THE ENIGMA OF THE PINANG DOME (KALIMANTAN TIMUR):

A REVIEW OF ITS ORIGIN, SIGNIFICANCE AND INFLUENCE ON COAL RANK AND COALBED METHANE PROPERTIES

Tim A. Moore[1,2]
Chairul Nas[3]

[1]Cipher Coal Consulting Ltd
[2]University of Canterbury
[3]Trisakti University

IPA 15th May 2013, Jakarta Indonesia
Paper: IPA13-G-119

Cipher

www.ciphercoal.com

OUTLINE OF PRESENTATION

- Key Questions
- Location
- Stratigraphy & Geology
- Data Types & Limitation
- Geothermal Gradient
- Vitrinite Reflectance/Rank Data –

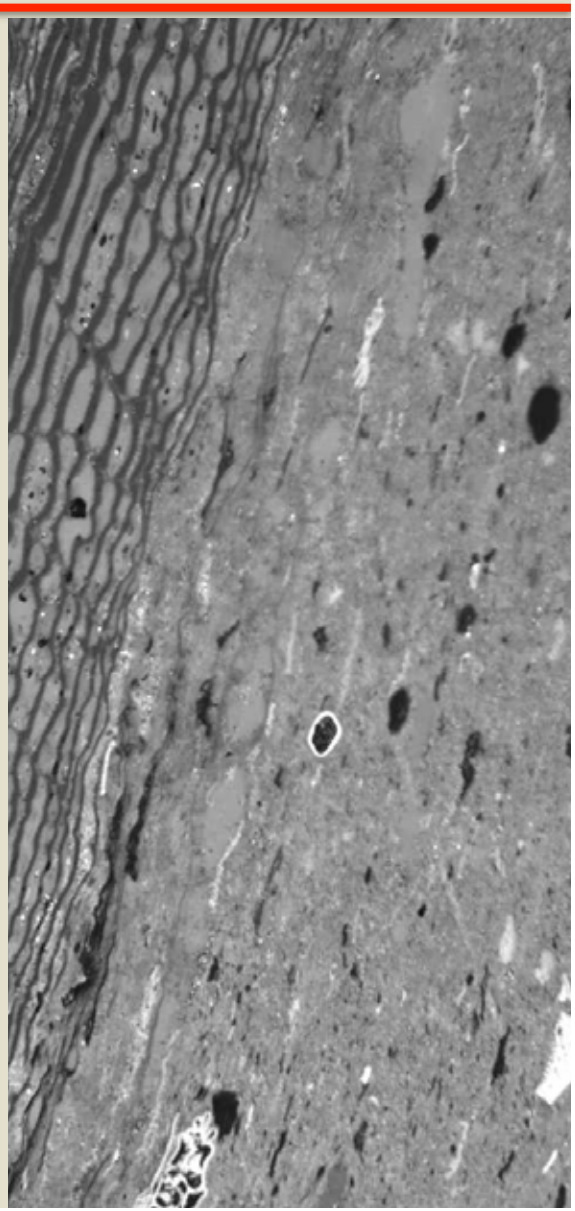
  Vertical & Lateral
- Gravity
- Summary, Conclusion & Implications

Key Questions

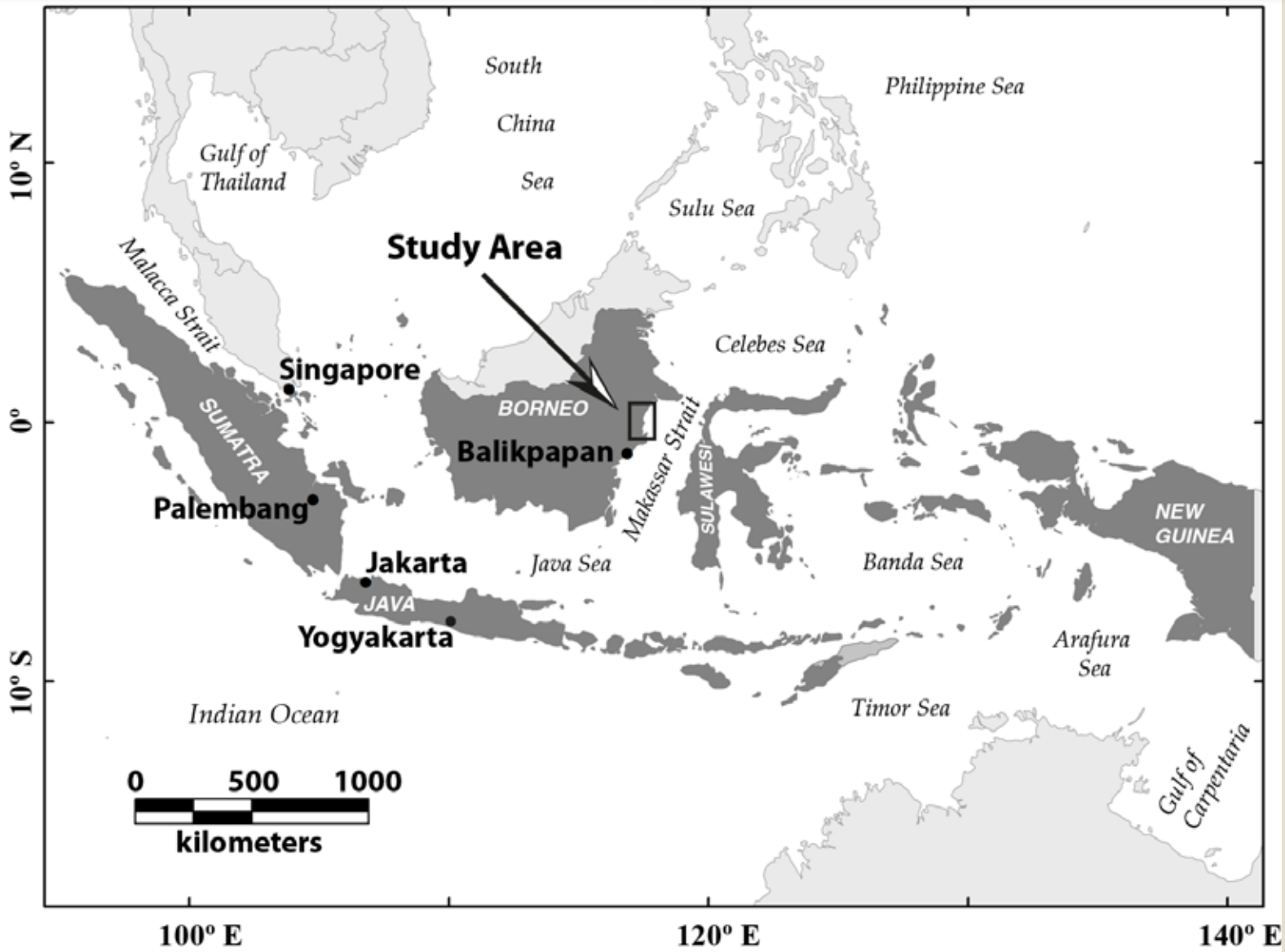
Cipher

Does the rank of coal increase towards the Pinang Dome?

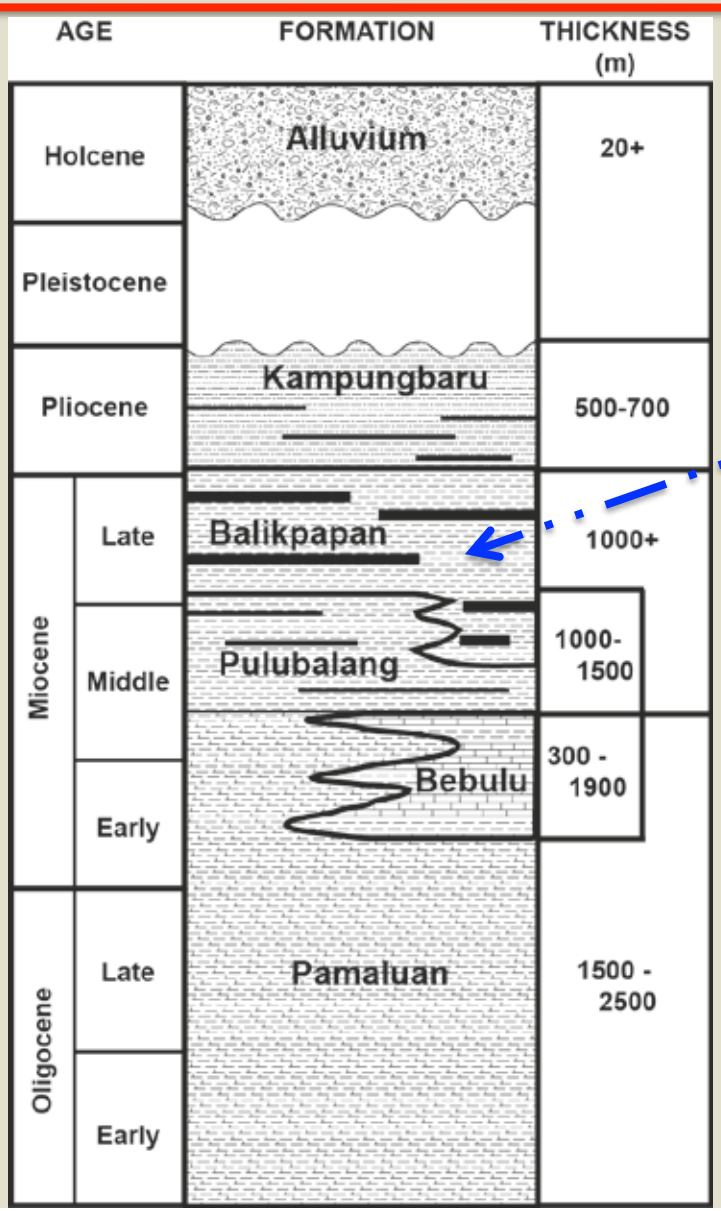
What is the cause of any rank increase?



Location


South
China
Sea
Philippine Sea
Gulf of
Thailand
Sulu Sea
Study Area
Malacca Strait
Celebes Sea
Singapore
BORNEO
SUMATRA
Balikpapan
Makassar Strait
SULAWESI
Palembang
NEW
GUINEA
Jakarta
Java Sea
Banda Sea
JAVA
Yogyakarta
Arafura
Sea
Indian Ocean
Timor Sea
Gulf of
Carpentaria
0
500
1000
kilometers
10° N
0°
10° S
100° E
120° E
140° E

Stratigraphy



Overall Regressive Sequence

Kampungbaru Formation:
Siltstones, sandstones, thin coal beds & claystones

Balikpapan Formation:
Coal (thin to med thick), siltstones, claystones & sandstones

Pulubalang Formation:
Siltstones, claystones, thin and occasional coal beds & sandstones

Bebulu Formation:
Limestones, sandstones, marls & claystones

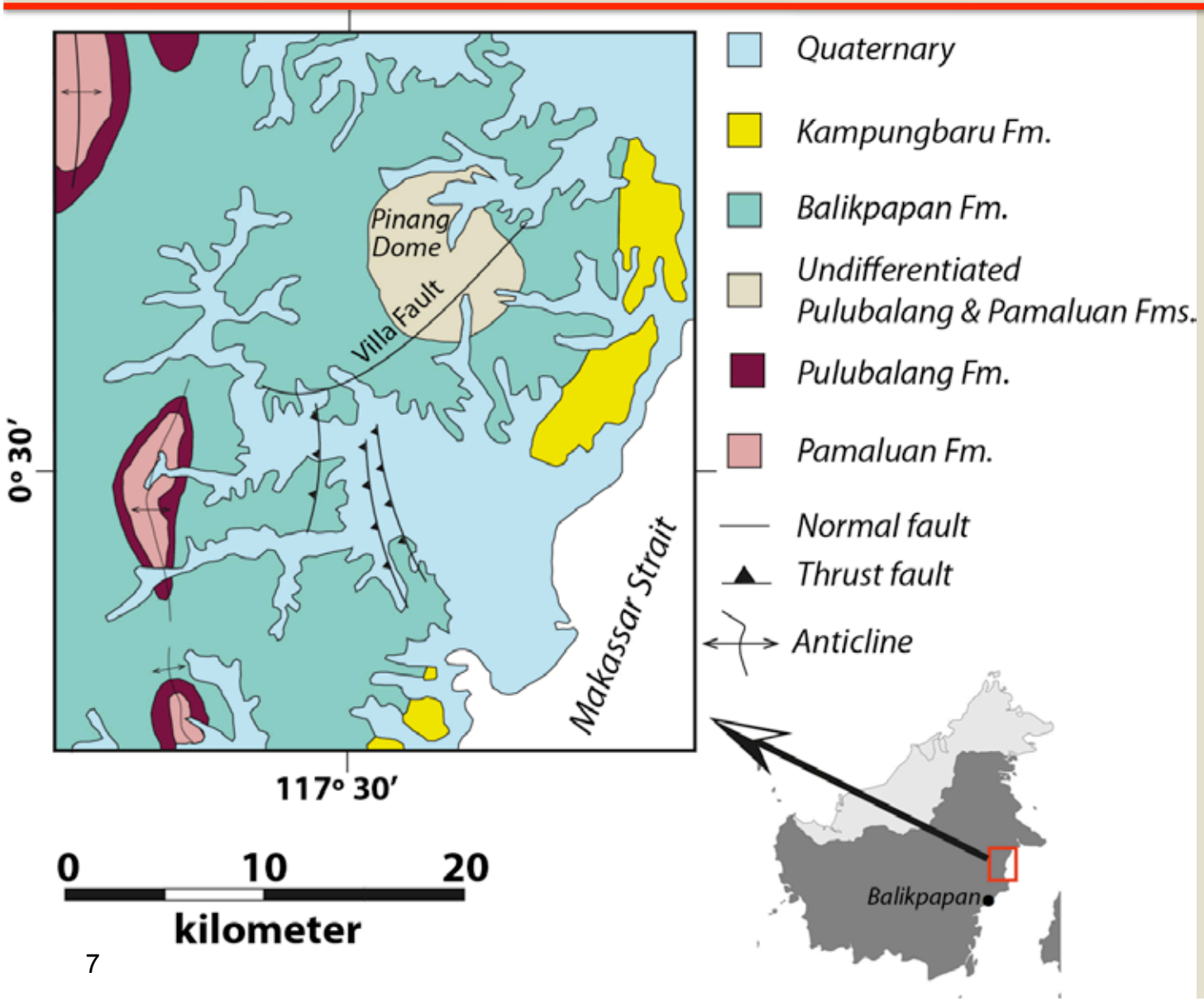
Pamaluan Formation:
Marls, siltstones, claystones

Coal seams in the Balikpapan Formation

from Nas, 199

Cipher

Geology


Quaternary
Kampungbaru Fm.
Balikpapan Fm.
Undifferentiated
Pulubalang & Pamaluan Fms.
Pulubalang Fm.
Pamaluan Fm.
Normal fault
Thrust fault
Anticline
Pinang
Dome
Villa Fault
Makassar Strait
0° 30′
117° 30′
0
10
20
kilometer
Balikpapan

Types of Data

Existing oil & gas wells: vitrinite reflectance measurements, down-hole temperature (Fukasawa et al., 1987; Herudiyanto, 2006)

Detailed mine drill holes: vitrinite reflectance (Nas, 1994)

Coalbed methane drill holes: vitrinite reflectance, coal quality, down-hole temperature (Moore et al., 2012)

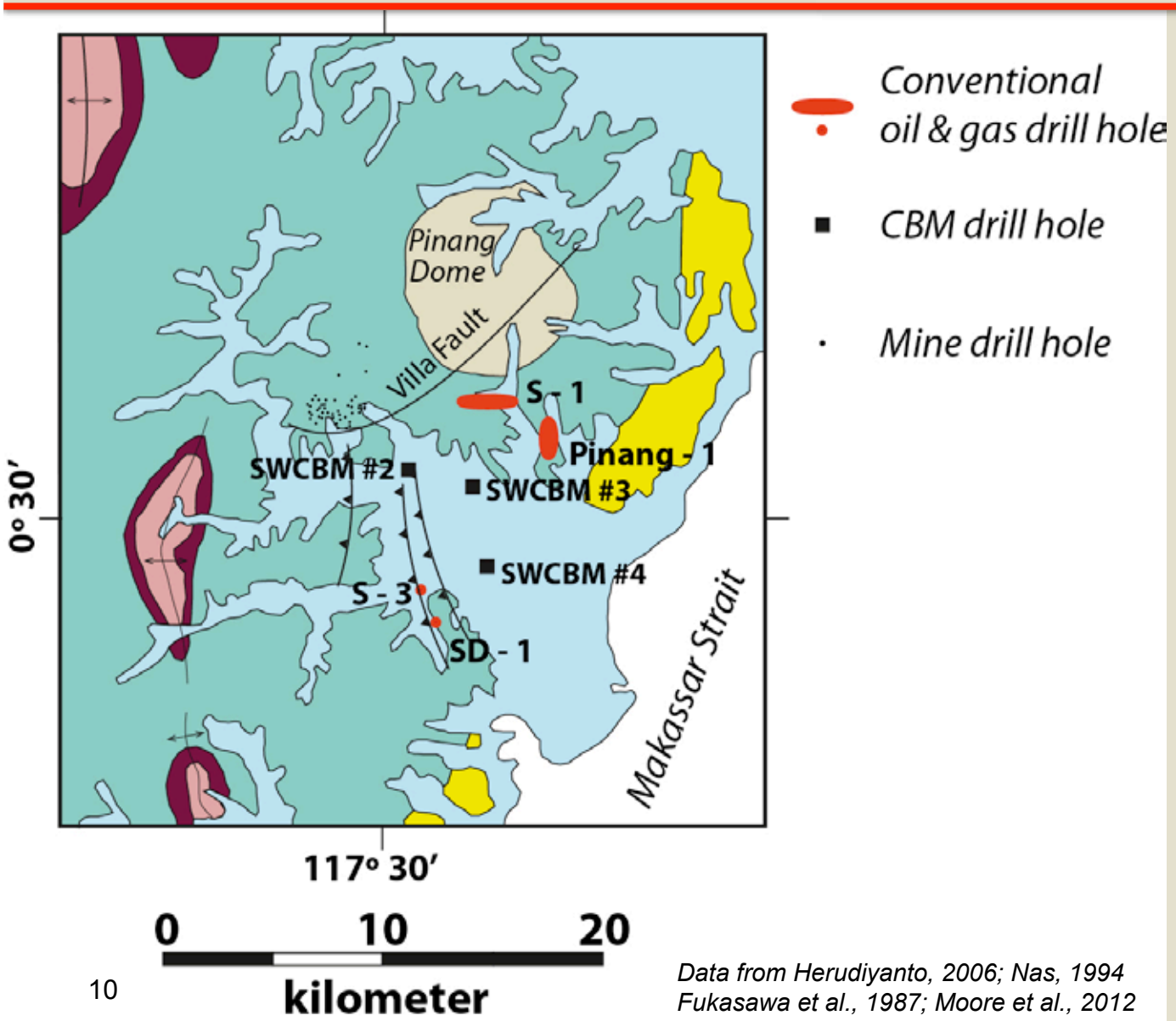
Geophysical surveys: Bouguer gravity anomaly (numerous references)

Data Limitations

- More data is out there – but very hard to obtain
- Some data is available, but not allowed to use
- Contradictory/imprecise locations for some data
- Not enough documentation on data collection and analysis methods

€ipher

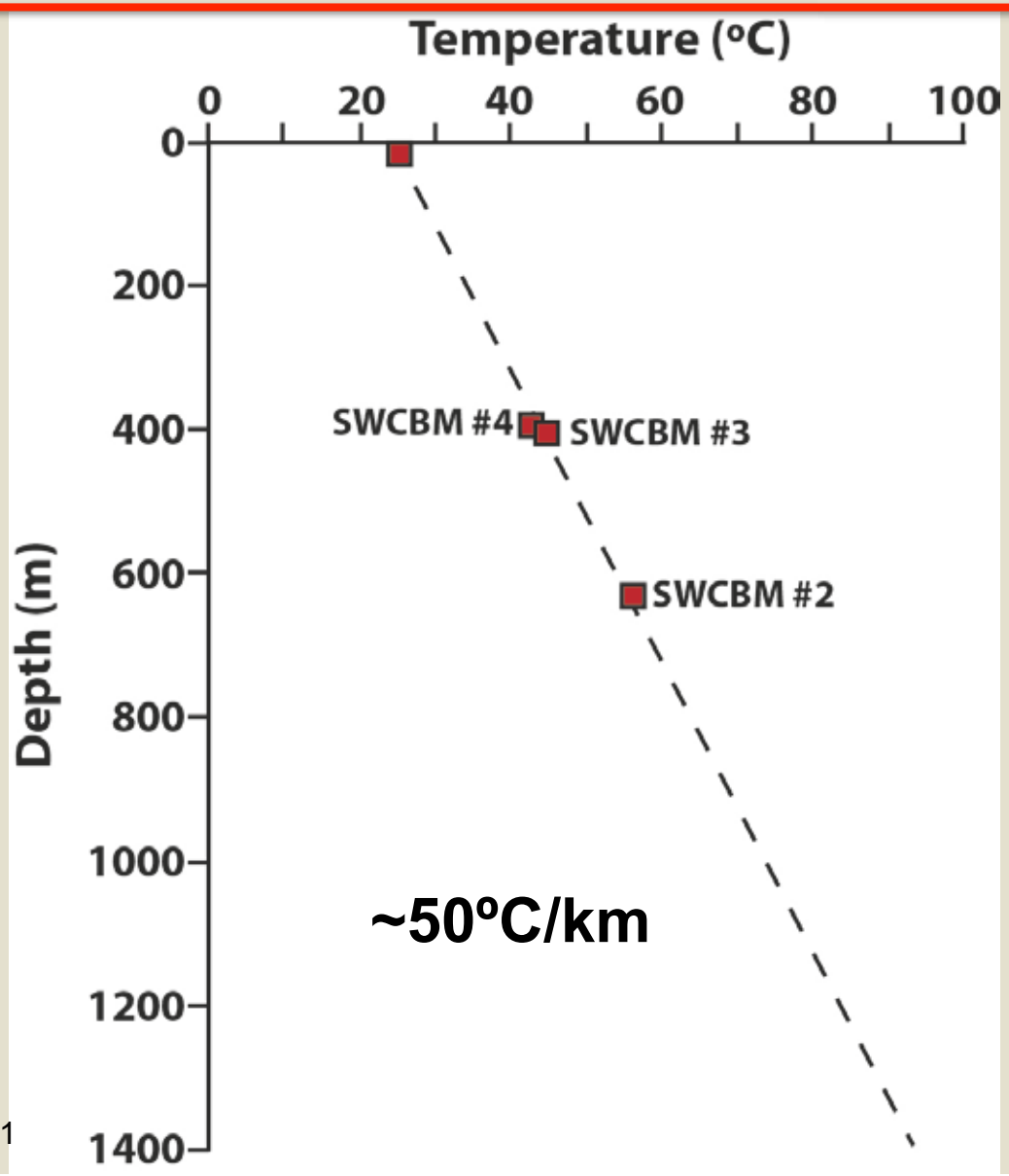
Data Distribution



Data from Herudiyanto, 2006; Nas, 1994
Fukasawa et al., 1987; Moore et al., 2012

Cipher

Geothermal Gradient



REGIONAL:

- 27° - 36°C/km (Kenyon et al., 1976)
- 30° - 39°C/km (Thamrin, 1985)

WELLS:

- SD-1 – 17° C/km

Cipher

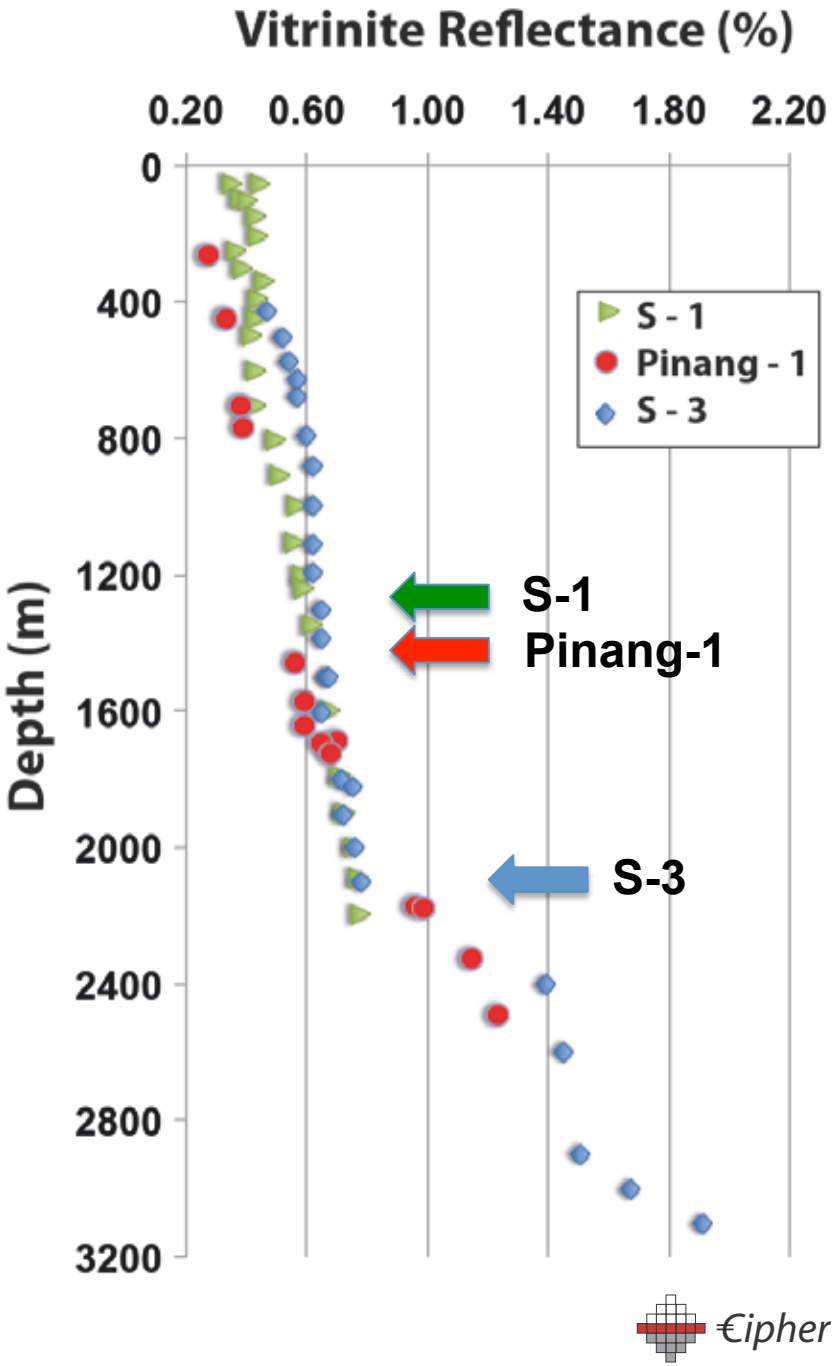
Conventional O&G wells

Bottom of the Balikpapan Fm:

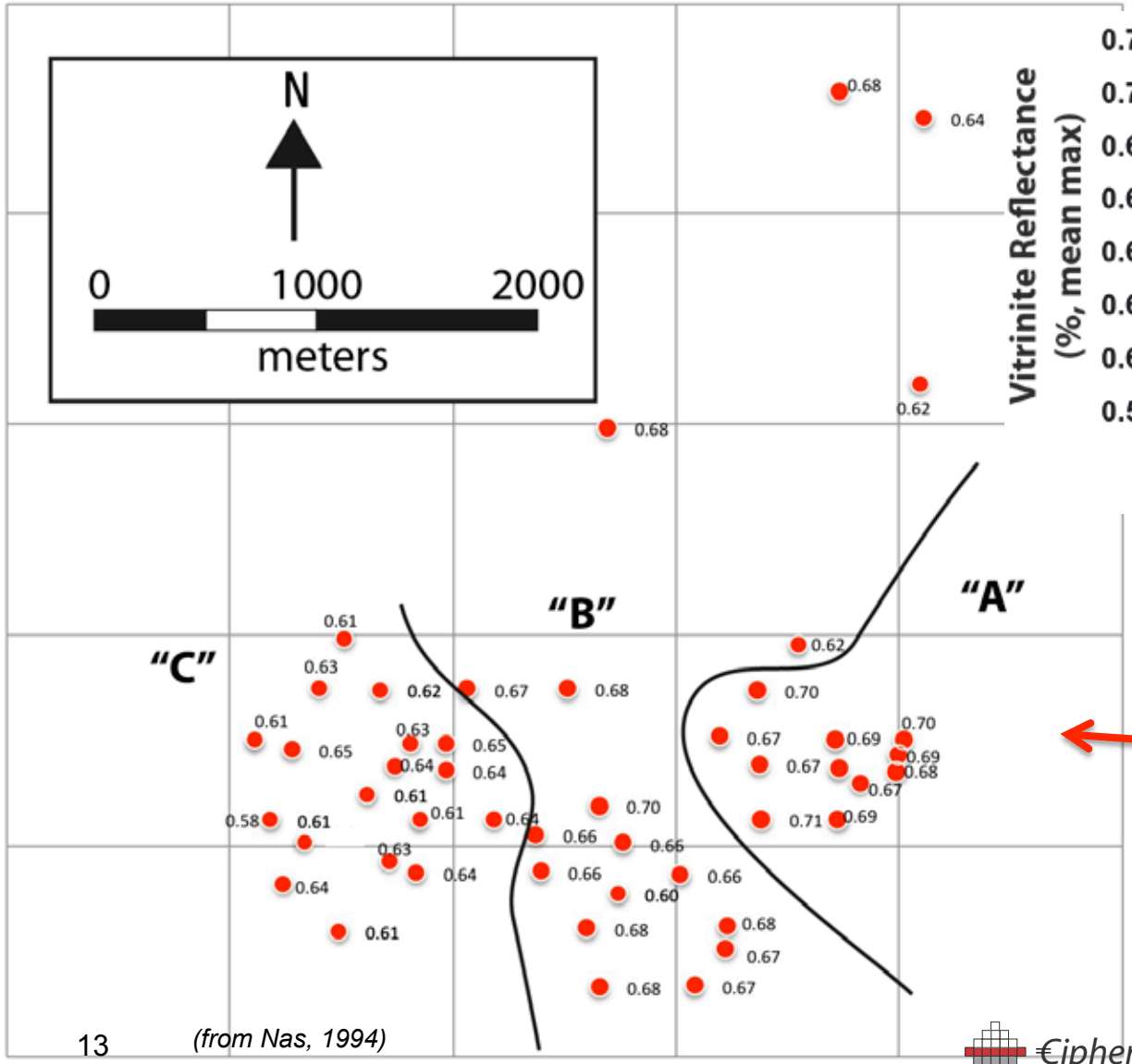
S-3:	2100 m
Pinang -1:	1372 m
S-1:	1250 m

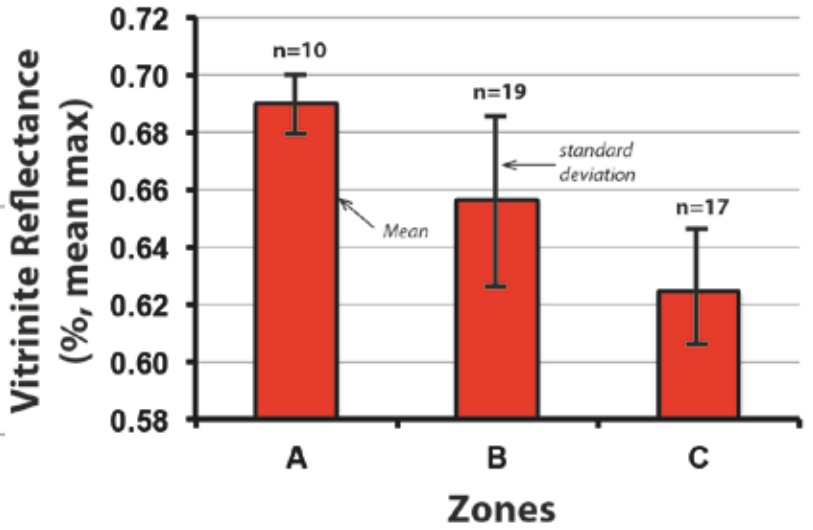
Rate of Vr increase down hole:

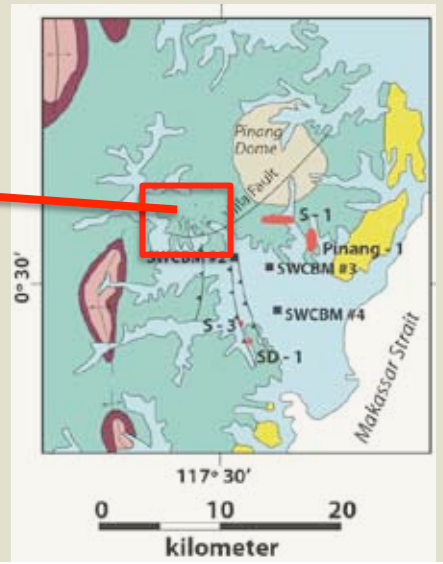
S-3:	0.19%/1000 m (0.74% lower)
Pinang -1:	0.24%/1000 m (0.83% lower)
S-1:	0.20%/1000 m



Mine Data: Vitrinite Reflectance Sangatta Coal Seam



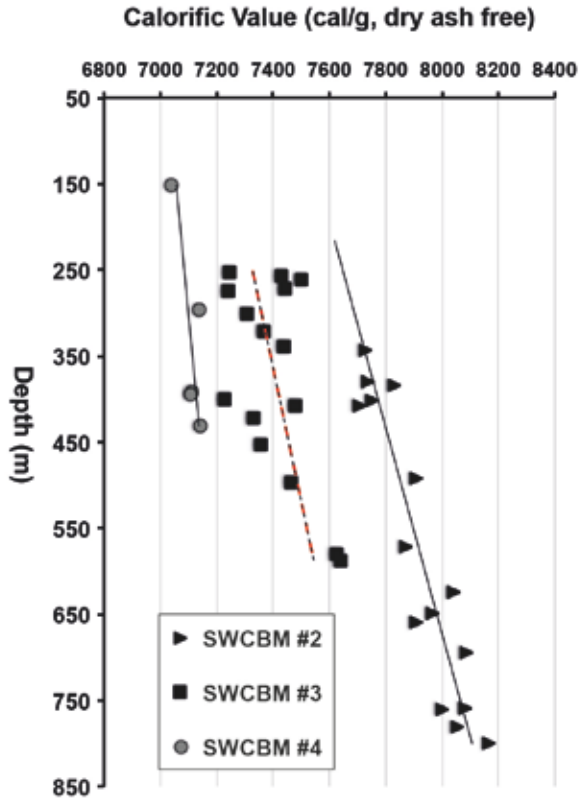


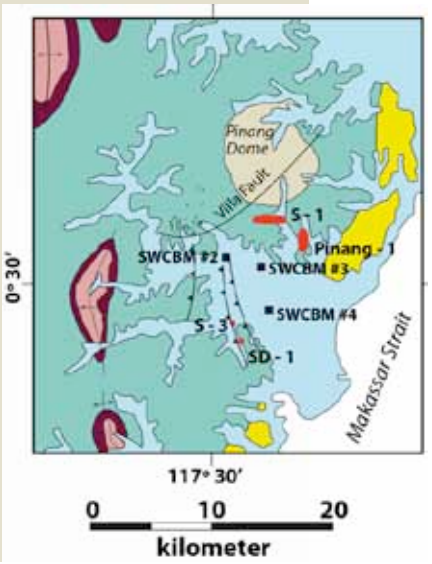


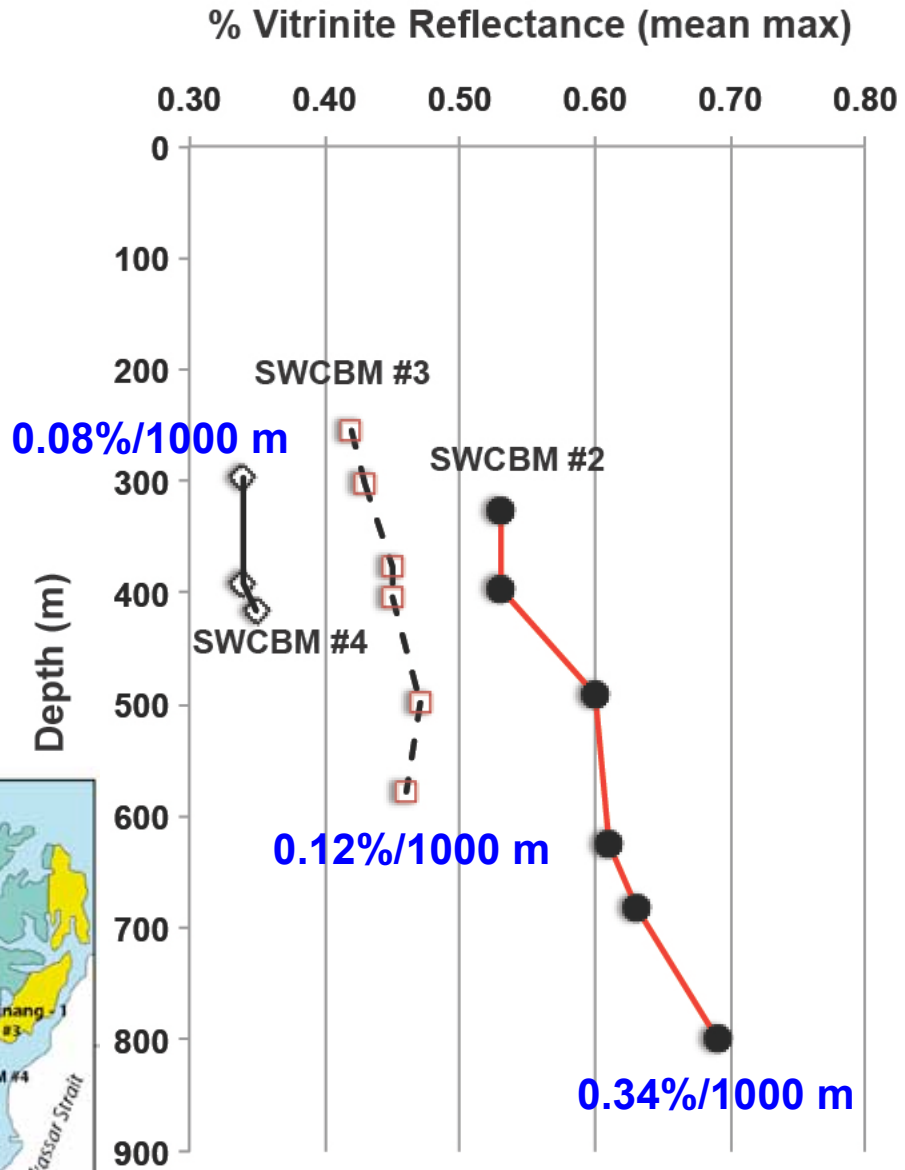
(from Nas, 1994)

Cipher

More Recent Data: Vitrinite Reflectance



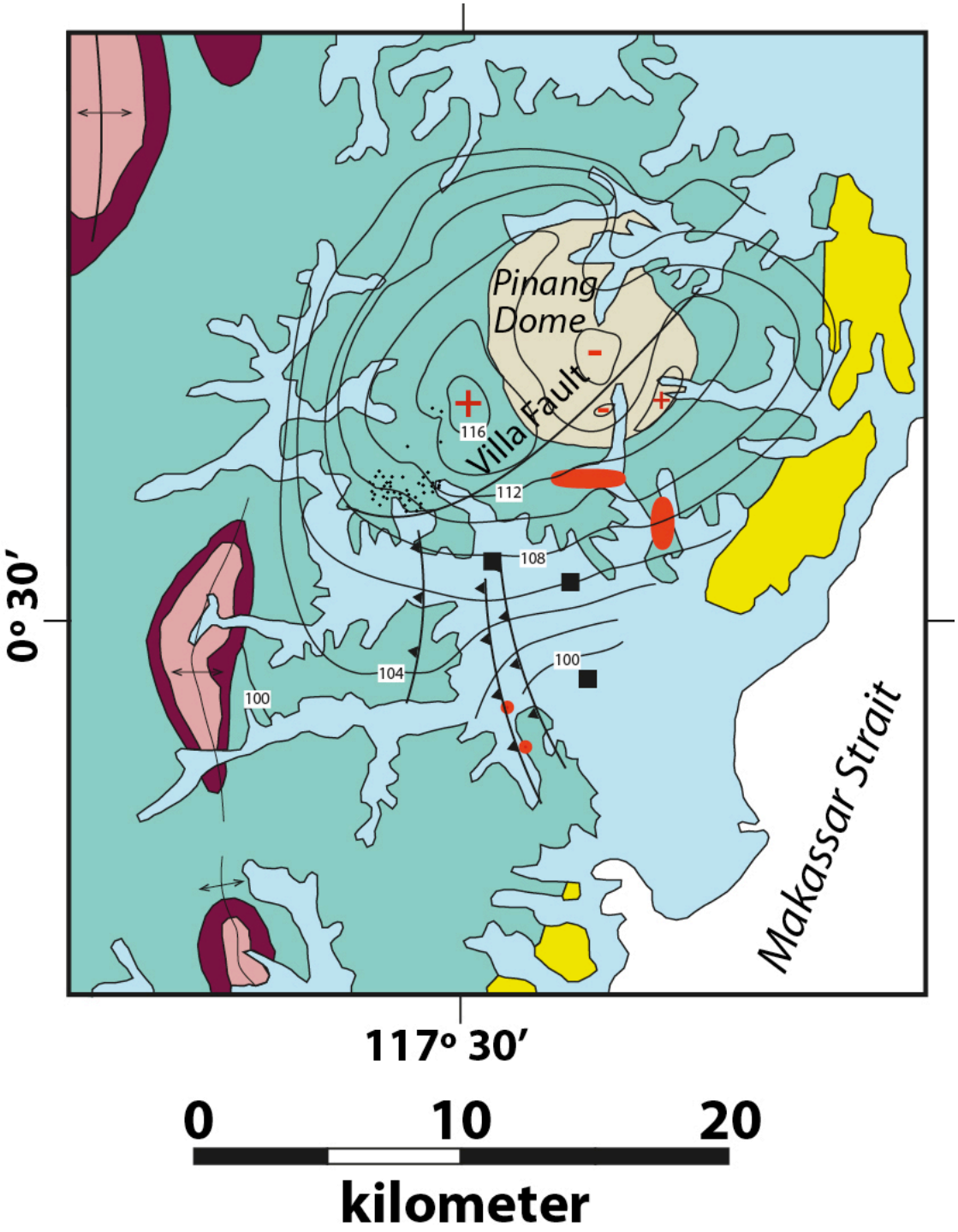




Cipher

Bouguer Gravity Anomaly

- There is a Bouguer Gravity Anomaly high associated with the Pinang Dome
- The high values are not perfectly centered over the Pinang Dome
- The highest values are to the west and southwest of the dome
- The high values indicate the presence of more dense rocks at some depth.



Cipher

Summary

1. The
   area
2. Sev
   dow
   to t
3. Two
   'nor
   the
   0.34
4. Vr c
   Dor
   has
5. High
   SW
   sug
   arou
6. High
   asso

ome

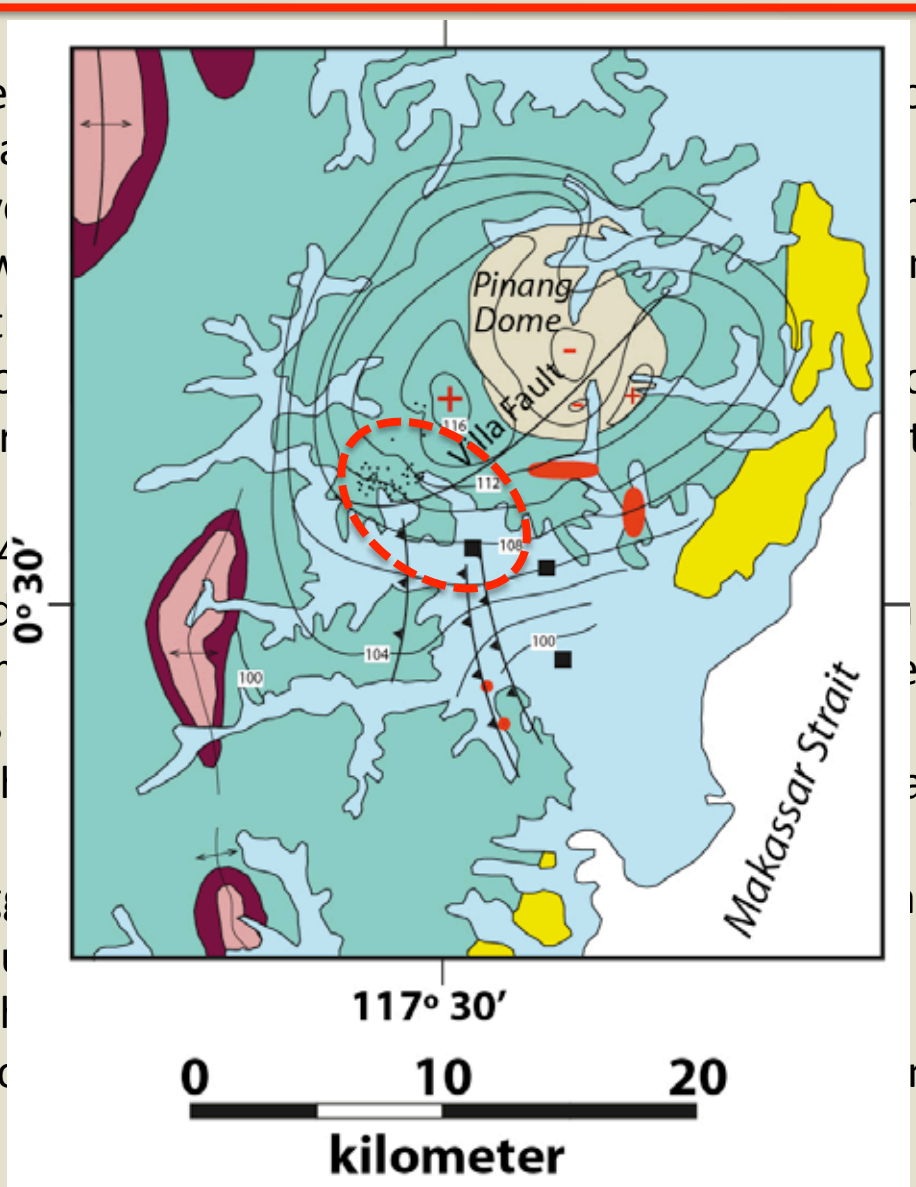
mal'
n close

ch have
than
about

ng
e and

and/or
that
lly

me



Conclusions

- **Does rank increase towards the Pinang Dome?**

  Yes, though it appears not uniformly

- **What is the cause of any rank increase?**

  The rank increase could only be an apparent increase and related to relative stratigraphic position

  But, the presence of a high geothermal gradient, high Bouguer Gravity Anomaly values *and* rank increases in coal seams, suggests a heat source at depth.

  A caveat: heat flow in the area is obviously complex, and it would be erroneous to assume a uniform increase in organic maturation from all directions towards the center of the Pinang Dome

Implications

- **Only the western and southwestern areas around the Pinang Dome may have coal ranks in the bituminous rank range (and thus have high graded value)**

- **Methane generated from the coal in the higher rank areas will be thermogenic, and thus the reservoir may be fully gas saturated. However, CO_2 may be an issue as a 'contaminant'.**