



SEAPEX Exploration Conference 2005
Orchard Hotel, Singapore
5th – 7th April 2005

ABSTRACT

Author(s) : Peter Cockcroft and Chris Kenyon
Company Affiliation : Premier Oil

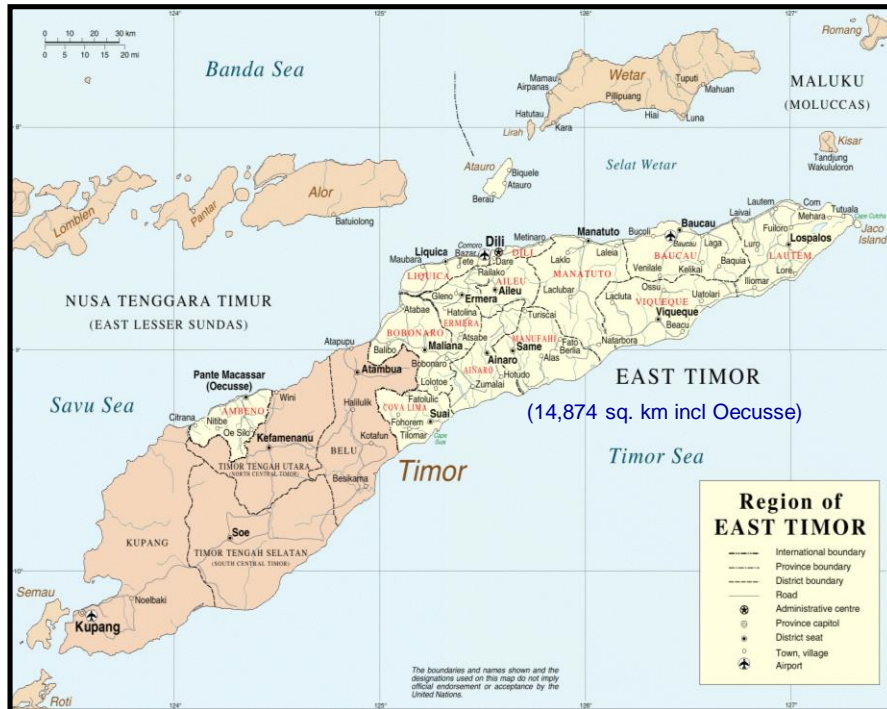
A Journey into East Timor's Exploration History

This paper looks at the history of oil and gas exploration in East Timor (Timor Leste). There are five distinct phases: the period 1893 to 1928, when small scale oil recovery operations were undertaken near Laclubar and Aliambata; the 1920's and 1930's, when Timor Oil and others were influenced by political events; the 1950's to mid 1970's, a phase in which Timor Oil was particularly active; the Indonesian period, in which exploration switched to the offshore, and the new era of Independence. In spite of the political perturbations, Timor Oil alone drilled over 20 onshore wells in the period 1911 to 1975, acquired marine data off the southern coast and conducted intensive field work over an extended period, the driver being the 30 or more oil and gas seeps known from the Permian and Mesozoic strata, from the Bobonaro Scaly Clay and from the Viqueque Formation and coastal alluvium. In the period subsequent to 1974 larger companies such as the Woodside-Burmah consortium, Adobe and others became involved as attention switched to the offshore.



A Journey Into the Exploration History of East Timor

Chris Kenyon
Peter Cockcroft
Wayne Spencer



acknowledgements:

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Odd-Arne Larsen (FUGRO MCS)
Charles Ramsden and Andy Cunningham (GGS)
Steve Jeffery and John Boldock (ASB)
Peter Baillie (TGS-Nopec)
Peter Nicholson ('The Australian')
Marie Van De Zuidwind

Overview attempts to be:

- Objective and without bias in reporting political and legislative events and milestones**
- Non-affiliated**
- Unrestrained and open in geological opinions!!**



THE PRINCIPAL AUTHORS – THE TIMOR CONNECTION

PETER COCKCROFT

(all things commercial, petroleum legislative, engineering & political)

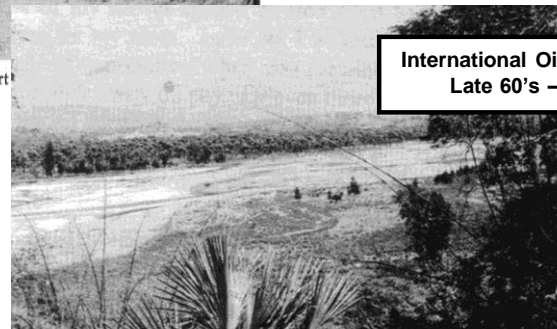
CHRIS KENYON

(geological, geophysical & general exploration aspects)

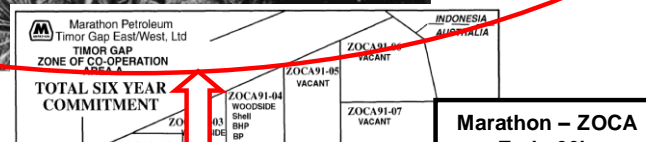
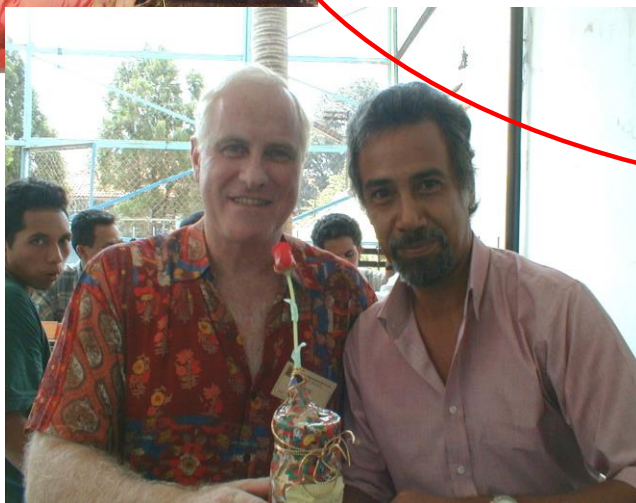


"Waiting for the AA." Brake failure, start

Kenyon, C.S., 1971. Viqueque Stratigraphy, Seismic Interpretation and the Search for Oil: Cape Suai. Report to International Oils Exploration N.L., 1971.
 Kenyon, C.S., 1974. Stratigraphy and sedimentology of the late Miocene to Quaternary deposits of Timor. Unpublished Ph.D. thesis, University of London.
 Kenyon, C.S., & Warwick, D.J., 1970. The Onshore Viqueque Group of Portuguese Timor: A Report on the Stratigraphy and Petroleum Prospects. Timor Oil, Internal Communication (BI/18).

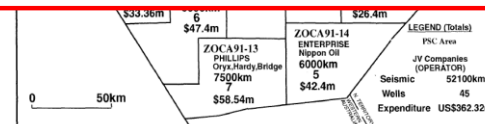


International Oils - West Timor
Late 60's – early 70's

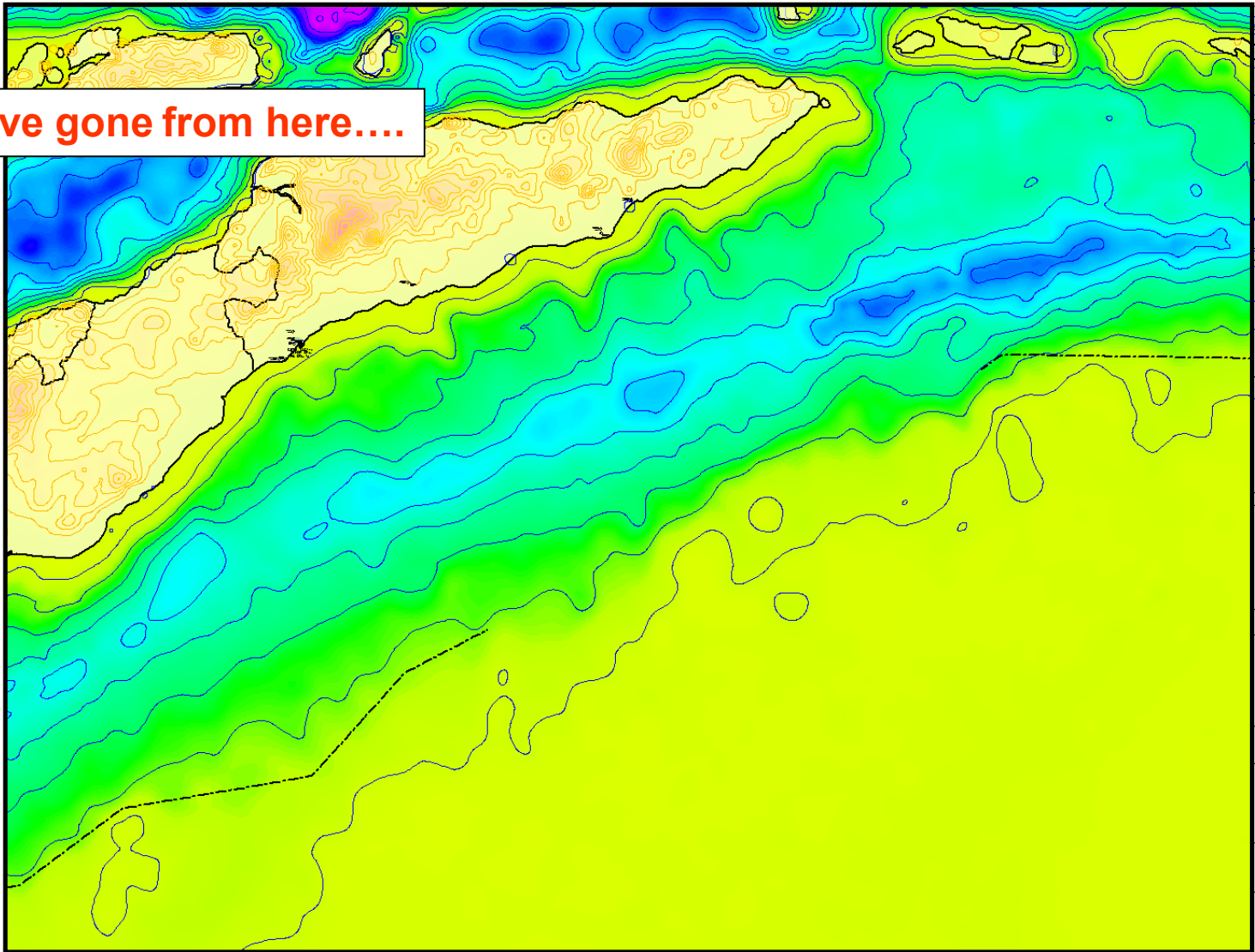


Marathon – ZOCA

In the period since these photographs were taken

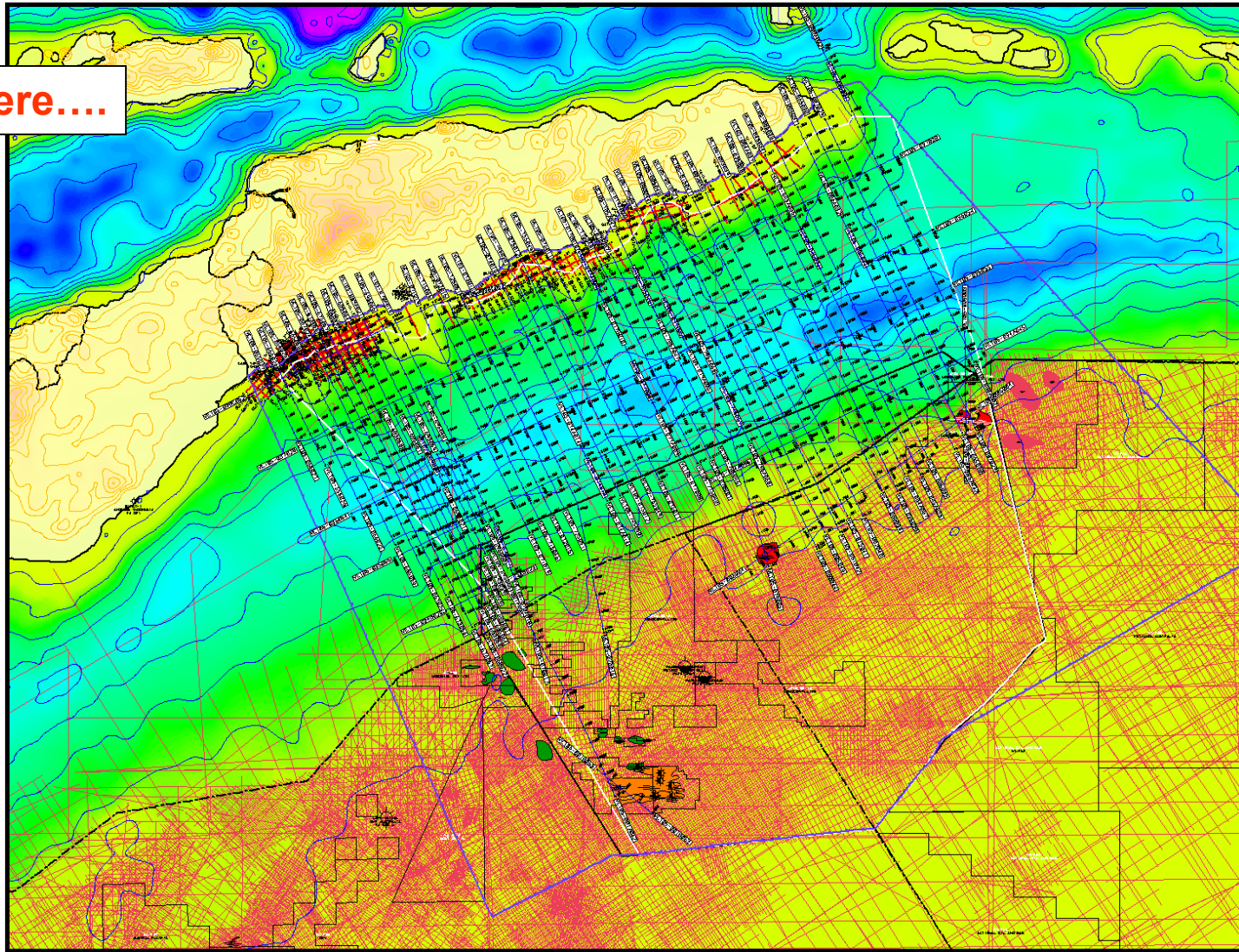


We've gone from here....



1969 Exploration Infrastructure

to here....



2005 Exploration Infrastructure

The Journey:

INTO THE PAST

- **Evolution in Geological Thinking**
- **Changing Exploration Focus**
- **Overriding Political Developments**

***THE PRESENT
AND FUTURE***

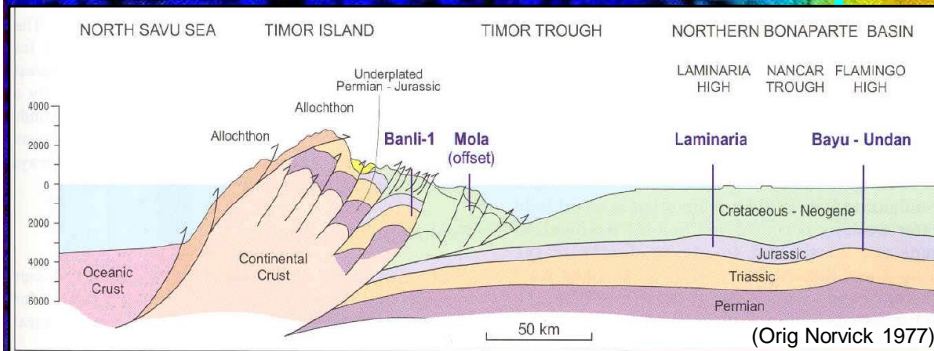
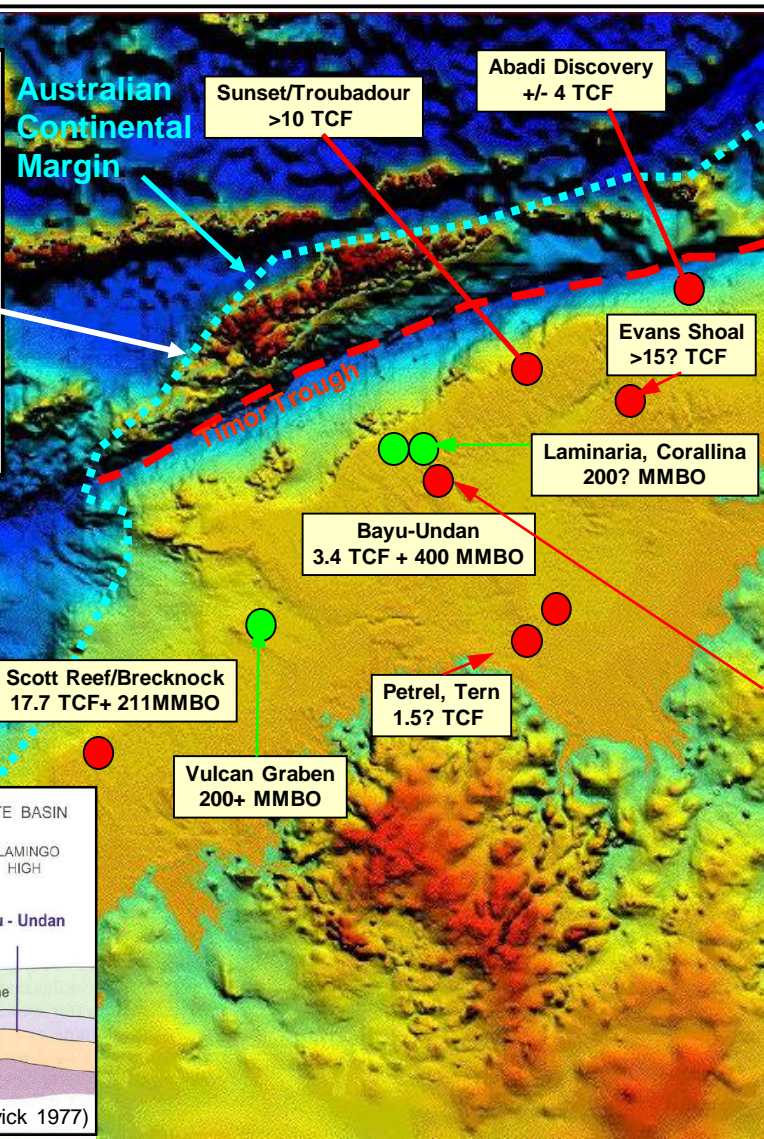
- **The Prize to date**
- **The Ultimate Prize**
- **How will we get there ? (resources)**

Regional Tectonic Framework of the Timor-N Bonaparte Basin Area

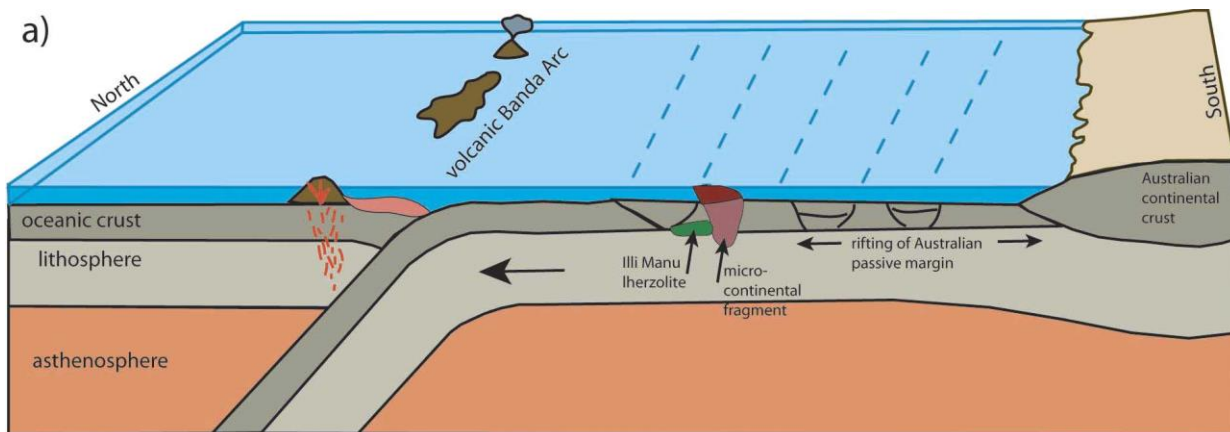
•Australian Continental Crust extends to the north of Timor

•Evidence: Gravity Surveys (Chamalaun et al 1976)
Timor stratigraphy & sediments with Australian affinities

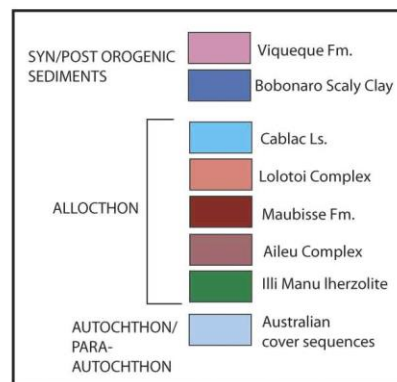
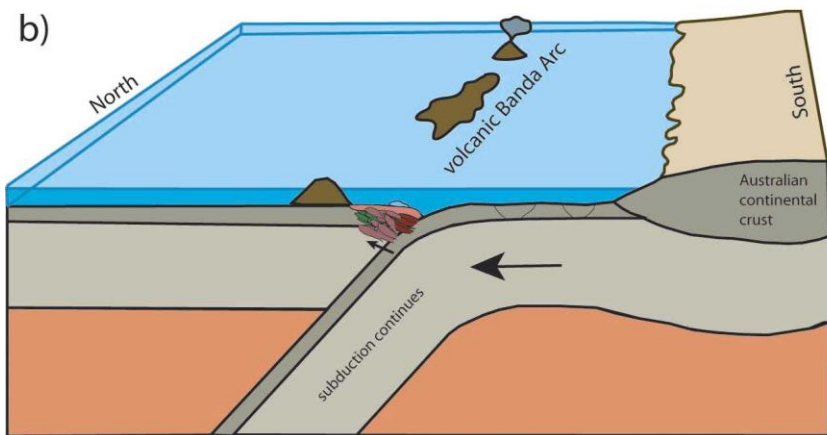
•Sharp, linear axis of Timor Trough marks leading edge of imbricates



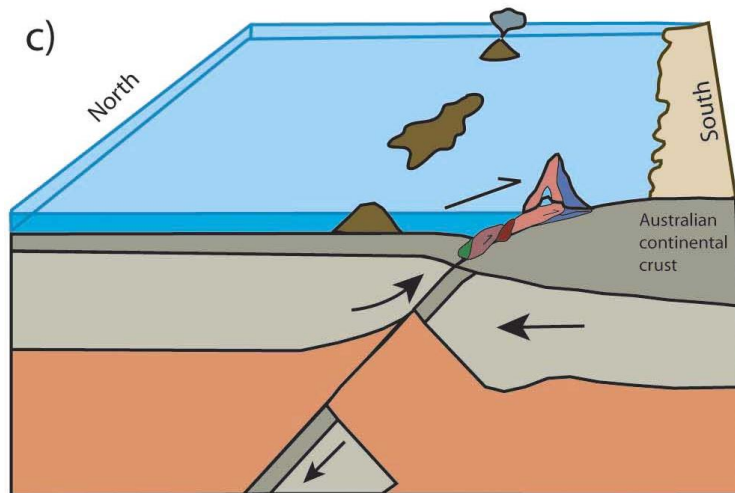
Outer Banda Arc including East Timor, marks the zone of collision between the northwestern edge of the Australian continent and a former oceanic subduction zone.



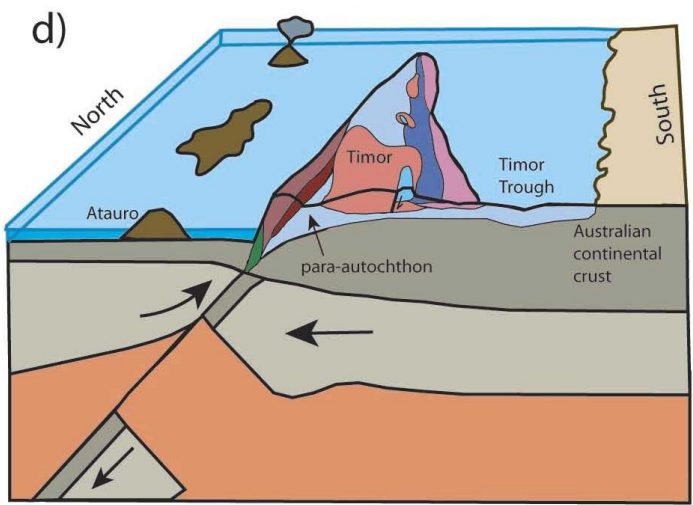
(a) Pre-collision: subduction of Australian Plate Beneath Eurasian Plate gives rise to Volcanic Banda Arc



(b) Subduction of the Oceanic Plate continues as the Continental margin approaches



(c) Onset of Arc-continent collision: the Australian Continental Margin reaches the subduction zone and jams collision. South-directed imbrication of the Aileu complex and parts of the Banda forearc (Lolotoi complex capped by Cablac Limestone) occurs as the allochthons are thrust towards the south onto the Australian continental margin. The Bobonaro Scaly Clay is emplaced as a gravity slide deposit beneath and in front of the southernmost thrust sheet

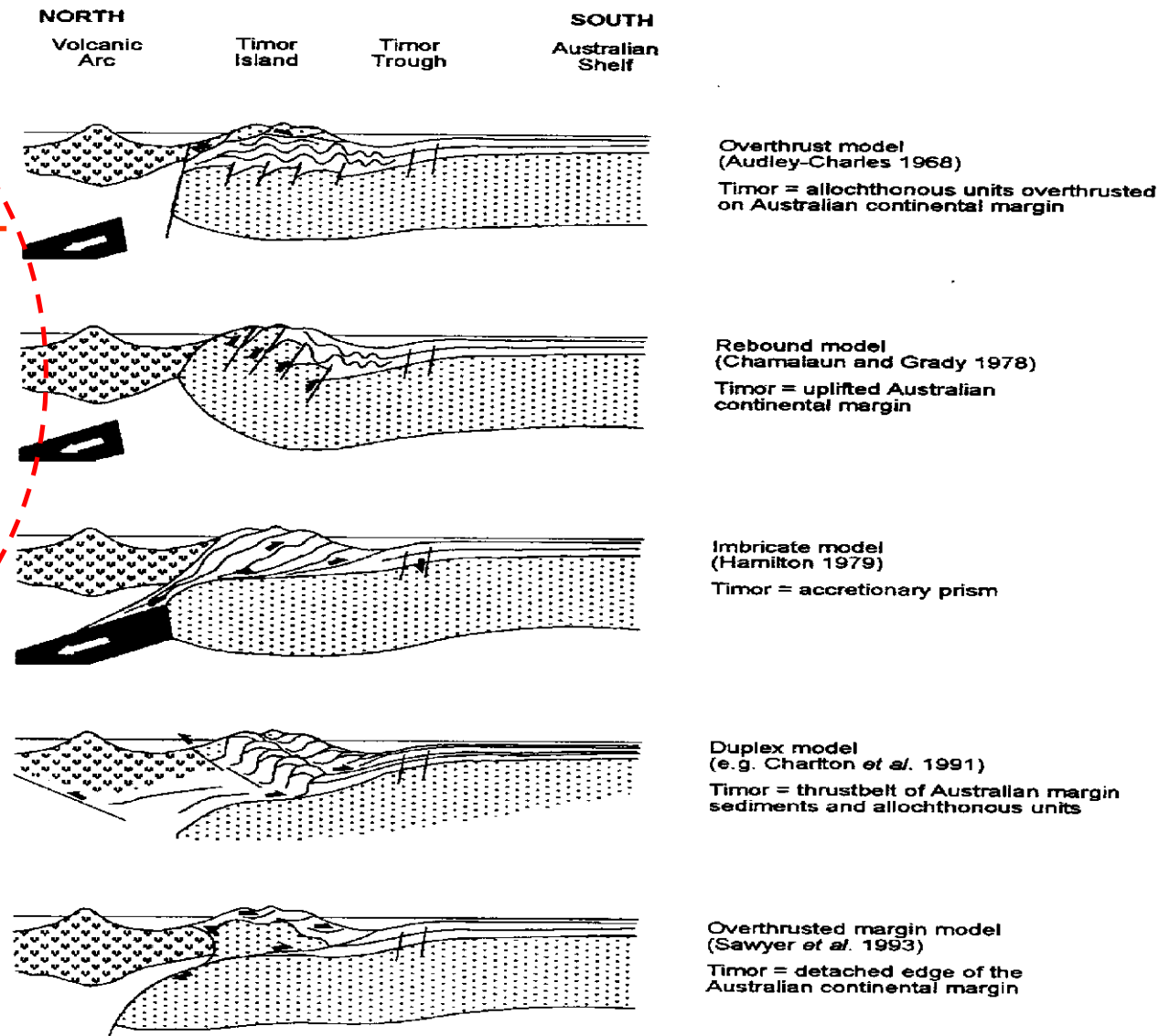


(d) Ongoing Collision: Shedding of sediments from the Lolotoi complex towards the south caused the deposition of the Viqueque formation

Most models are of the thin-skinned variety –

Sediments of the Australian Continent are in some cases exposed, in others accessible beneath thrust sheets on Timor

Sets up accessibility of N Bonaparte Basin play equivalents



Various models for the structural evolution of Timor (taken from Reed et al 1996, after Barber 1981)

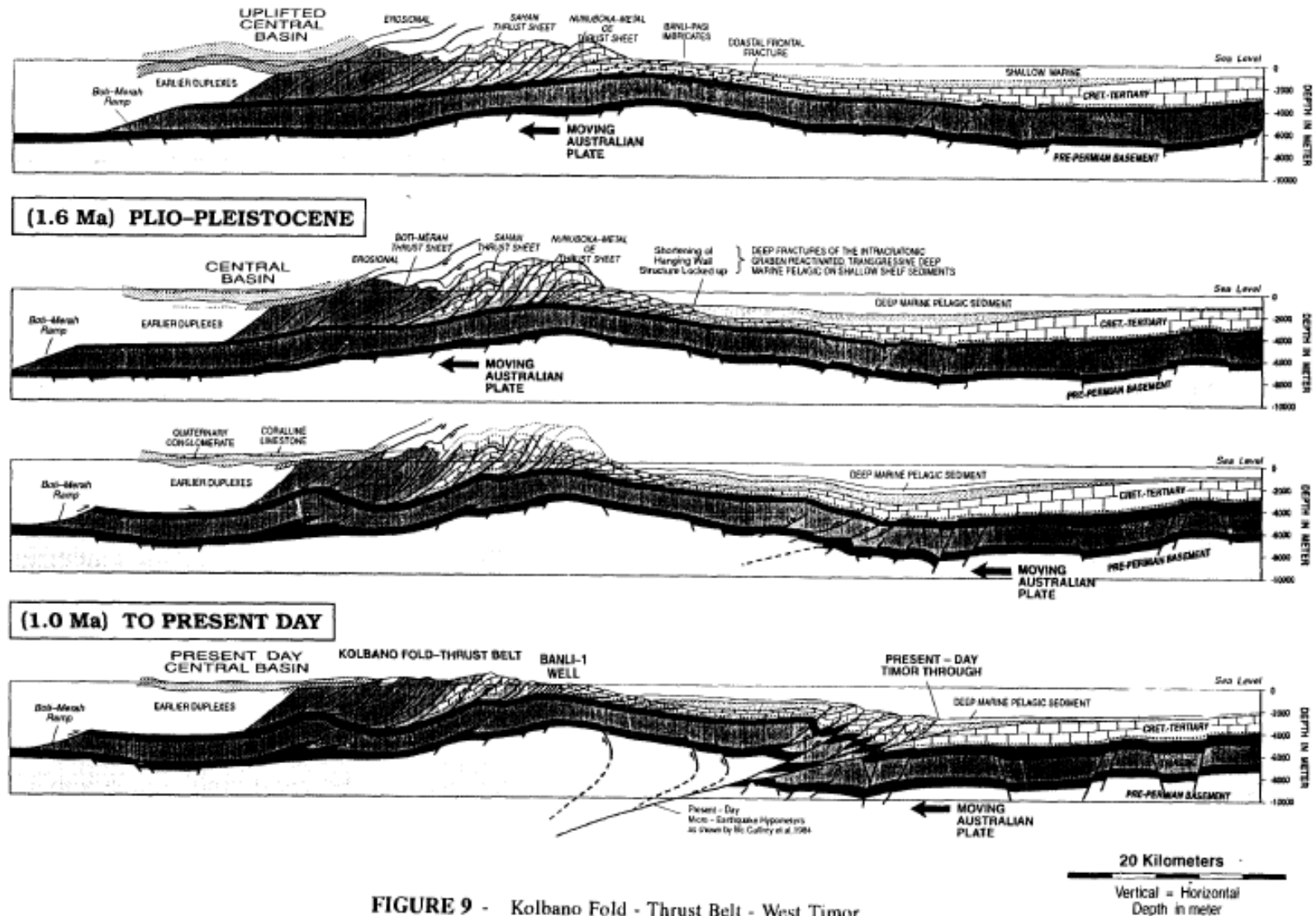
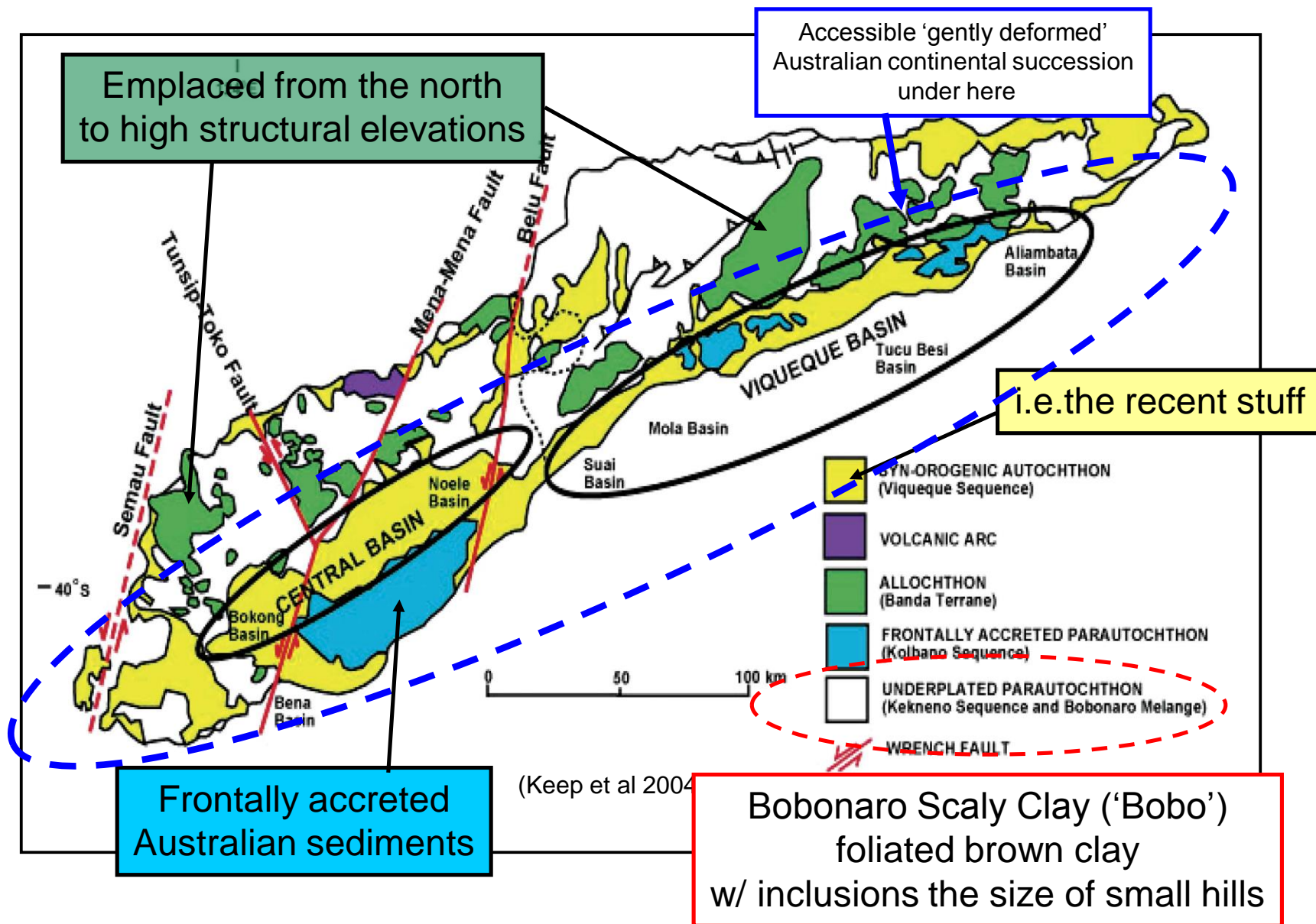


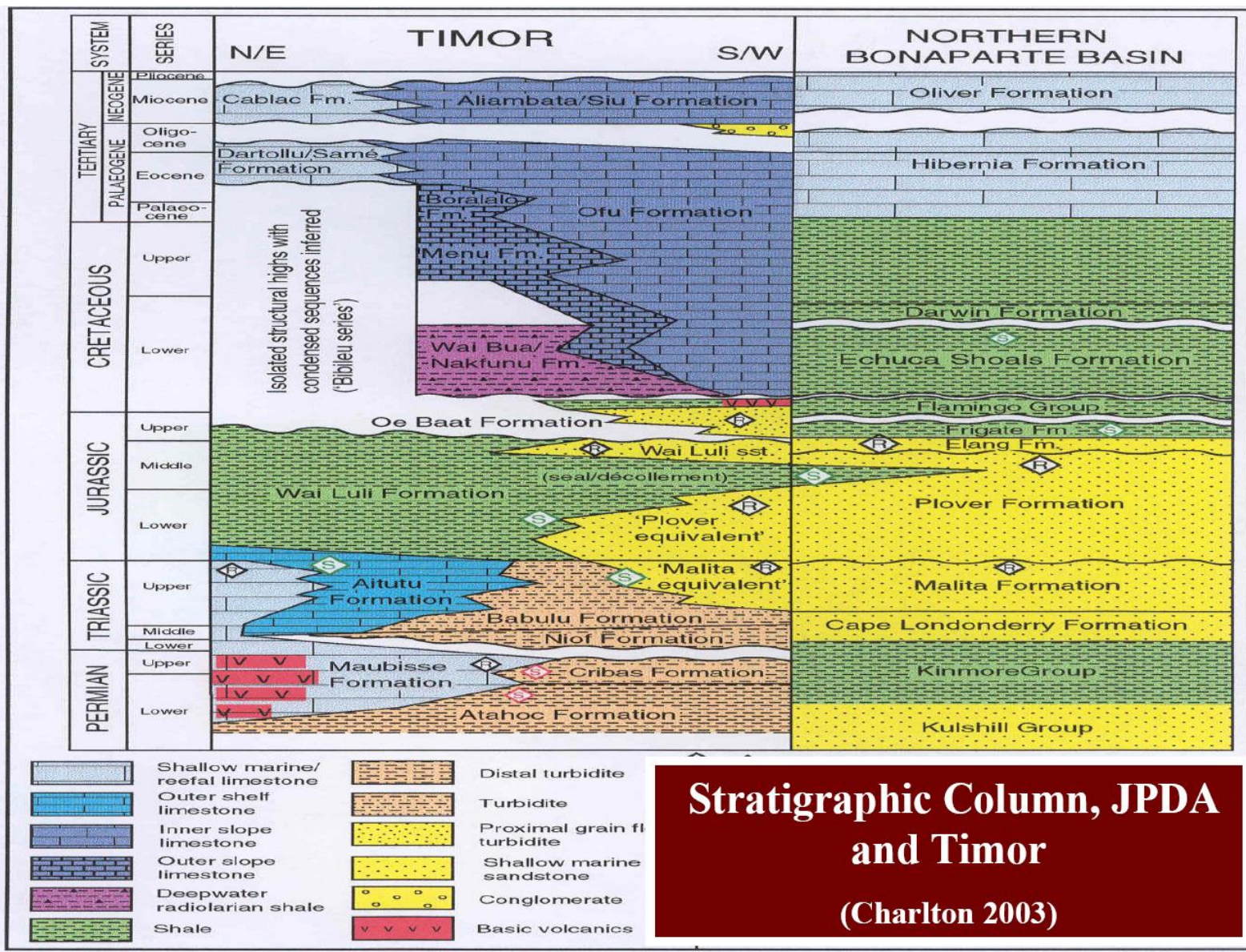
FIGURE 9 - Kolbano Fold - Thrust Belt - West Timor Underthrusting Model Sequential Restoration
Figure 9 (Cont.)

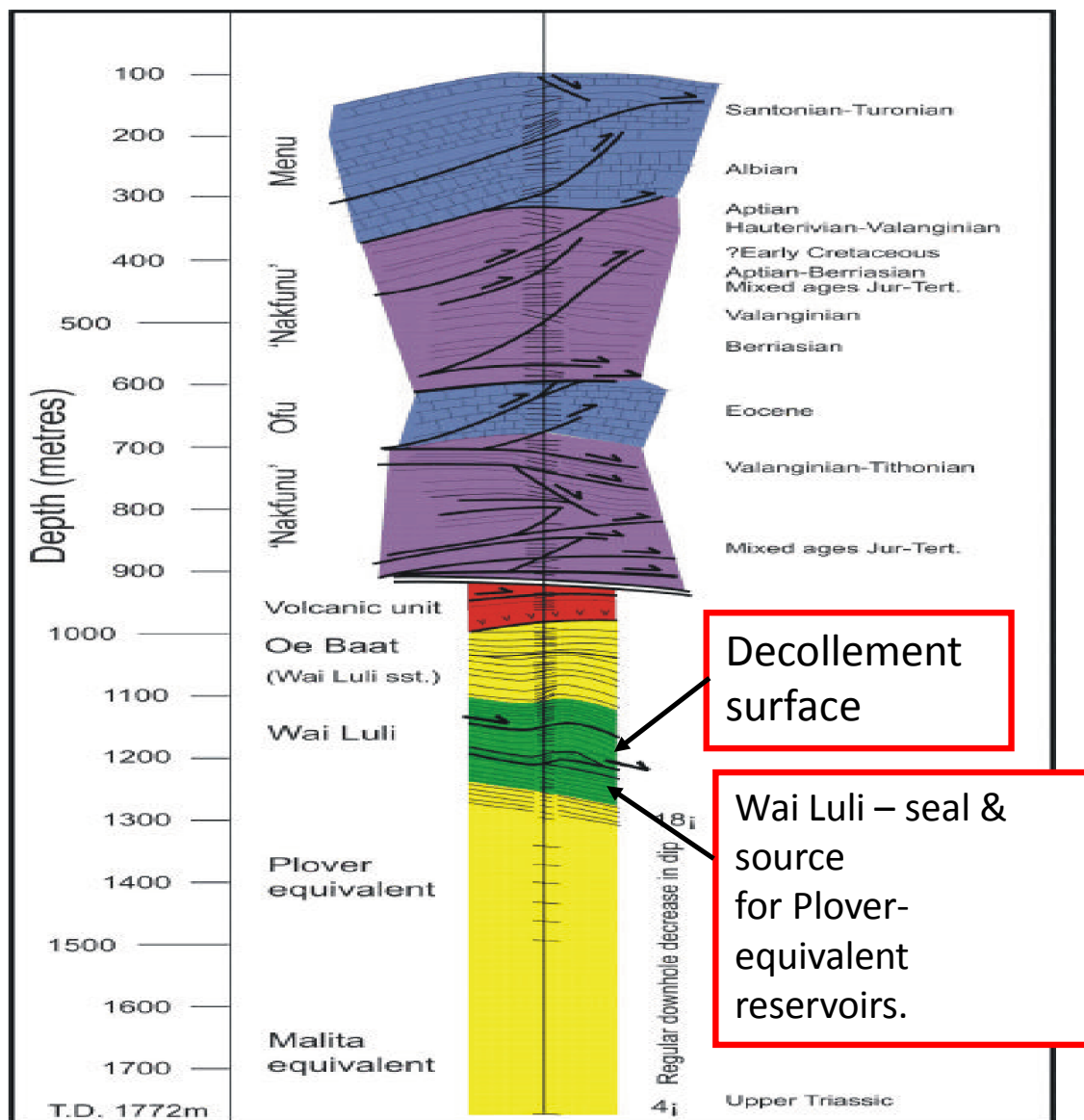
Stratigraphic succession on Timor Island:

The rocks exposed in Timor include:

- **Early-Permian to Early-Pliocene variably deformed and metamorphosed deep water sediments of the Australian passive margin (Gondwana and Kolbano Sequences)**
- **Late-Miocene-Early Pliocene Bobonaro Scaly Clay, an olistostrome thought to be emplaced as a gravity slide in response to the southward tilting of Timor during subduction (Johnston & Bowin, 1981).**
- **Banda Allochthon: pre-Cretaceous metamorphic rocks overlain by sedimentary deposits and ophiolites of upper Jurassic to Lower Pliocene age, all of which are derived from the pre-collisional Banda fore-arc**
- **Post-orogenic Upper-Miocene to Recent coral reefs, alluvial terraces and turbidites, unconformably overlying all other lithotectonic units**

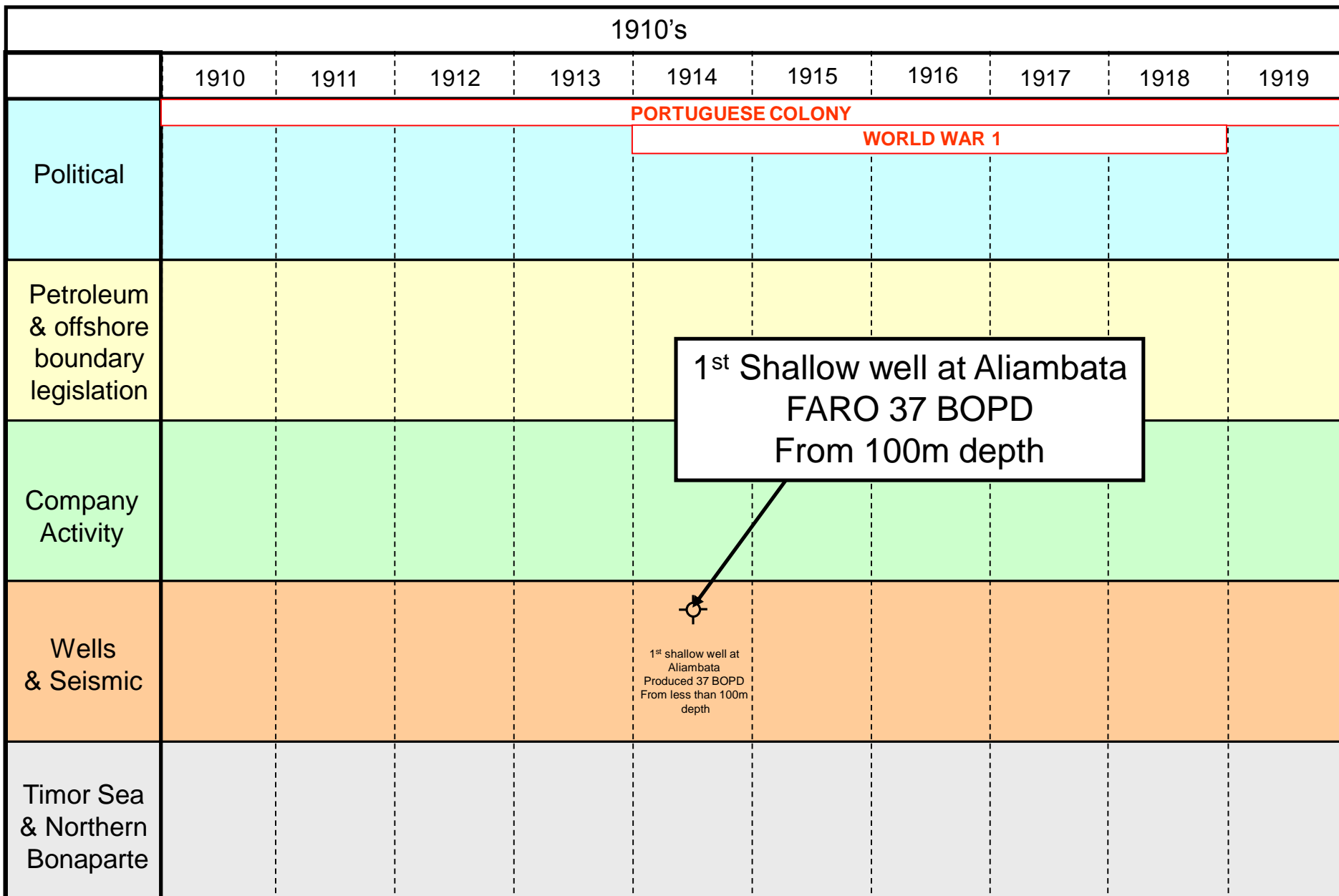






Structure and Stratigraphy of Banli-1 (Sani et al 1995, Charlton 2001)

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**Seeps known since
the 18th Century**

Seep occurrences:

- **Long history of exploitation of the seeps by local communities – helped fire steam boilers around Viqueque in the early 1900s**
- **Industry Interest began in late 1890s**
- **Used to place initial wells**
- **A pit in Paulaca produced 10s of thousands barrels until 1960s**
- **Japanese mined light oil from one of the seeps on the foreshore during WW2 – 100 bbls/day and converted it to fuel on the spot**
- **Seeps are most prolific along the south coast of East Timor, but extend over the border to West Timor in the Tertiary basin**

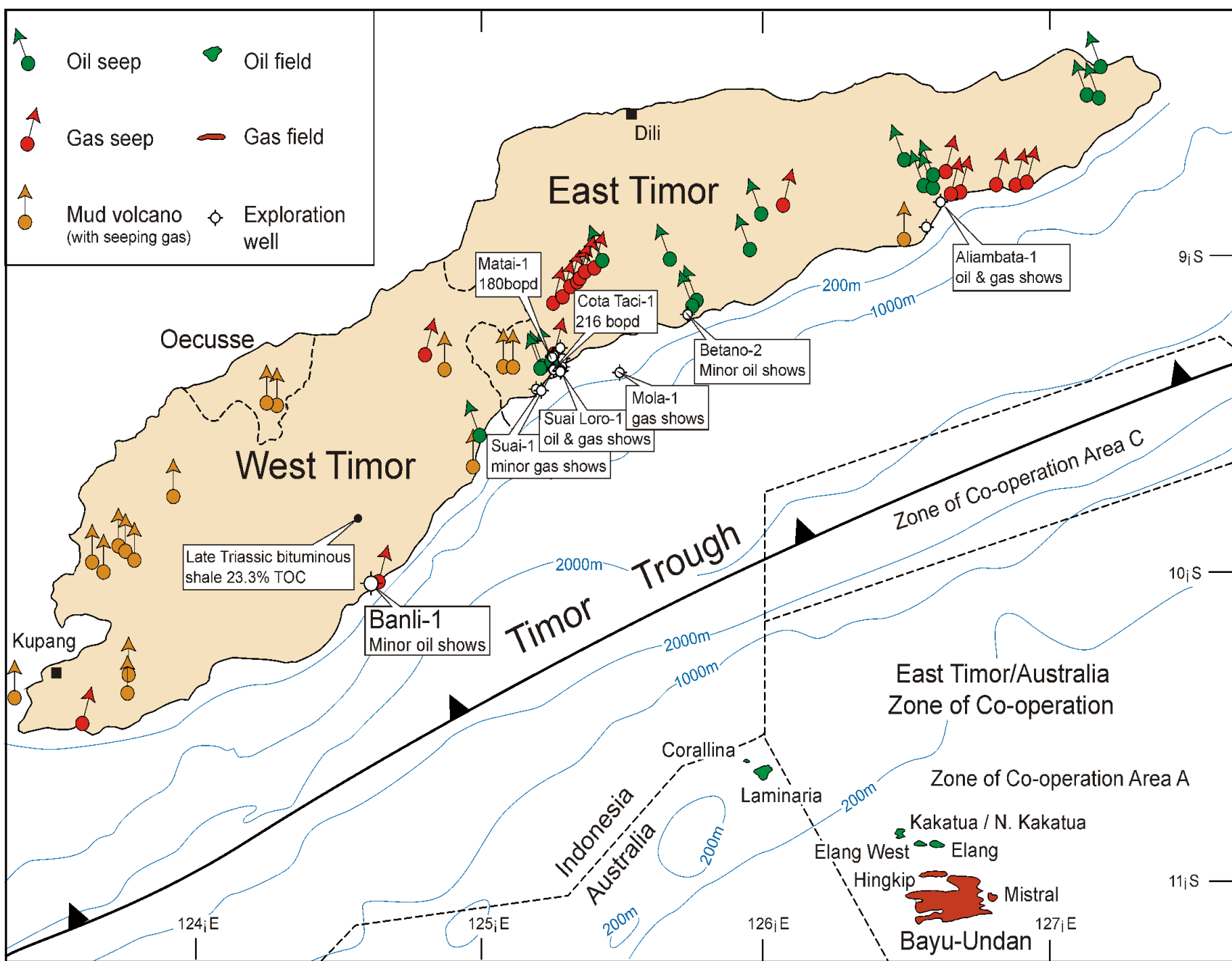
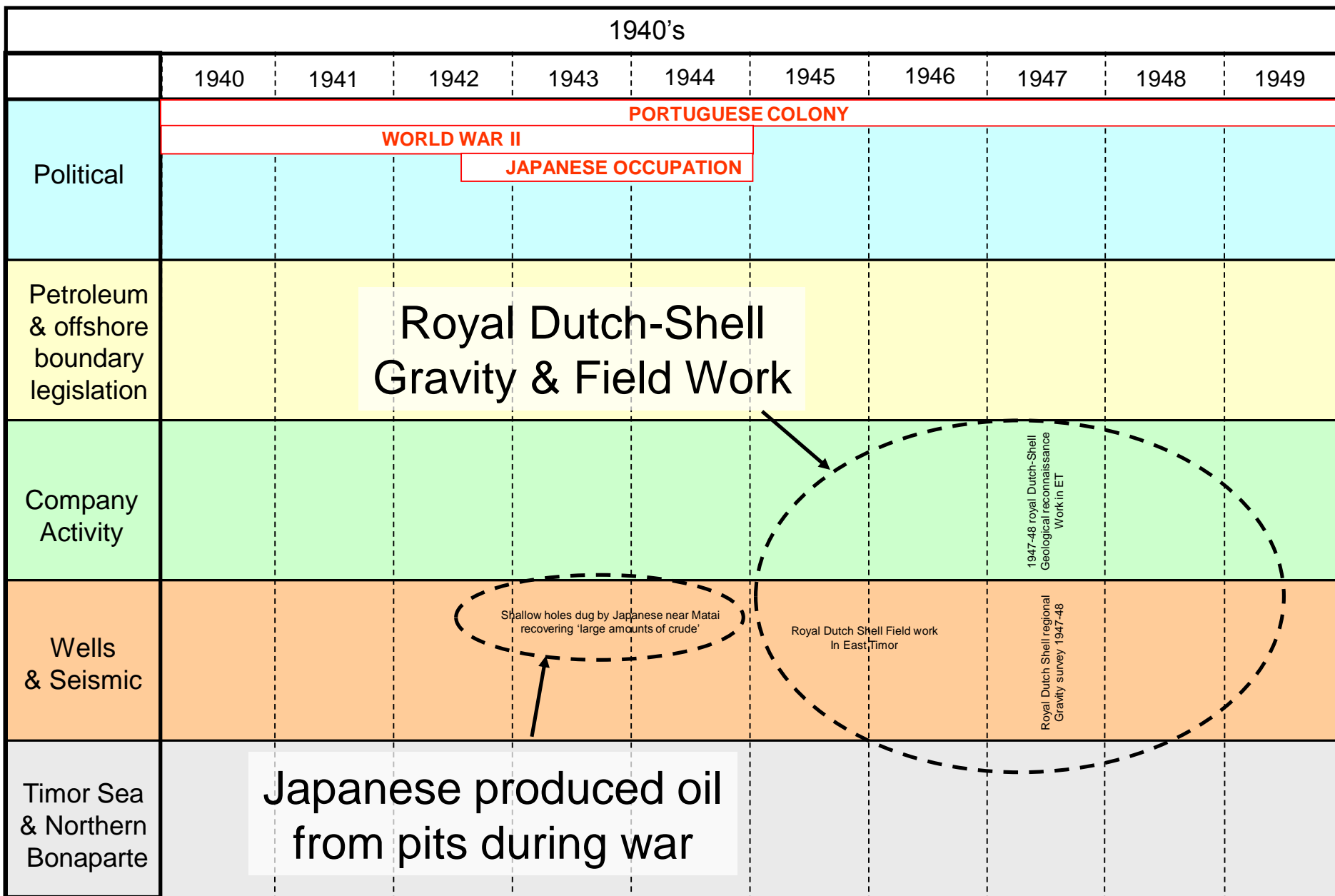
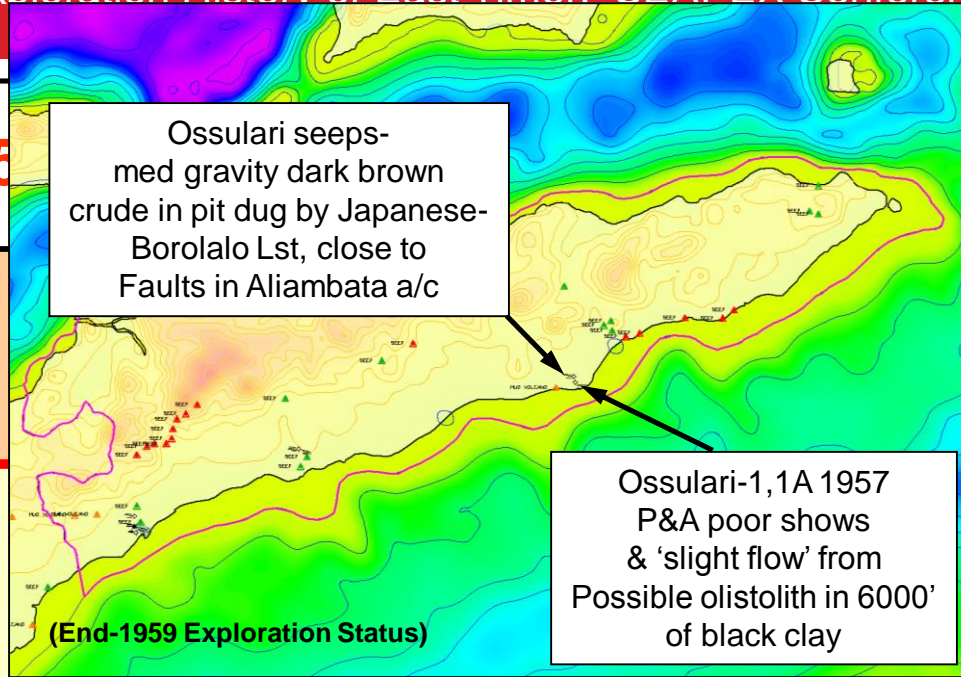


Figure 19 Petroleum Occurrences of Timor (Charlton 2001)

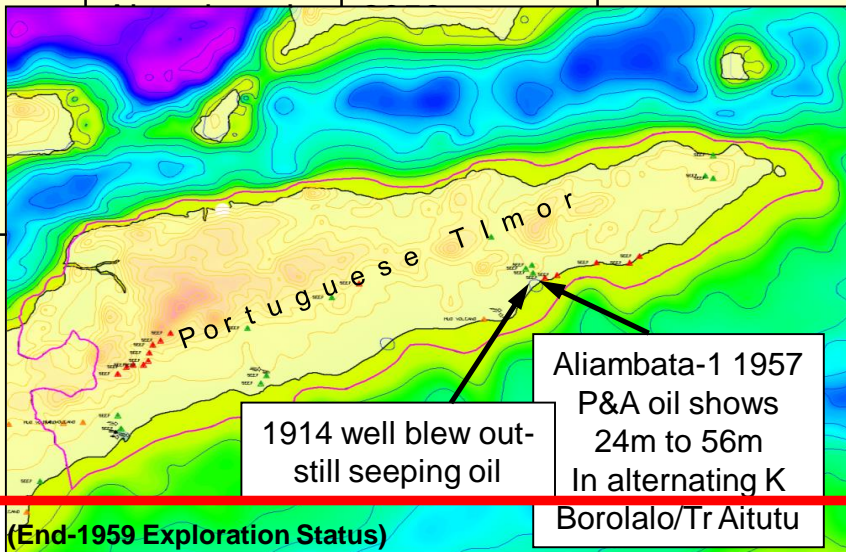


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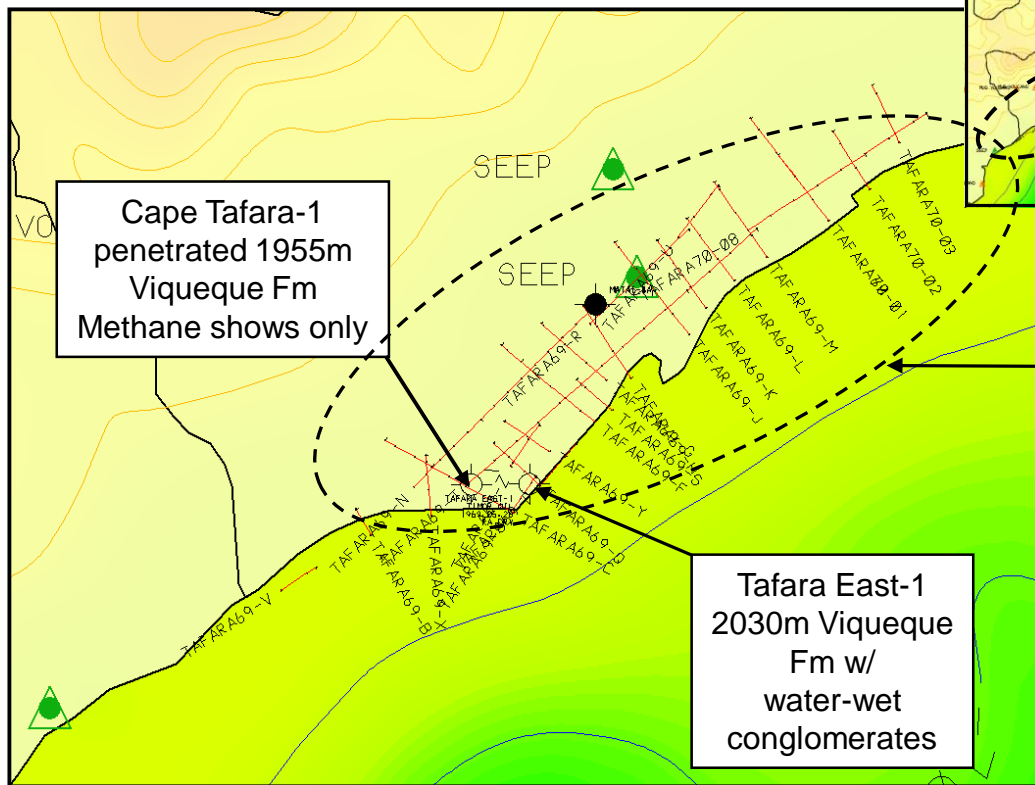
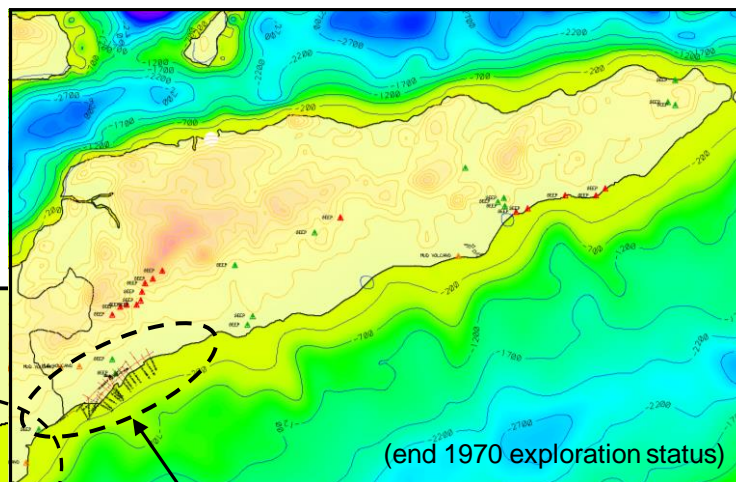


Well	Year		n	Comments
Aliambata-1	1957	<p>(End-1959 Exploration Status)</p>	<p>nd a 62m K o Lst n by Aitutu & re</p>	<p>Oil at 24m, 27m and 56m</p>
Ossulari-1	1959		<p>Bobonaro almost at surface. Also Penetrated a 1st horizon at depth before Tertiary shales to TD</p>	<p>No shows. Located near Ossulari seeps. Drilled on gravity anomaly</p>
Ossulari-1A (aka Maku Lico-1)	1959		<p>Bobonaro almost at surface. Penetrated the same Miocene 1st as Ossulari-1</p>	<p>Oil in mud at 82m</p>



1960 s Wells Drilled by Timor Oil

Well	Year	Status (m)	TD	Flowed	Section	Comments
Matai-1	1960	P&A	2037'	180 BOPD	Bobonaro	Flowed from



UGC 1969 & 70 Taffara Area onshore surveys
3-6 fold dynamite
110 miles

3

egins
g of
or
L Gian
akes
begins
timor

East-1

Taffara-1

onshore
survey
past

ul-1

P

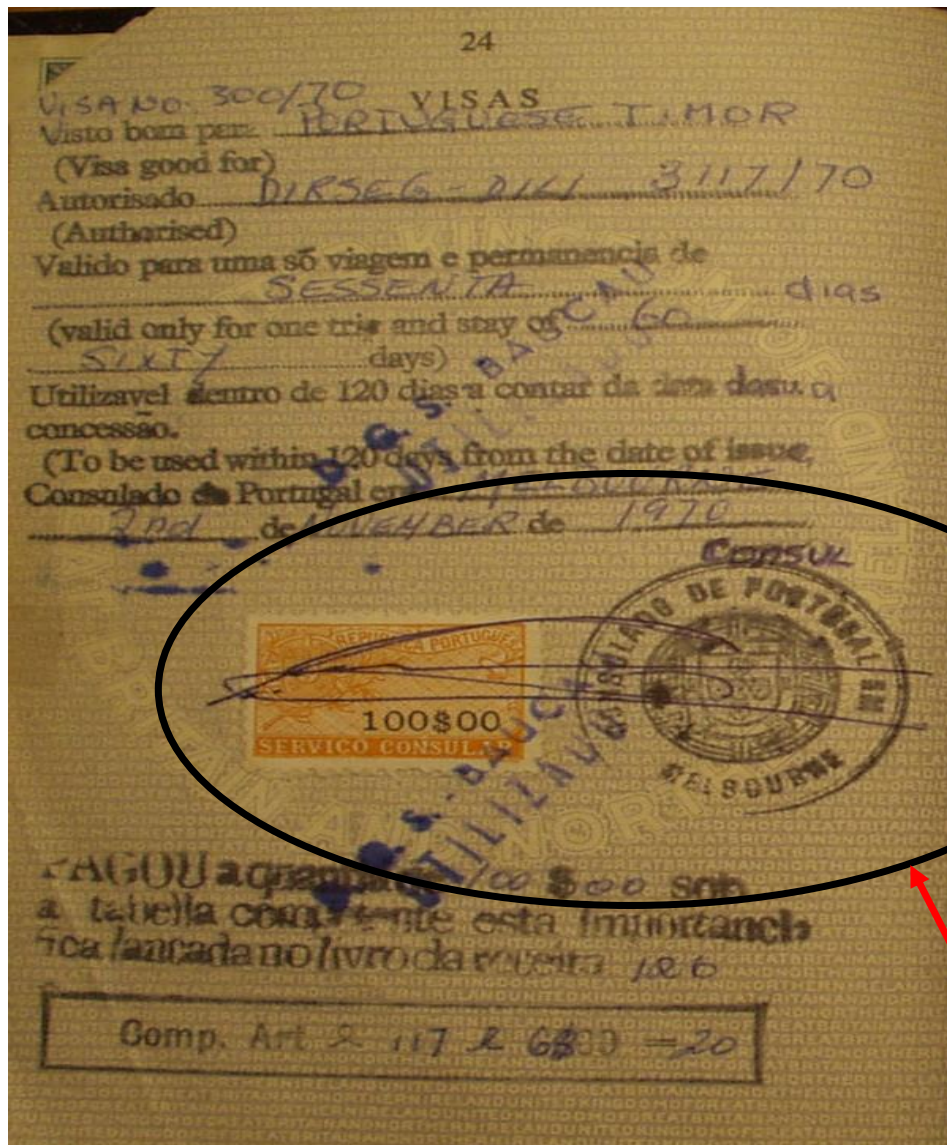
Pe
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Bonaparte



CONSUL OF THE
REPUBLIC OF
PORTUGAL AT THE
HEIGHT OF TIMOR OIL'S
ACTIVITY IN THE
1960s and 1970s

=

R. ALEC DODSON
(Founder, CEO &
'driver'
of Timor Oil
From the
1950s
To the 1970s!!)

**One of my Portuguese Timor
visas issued by 'the boss'!**

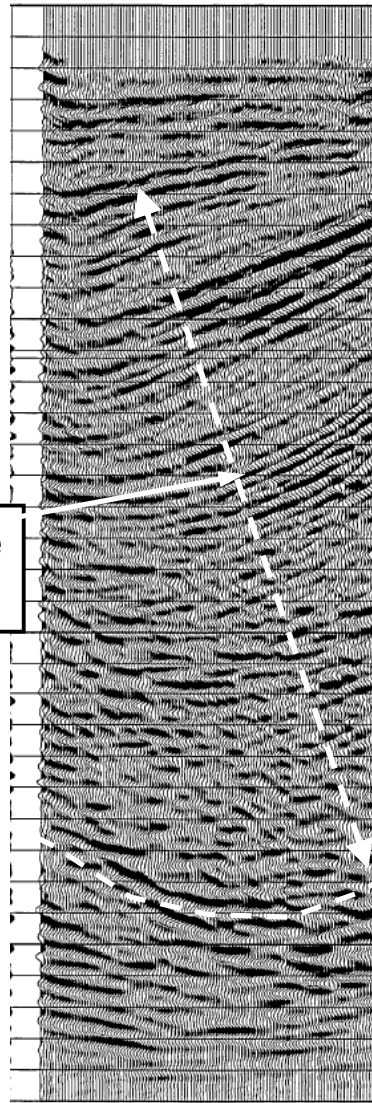
NW



Viqueque Fm

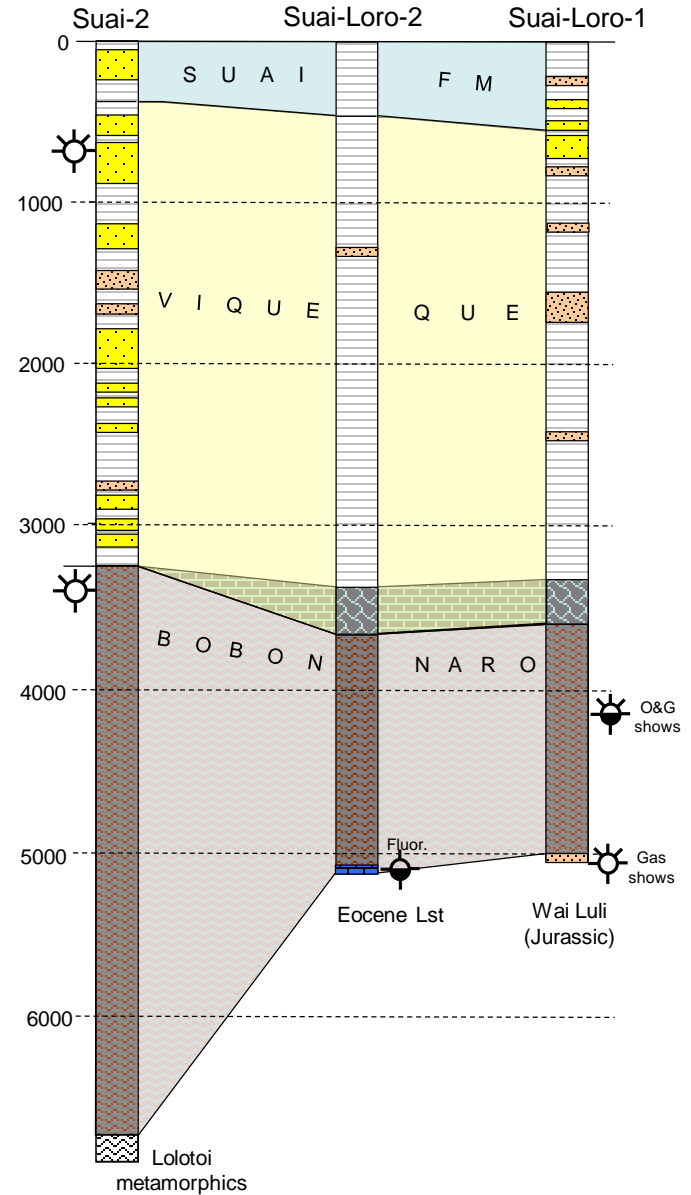
Suai Line T
(Courtesy: Australian Seismic Brokers)

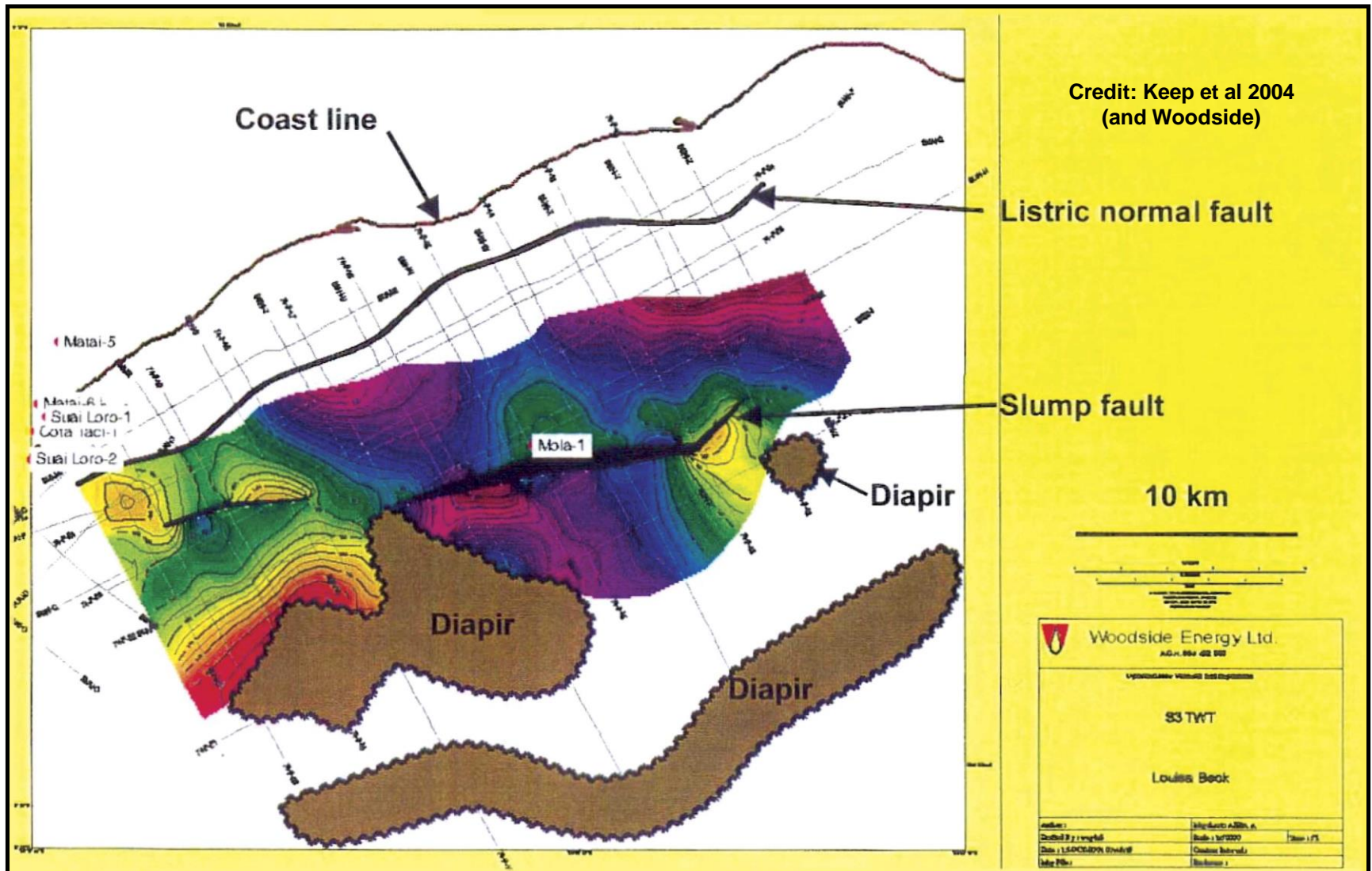
80 73 70 63 60



Drilled W. of Cape Suai
on downthrown side of fault

Drilled on Suai Loro Structure
together with later well Cota Taci-1





Credit: Keep et al 2004
(and Woodside)

Listric normal fault

Slump fault

Diapir

10 km

Mola-1 – the only well drilled to date offshore East Timor After Keep et al



THE VIQUEQUE FORMATION (a) Fine - distal




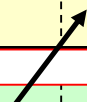
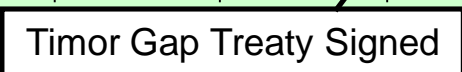
THE VIQUEQUE FORMATION (b) Coarse - Proximal



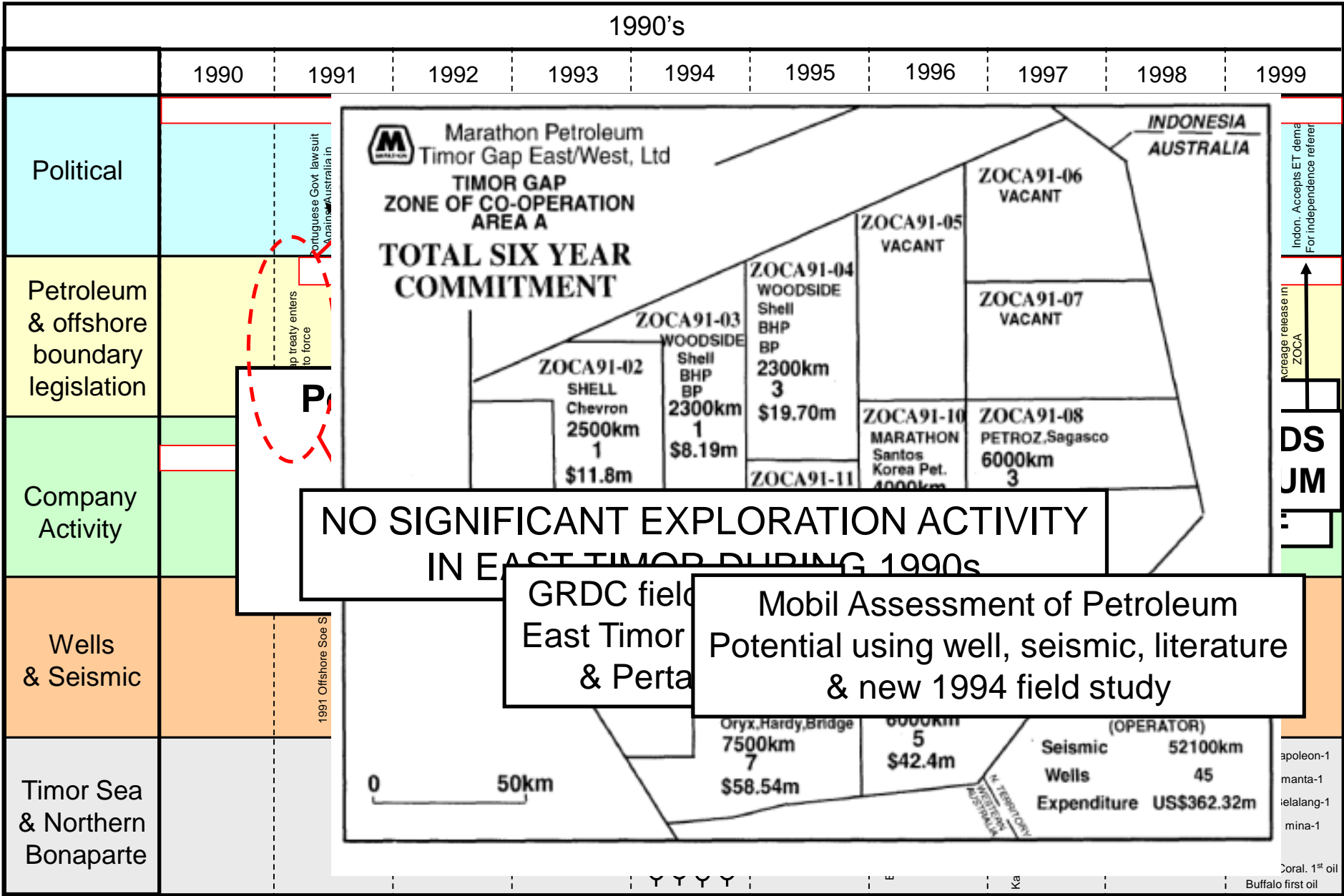
Viqueque prospectivity – the key?

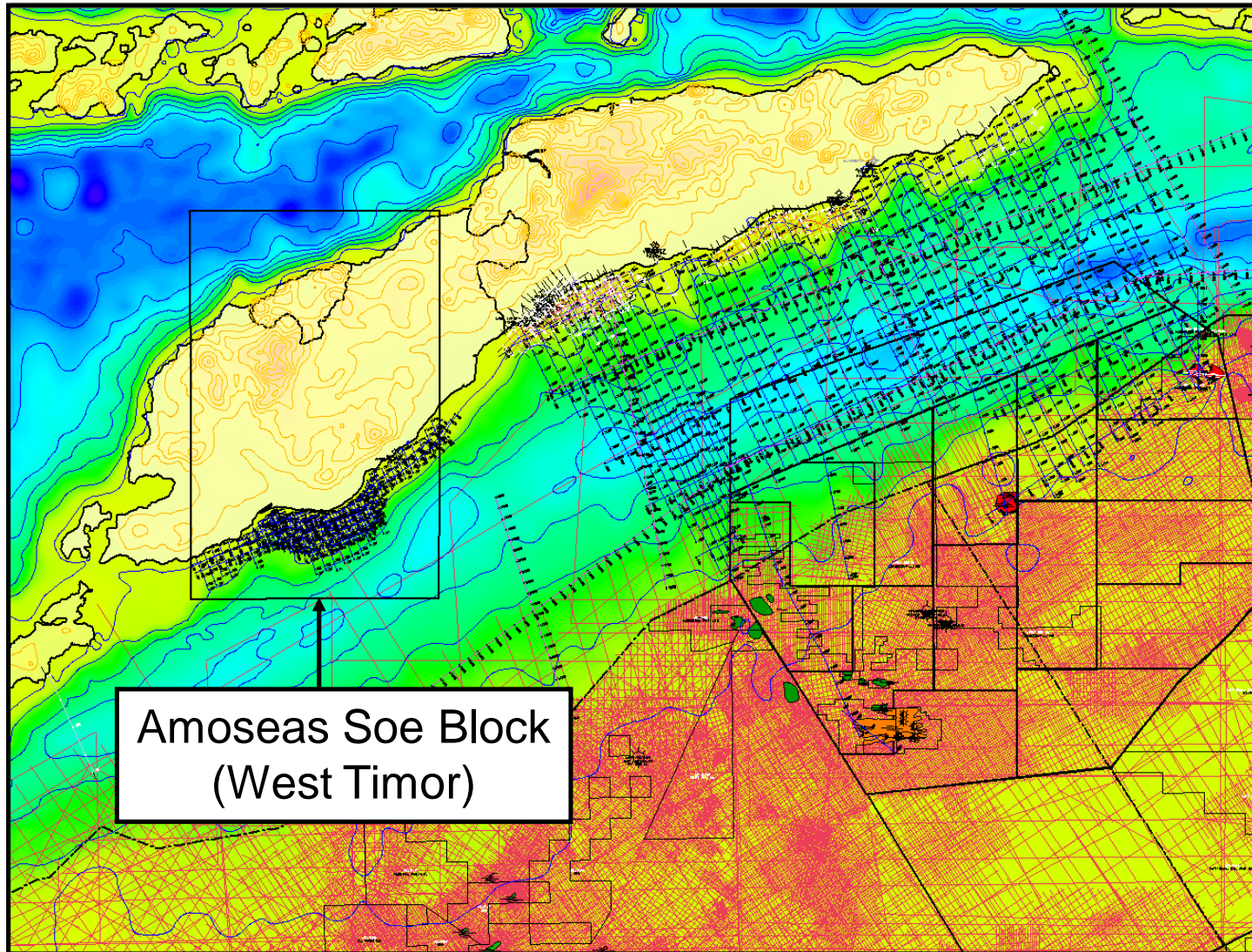
- In many places on the south coast of East Timor and over most of West Timor, the Bobonaro Scaly Clay lies between the presumed source (Jurassic Wai Luli) and the deep water reservoirs of the Viqueque Fmn .
- The Bobonaro is very fluid and mobile and forms diapirs and mud volcanoes over many parts of both halves of the island
- Mobility in part driven by lateral stresses imparted by advancing thrust fronts of the allochthon from the north
- Although the plate setting is different, this situation has parallels with the plumbing system of parts of W Africa (e.g Mauritania) – where Mio-Pliocene deep water reservoirs are charged from Mesozoic sources through a salt layer. In that case mobility is driven by gravity sliding (including toe-thrusts) and of course buoyancy.
- There is some evidence to suggest that transmission of hydrocarbons from deep source to shallow reservoir takes place via the interface between diapir and sediment
- Could this be one possible mechanism for charging Viqueque reservoirs??

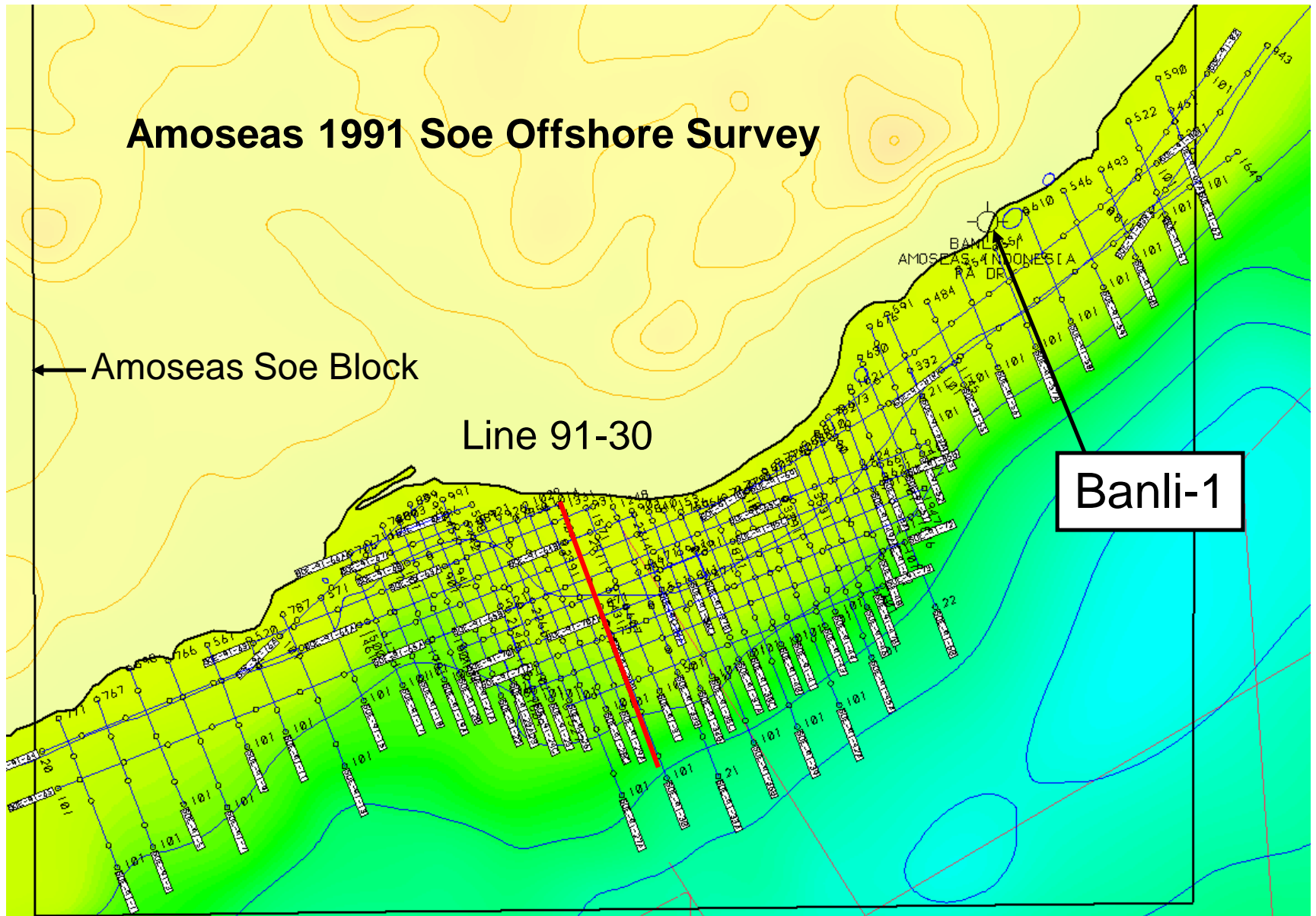
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1980's										
	1980	1981	1982	1983	1984	1985	1986	1987	1988	1989
Political	INDONESIA 27 TH PROVINCE - RECOGNISED BY AUSTRALIA									
Petroleum & offshore boundary legislation	'1972' AUS-IND BOUNDARY TREATY - 'GAP' REMAINS UN-NEGOTIATED									
Company Activity	NO EXPLORATION ACTIVITY IN EAST TIMOR									
Wells & Seismic	NONE IN EAST TIMOR									
Timor Sea & Northern Bonaparte				 Jabiru 1A -oil discovery	JABIRU-1A					
										Australia 7 Indonesia Sign Timor Gap treaty 
										Timor Gap Treaty Signed 

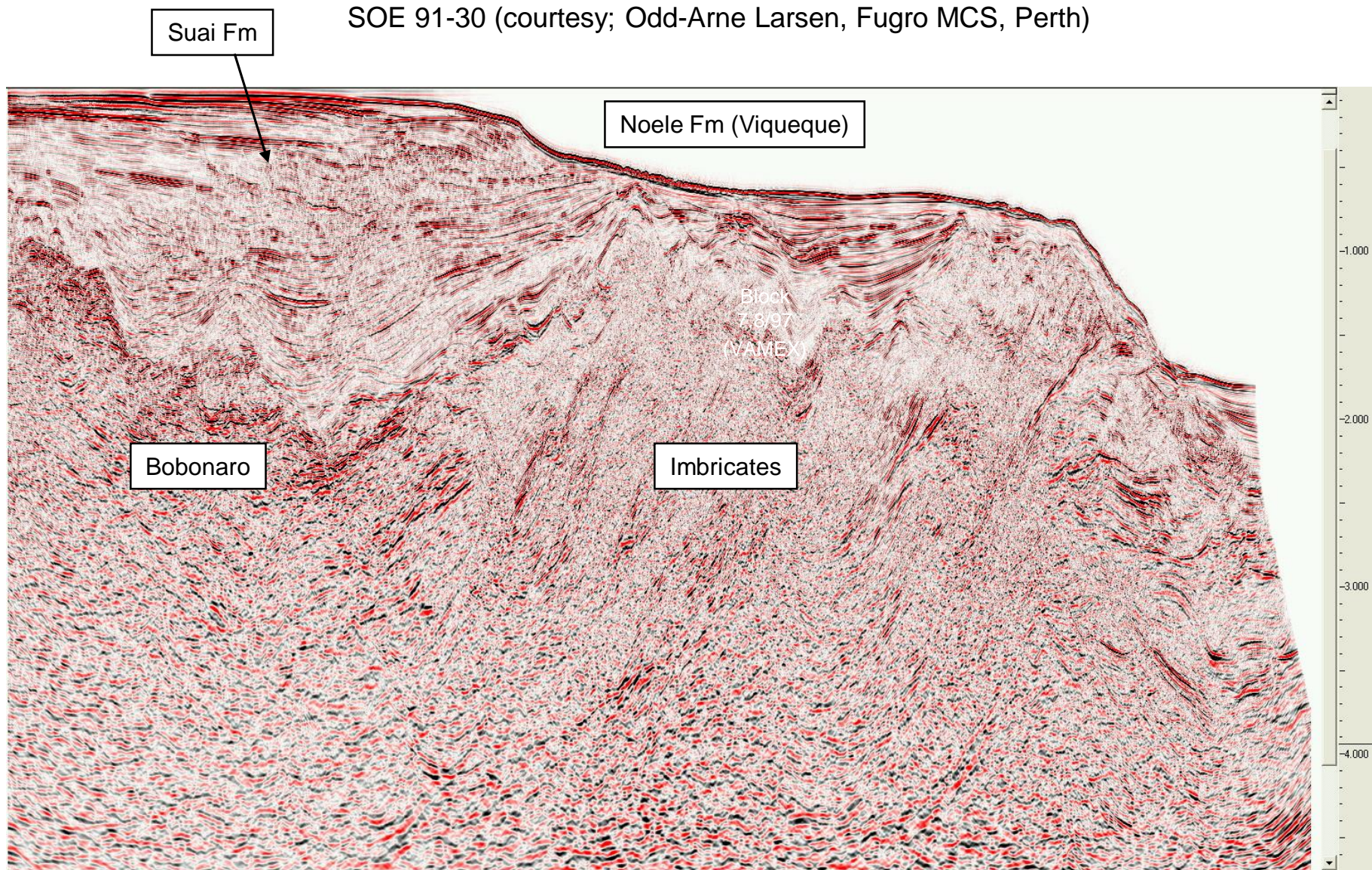
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SOE 91-30 (courtesy; Odd-Arne Larsen, Fugro MCS, Perth)

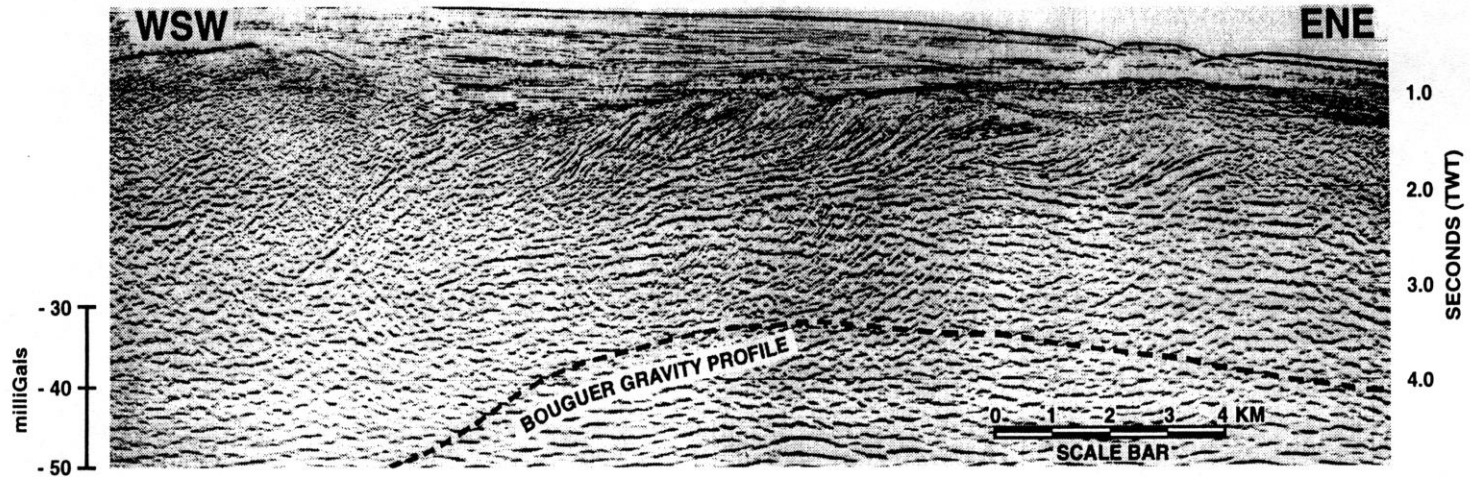


Banli-1 (1993-94)

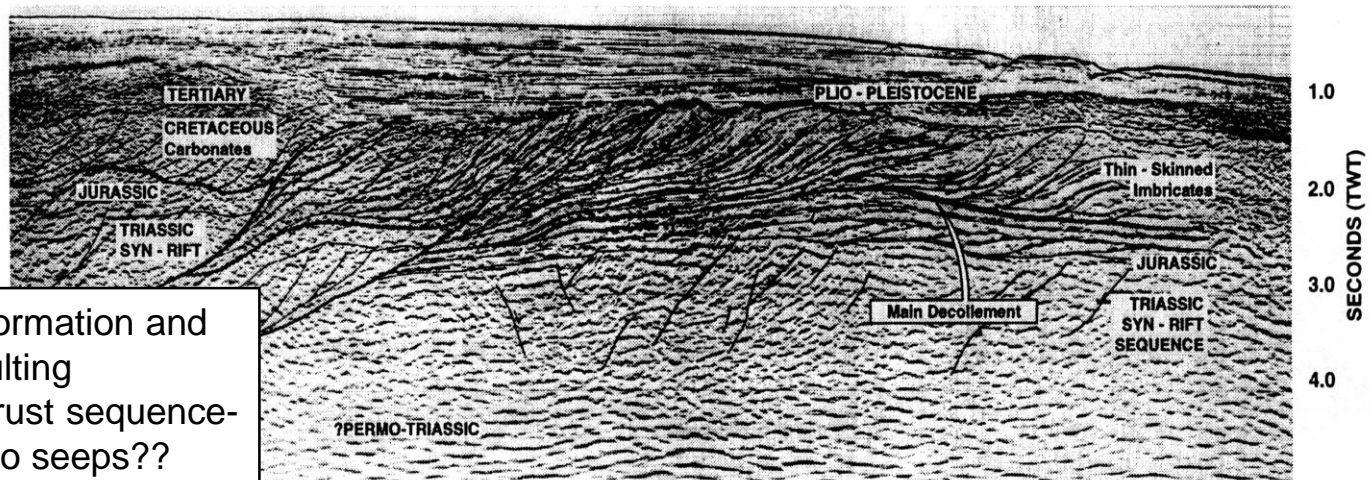
Banli-1 (1993-94)

- **Drilled 1993-94 in the Kolbano structural block**
- **The Kolbano block comprises a thin-skinned fold and thrust belt consisting of imbricated Australian continental margin strata, primarily Cretaceous and Tertiary in age, but with Upper Jurassic rocks exposed in a pseudoantiformal core (the Pasi Inlier)**
- **Located on gravity high**
- **The upper 900m of the well column consists of strongly deformed Cretaceous and Tertiary strata, with a complex imbricated thrust structure**
- **Below this, in a structural transition zone consisting of rocks of earliest Cretaceous to Middle Jurassic age, structural disruption is much less intense than in the upper structural domain, and no structural duplications of stratigraphy are recognised, although bedding-parallel thrusts are identified, particularly in the Middle Jurassic shales of the Wai Luli Formation.**
- **Below the Wai Luli Formation the well intersected a remarkably simple succession of Middle Jurassic to Upper Triassic sandstones, equivalent to the Malita and Plover formations of the Australian Northwest Shelf.**

SEISMIC LINE : SOE-91-85



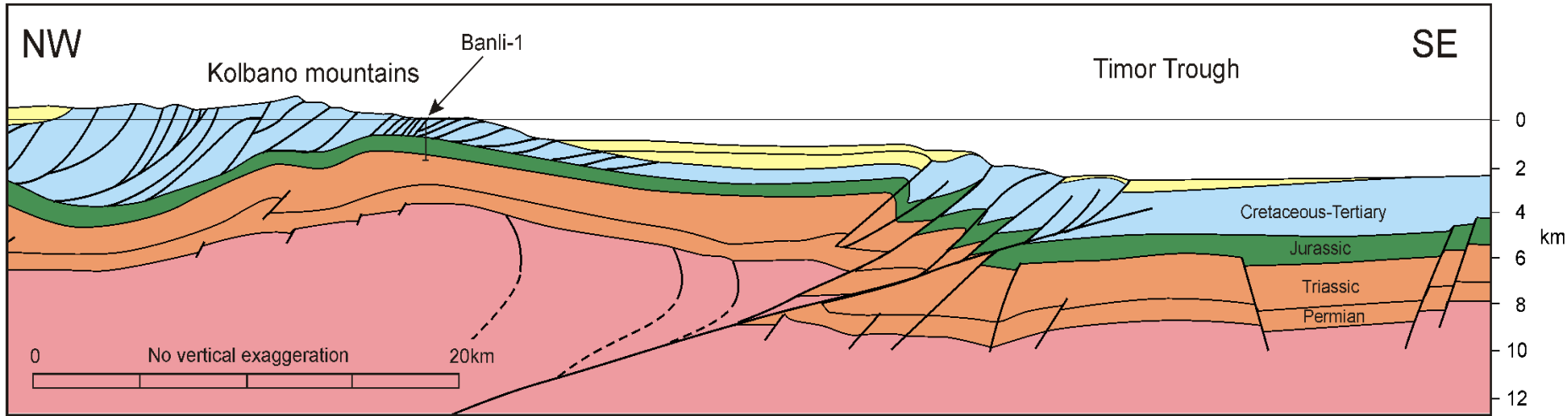
INTERPRETED SECTION



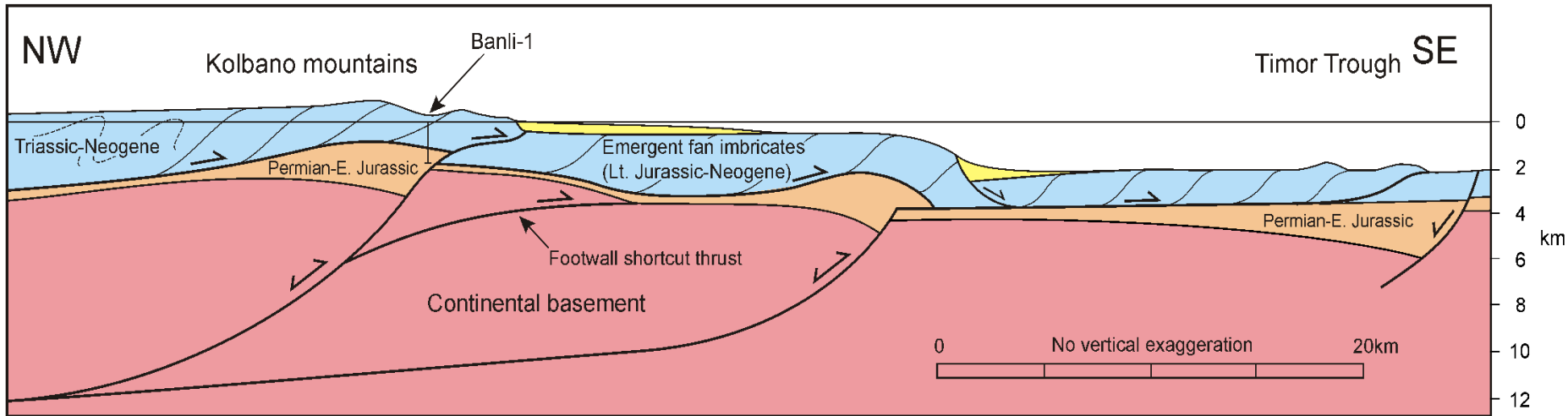
Shows deformation and faulting of the sub-thrust sequence- so why no seeps??

Migrated seismic line from offshore south of the Kolbano fold-thrust belt shows thin-skinned thrust imbricates overlying a gently deformed stratigraphic sequence.

(from Sani et al, 1995)



Cross section through the Kolbano-Timor Trough region (Sani et al 1995)



Cross section through the Kolbano-Timor Trough region (Charlton 2001)

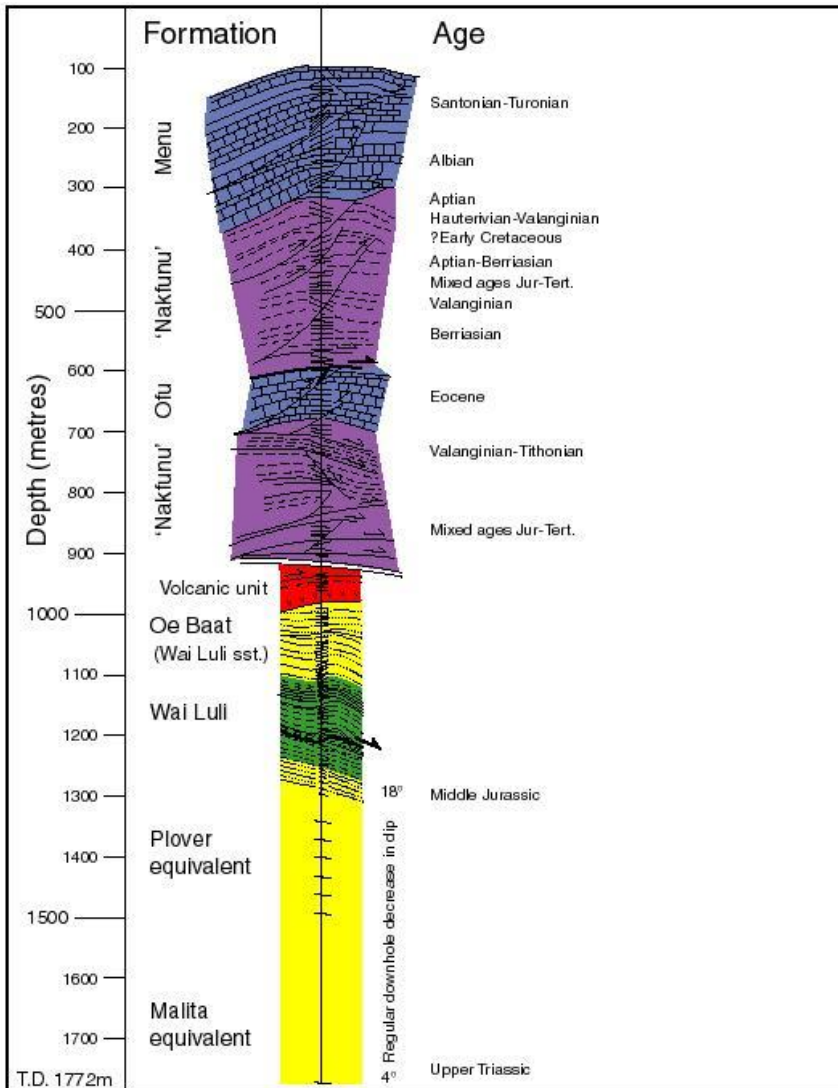


Figure 8: Banli-1 well column. Modified from Sani et al. (1995)

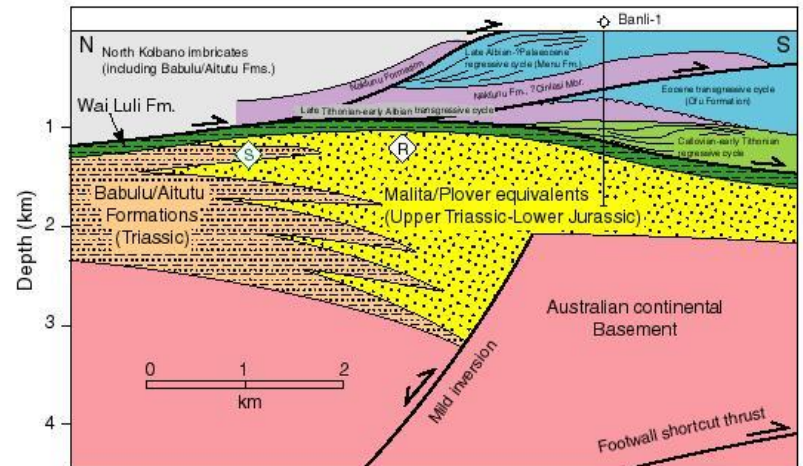
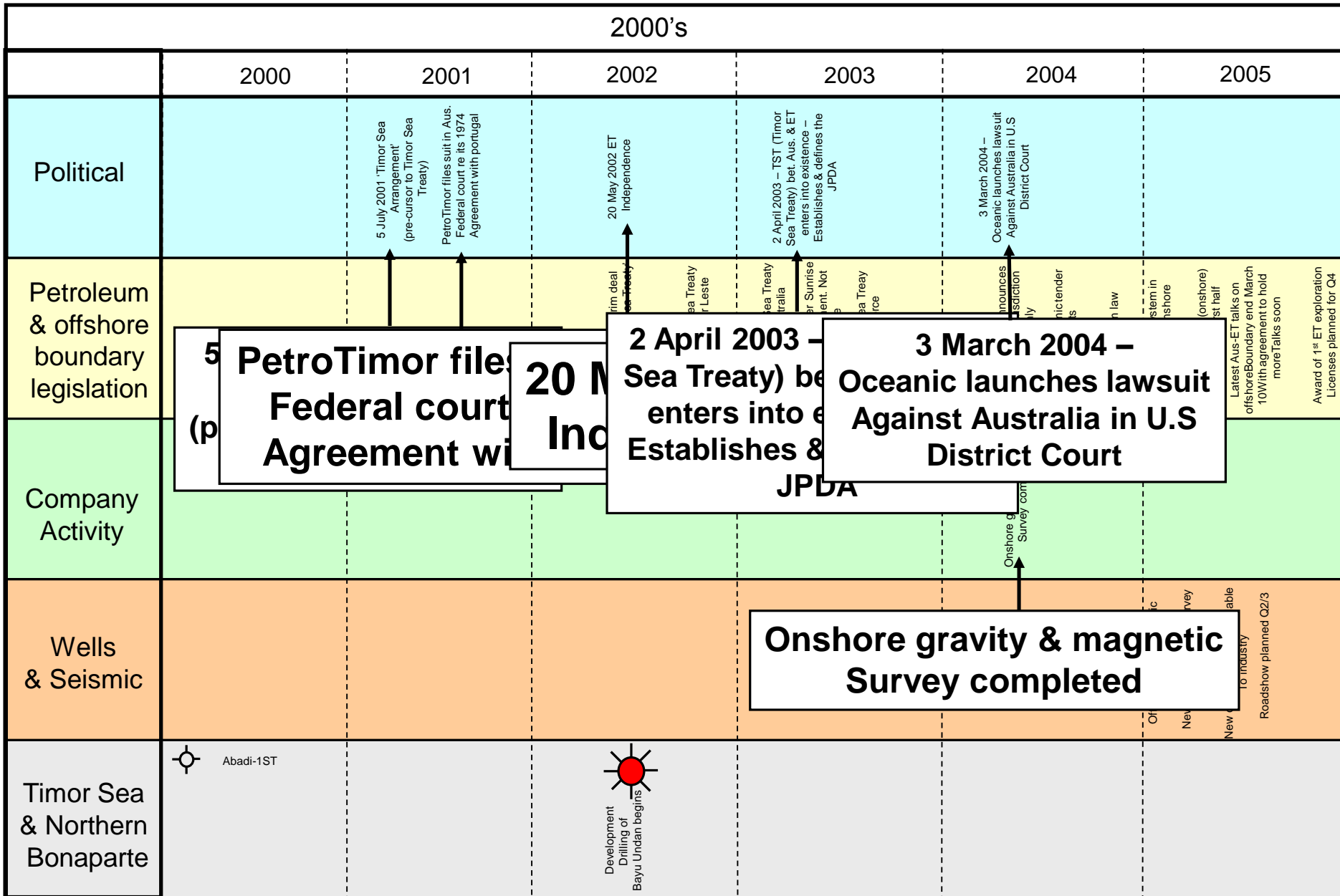


Figure 9: The Sub-Kolbano inversion structure, southern West Timor.

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1974 Oceanic Concession: 2004 events

- **Loses lawsuit aimed specifically at Australia in Federal 2003: Oceanic claims it was illegally deprived of its rights after ‘years’ of acquisition and analysis of exploration data and claims up to \$30-billion in compensation**
- **Lawsuit launched against Australia, Indonesia and ConocoPhillips in US federal Court in 2004**
- **Legal status of the Oceanic Exploration permit issued by Portugal and covering most of what is now called ‘ZOCA’. “The status of this permit is unclear even today”**

Planned Licensing Rounds:

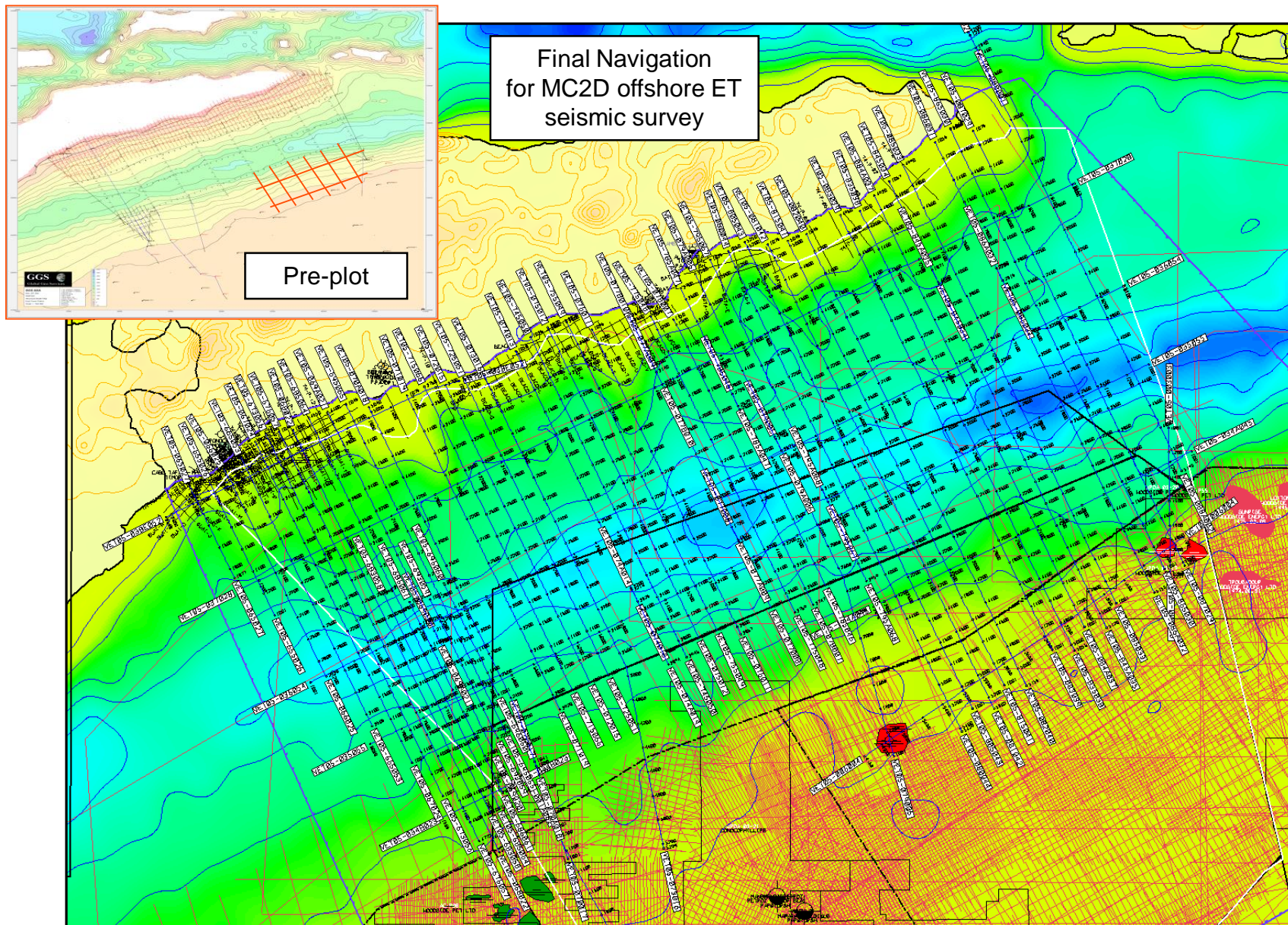
- **Maiden exploration licensing Round scheduled for June**
- **ET Parliament to pass legislation finalising new petroleum laws**
- **Offshore, onshore and nearshore acreage**
- **International roadshow planned.**
- **Initial expressions of interest will be sought followed by data review**
- **Intense interest by multinationals – according to the ET Govt**
- **Size of exploration blocks awaiting review of new offshore seismic**
- **Possible plans also for 2-4 blocks in the Joint Petroleum Development Area to be offered this year**

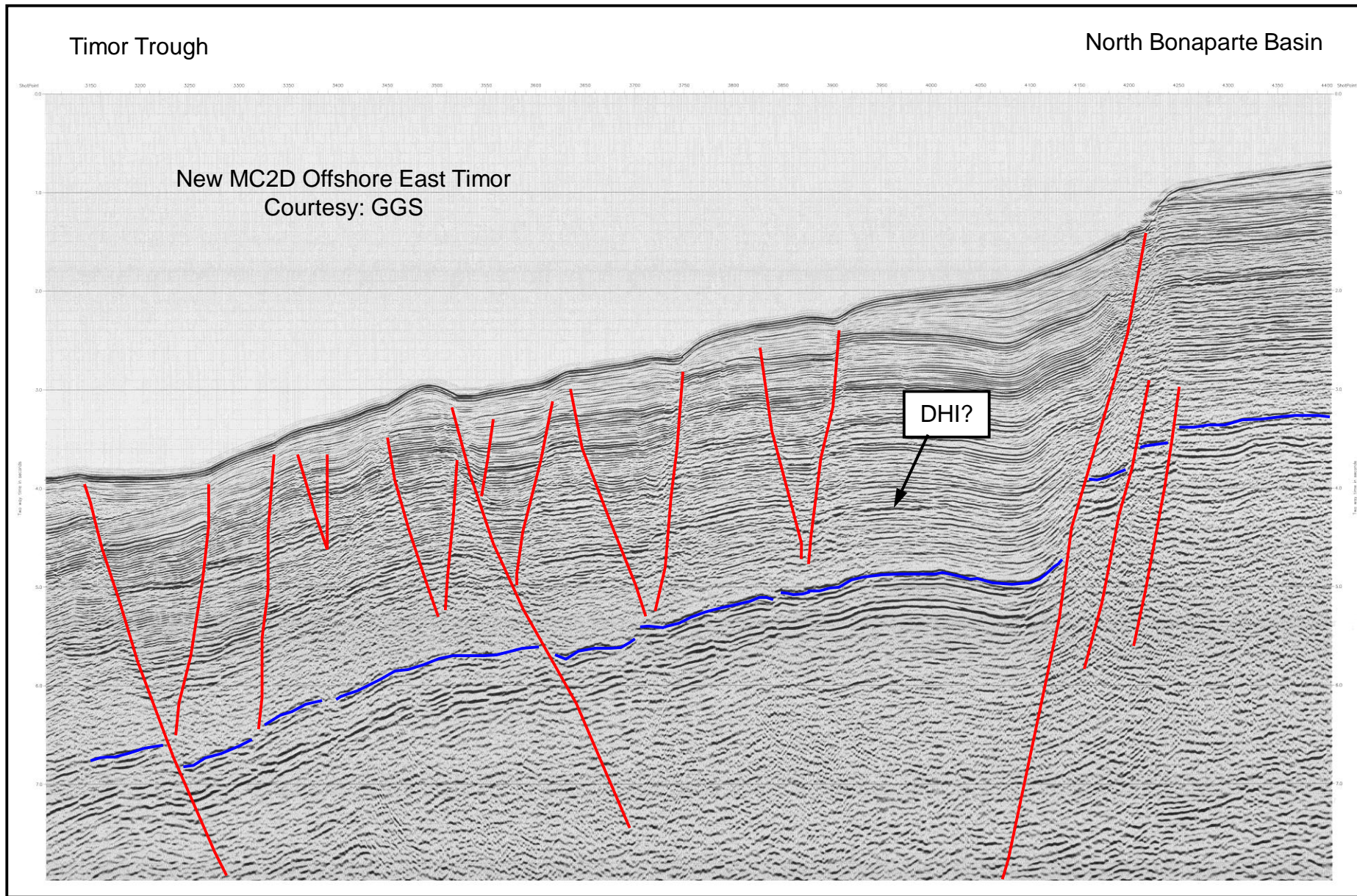
GGG Seismic Survey

GGG Seismic Survey

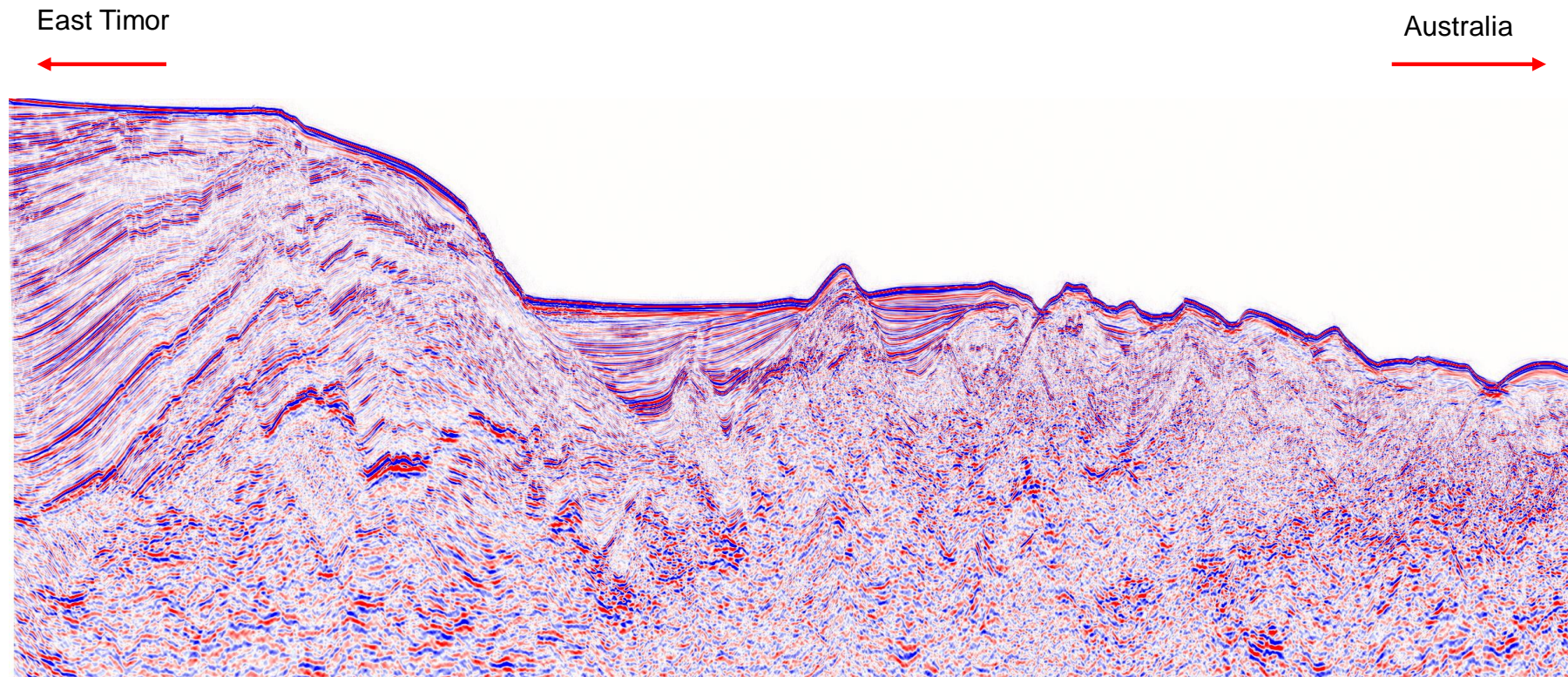
- **Completed and on display here**
- **Area defined by the southern coastline and the northern edge of the JPDA (but runs over into JPDA)**
- **This data will shortly be made available for industry to bid for exploration rights**
- **The survey was conducted by the BGP-GGS consortium. BGP is owned by PetroChina and GGS is a Norwegian company.**
- **All previous petroleum activities have been conducted with Australia in the Joint Petroleum Development Area, which was created by the Timor Sea Treaty.**
- **The seismic, gravity and bathymetric data to be collected will be mandatory data for the first licensing round in East Timor, planned for 2005**

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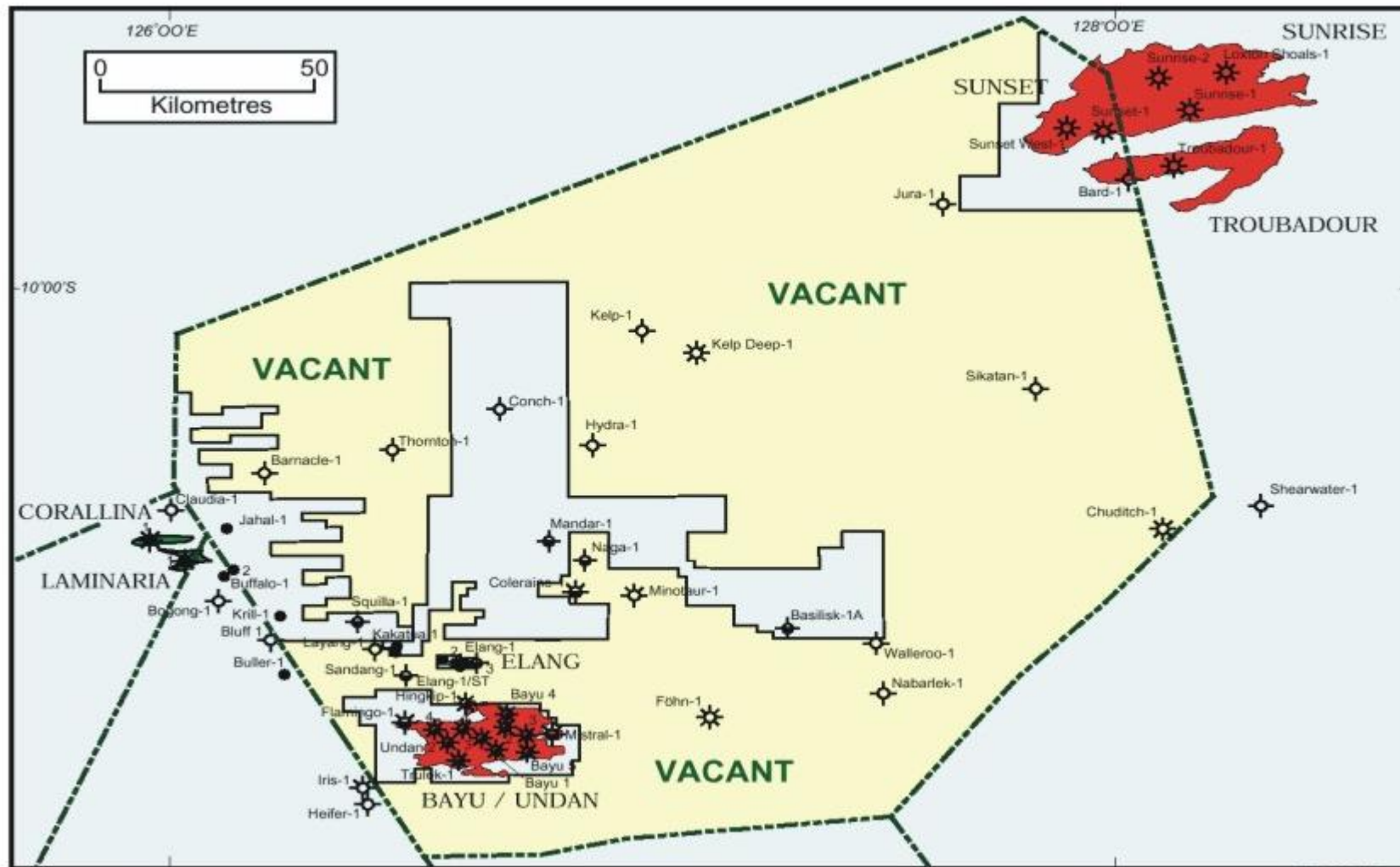
FUGRO Seismic Data

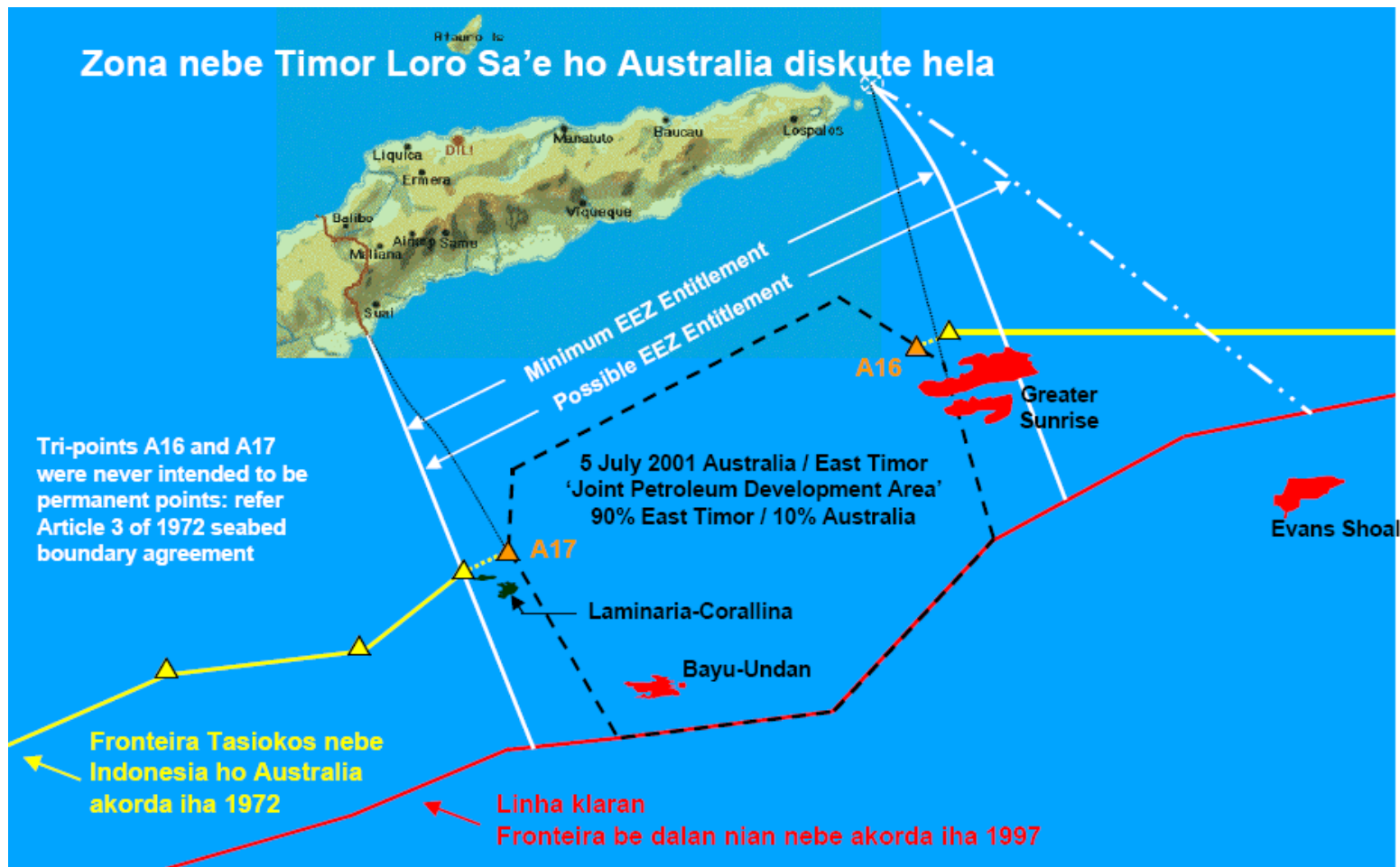


Courtesy: Odd-Arne Larsen of Fugro MCS

JPDA

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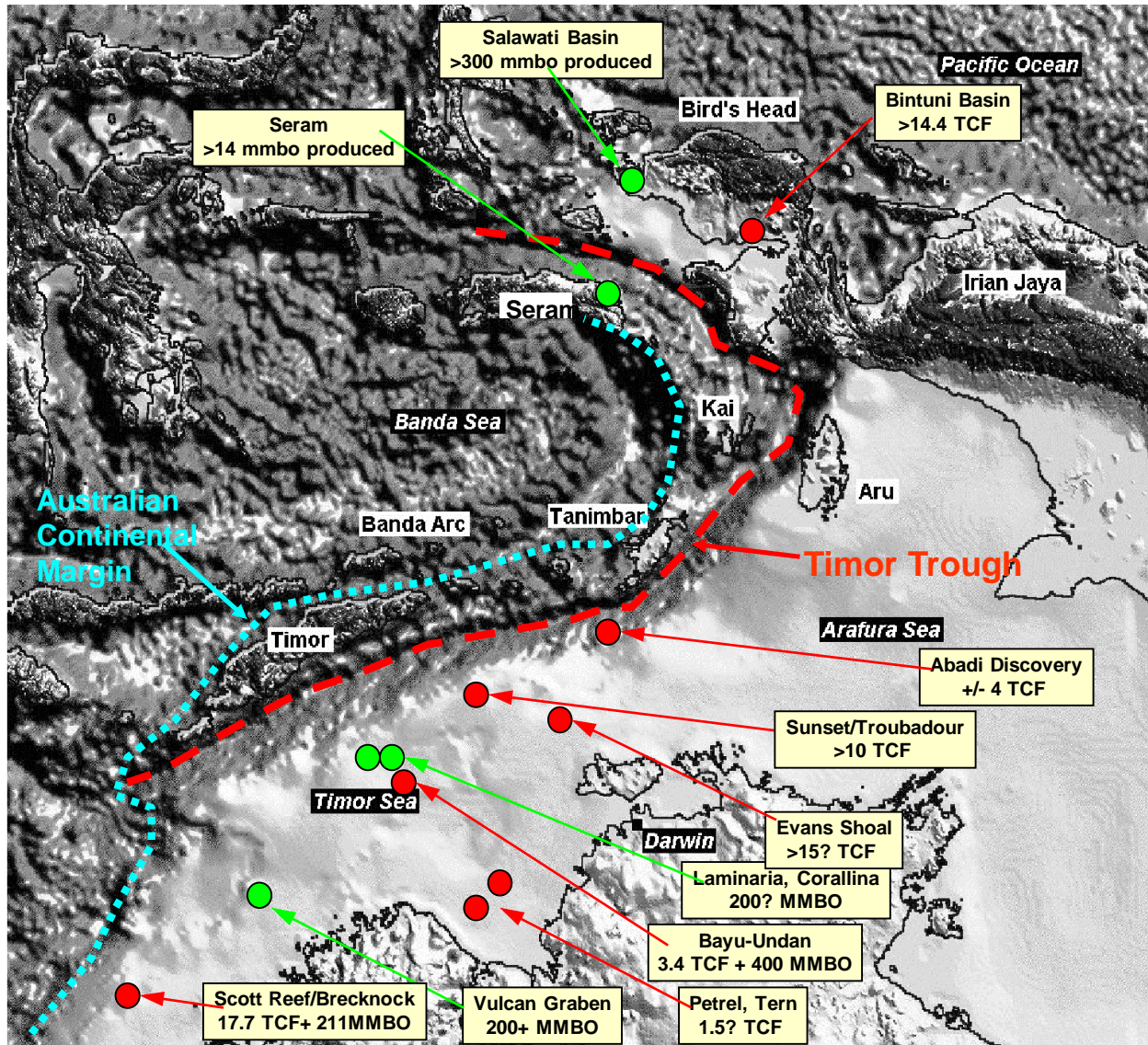
The Prize to Date

Onshore East Timor

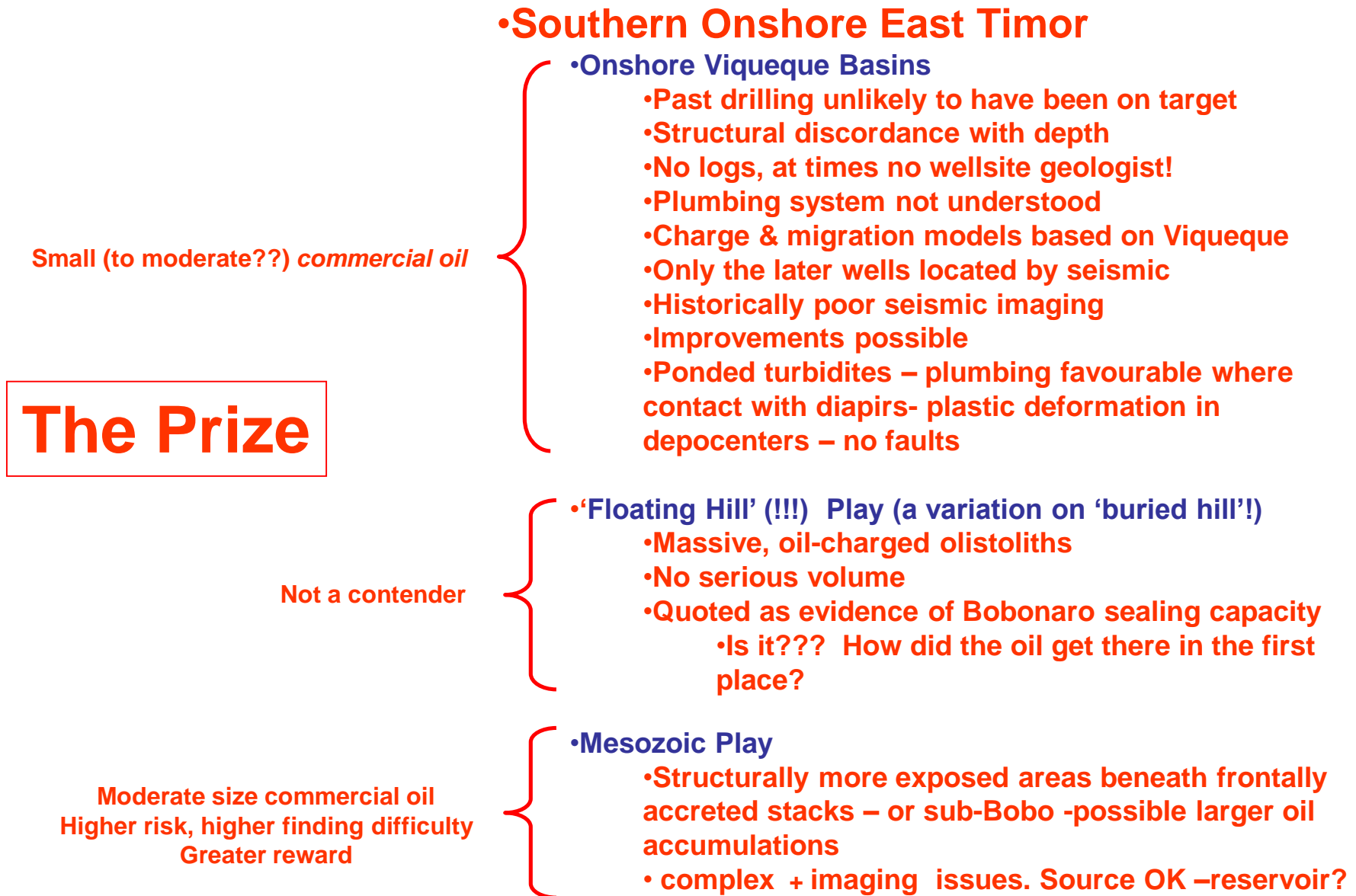
- **Small, non-commercial oil accumulations that have yielded oil only for local use to date**

North Bonaparte Basin

- **Vulcan sub-basin: around 200 mmbbls produced**
- **N Bonaparte gas fields: ?20 Tcf – not yet all commercially or politically exploitable**
- **North Bonaparte oil fields: ?300 mmbbls in several fields, some small**



The Ultimate Prize



Small (to moderate??) *commercial oil*

•Immediately Offshore East Timor

•Viqueque Basins

- Only one well – on a high
- Ponded turbidite play so lows attractive?
- Seismic data quality much better than onshore
 - Attribute analysis easier – DHIs visible?

**The Prize
Contd.**

Moderate size commercial oil
Higher risk, higher finding difficulty
Greater reward

•Mesozoic Play

- Mesozoic Plays probably mostly sub-Bobo –
- Bobonaro thicker?
- Imaging easier than onshore

The Prize Contd.

- **North Slope of Timor Trough**

- **Imbricate Zone**

Risk too high



- **Too structurally complex**
- **Imaging Problems**
- **Australian Continental margin sediments (N Bonaparte play too deep in the proximal parts)**

The Prize Contd.

Low to moderate risk
For moderate to large
Gas (oil?)



•South Slope of Timor Trough

•Gently Deformed N Bonaparte Basin Sequence

- Excellent Imaging
- Continuation of N Bonaparte play
- Late trap breach issues

Mesozoic Petroleum System Summary

- **Reservoir:** Presence: Jurassic clastic reservoir (Plover fm equiv) may not be present everywhere & may not have good sand development. The Jurassic/Triassic reservoir in Timor may not be laterally continuous or may degrade laterally..
- **Seal:** The distribution of the Wai Luli shales is not well understood (at this point) and they may not always be present in an effective sealing facies.
- **Trap:** Inability to image the Mesozoic will remain a significant risk. This may decrease once the structural model for Timor becomes better understood.
- **Source:** The presence of oil seeps proves the active oil source in East Timor. There is a risk that any given large structure may not be “plumbed” into the source. Timing of maturity (through thrust burial) mechanism makes the migration and migration timing difficult to understand, though quite likely very recent.



AN EARLY ATTEMPT TO SIMPLIFY THE POLITICAL SITUATION



