

OCEAN THERMAL ENERGY DEVELOPMENT IN MALAYSIA: PROGRESS TOWARD A SUSTAINABLE ENERGY FUTURE

By

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Maritime Institute of Malaysia



THE SUBJECT OF OCEAN
THERMAL ENERGY
HAD BEEN OF ACADEMIC
INTEREST SINCE 1981 TO
ABU BAKAR JAAFAR,
PhD GRADUATE OF
UNIVERSITY OF HAWAII
@MANOA &
EAST-WEST CENTER
RESEARCH GRANTEE (1980-
1981)

[Photo: Abu-san sitting to
the left of
Prof Tommy Koh,
President of the Third UN
Conference on the Law of
the Sea @the EWC –EAPI
Workshop on Shipping,
Energy, and the
Environment,
Honolulu, November 1981

ACADEMIC INTEREST 1981-2008

1980-81:

PhD Course in Marine Resources:

OTEC @University of Hawaii-Manoa
with

Prof John Bardach and Dr John Craven;

OCEAN THERMAL ENERGY: THE SOURCE OF KNOWLEDGE

Darkness in the Depths of the Ocean

﴿أَوْ كُظُمَاتٍ فِي بَحْرٍ لُجِّيٍّ يَغْشَاهُ مَوْجٌ مِّنْ فَوْقِهِ، مَوْجٌ مِّنْ فَوْقِهِ، سَحَابٌ
ظُلُمَاتٌ بَعْضُهَا فَوْقَ بَعْضٍ إِذَا أَخْرَجَ يَكْدُهُ، لَمْ يَكِدْ يَرِنَهَا وَمَنْ لَمْ يَجْعَلِ اللَّهُ لَهُ
نُورًا فَمَا لَهُ مِنْ نُورٍ﴾

“... the depths of darkness in a vast deep ocean overwhelmed by waves, topped by dark clouds, [layers of] darkness upon darkness ...”

The meaning of Al-Qur'an 24:40.

Zakri Naik (2007). The Qur'an and the Modern Science: Compatible or Incompatible? Riyadh: Darussalam. p.

38.

Darkness in the Depths of the Ocean (Cont'd)

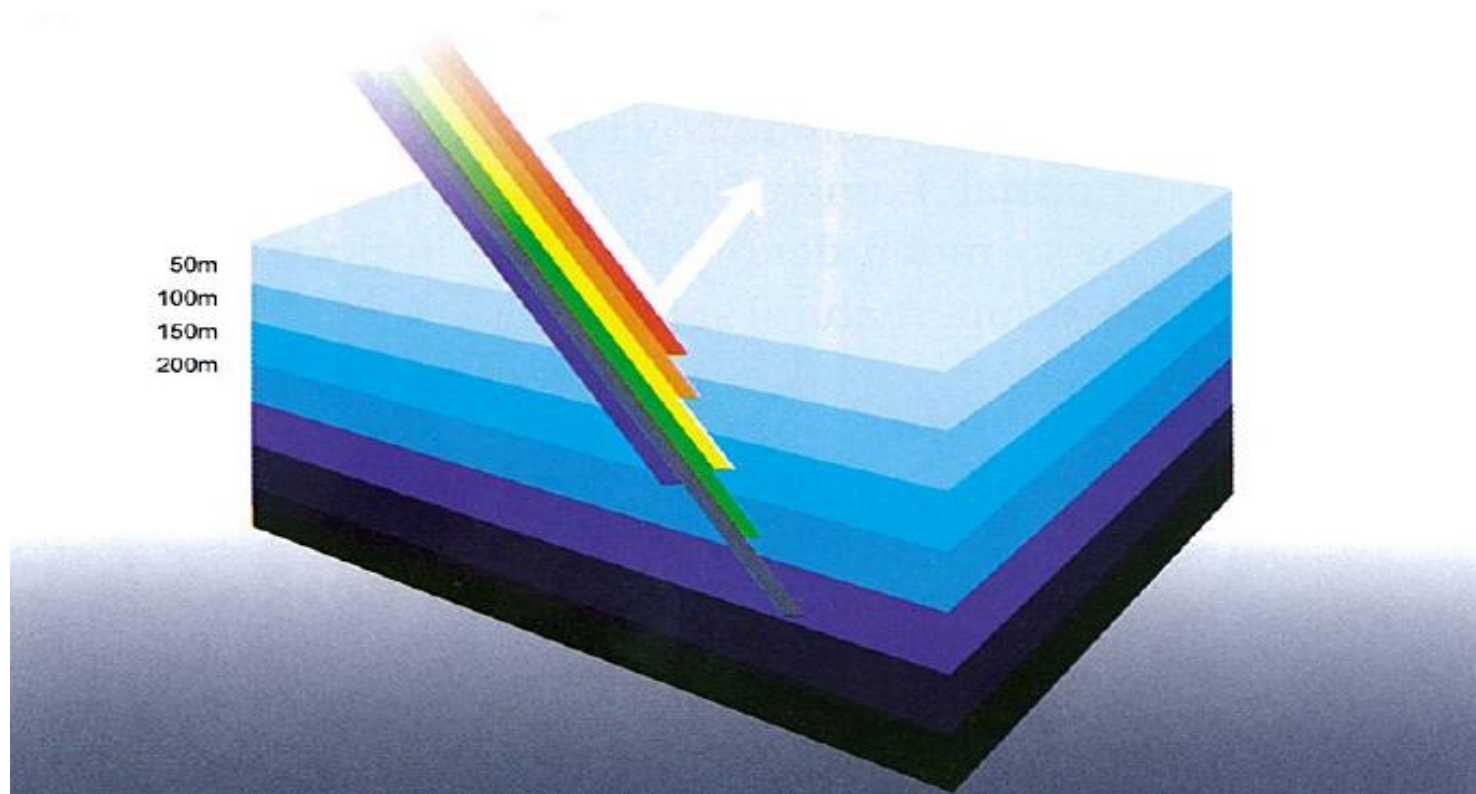
﴿أَوْ كَظُلُمَاتٍ فِي بَحْرٍ لُجِّيٍّ يَغْشَاهُ مَوْجٌ مِّنْ فَوْقِهِ، مَوْجٌ مِّنْ فَوْقِهِ، سَحَابٌ
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نُورًا فَمَا لَهُ مِنْ نُّورٍ﴾

“... or like darkness on a bottomless ocean spread with clashing billows and overcast with clouds: darkness upon darkness. If he stretches out his hand he can scarcely see it. Indeed the man from whom God withholds His light shall find no light at all.

The meaning of Al-Qur'an 24:40.

Ref: Dawood, N.J. (2006). The Koran. Penguin Classics. England. p. 249

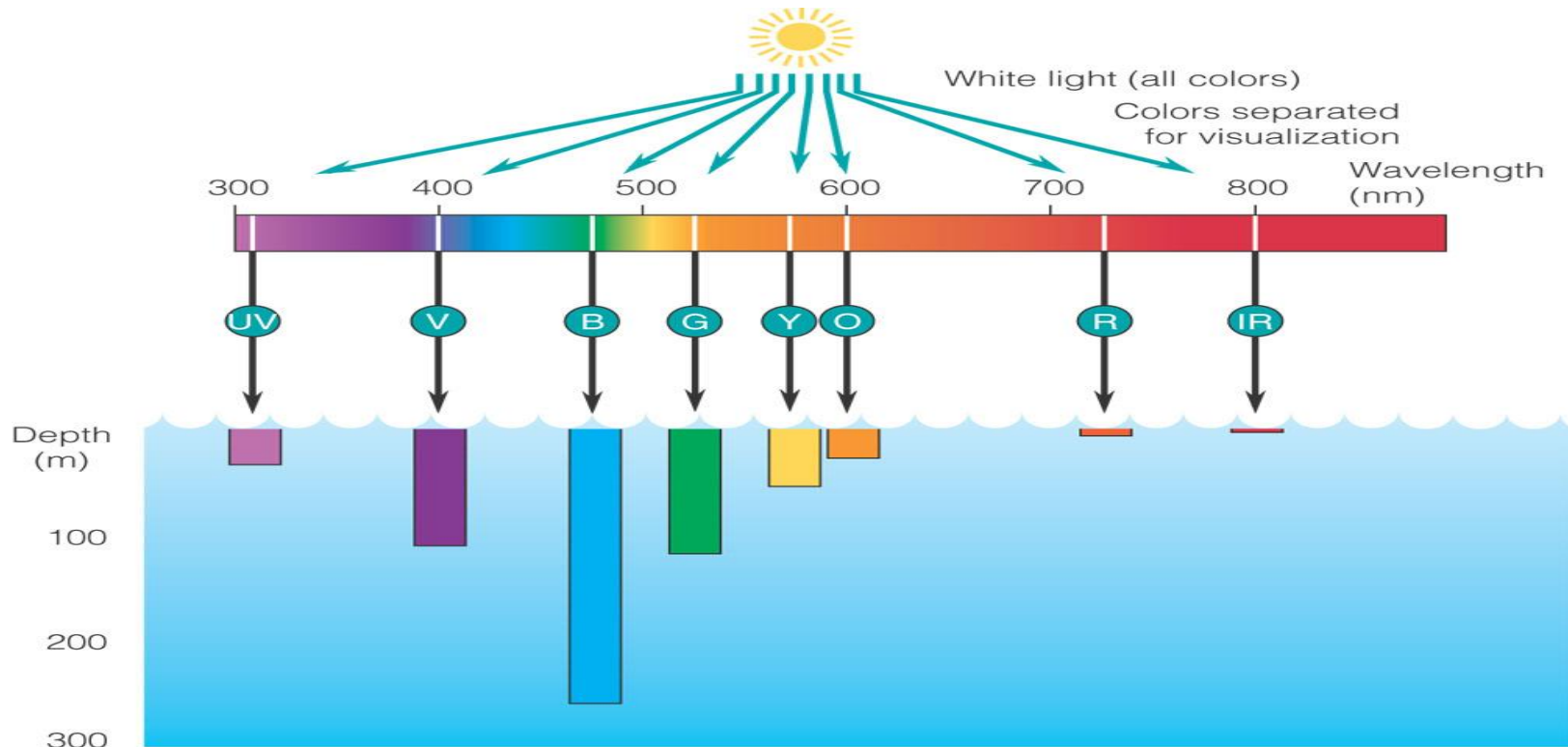
Darkness in the Depths of the Ocean (Cont'd)



Zakri Naik (2007). The Qur'an and the Modern Science: Compatible or Incompatible? Riyadh: Darussalam p.39

A Bakar Jaafar@SHOP_Cabinet-Secretariat_Government of Japan

Darkness in the Depths of the Ocean (Cont'd)

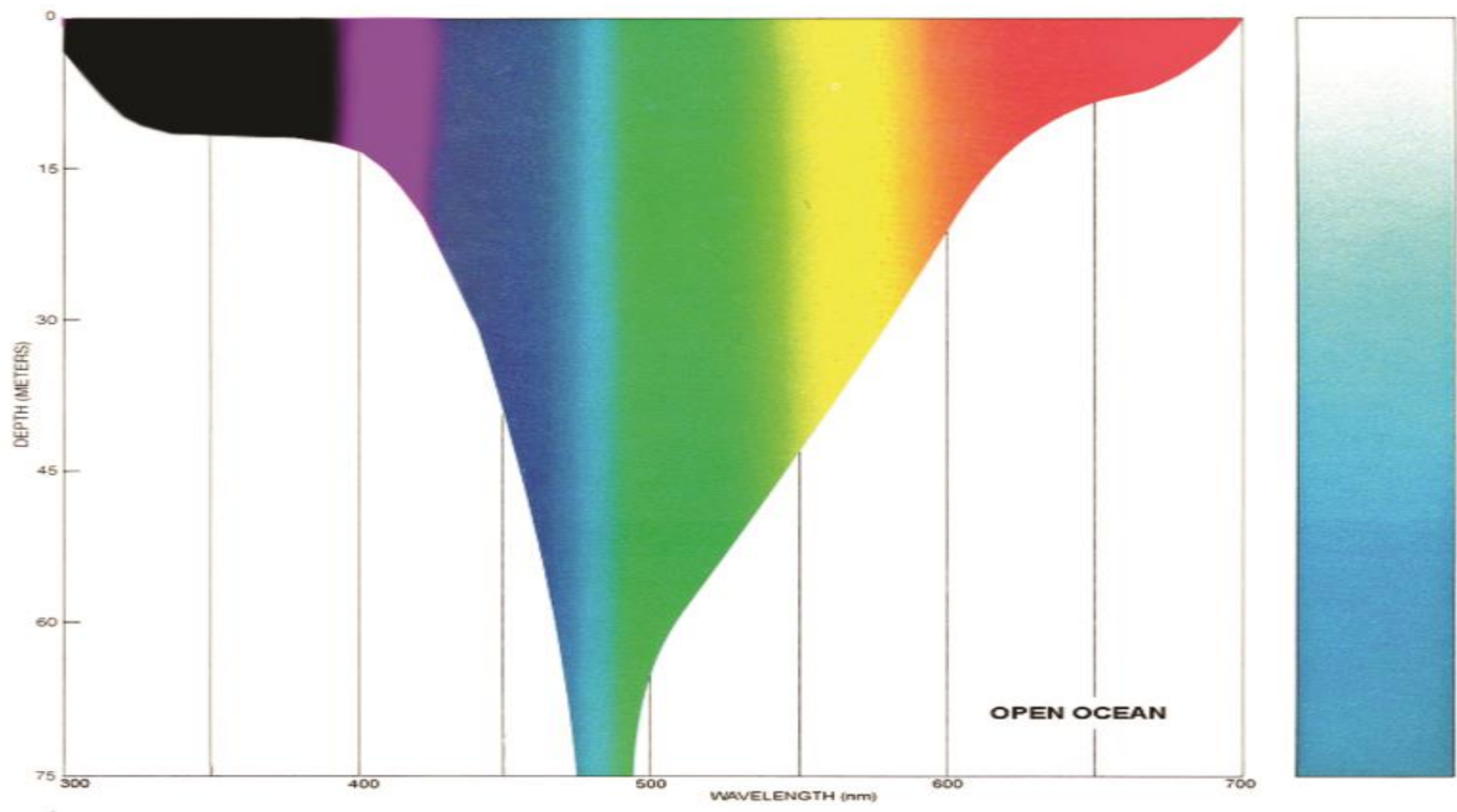


© 2005 Brooks/Cole - Thomson

Penetration of Light in Water Depth by Wavelength

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Darkness in the Depths of the Ocean (Cont'd)

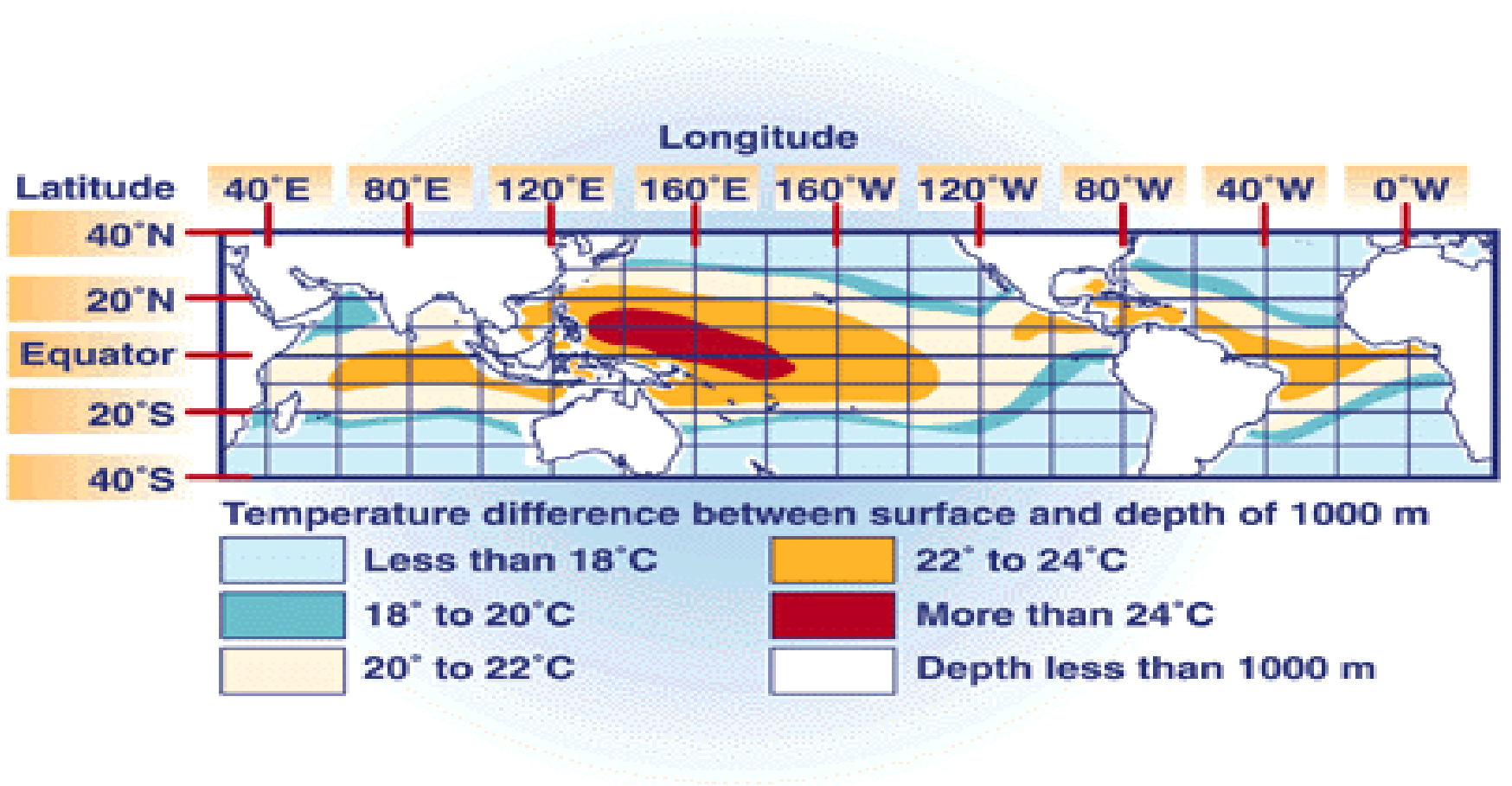


Attenuation of light in the water: $\text{depth} = f(\text{wave length})$

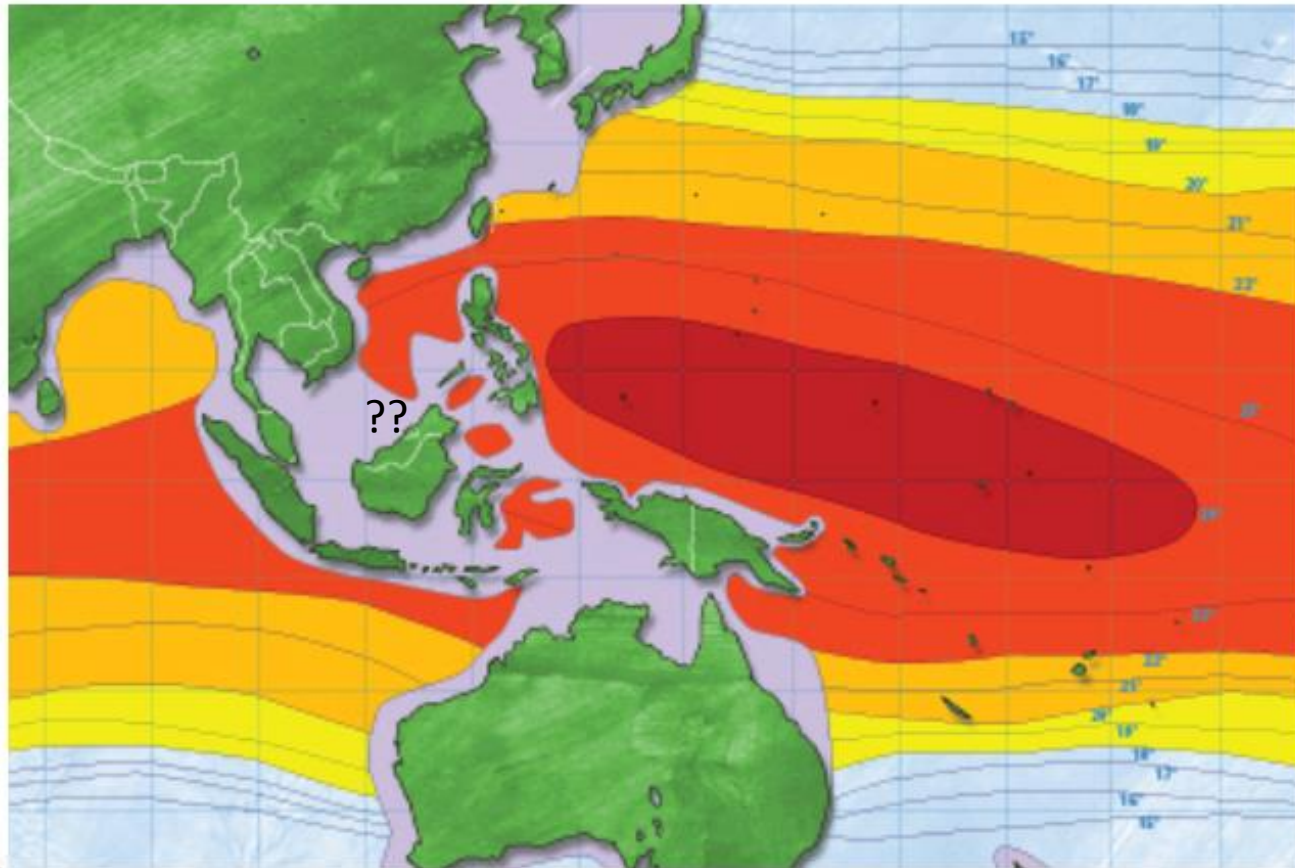
Adapted from Levine and MacNichol, 1982

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FOR MANY YEARS,
MALAYSIA WAS NOT KNOWN TO HAVE OCEAN THERMAL ENERGY POTENTIAL



Ocean thermal energy resources: Indonesia

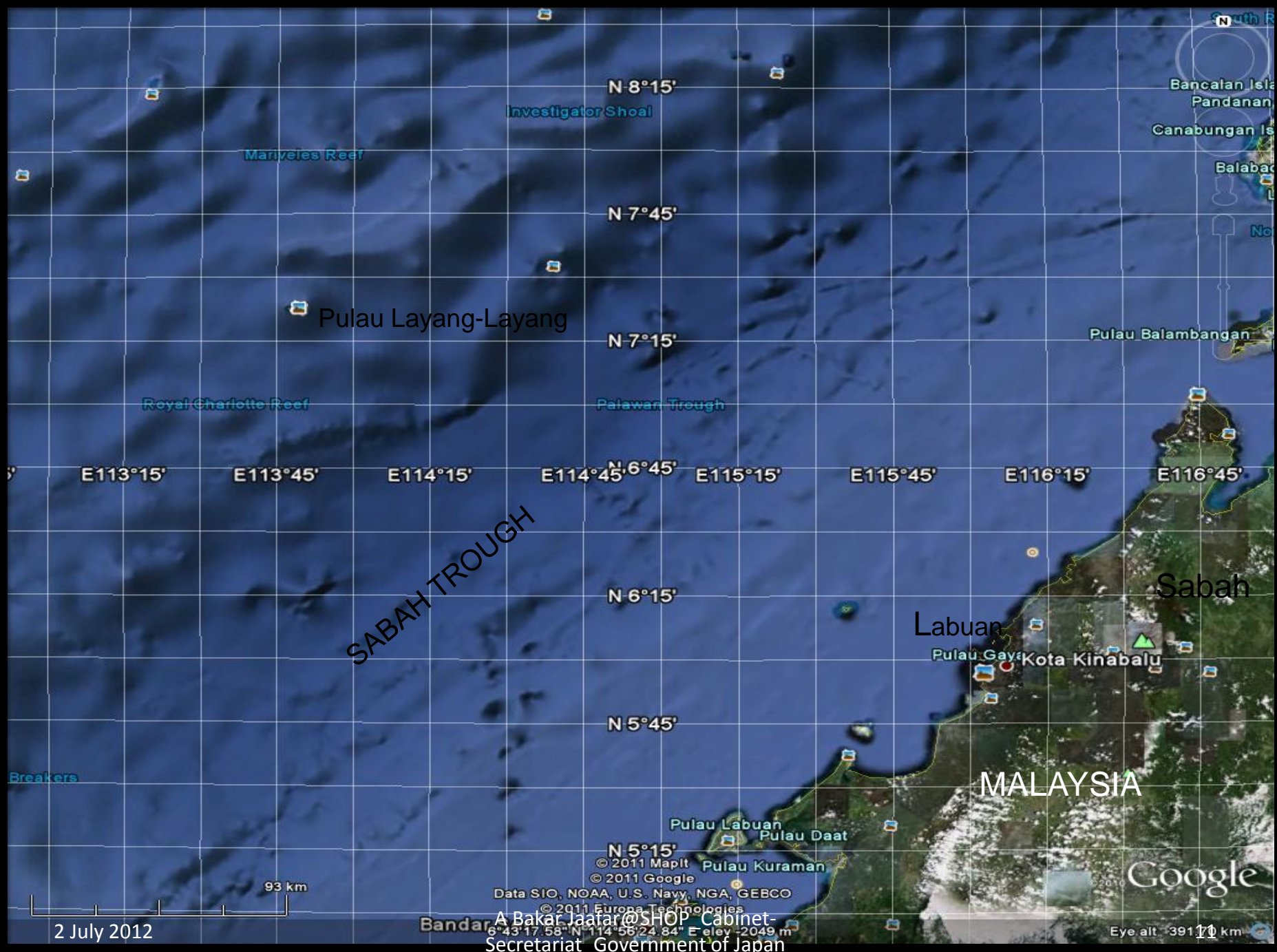


UNSW IPEN

Ocean Energy

19

Hugh Outhred, STTNAS Seminar, 30 July 2011



2 July 2012

Bandar
A Bakar Jaafar@SHOP Cabinet-Secretariat, Government of Japan

Google
Eye alt: 391 km

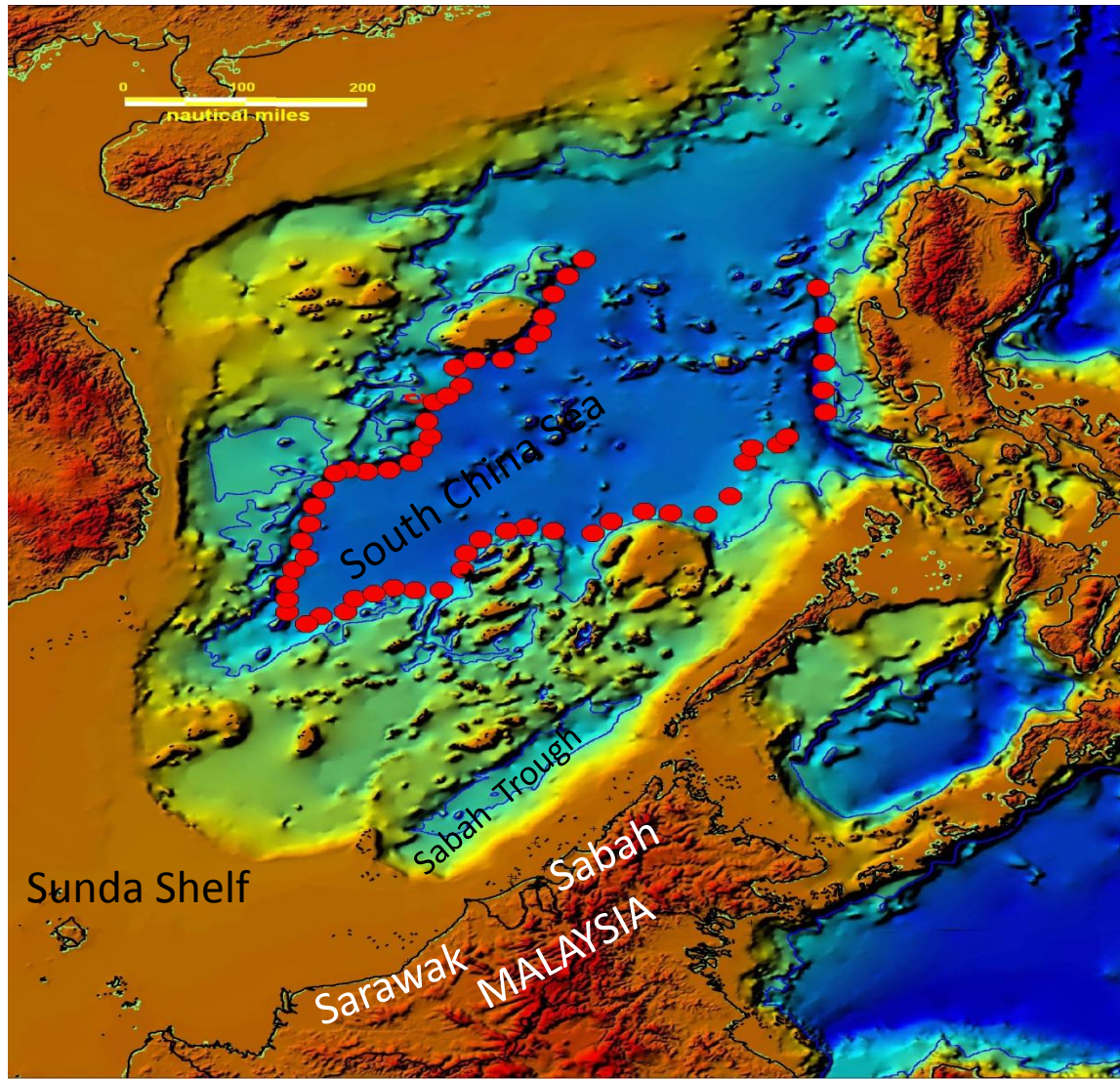
MALAYSIA MARINE SURVEY IN THE SOUTH CHINA SEA (MyMRS) 2006-08

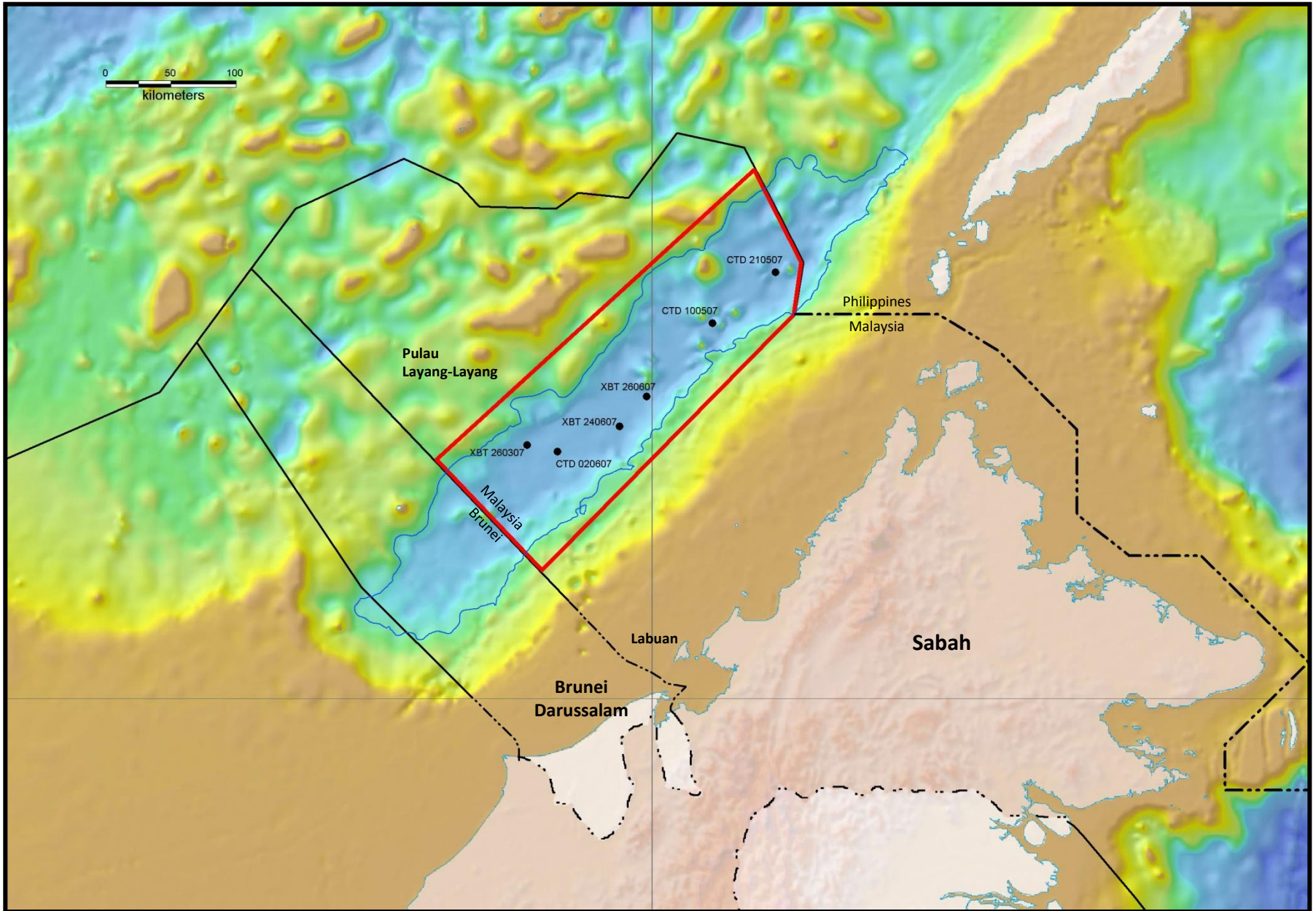


TL Geohydrographics



University of Tokyo RV *Hakure-maru II*
(now, renamed, MV Teknik Perdana operated by a Malaysian company:
Sapura-Crest Group's Subsidiary TLG GeoSciences.

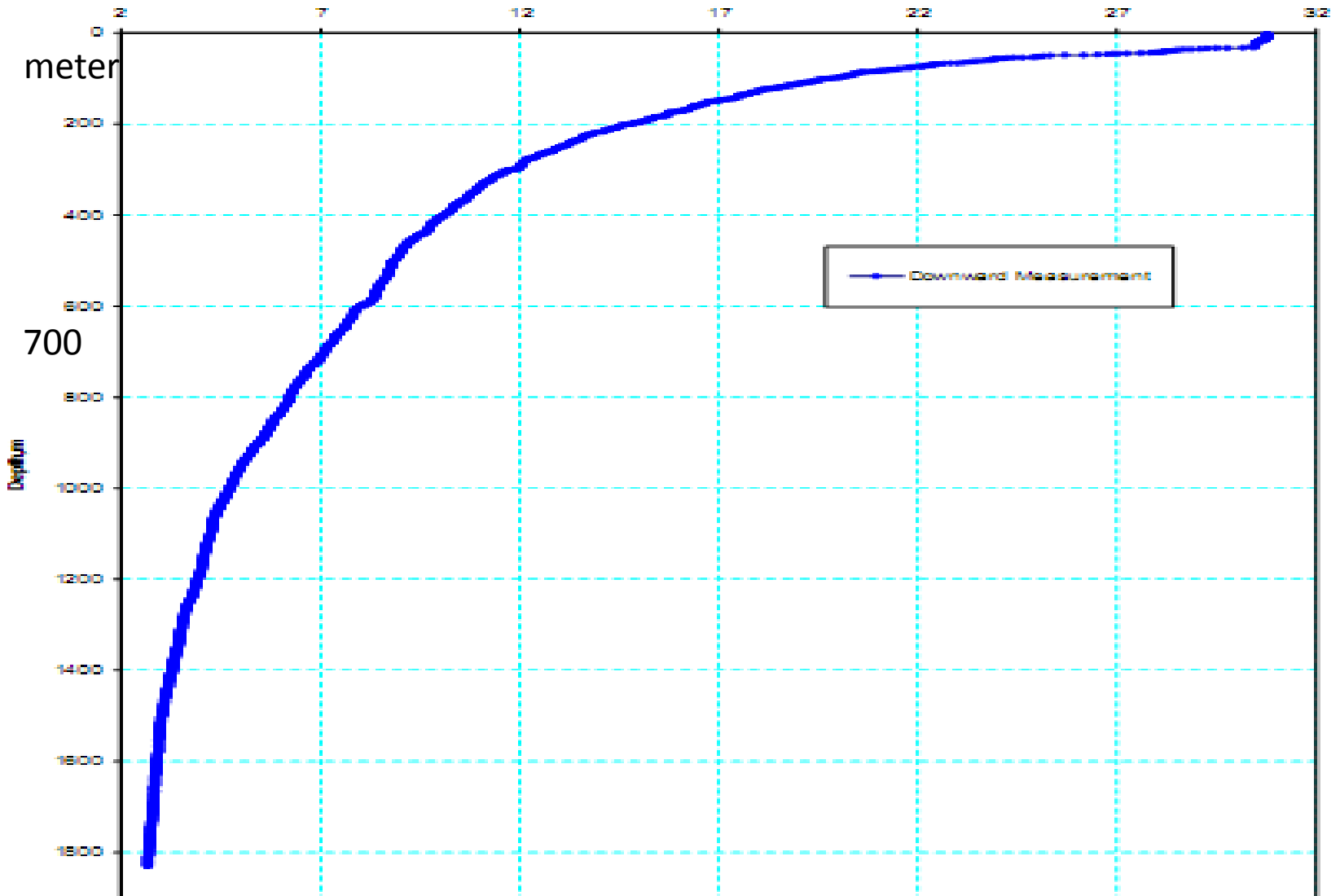




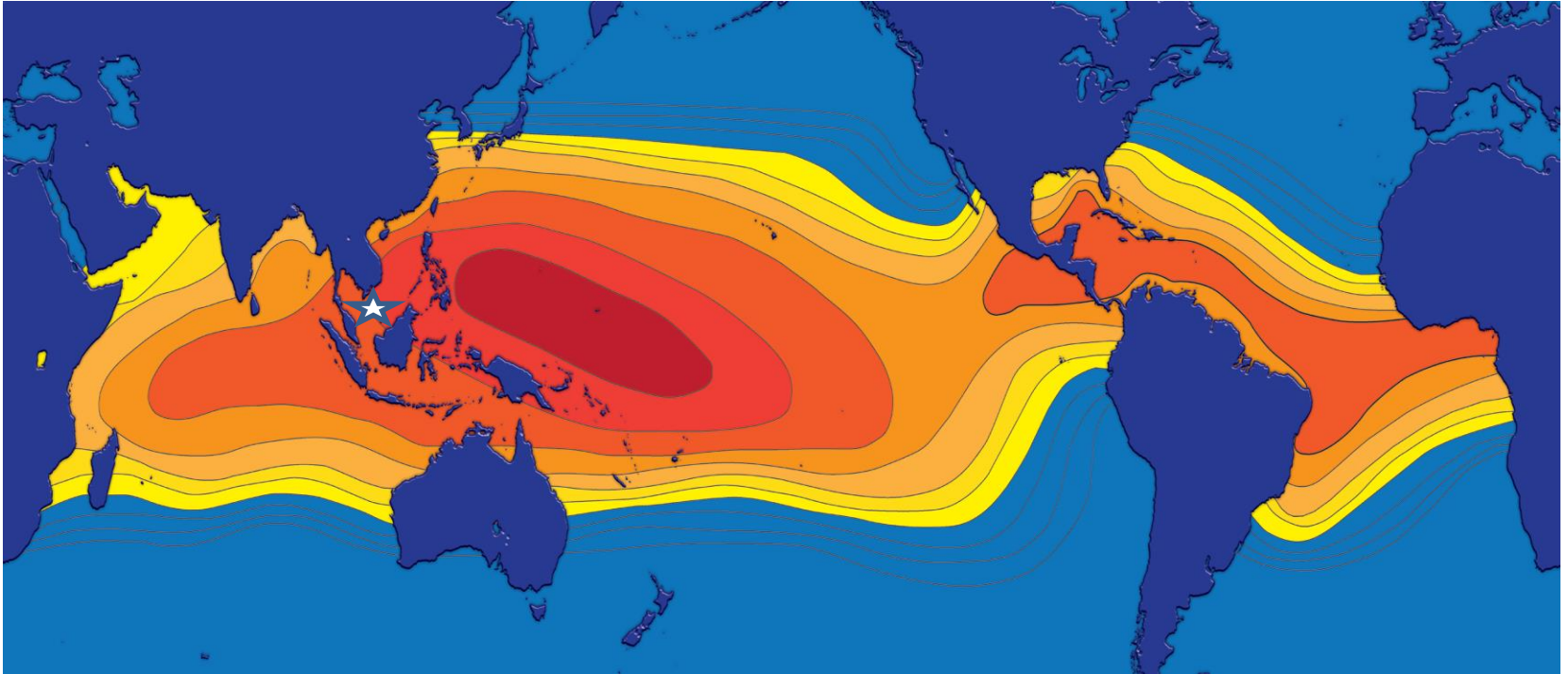
MALAYSIA: SABAH TROUGH

Temperature Profile (26th June 2007)
MYMRS Marine Research Survey

Temperature Temp (°C)



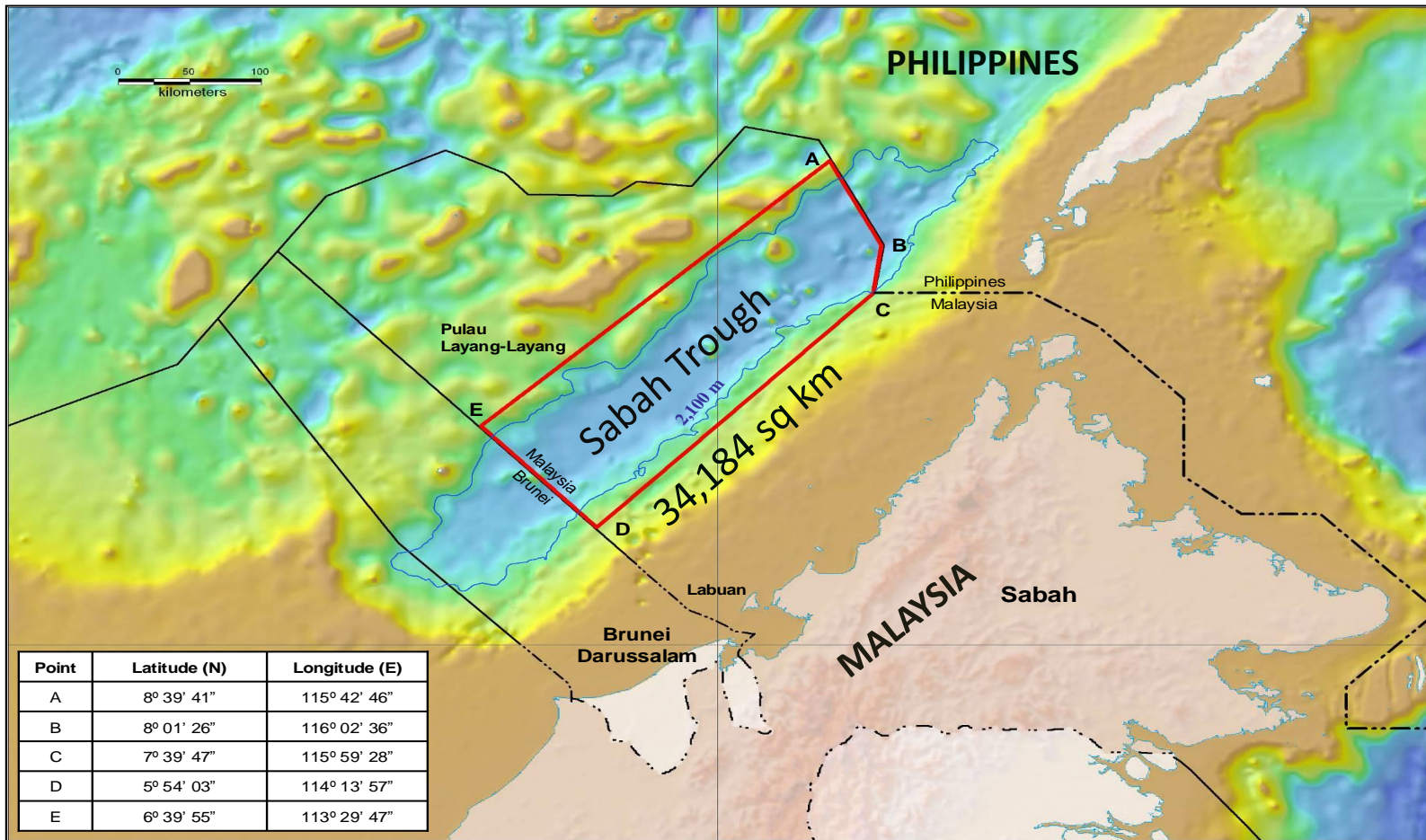
Where OTEC would work



Source: www.lockheedmartin.com/us/products/otec.html

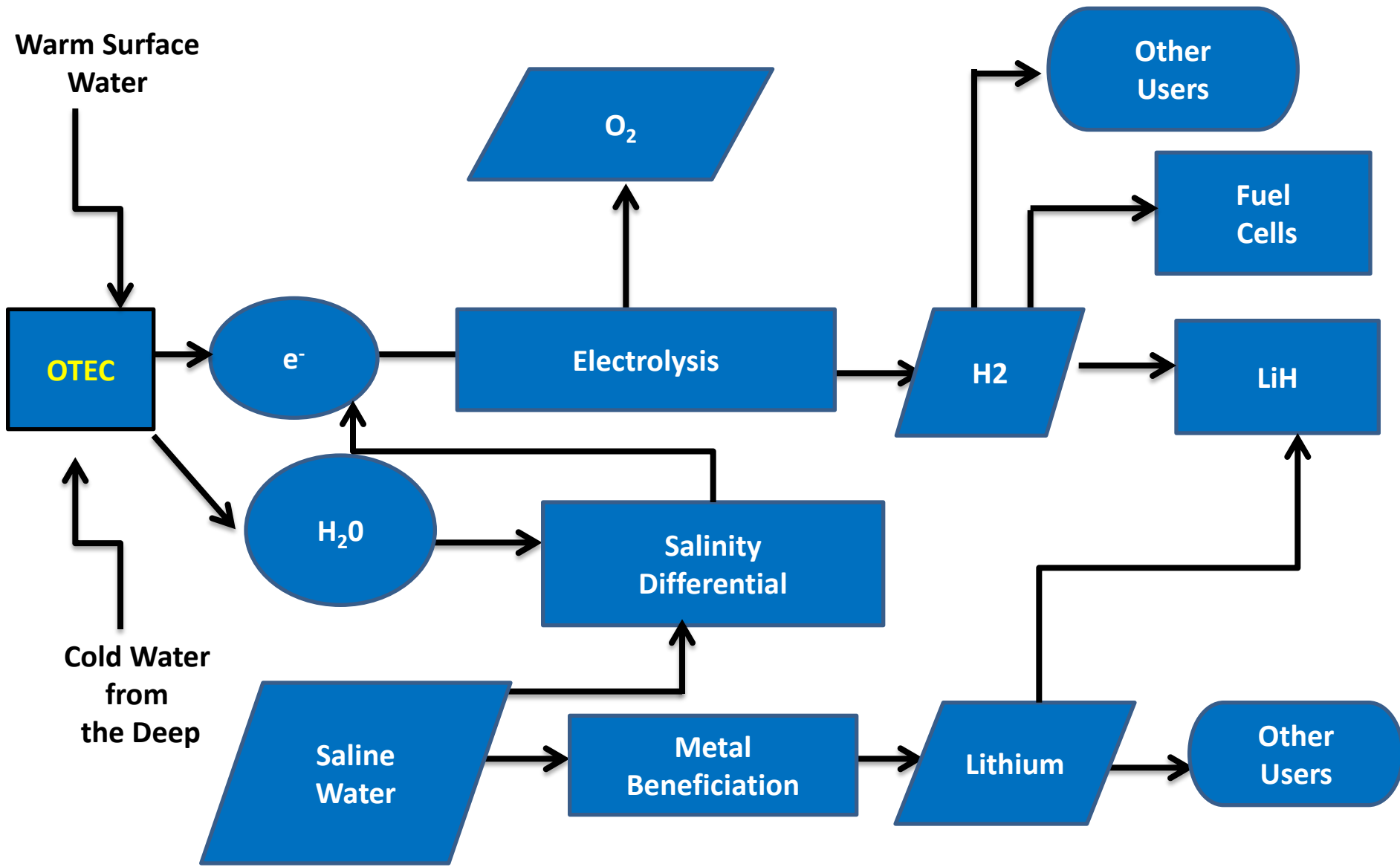
The map above shows the temperature differentiation in our ocean's waters. Areas highlighted represent optimum locations for OTEC.

SUBREGIONAL COOPERATION IN OCEAN THERMAL ENERGY DEVELOPMENT: BRUNEI DS-MALAYSIA-PHILIPPINES



POWER POTENTIAL & PROPOSED SCHEME

- Potential: 50,000 MW i.e., double the currently installed electrical power capacity in Malaysia
- Producing, other than freshwater, Hydrogen, Lithium, Lithium Hydride



The Barrier between the Sweet and Salt Waters

﴿ مَرَجَ الْبَحْرَيْنِ يَلْتَقِيَانِ ﴿١٩﴾ بَيْنَهُمَا بَرْزَخٌ لَّا يَبْغِيَانِ ﴿٢٠﴾ ﴾

“He has let loose the two seas [the salt and freshwater] meeting together. Between them is a barrier which none of them can transgress”

The meaning of Al-Qur'an 55:19-20.

Zakri Naik (2007). The Qur'an and the Modern Science: Compatible or Incompatible? Riyadh: Darussalam. p. 35.

The Barrier between the Sweet and Salt Waters (Cont'd)

﴿وَجَعَلَ بَيْنَ الْبَحْرَيْنِ حَاجِزًا﴾

“...And he has set a barrier between the two seas (of salt and sweet water)...”

The meaning of Al-Qur'an 27:61.

Zakri Naik (2007). *The Qur'an and the Modern Science: Compatible or Incompatible?*
Riyadh: Darussalam. p. 36.

Every Living thing is Made of Water

﴿وَاللَّهُ خَلَقَ كُلَّ دَابَّةٍ مِّن مَّاءٍ﴾

“Allah has created every moving (living) creature from water...”

The meaning of Al-Qur'an 24:45.

Zakri Naik (2007). *The Qur'an and the Modern Science: Compatible or Incompatible?* Riyadh: Darussalam. p. 42.

L.I.F.T. APPROACH

1. Legal Framework: Section 3 of EEZ Act of 1984; new OTEC Development Bill 2013?
2. Policy for Concession to OTE-NAS, not PETRONAS, for the right to explore and exploit the water column in the Sabah Trough within 2100 m isobath
3. Financed through private investments, block by block, through production sharing
4. Promotion of commercially viable technology for power generation, freshwater harvesting, mineral water production, hydrogen production, lithium beneficiation, high value fish-culture, and manufacture of lithium-hydrate cells.

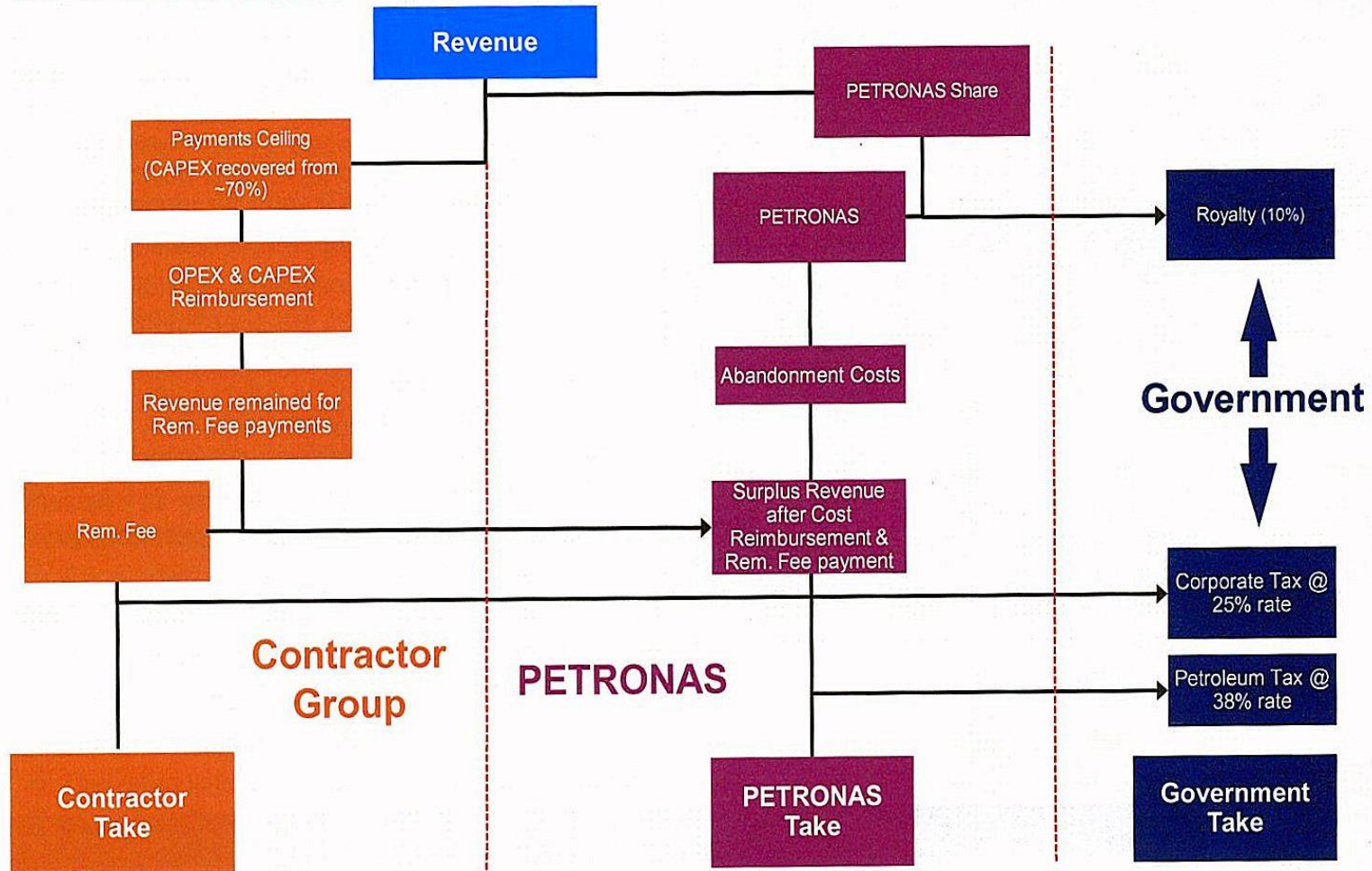
PROPOSED CONCESSION AREA
IN THE EEZ OF MALAYSIA [AT LEAST 25,000 SQ KM]
IN 25 BLOCKS @ 2000 MW/BLOCK
TO ATTRACT TOTAL CAPITAL INVESTMENT OF
USD 500 BILLION @USD 10 MILLION/MWe

A	B	C	D	E
F	G	H	I	J
K	L	M	N	O
P	Q	R	S	T
U	V	W	Y	Z

**OTENAS vis-à-vis
PETRONAS PRODUCTION-
REVENUE SHARING FORMULA OF
GOVERNMENT (G), PETRONAS (P),
& ITS CONTRACTOR-INVESTOR (C) :**



RSC Flowchart



OUTSTANDING POLICY QUESTIONS

1. WOULD THE SAME FORMULA FOR NON-RENEWABLE BE APPLICABLE FOR RENEWABLE ENERGY?
2. WHO WOULD MANAGE THE CONCESSION AREA FOR THE GOVERNMENT AND PEOPLE OF MALAYSIA? THE PROPOSED OCEAN THERMAL ENERGY NASIONAL [OTENAS]?
3. WOULD AN OCEAN THERMAL ENERGY DEVELOPMENT UNIT BE ESTABLISHED IN THE PRIME MINISTER'S DEPARTMENT?

OTEC Programme Impact & Stakeholders

Impact	Stakeholders	Concerns & Input
Energy & Security	Ministry of Energy-Green Technology-Water (KeTTha), Energy Commission, Sustainable Energy Development Agency (SEDA), MINDEF, National Security Council, MOFA	
Environment & Living Resources	Ministry of Natural Resources and Environment (JUPEM, DOE), MOA (Fisheries)	
Regulatory	AGC, DOE, DOF, MOT (MARDEP)	
Socio-Economic	Economic Planning Unit, MIDA, MIMA, PEMANDU,	
Technology	MOSTI (NOD), MIGHT, Ministry of Higher Education	

Region

Temperate

Sub-Tropic

Tropic

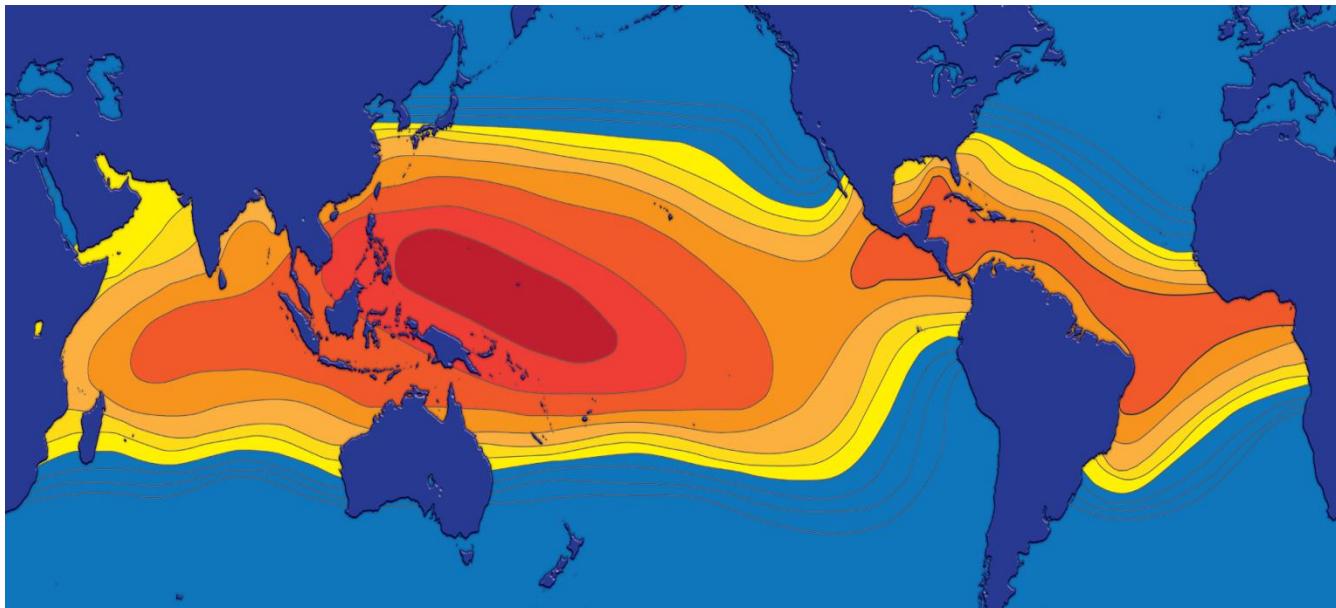
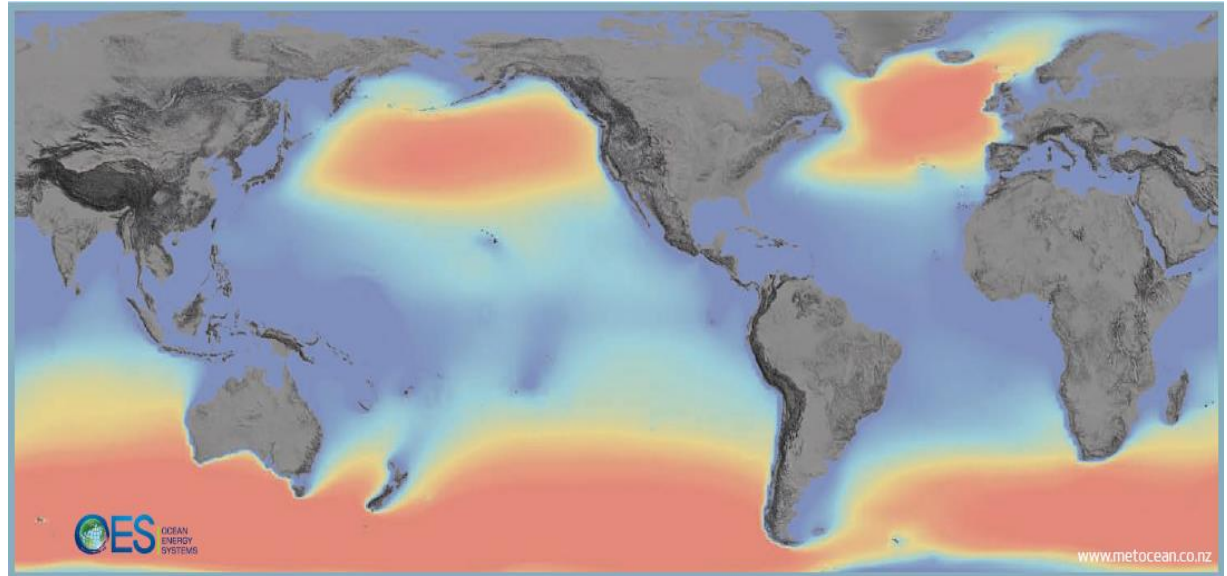
OTEC	TIDAL	WAVE WIND
TIDAL	OTEC WAVE	WIND
WAVE WIND	TIDAL	OTEC

LOW

MEDIUM

HIGH

Wave Power Potential in Temperate Regions

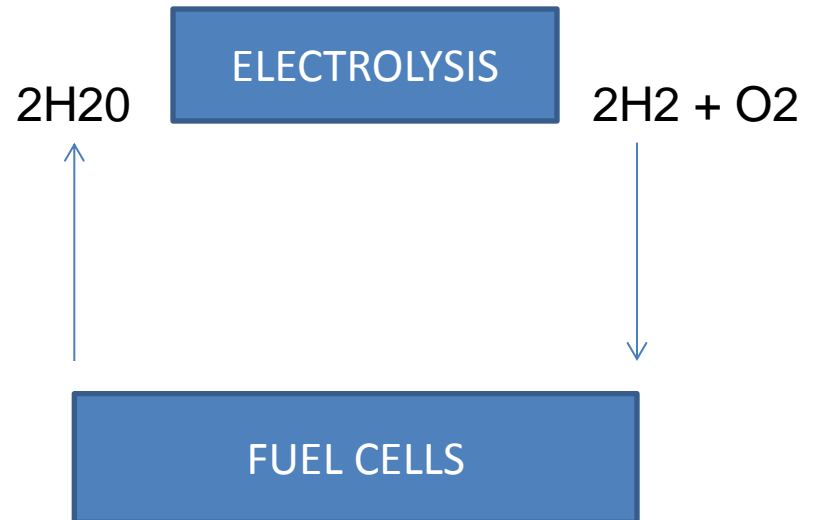


OTEC Potential in the Tropics & Subtropics

PETRONAS



OCEAN THERMAL ENERGY NASIONAL (OTENAS)



=> SUSTAINABLE ENERGY FUTURE

ARIGATOU
TERIMA KASIH

شكر

(shukran)

谢谢 (xiè xiè)

Thank You

Merci

Gracias

Спасибо



IN MEMORIA OF
THE LATE PROF
DR KENSAKU
TAMAKI (1948-
2011) & MR
ALEXANDRE
ALBUQUERQUE
(1939-2012)
*“May Their Souls
Rest in Peace”*

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KMN, JSM, DPMP
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