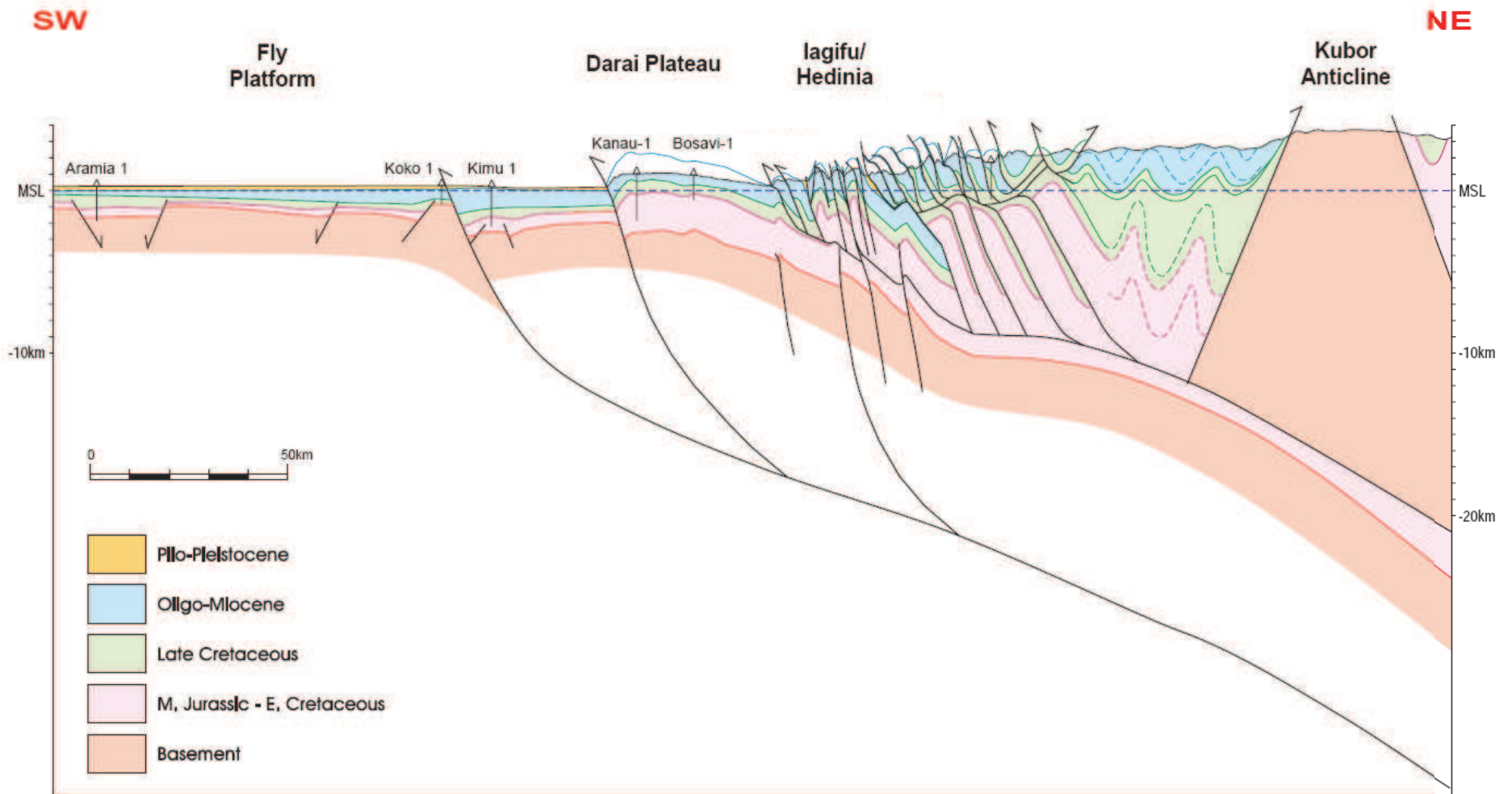
Papuan Basin Chronostratigraphy



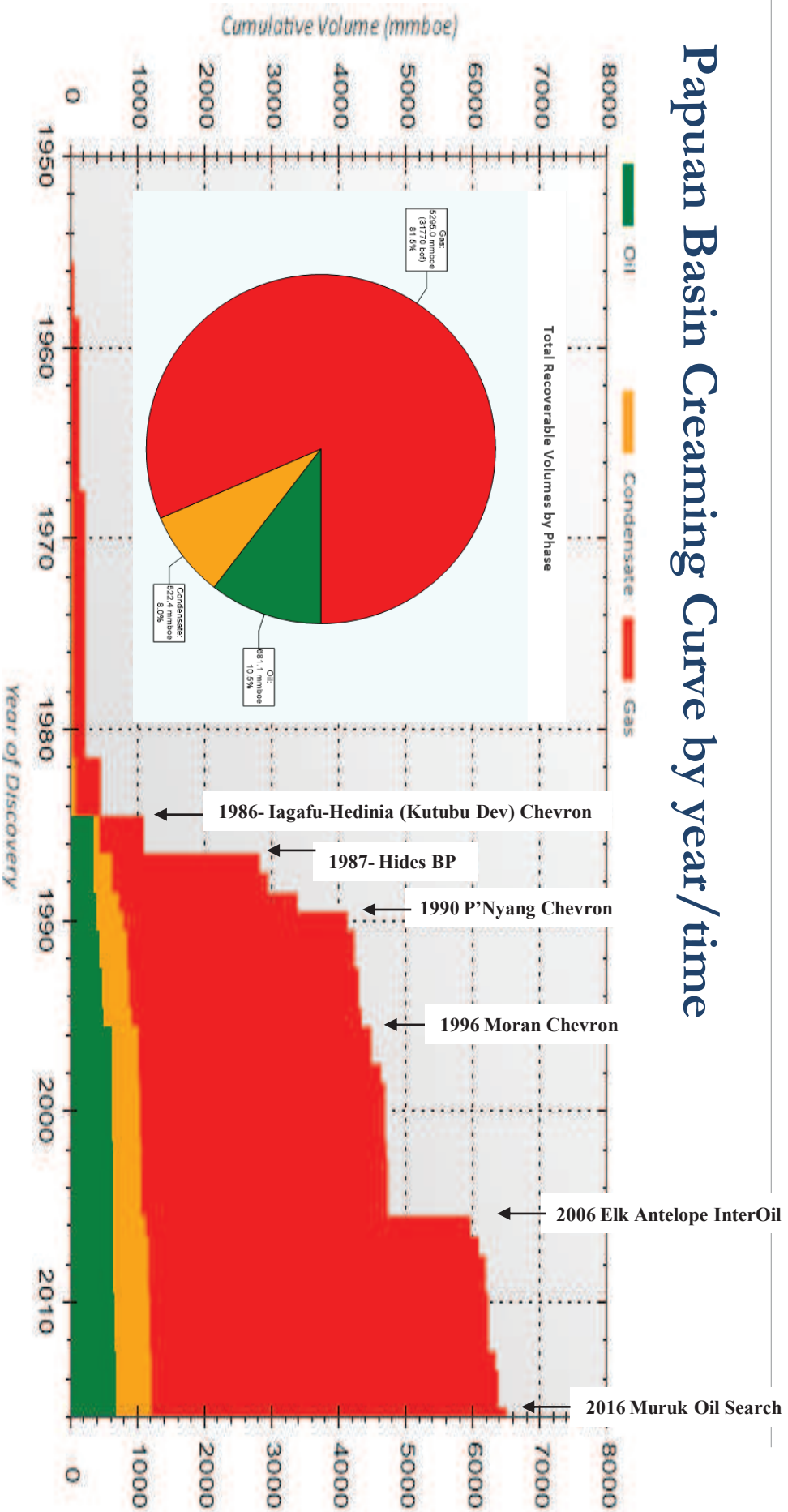
Regional Top Toro Depth Map



Papuan Basin Regional Cross-section



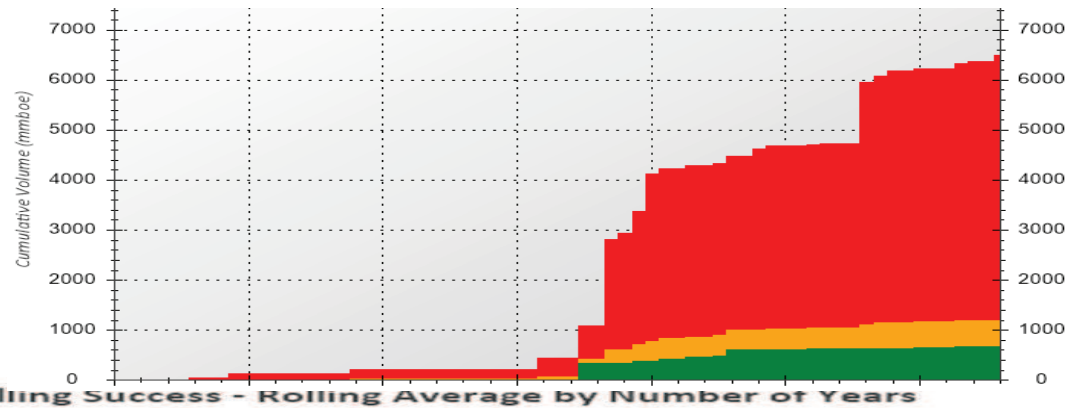
Papuan Basin Creaming Curve by year/time



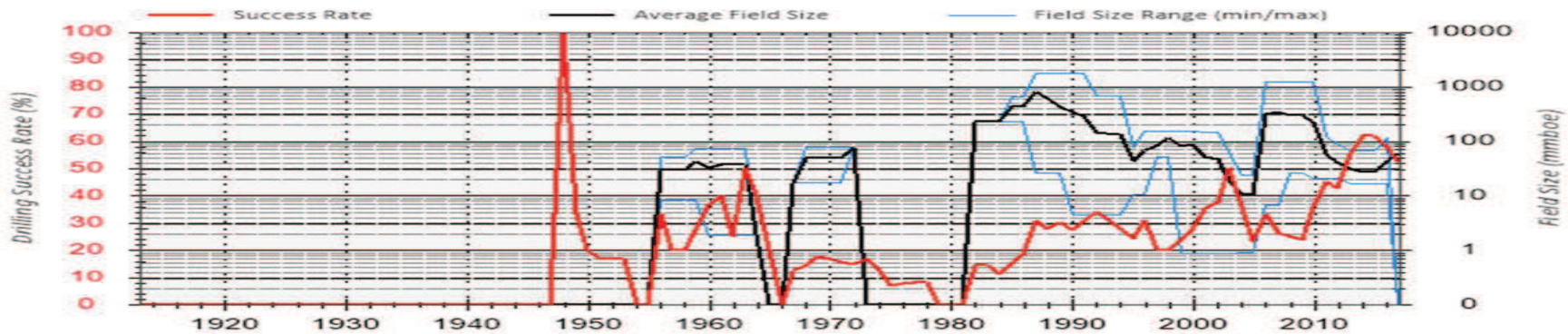
~31 tcf 2P gas reserves discovered + 680mmb oil and 520mmb condensate

Drilling Activity and Success Rates/Average Discovery sizes

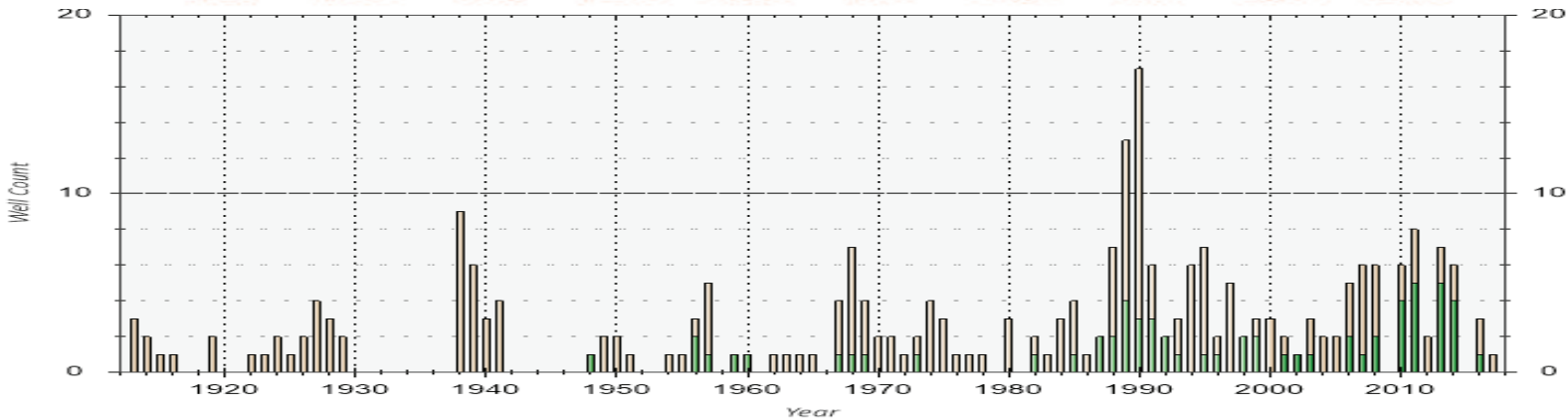
Basin delivering consistent
 ~100mmboe average
 discovery sizes and has an
 increasing success rate
 approaching 60%
 Not Creamed



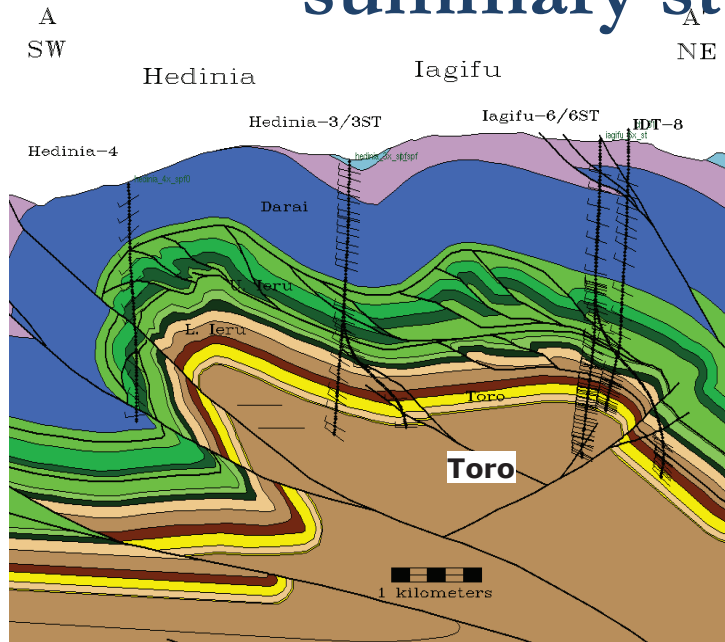
Historical Drilling Success - Rolling Average by Number of Years



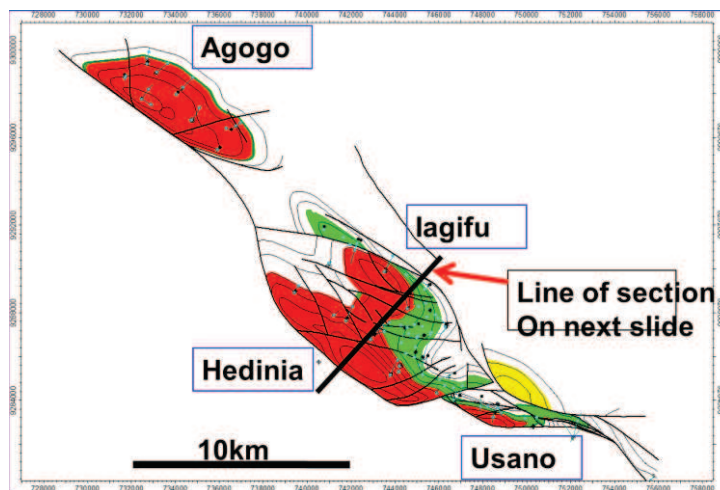
5 year rolling averages



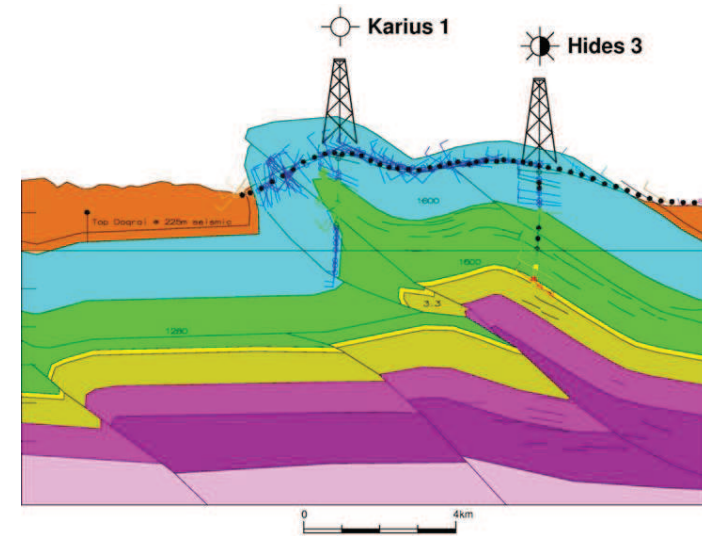
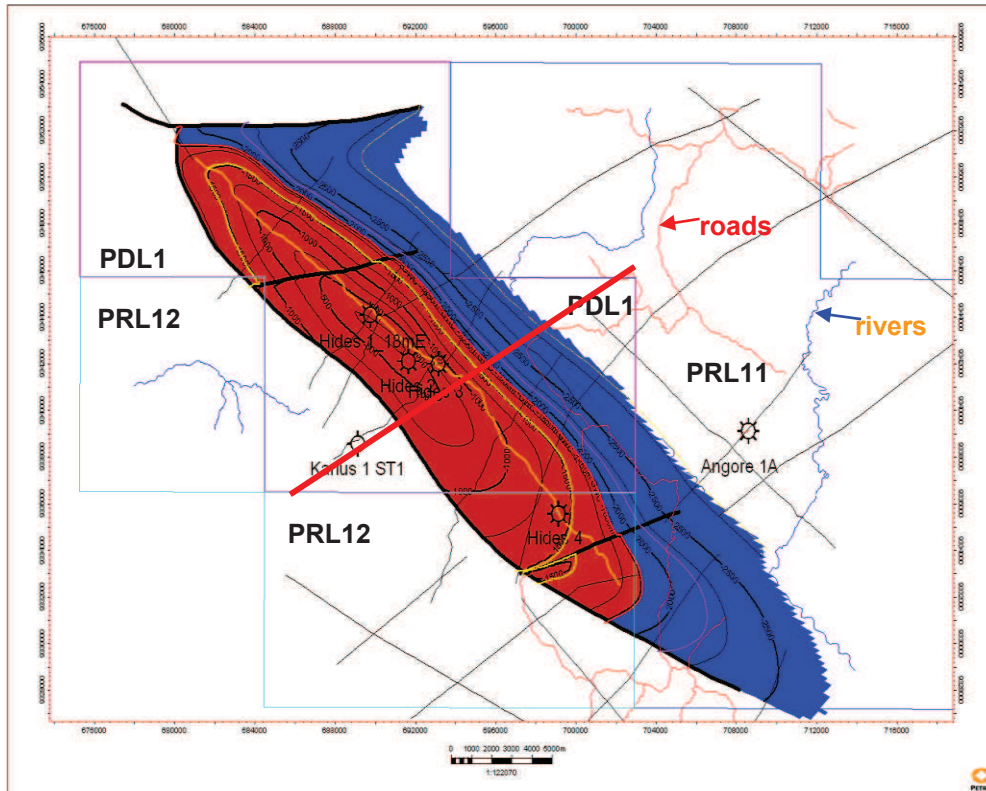
Kutubu Crestal Cross Section and summary stats



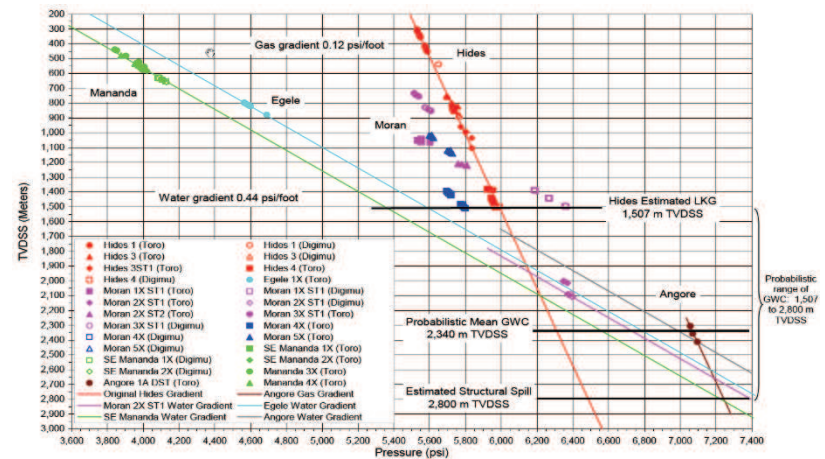
- Papua New Guinea's largest oil field
- Discovered 1986
- First production 1992
- Main formations Toro A,B,C sands
- STOOIP about 600 MMstb
- EUR about 350 MMstb



Hides Field Top Toro Depth Map (after ExxonMobil)

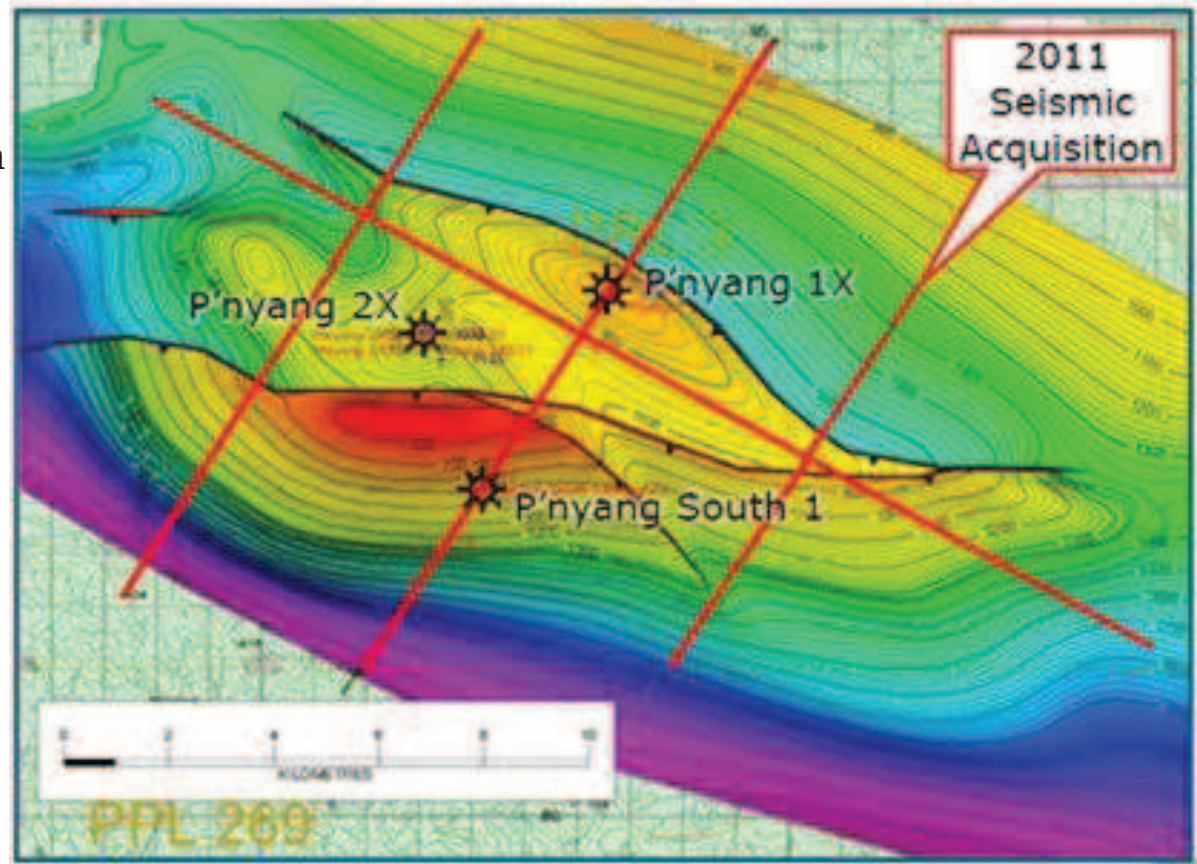


1987 Discovery
 Anticline with Surface Relief
 9tcf ~200mmbc



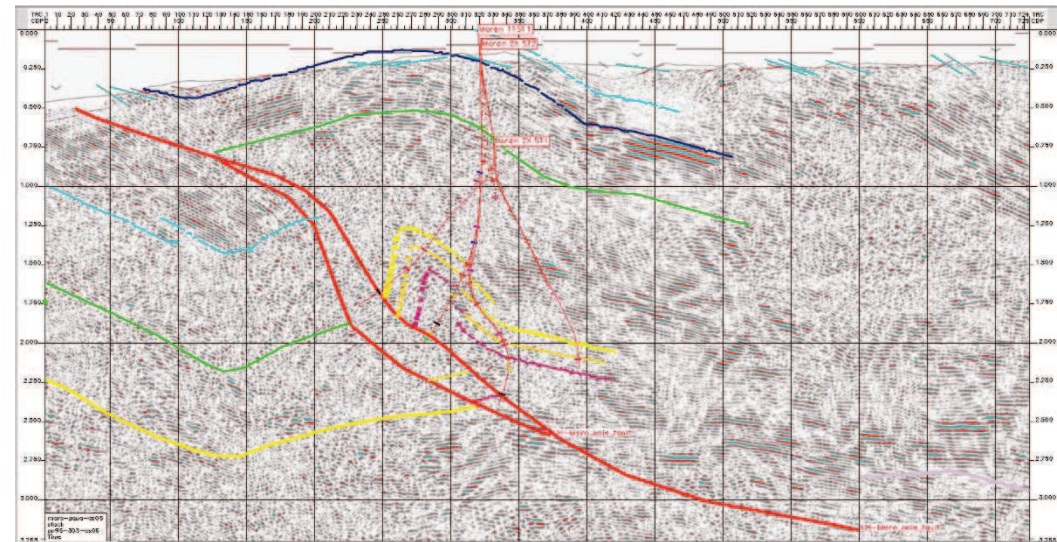
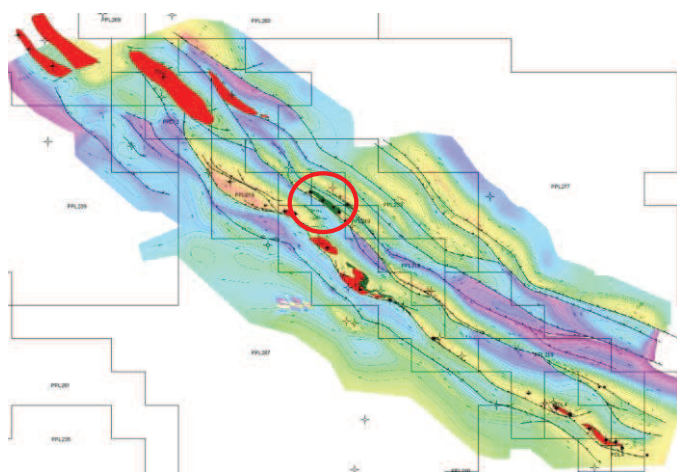
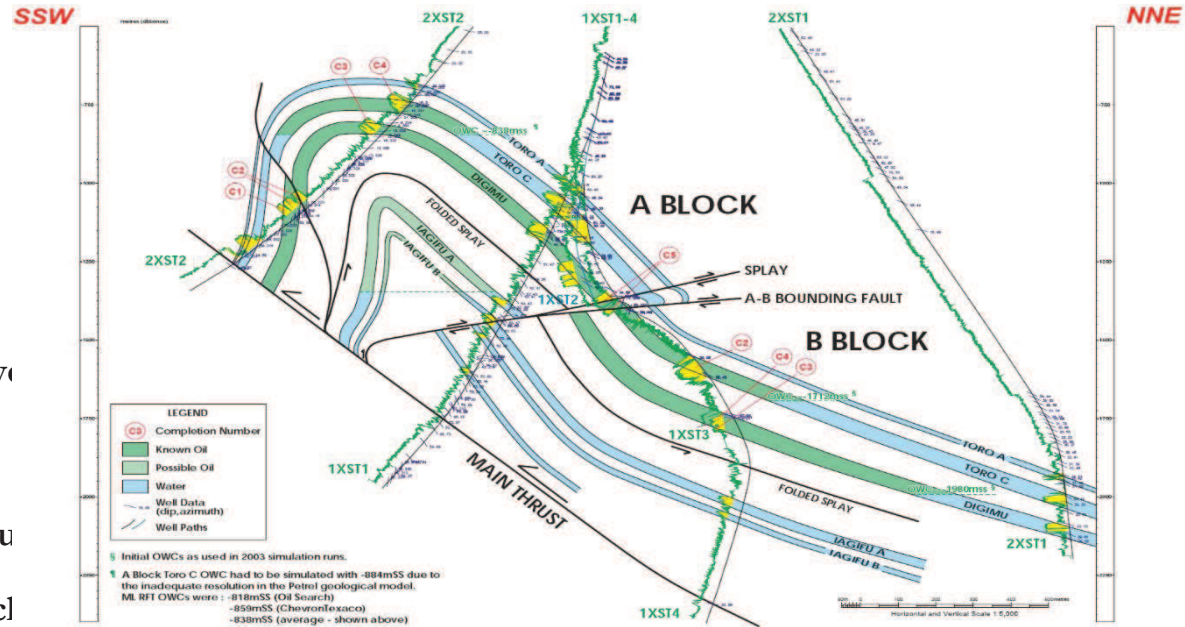
P'nyang

- Discovered 1990 by Chevron
- Surface Expression
- 3.7 tcf & 60mmbc
- ?Oil Leg under gas found in P'nyang South
- Got bigger with appraisal drilling



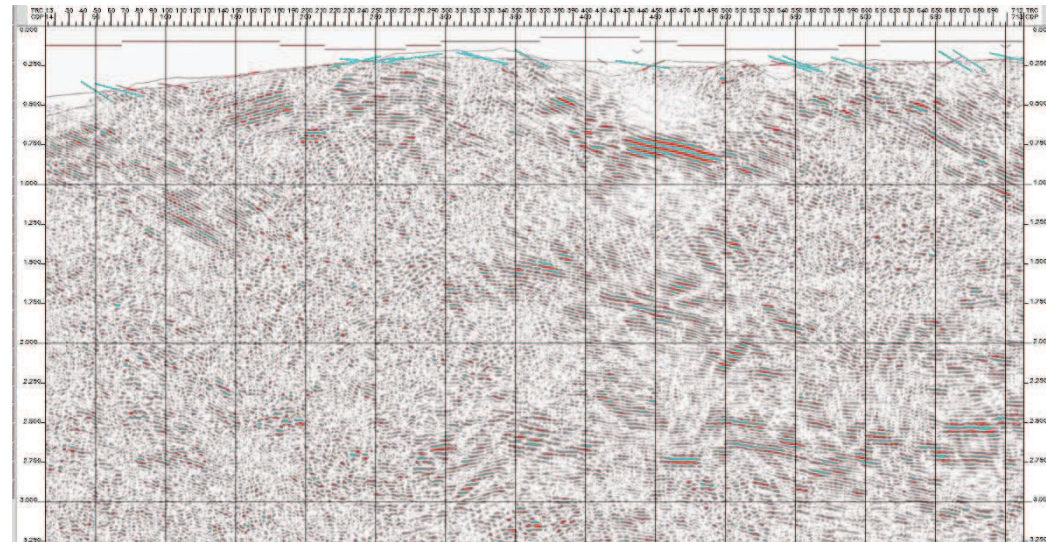
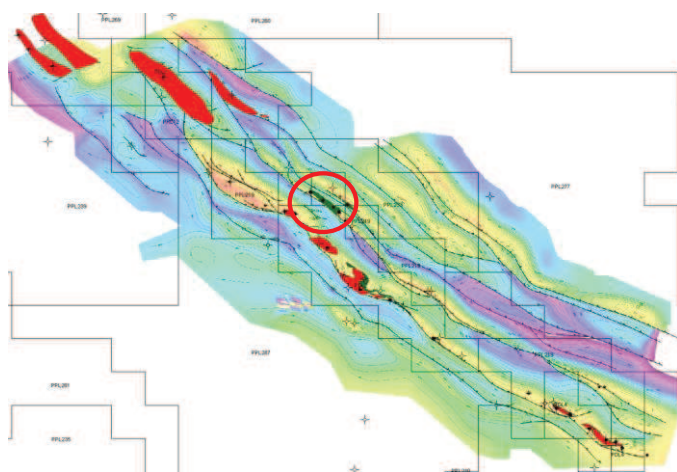
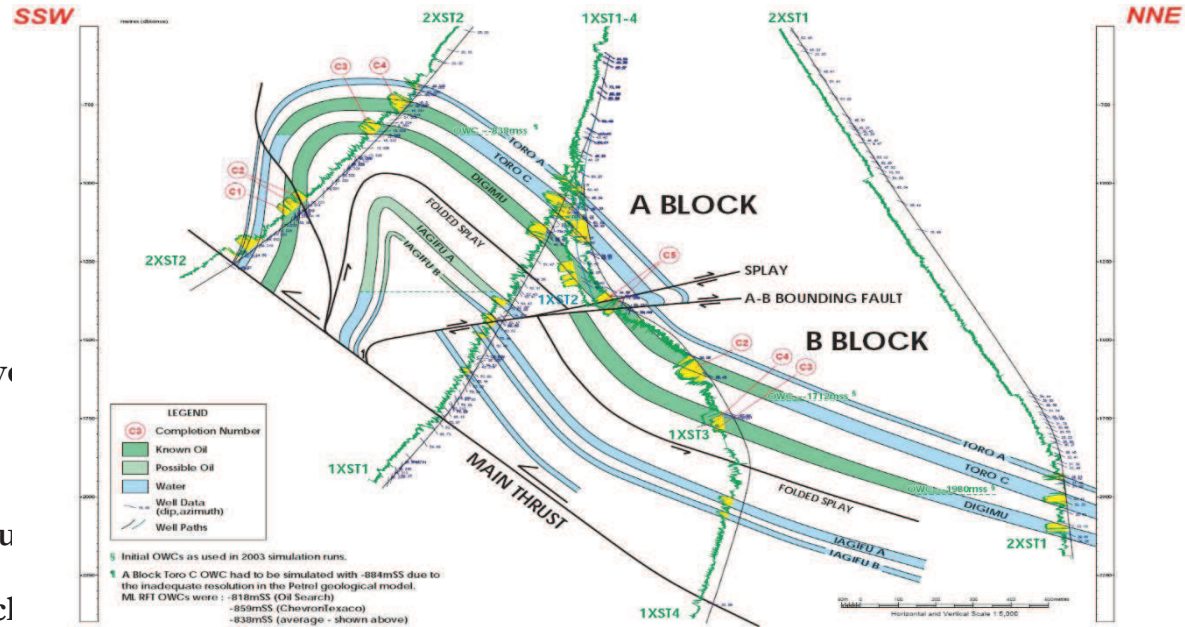
Moran

- Discovered 1996
- Surface Expression
- 110mmbo 200bcf rec
- Post Discovery 4 sidetracks follow immediately with Moran 2 + 2 sidetracks
- Up to 1200m oil column in Digimu
- First Second Trend Discovery back from the frontal thrust play



Moran

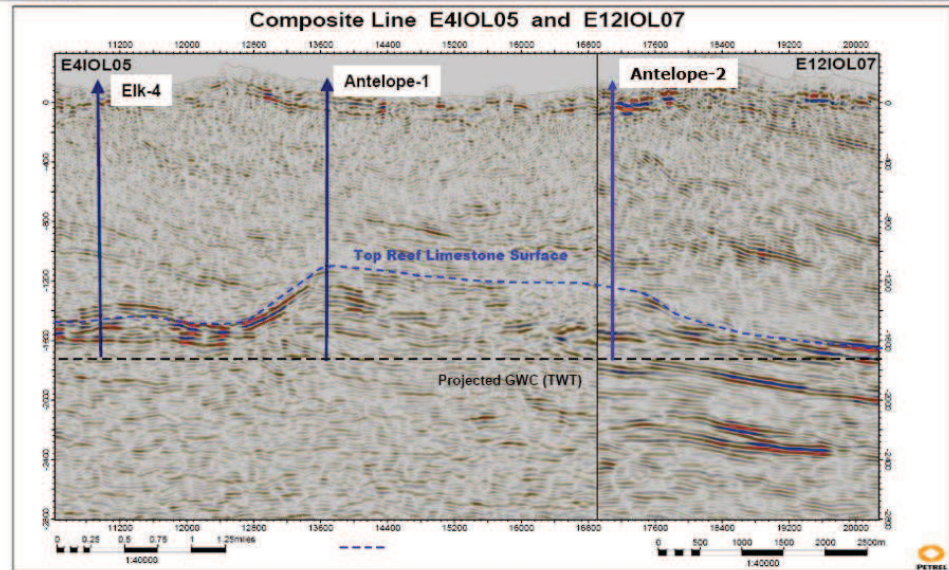
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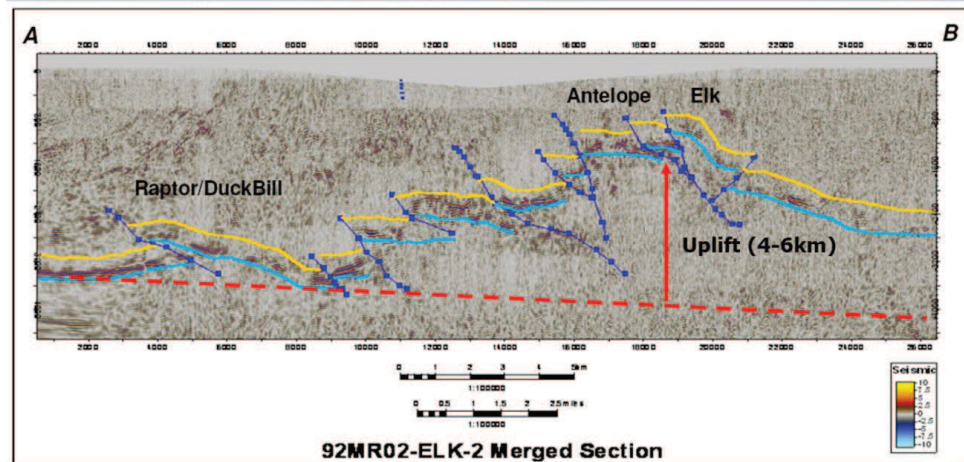
Antelope

- Discovered 2006 InterOil
- No Surface Expression (on a large gas seep)
- Seismic defined Antelope after initial Elk platform limestone discovery
- ~7tcf and 60mmbc rec
- Combination structural stratigraphic trap on back of a thrust sheet
- Has been deeply buried and uplifted – good secondary porosity developed

Seismic Established the Reef



Elk – Raptor Seismic Section

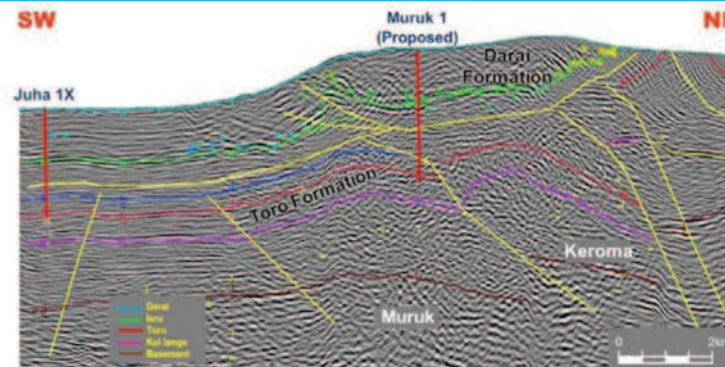


Muruk

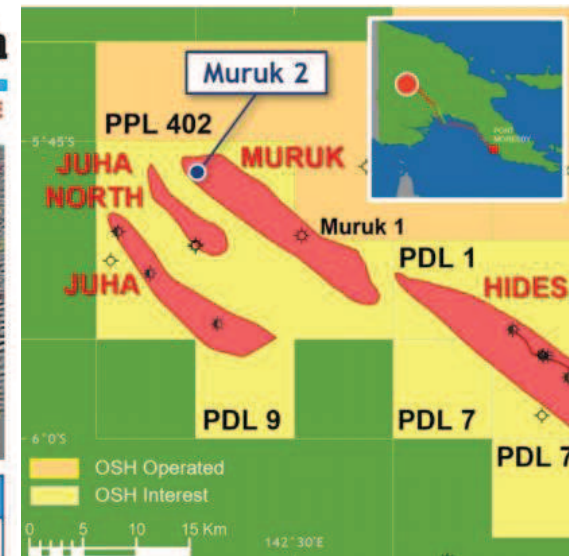
- 2016 Foldbelt discovery Oil Search
- First significant highlands discovery with NO surface expression
- ?1-2 tcf – close to Hides so hopefully easy to develop
- Largest operated exploration discovery ever by Oil Search in PNG

Muruk 1 (PPL 402): High potential NW Highlands exploration

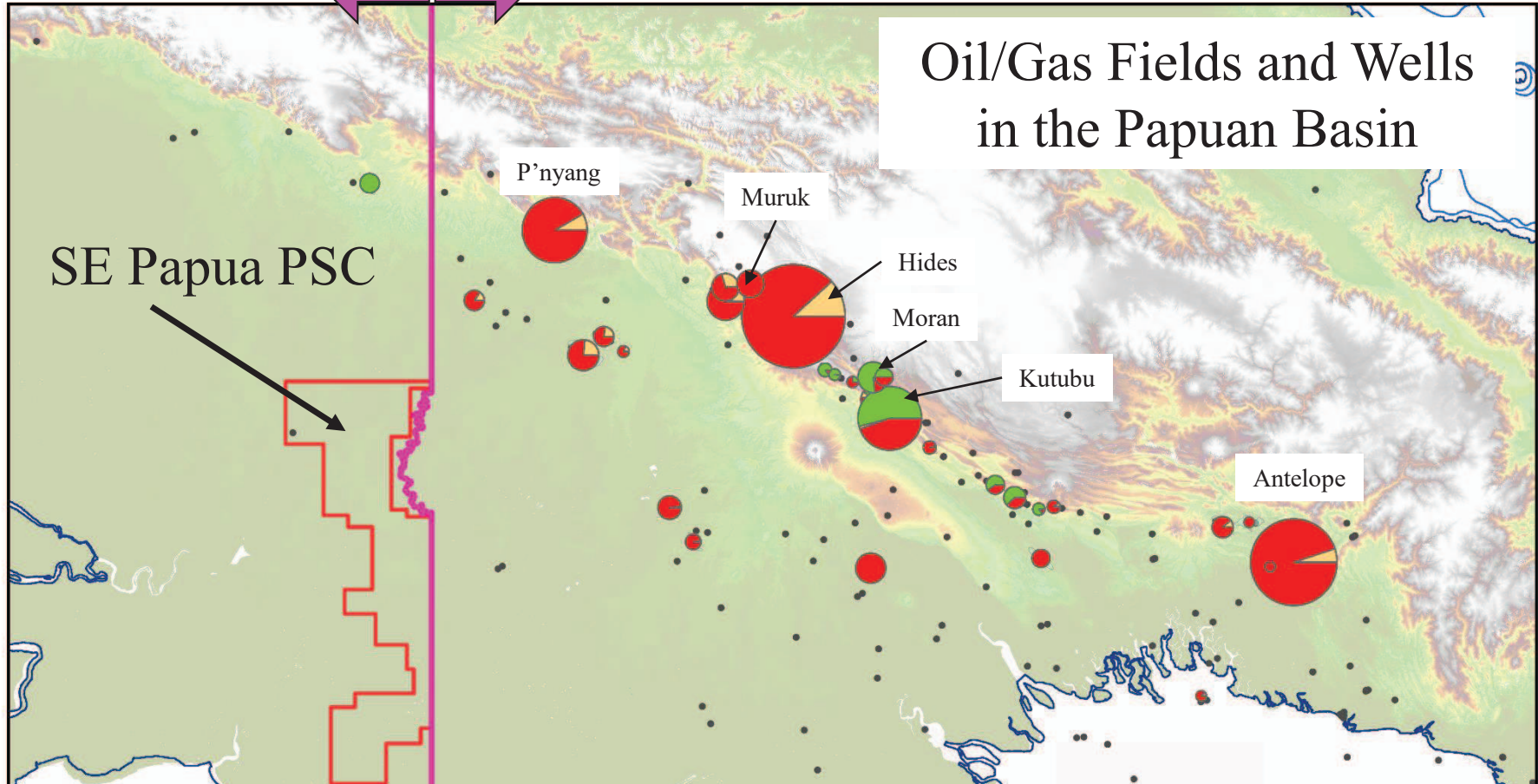
- » Muruk 1 targeting multi-tcf exploration prospect on-trend with Hides
- » Located north-east of Juha and Juha North pools
- » Operated by OSH in co-venture with ExxonMobil
- » High-impact well and potential new source of gas for PNG LNG expansion, if successful
- » Expected to spud in 1Q16, subject to pad readiness and rig mobilisation
- » Part of coordinated OSH 2016 Highlands drilling campaign to source gas for expansion



PPL 402	WI %
Oil Search	50.0
Esso PNG Wren Ltd (ExxonMobil affiliate)	50.0



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Summary

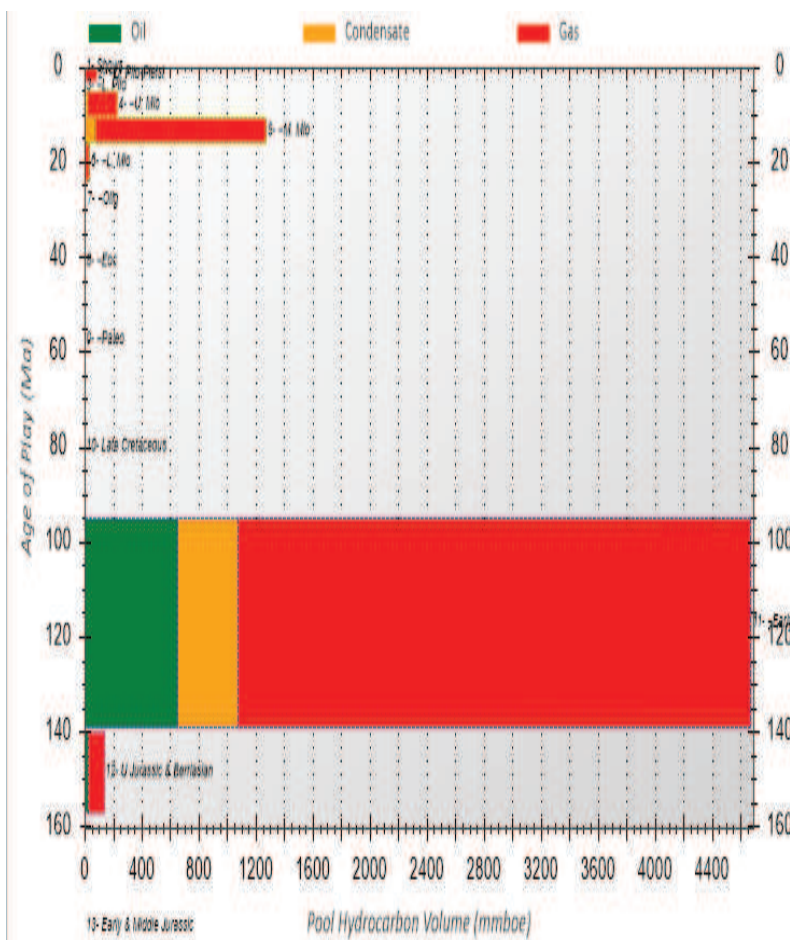
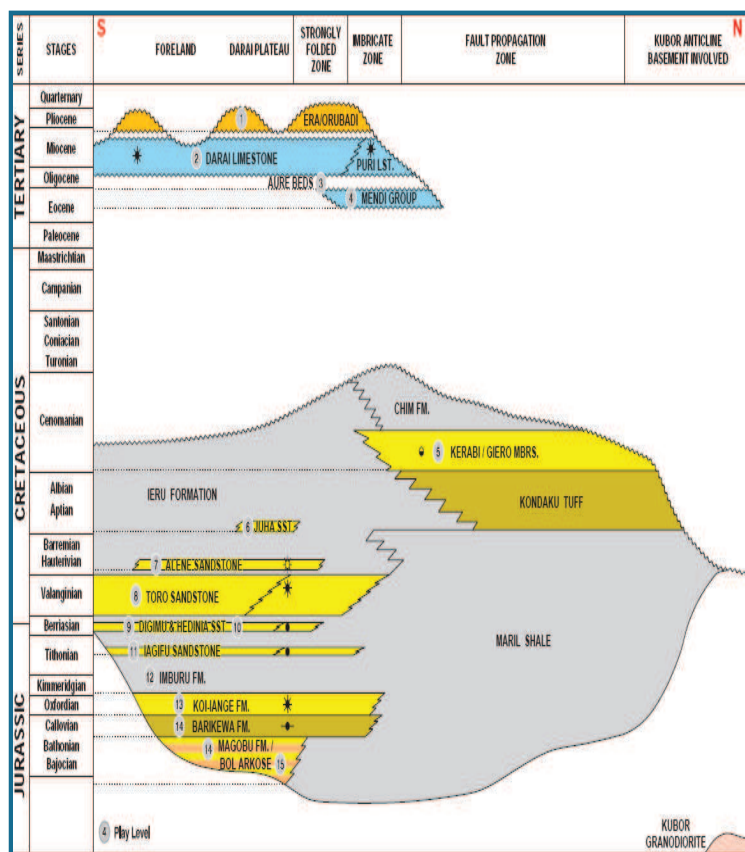
- All large discoveries are in the Foldbelt
- We are currently finding something big every 10 years...
- Why has the foreland not delivered a large discovery?

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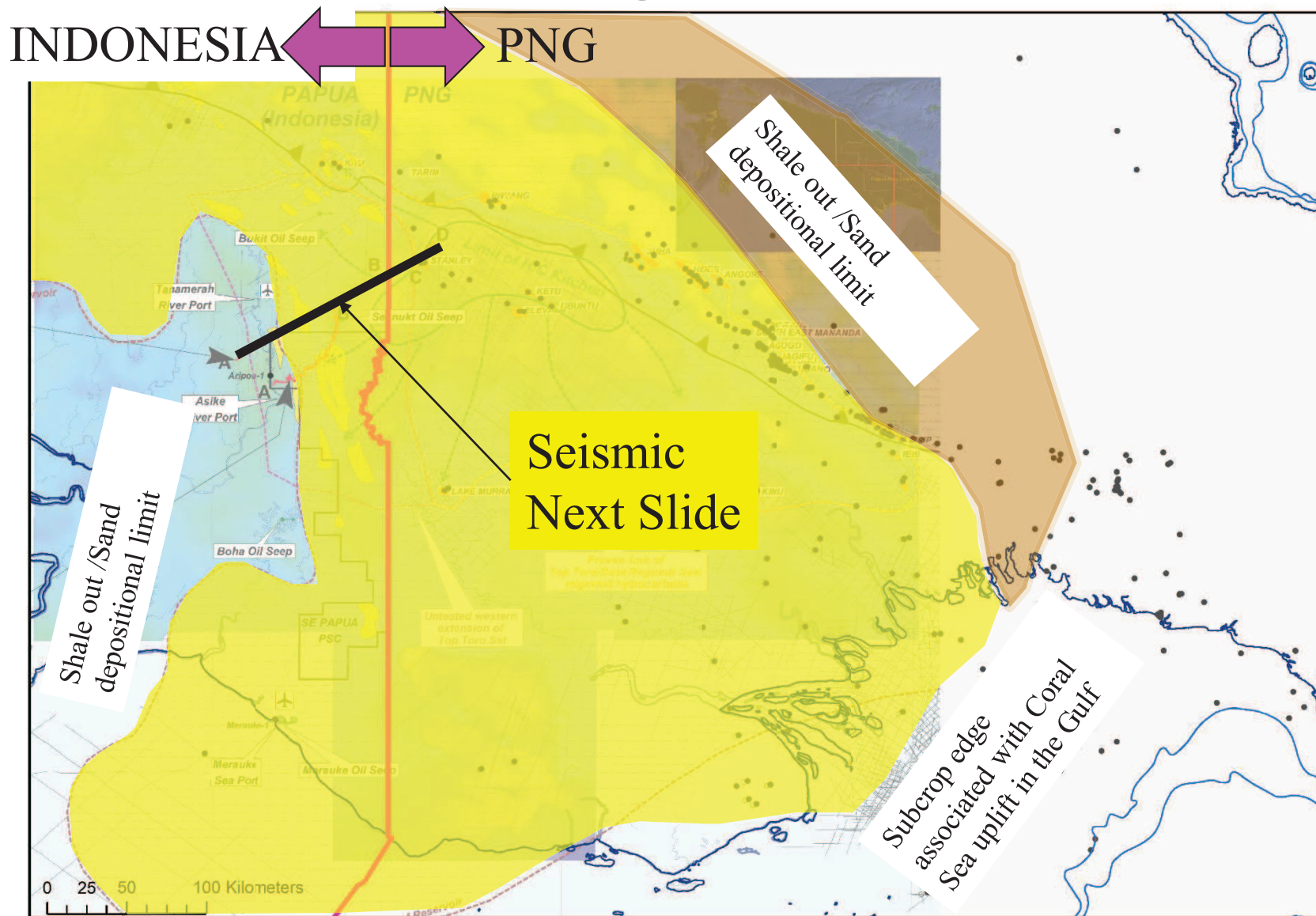
Base Regional Seal Play Definition

- We over complicate the nomenclature of the targets beneath the regional seal.. The first sand beneath the thick Ieru shale is normally the one with the HC's...
- The base Ieru Play we call the base regional seal play .. It hosts ~75% of the reserves...



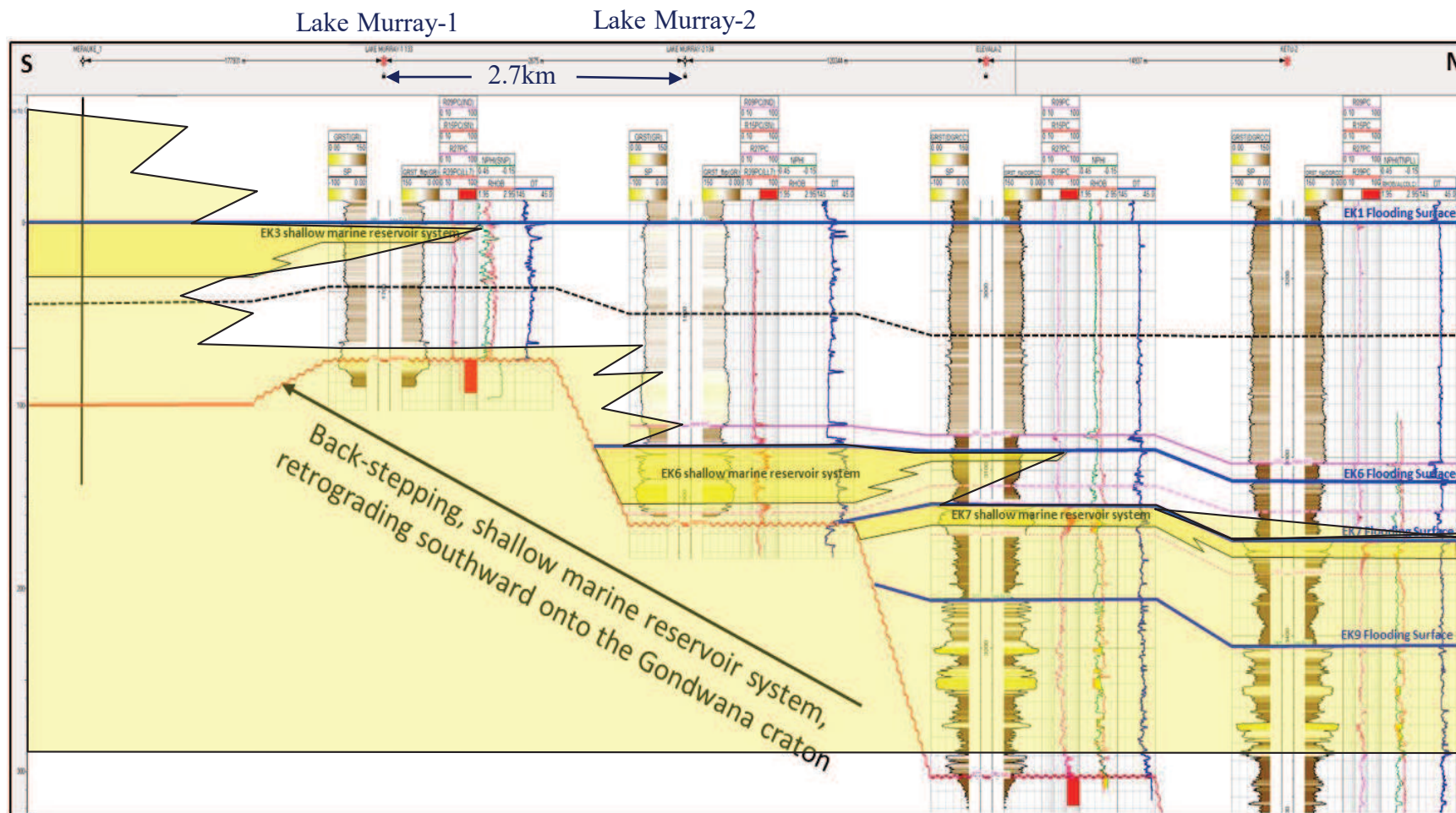
Base Regional Seal Reservoir Notes

Extensive well and Seismic control of regional sands



Reservoir Distribution – Biostratigraphy

Reservoir “Younging” onto older basement structures and flank of basin

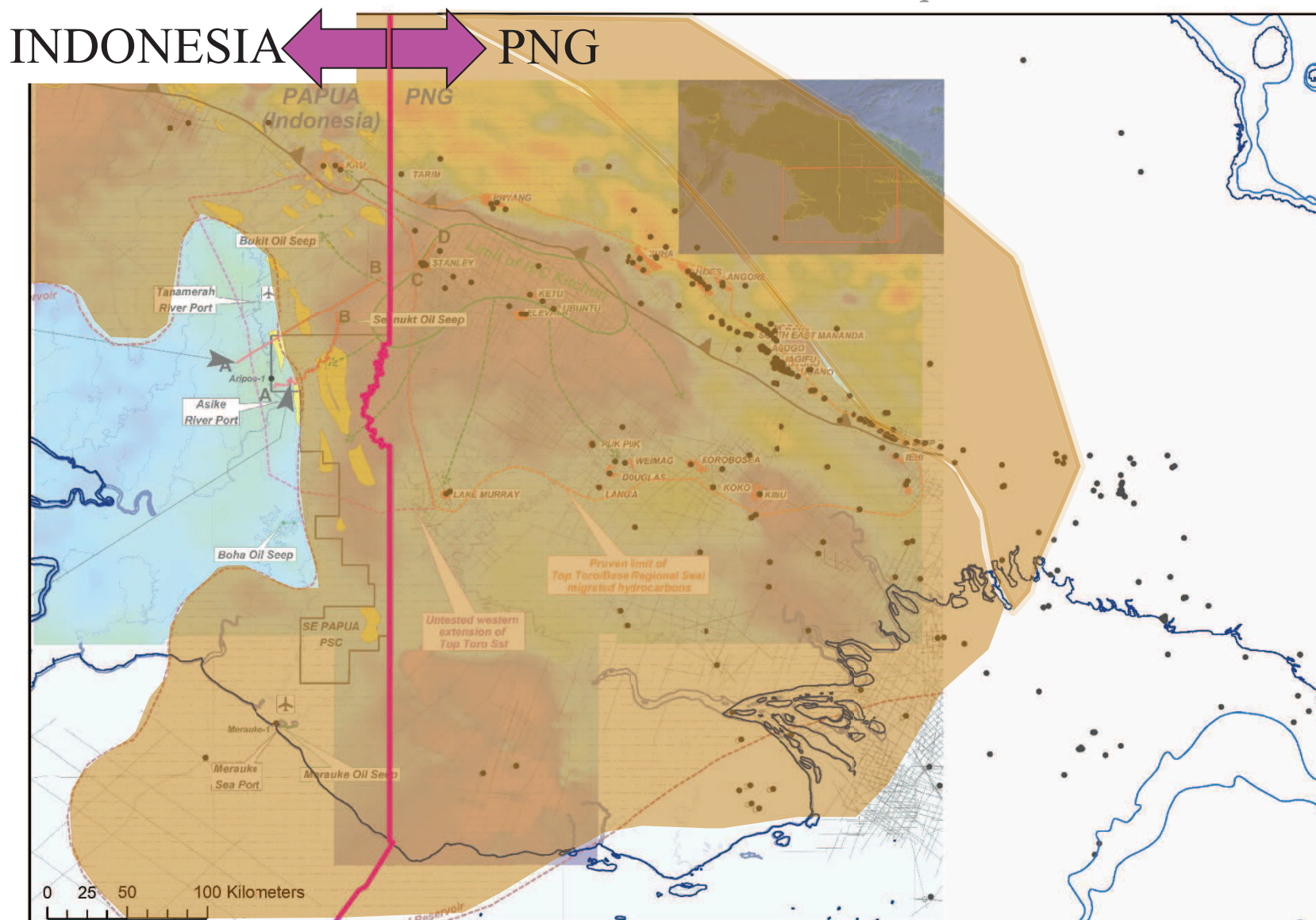


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Base Regional Seal Reservoir Notes

Extensive well and Seismic control of thick marine shale sequence

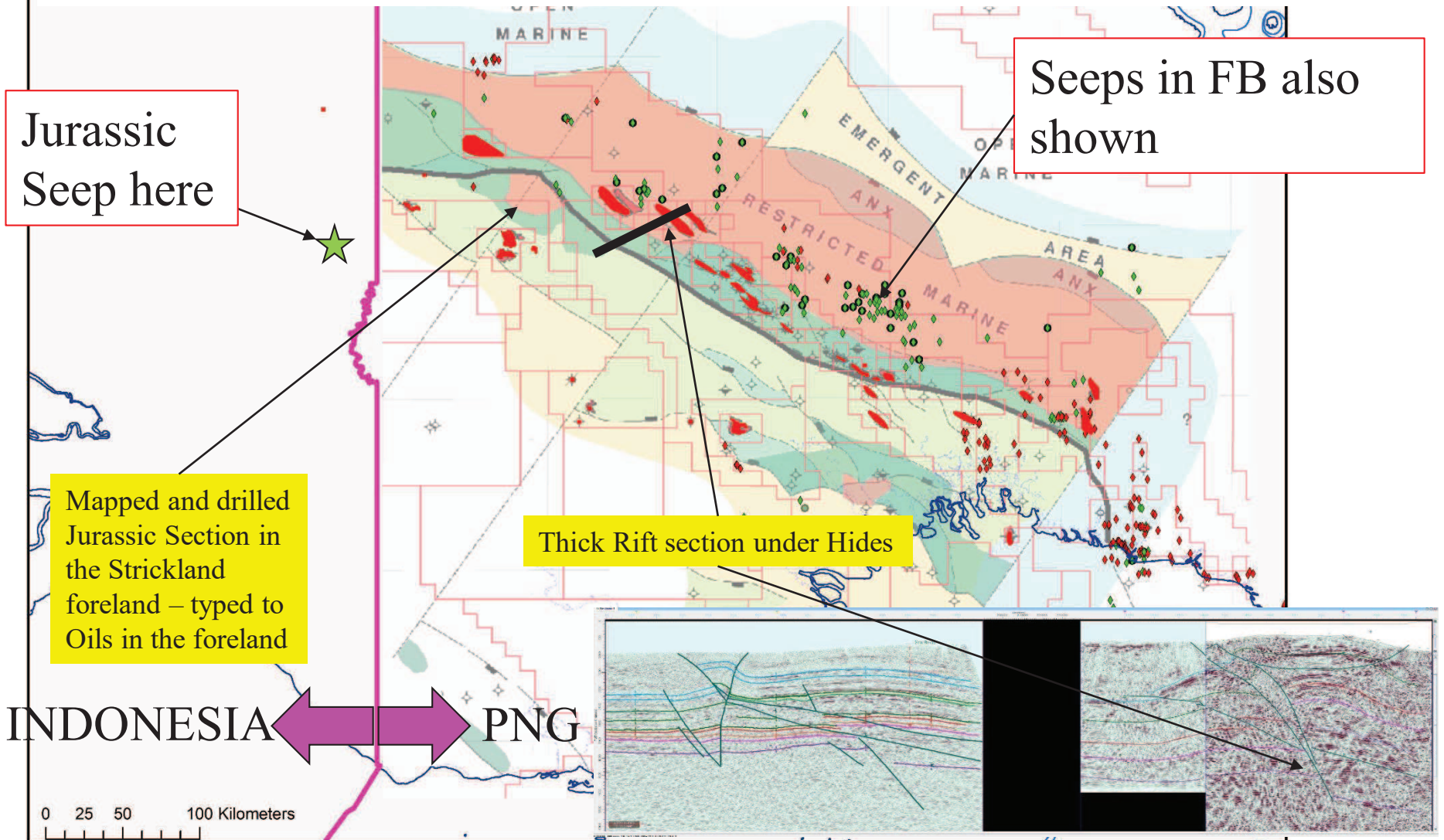


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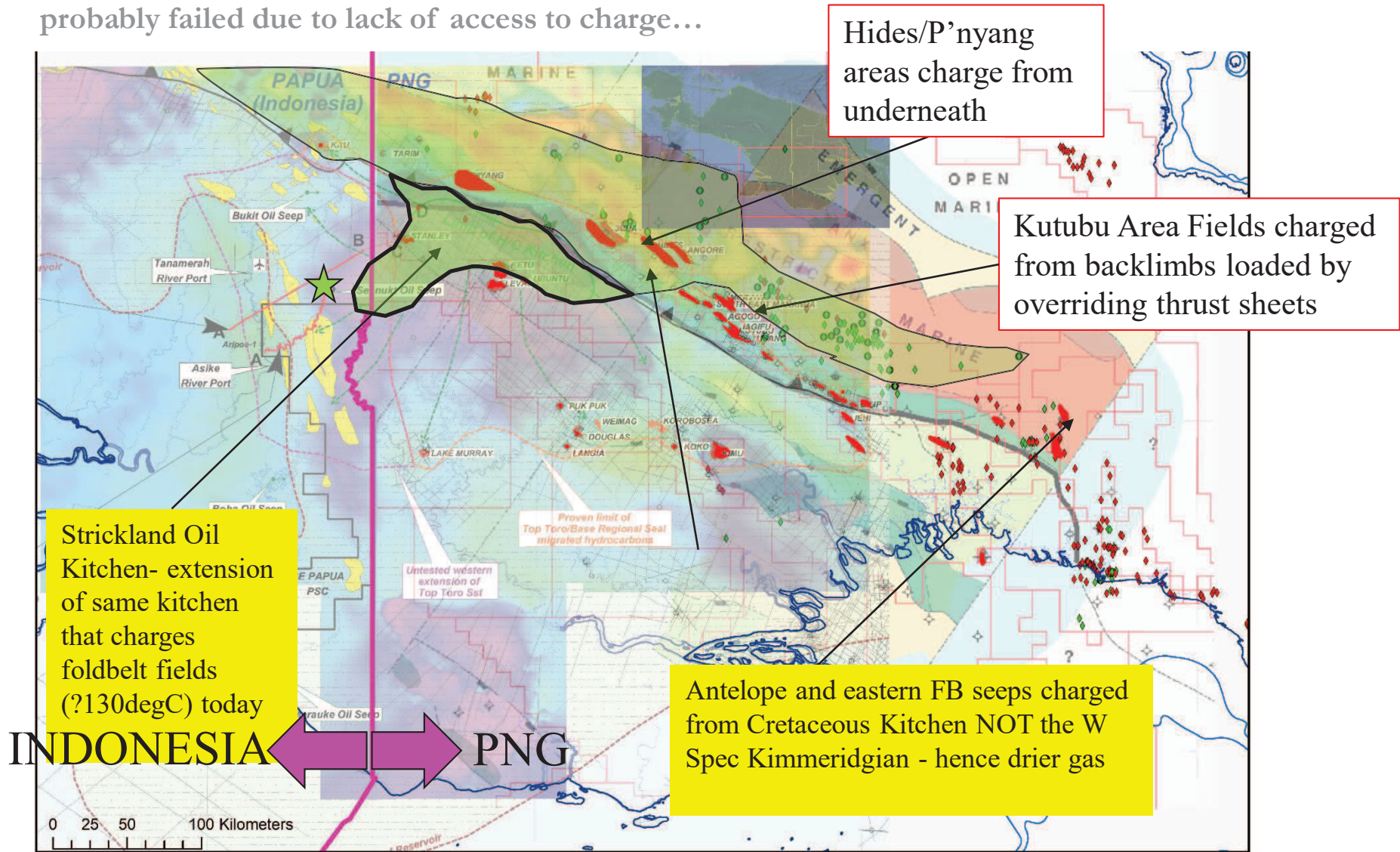
Source Rock Presence Distribution Notes

Main source rock is W Spectabilis Upper Jurassic Type II (Type D/E) oily source rock
Distribution is in Graben – published map below



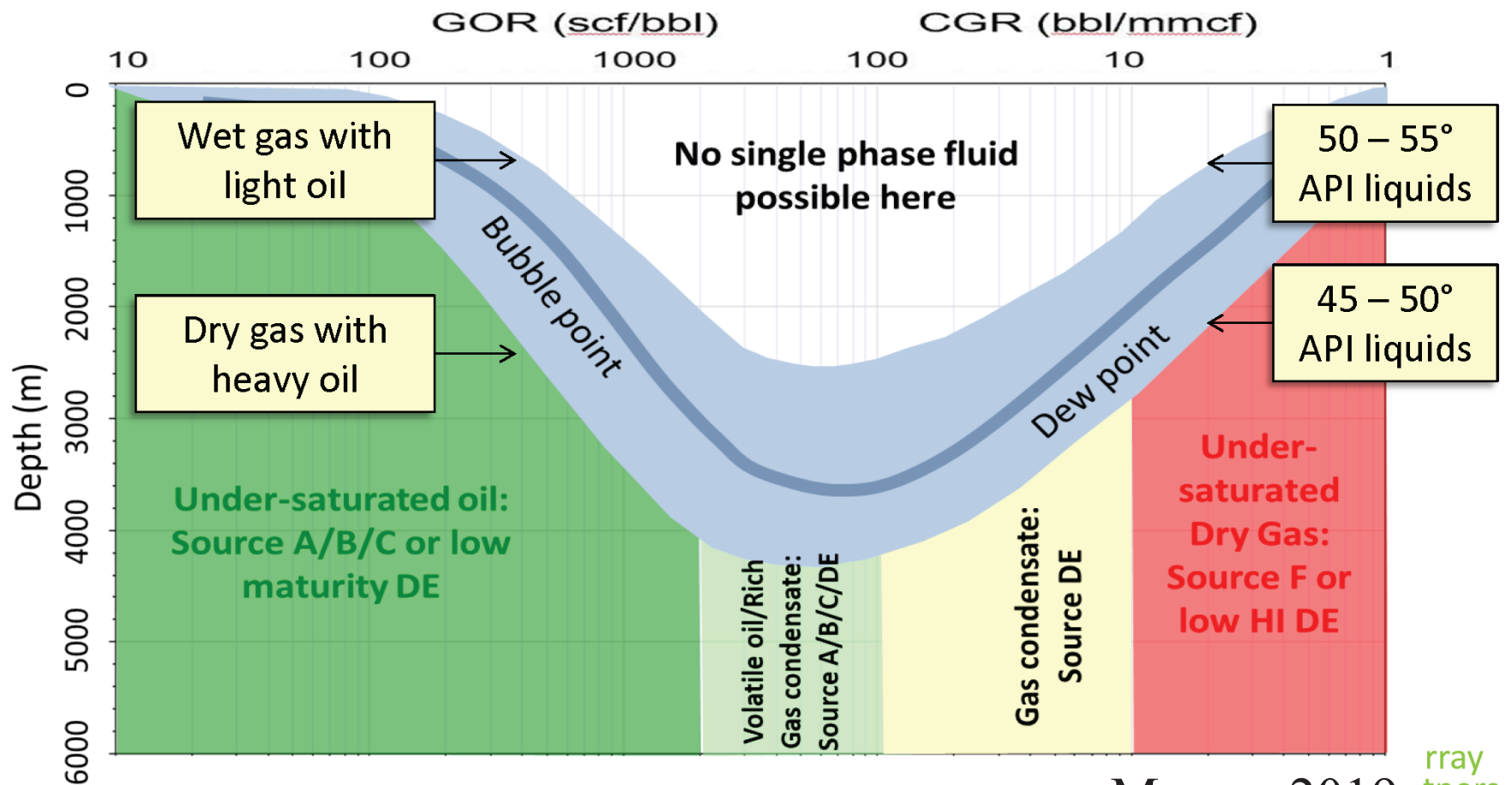
Source Rock Maturity Notes

Foreland basin area easy to evaluate – Foldbelt more complex. Many wells in the foldbelt have probably failed due to lack of access to charge...



What is a practical approach to prospect phase prediction ?

- Firstly, acknowledge the irreducible uncertainties and not over-sell our ability to predict HC phase at the prospect level using a purely “bottom-up” approach
- Even if we only know the dominant source type and target trap depth:

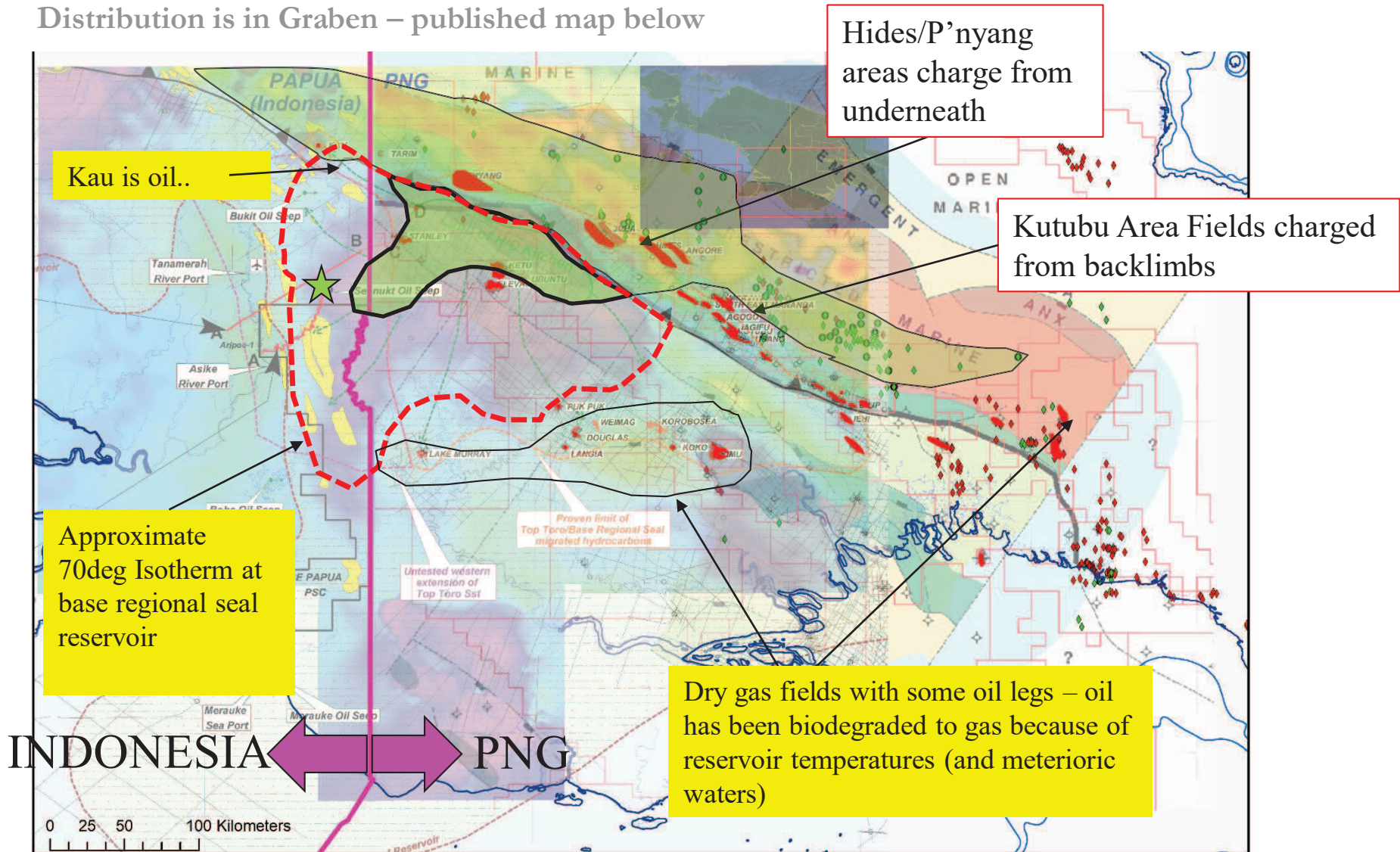


Murray 2019

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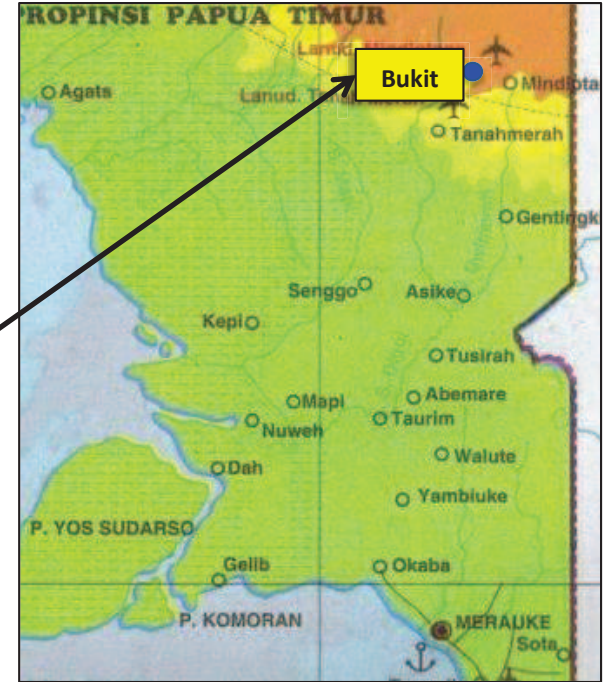
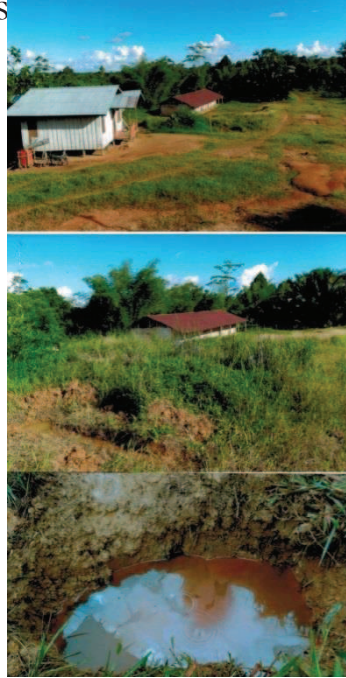
Source Rock Maturity Notes

Main source rock is W Spectabilis Upper Jurassic Type II (Type D/E) oily source rock
 Distribution is in Graben – published map below



West Papua Surface Seep Sampling – Bukit Site

- Sample site was covered by dirt path some years ago
- Minor excavation
- Seep collected off water surface
- Projected SR Type – Marine/Paralic-Deltaic
- Maturity – 0.7-0.75 VRE
- API – 35.1 (non-degraded)



O.I.L.S.		GEOMARK RESEARCH, INC.											
Oil Information Library System		9748 Whithorn Drive Tel: (281) 856-9333 Houston, Texas 77095 Fax: (281) 856-2987 info@geomarkresearch.com www.RFDbase.com											
GEOCHEMICAL SUMMARY SHEET													
Country: Indonesia	Depth (ft):	22-Jul-13											
Basin:	Age:	Sample ID: ID0322											
Field:	Formation:	LAT:											
Well: Bukit Village Sample 01		LONG:											
BULK PROPERTIES	API Gravity: 35.1	% S: 0.27	ppm V: 0										
C15+ Composition	% < C15: 68.5	ppm Ni: <15											
% Sat: 77.8	<table border="1"> <tr> <th colspan="2">Stable Carbon Isotope Composition</th> </tr> <tr> <td colspan="2">δ per mil PDB</td> </tr> <tr> <td>C15+ Saturate:</td> <td>-27.37</td> </tr> <tr> <td>C15+ Aromatic:</td> <td>-26.47</td> </tr> <tr> <td>Canonical Variable:</td> <td>-1.17</td> </tr> </table>			Stable Carbon Isotope Composition		δ per mil PDB		C15+ Saturate:	-27.37	C15+ Aromatic:	-26.47	Canonical Variable:	-1.17
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% NSO: 5.3													
% Asp: 0.0													
Sat/Aro= 4.60													
n-Paraffin/Naphthene=	Miscellaneous:												
WHOLE CRUDE GAS CHROMATOGRAPHY Pr/Ph= 2.80 Pr/n-C17= 0.76 Ph/n-C18= 0.28 n-C27/n-C17= 0.18 CPI= 1.077													



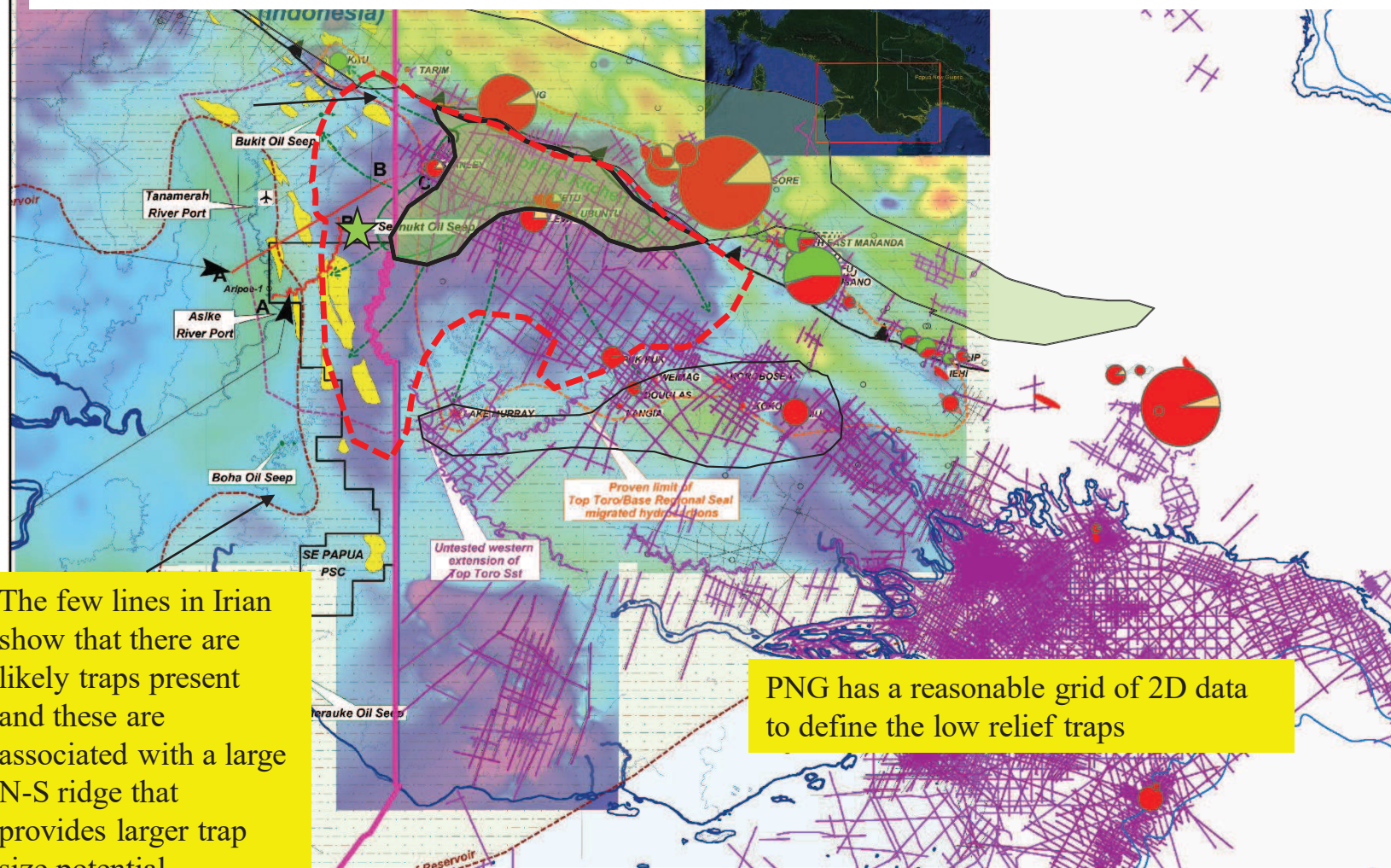
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Trap Element Notes

PNG has a good 2D seismic coverage – Irian does not... we have to rely on a few lines and gravity etc

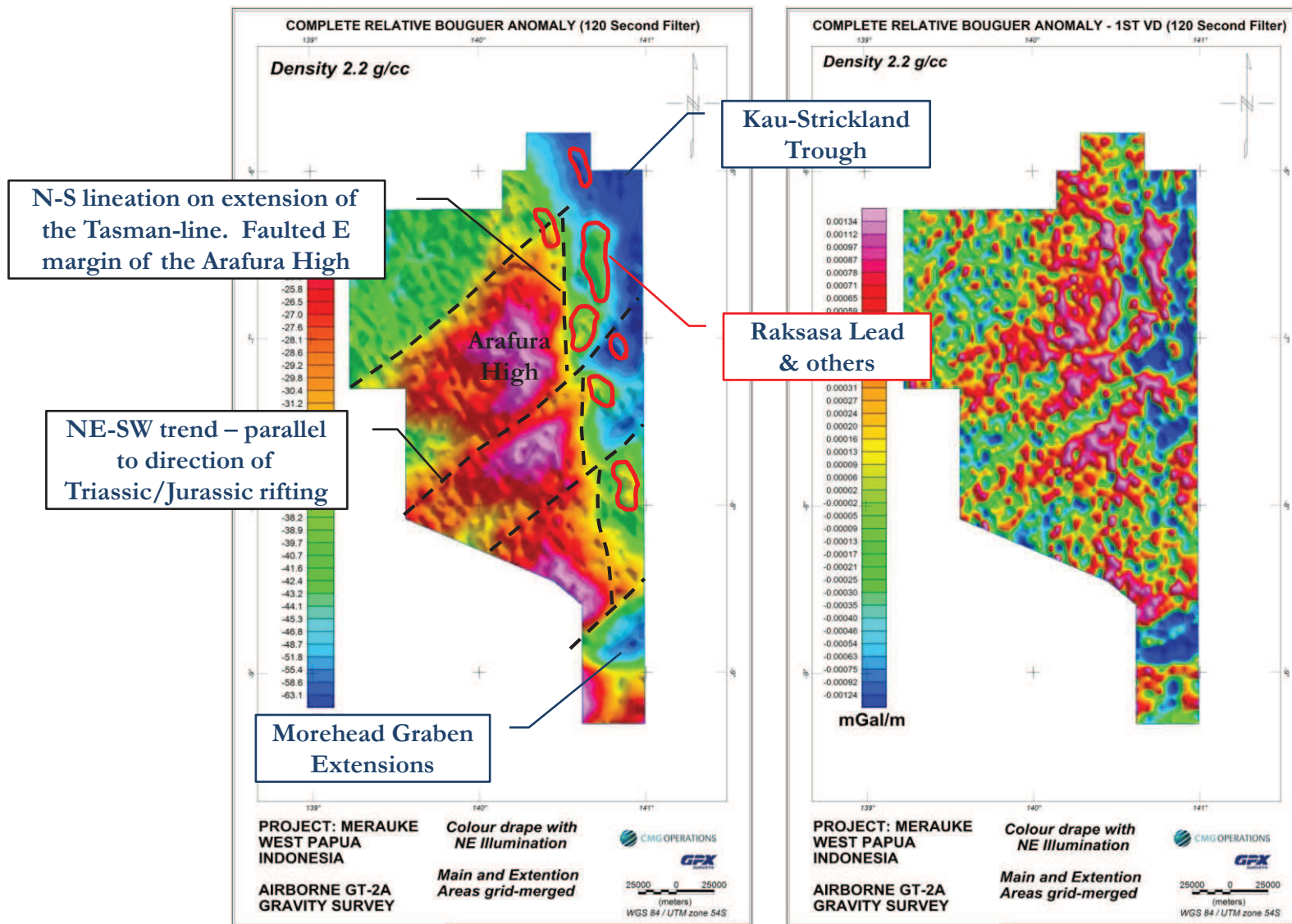
Traps different in Irian – NOT low relief like in PNG



The few lines in Irian show that there are likely traps present and these are associated with a large N-S ridge that provides larger trap size potential

PNG has a reasonable grid of 2D data to define the low relief traps

SE Papua Aero Gravity & Magnetic Survey



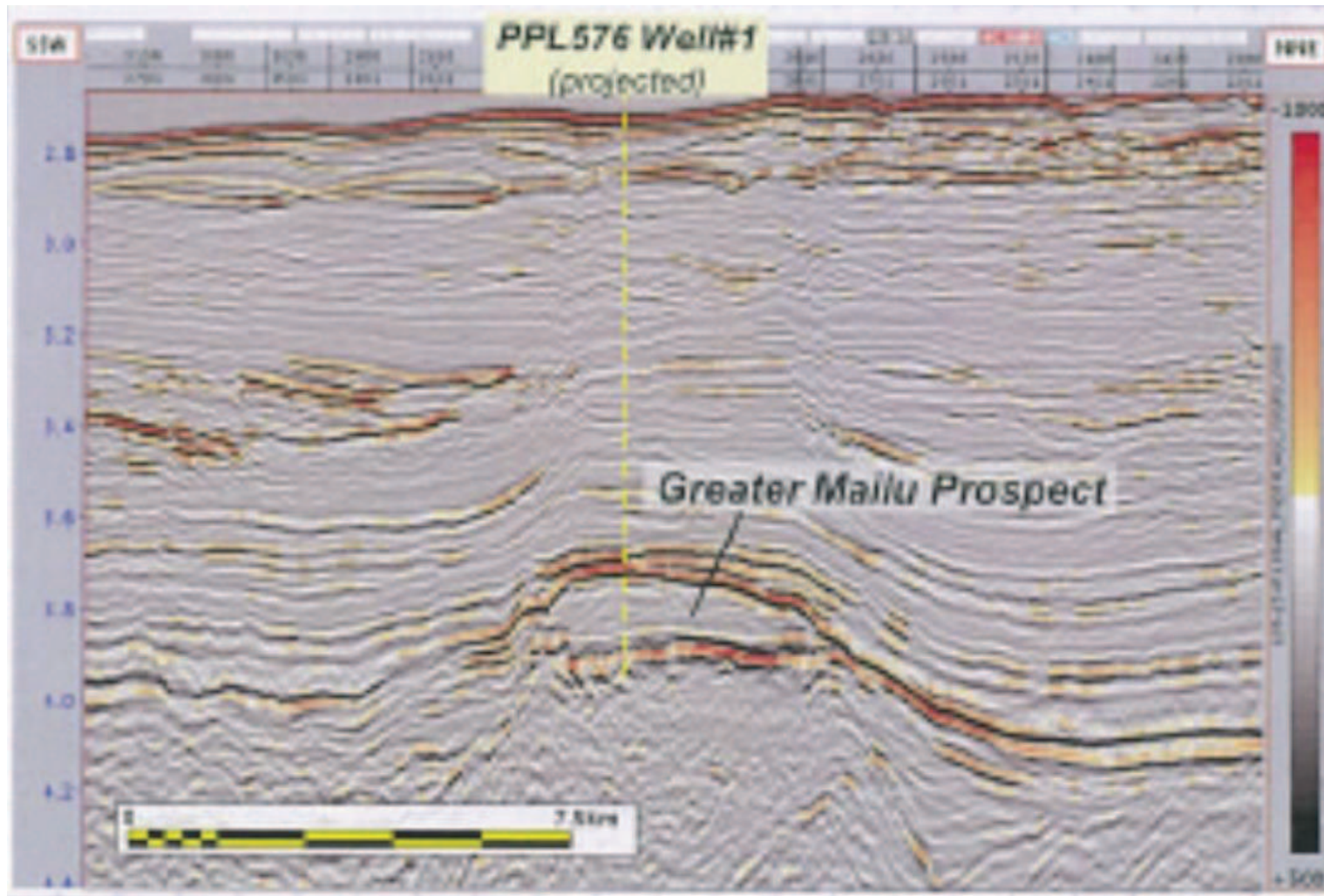
Exploration & Resource Potential (Unconstrained; Unrisked)

Lead (Target Depth)	Comment	Gross Reservoir Thickness (m)	N:G (%)	Porosity (%)	Shc (%)	GEF/FVF	RF Gas/Oil (%)	Mean rec. gas (bcf)	Mean rec. oil (mmbbls)
Raksasa (1600m)	Mostly gravity defined, one poor quality river- line across northern flank	20	60	14	65	150/1.1	70/35	3384	1731
Sedikit Raksasa (1750m)	2 loosely spaced (+30km) 2D dip-lines	20	60	14	65	150/1.1	70/35	752	385
EPJ1 (2100m)	1 poor quality 2D dip- line	20	60	14	65	150/1.1	70/35	885	399
Lead C (1800m)	Gravity defined	20	60	14	65	150/1.1	70/35	640	379
Lead D	Gravity defined	20	60	14	65	150/1.1	70/35	308	182
Lead E	Gravity defined	20	60	14	65	150/1.1	70/35	546	324
Lead G (1900m)	Gravity defined	20	60	14	65	150/1.1	70/35	506	300
								7021	3701

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Total Malu Prospect DW Gulf of Papua PPL576 ~2000m WD



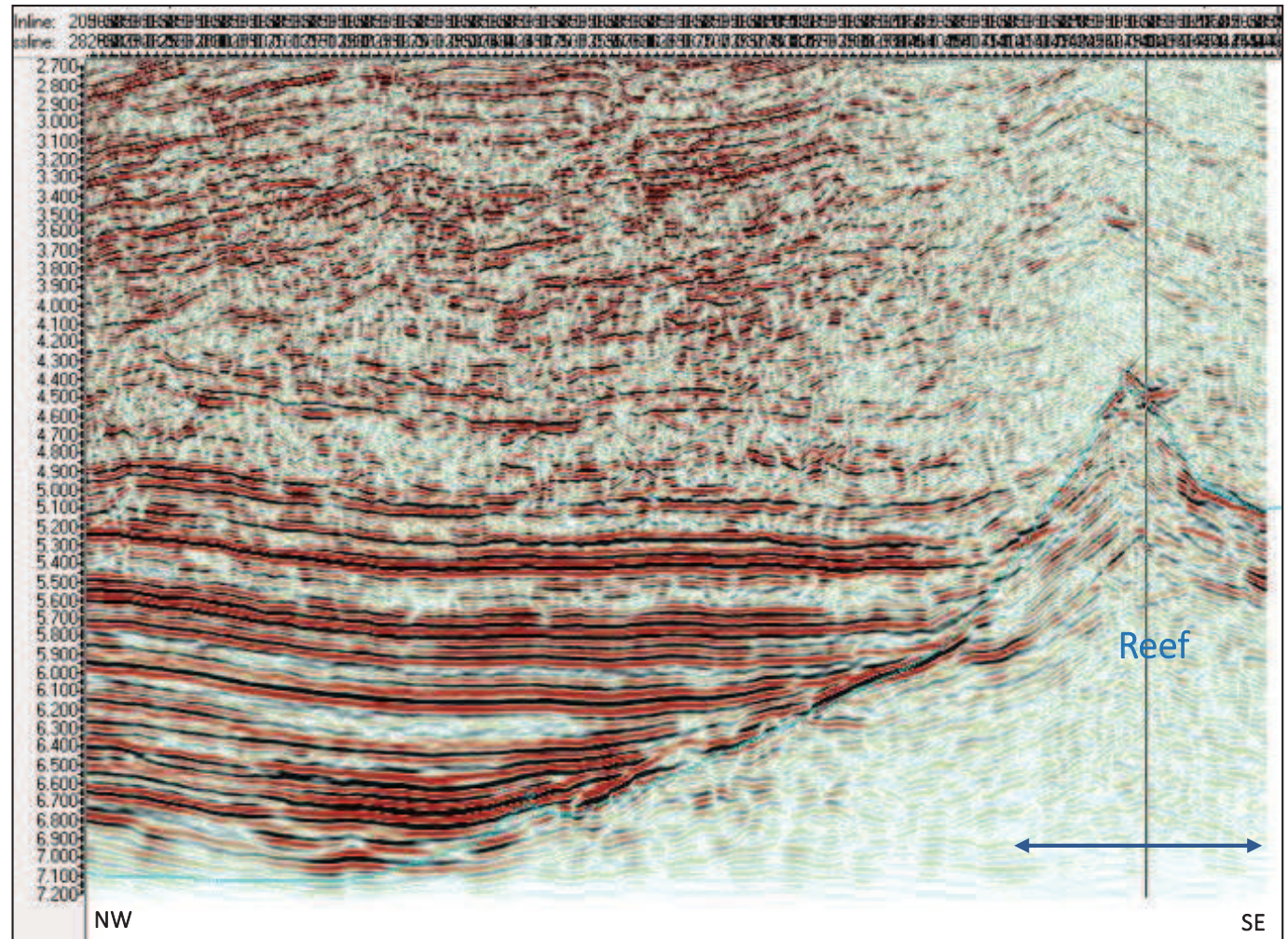
Deep water potential remains untested..

Undrilled PNG shallow offshore opportunity in The Gulf (Papua not Mexico!)

Undrilled & 5-10tcf simple Miocene build up exploration potential...

~5km to top target

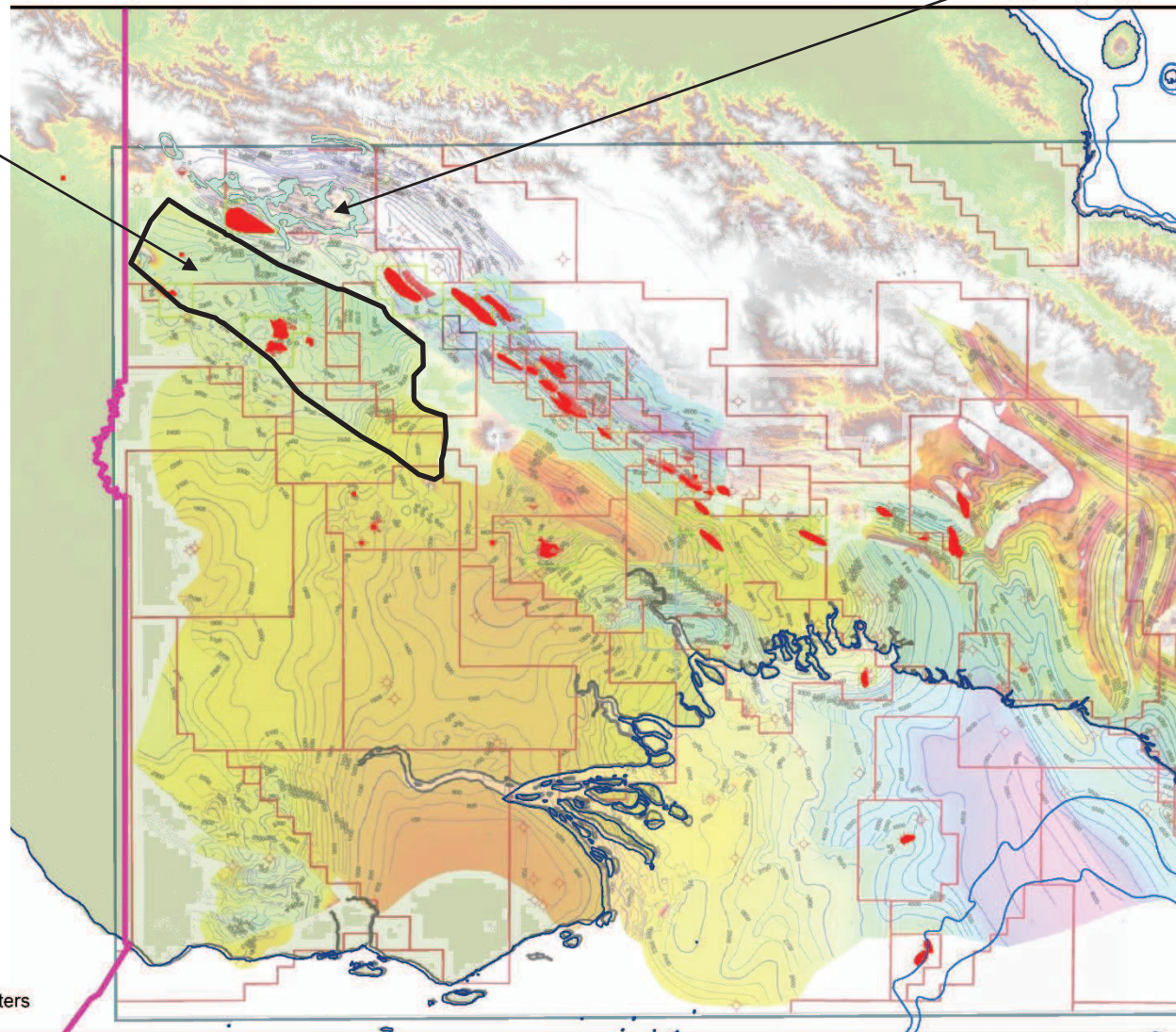
Like in Luconia – the deep carbonates can be filled and this feature could have a 1km HV column



Alene Pressure Cell Play

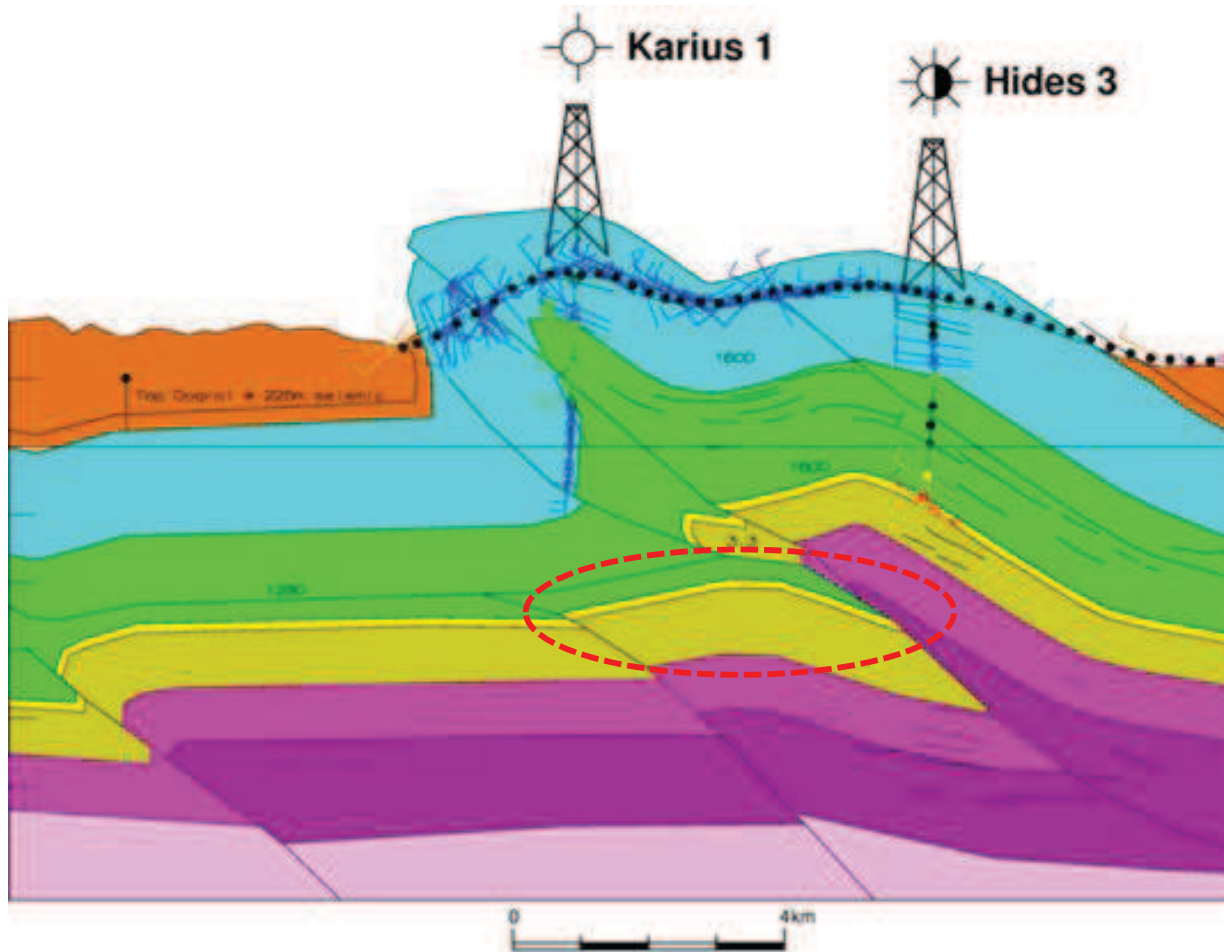
Toro at surface

In this region the Toro is connected to the uplifted Toro outcrops in the foldbelt and is overpressured... where as the Alene above does not see this overpressure.. Means the Alene is regionally isolated and a large fault trap may be present somewhere - ?Multi-tcf.?



The prospect with the MOAST...

The Mother Of All Sub Thrust Prospects



This should be charged... analog is P'nyang South Footwall

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Summary

- The Papuan Basin is underexplored and has significant remaining exploration potential
- There are many different opportunities available beyond the simple structures that the industry has focussed on to date
- The SE Papua PSC opportunity can be summarised below

	Reservoir	Seal	Source	Migration/ Phase	Trap
Status	Very Likely Present	Proven – not an issue	Shares the same oily mature kitchen as the large foldbelt fields	Simple migration path – Raksasa in oil goldilocks depth range	Potentially large – needs more seismic (or a brave driller!)

- If you don't want to enter into PNG but want a slice of the action from the Indonesian side of the fence then this is the opportunity for you!
- Visit us at our farmout booth Contact Agü Kantsler agu.kantslaer@transform.com.au or +61(0)419937917 for more information - we have evacuation routes down the Digul river and solid economic evaluations...

The field geology is always fun...





PNG is full of surprises... some of them are good..



Thank You...