

# **GEOLOGY OF THE LANGKAWI-TARUTAO TRANSECT AREA ALONG THE MALAYSIA-THAILAND BORDER**

**11 SEPTEMBER 2013  
DE' GARDEN HOTEL,  
BUTTERWORTH, P.PINANG**

**By  
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**The Transect area on the Thai side = 360 sq. km**

Ko Tarutao

06° 30' N to 06° 45' N

99° 30' E to 99° 45' E,

Ban Ko Adang

06° 25' N to 06° 40' N

99° 08' E to 99° 23' E.

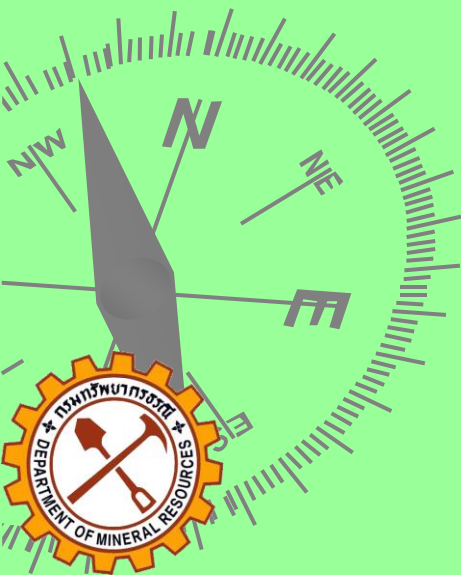


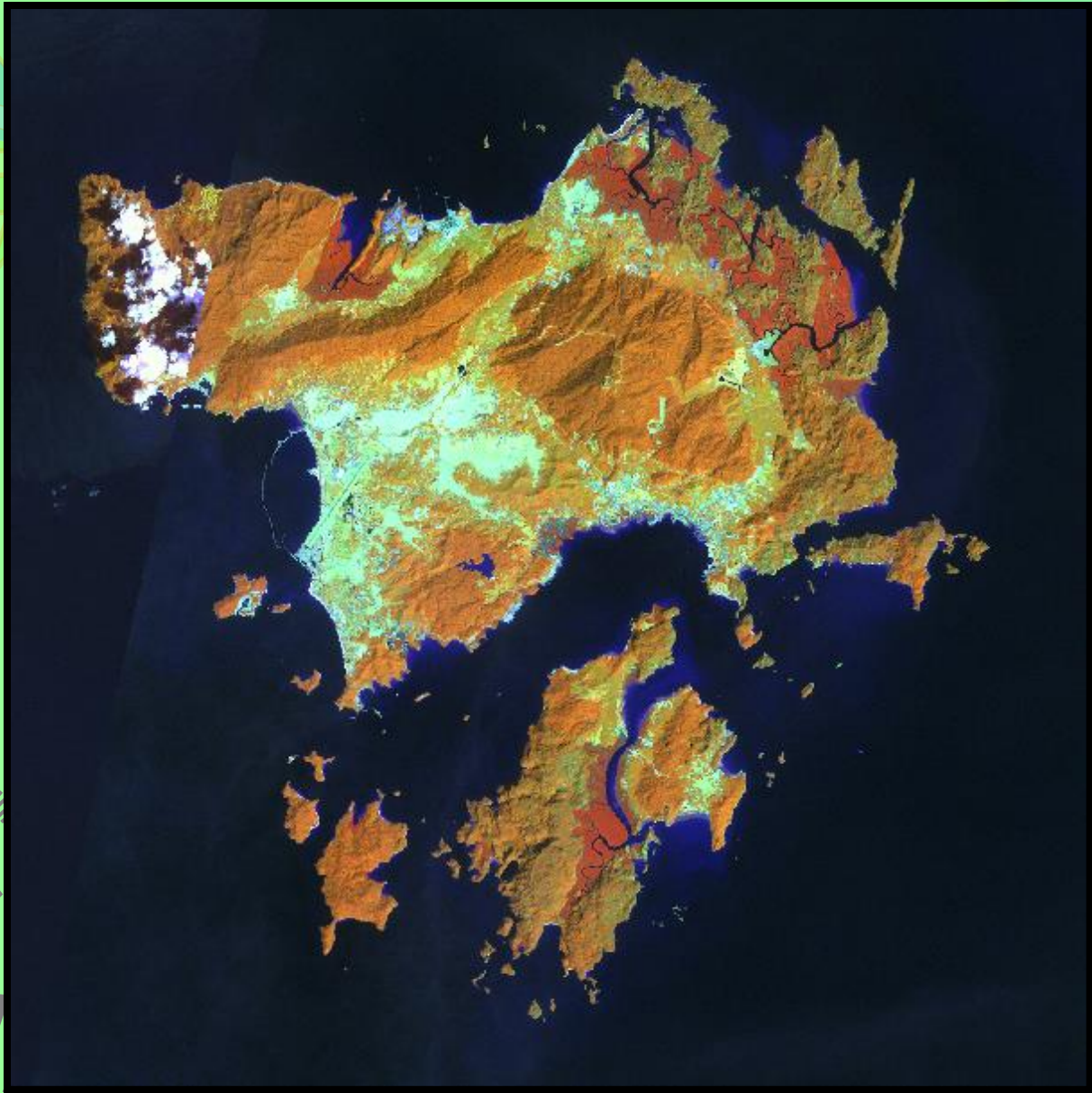
**The Malaysian side of the Transect = 478 sq. km**

6° 09'N to 6° 29'N

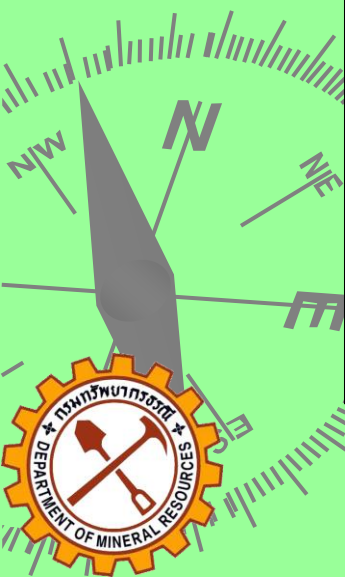
99° 38'E to 99° 57'E

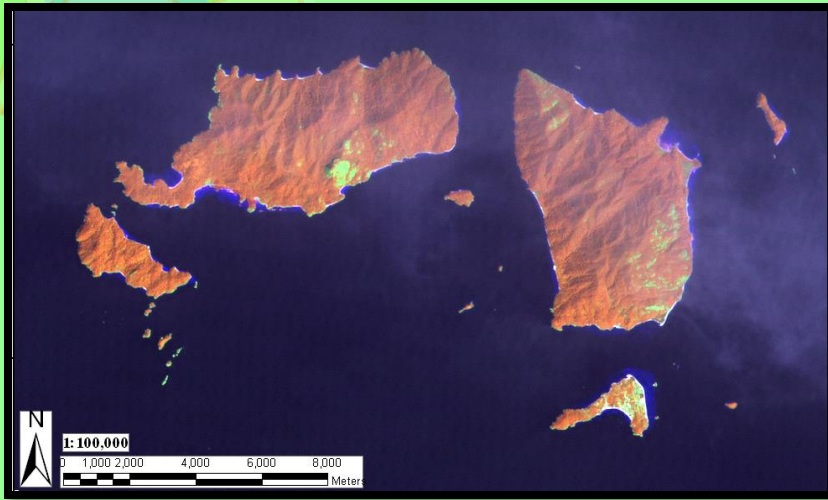
(Langkawi Islands)



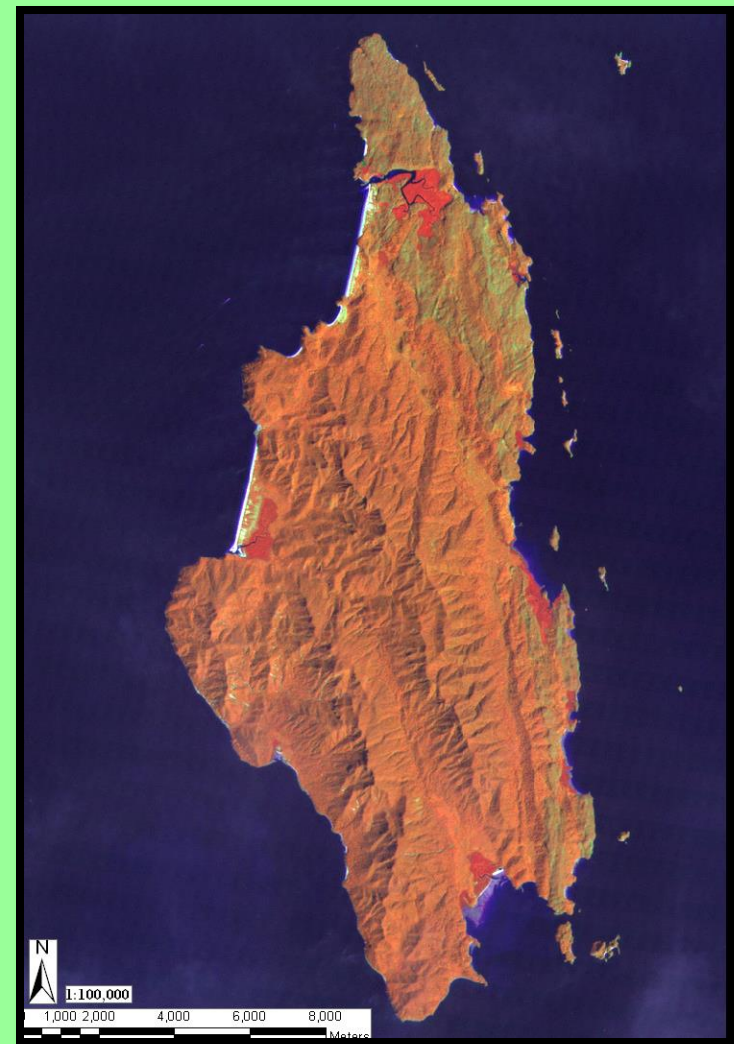


False colour composite (RGB 453) Landsat  
TM image of Langkawi Islands





Landsat TM satellite image of the Transect area (Adang-Rawi area:Thai side)



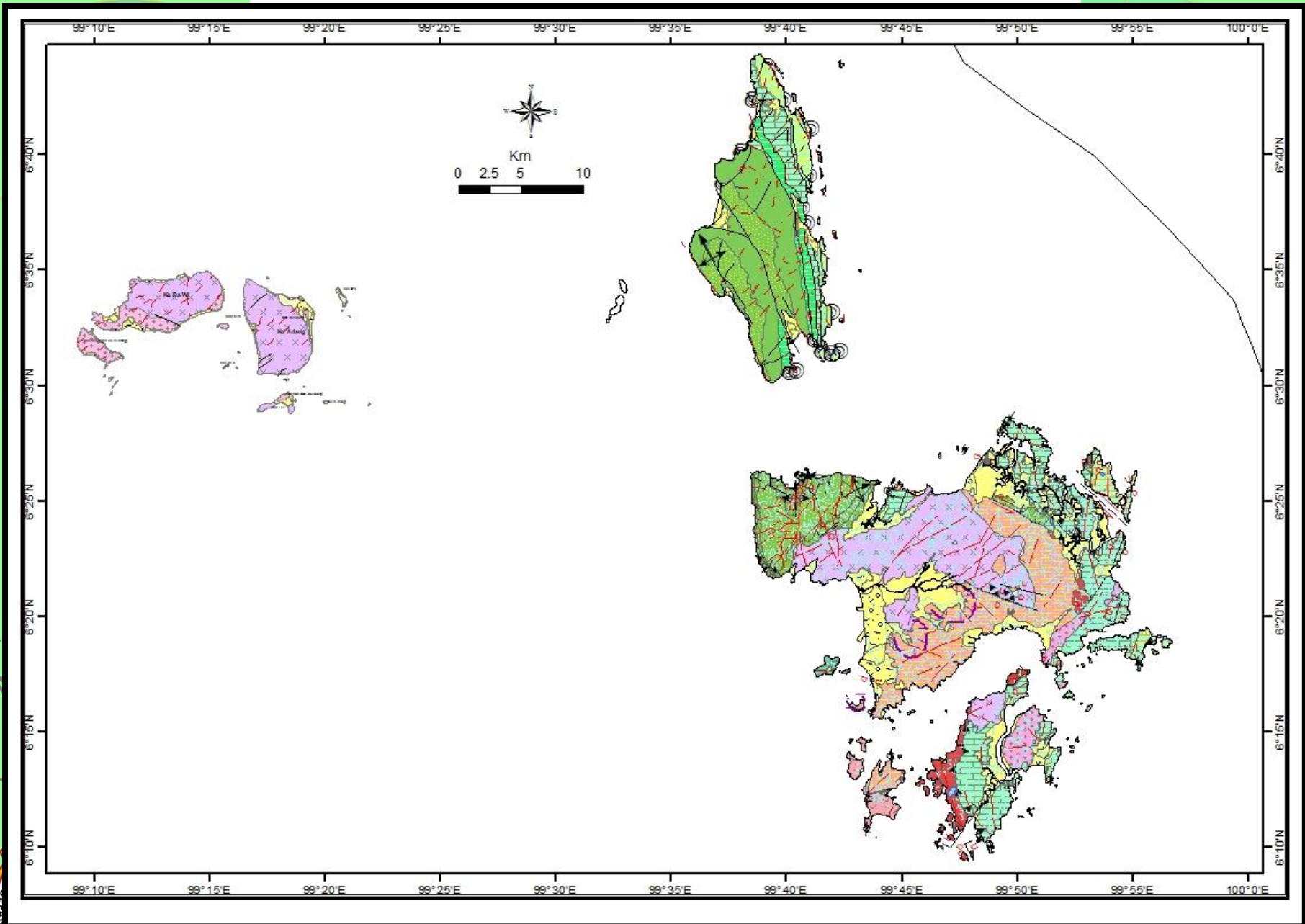
Landsat TM satellite image of the Transect area (Tarutao area:Thai side)



# LITOSTRATIGRAPHY

| LANGKAWI              | TARUTAO                        | AGE                              |                       |
|-----------------------|--------------------------------|----------------------------------|-----------------------|
| CHUPING FORMATION     |                                | EARLY TO MIDDLE PERMIAN          | WHITE LIMESTONE       |
| SINGA FORMATION       | -Khao Chao Fm<br>-Khao Phra Fm | MIDDLE DEVONIAN TO EARLY PERMIAN | GREY MUDSTONE         |
| REBAK FORMATION       |                                | MIDDLE TO UPPER DEVONIAN         | RED & GREY MUDSTONE   |
| JENTIK FORMATION      |                                | DEVONIAN                         | BLACK SHALE           |
| SETUL FORMATION       | THUNG SONG GROUP               | ORDOVICIAN                       | GREY LIMESTONE        |
| MACHINCHANG FORMATION | TARUTAO GROUP                  | CAMBRIAN-ORDOVICIAN              | INTERBEDDED SANDSTONE |





## MACHINCHANG FM / TARUTAO GROUP

Machinchang Formation/Tarutao Group covers an area of 52 km<sup>2</sup> in the northwestern part of Pulau Langkawi and extends to a small island nearby; Pulau Jemuruk. It extends northwardly into the Thailand frontier.



Gunung Machinchang (Machinchang Cambrian Geoforest Park) - thickly-bedded sandstone



## MACHINCHANG FM / TARUTAO GROUP

| <b>MACHINCHANG FORMATION</b> | <b>TARUTAO GROUP</b> | <b>LITHOLOGY</b>   |
|------------------------------|----------------------|--|
| JEMURUK MEMBER               | TALO WOW FORMATION   | Well-bedded and well-foliated grey sandstone with fossiliferous beds |
| CHINCHIN MEMBER              | AO MO LAE FORMATION  | Thick comprise grey & light purplish sandstone                       |
| ANAK DATAI MEMBER            | AO TAMI FORMATION    | Graded-bedded, cross-bedded pebbly sandstone & conglomerate          |
| HULOR MEMBER                 | AO MAKHAM FORMATION  | Grey fine clayey sandstone, fine sandstone & siltstone               |



# MACHINCHANG FM / TARUTAO GROUP



Lower part of the Ao Mo Lae Formation at Ao Son, western part of the Tarutao Island



Wave erosion features along the joints on the sandstone beds at Tanjung Buta, Langkawi



Closed- up view of giant spines of trilobites in the Ao Mo Lae Formation



Trace fossil *Dictyodora* sp. on the sandstone bed of the Jemuruk Member/Talo Wow Formation at Pulau Jemuruk



# SETUL FORMATION/ THUNG SONG GROUP

| <b>AGE</b> | <b>ROCK UNITS</b>    |                        |  |                    |                                  |   |
|------------|----------------------|------------------------|--|--------------------|----------------------------------|---|
|            | <b>MALAYSIA SIDE</b> |                        | <b>THAI SIDE</b>                         |                    | <b>LANGKAWI-TARUTAO TRANSECT</b> |   |
| Devonian   | Setul Formation      | Mempelam Member        | Thung Song Group                         | Rung Nok Formation | Setul Formation/Thung Song Group | Mempelam Member                           |
| Silurian   |                      |                        |  |                    |                                  |   |
| Ordovician |                      | Tanjong Dendang Member |  | Lae Tong Formation |                                  | Tanjong Dendang Member/Lae Tong Formation |
|            | Kaki Bukit Member    | Pante Malaka Formation | Kaki Bukit Member/Pante Malaka Formation |                    |                                  |   |

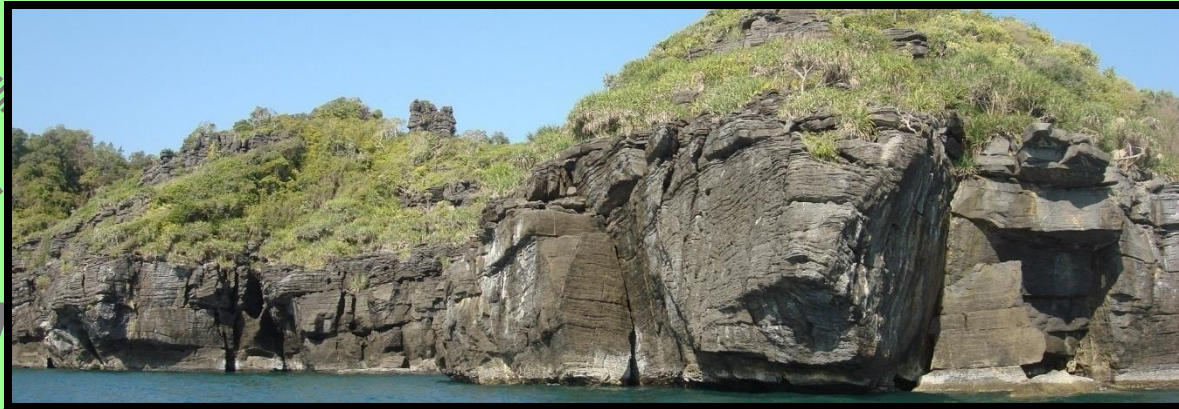
# SETUL FORMATION/ THUNG SONG GROUP



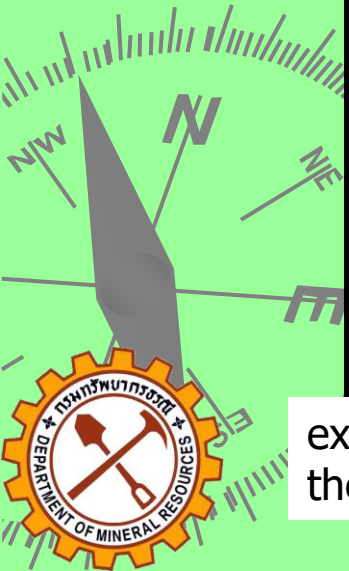
Well-bedded stylolitic limestone of the Mempelam Member ( $SD_{rn}$ ), containing *Scyphocrinites* sp. at Teluk Mempelam, Pulau Langgun



Graptolite bearing dark grey slaty shale (Tanjung Dendang Member) at Teluk Mempelam, Pulau Langgun



exposure of the medium-to thick-bedded limestones, lower part of the Pante Malaka Formation at Malaka creek Tarutao Island



# SETUL FORMATION/ THUNG SONG GROUP



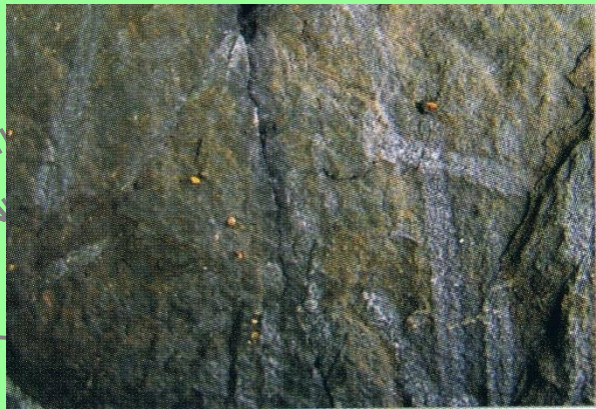
*Malayaspira rugosa*



*Teiichispira kobayashi*



*Climacograptus sp.*



Graptolite from the Lower Detrital Member of the Setul Formation



Pygidium of late Ordovician trilobite



*Scyphocrinites lobiliths*



Red conglomeratic mudstone and light to dark grey quartzite and flag of the late Devonian to Early Carboniferous Rebak Formation overlying part of Jentik Formation

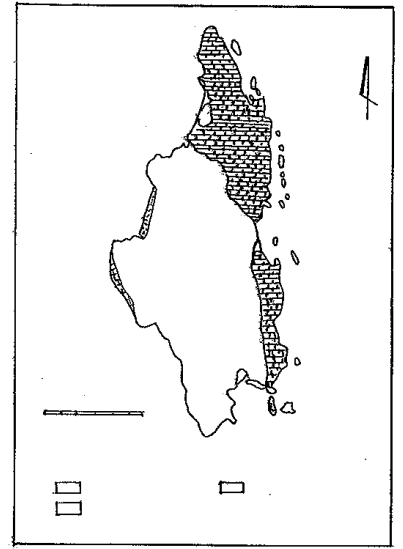
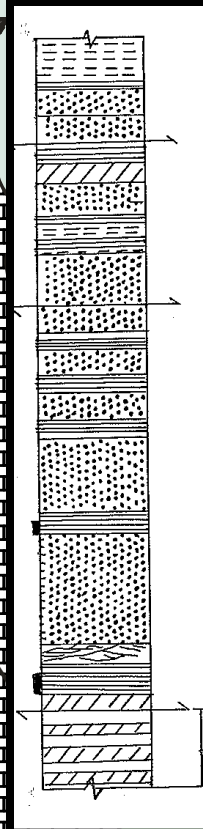
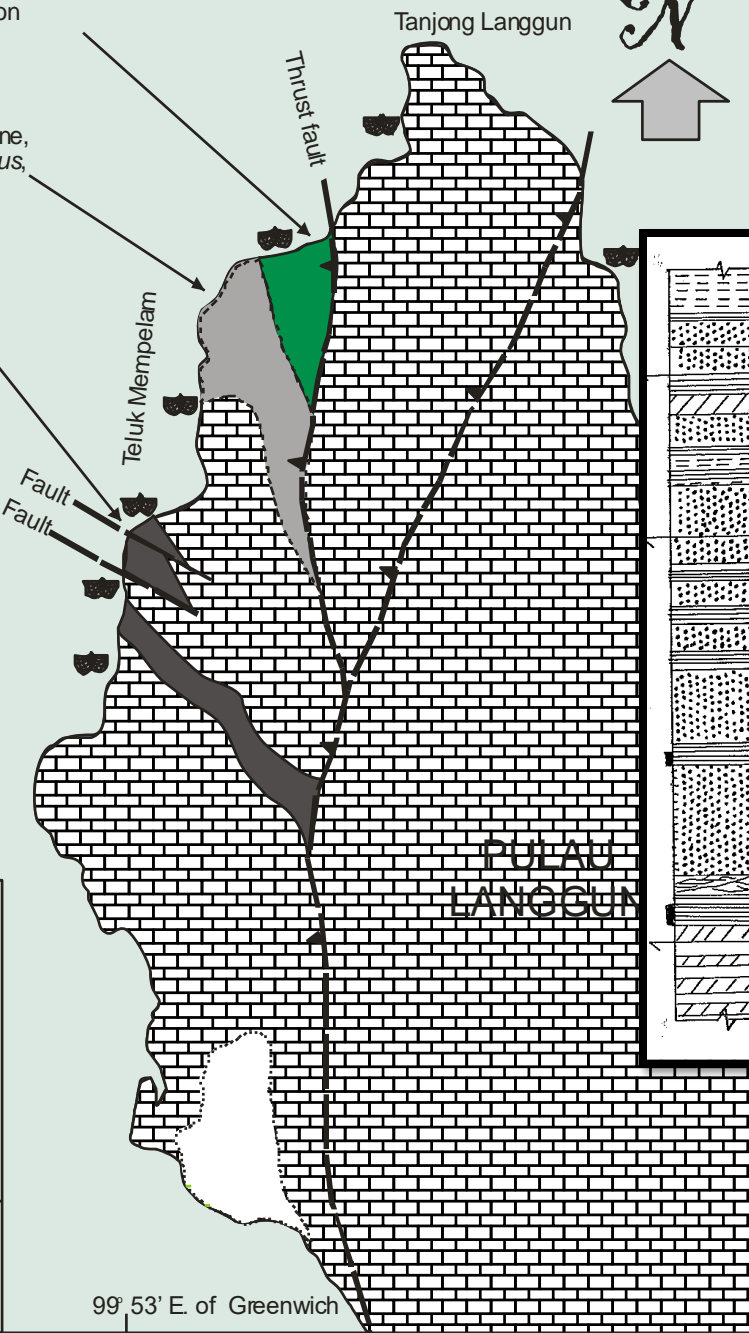
Jentik Formation consisting of contorted reddish grey to grey mudstone, siltstone and quartzite with *Monograptus*, and tentaculitids at the base

Lower Detrital Member consisting of black carbonaceous flag and cherty rocks with *Monograptus*, *Glyptograptus*, *Dalmanitia*, etc.



# SETUL FORMATION/ THUNG SONG GROUP

- LEGEND:**
- Rebak member of the Singa Formation
  - Unconformity
  - Jentik Formation
  - SETUL FORMATION
  - Upper Setul limestone
  - Lower Detrital Member
  - Lower Setul limestone
  - Fossil localities
  - Faults: indicating downthrow side



99° 53' E. of Greenwich

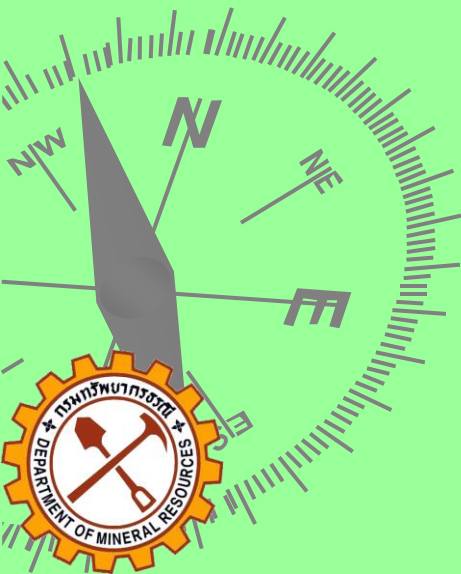


## JENTIK FORMATION

- a. Jentik Fm is well exposed at Teluk Mempelam, Langkawi about 140 m thick. Also at Pulau Tuba, reaches about 300 m thick.
- b. Jentik Fm in Pulau Langgun consist of red-brown sandstone, grey to dark grey mudstone & tentaculitids bearing shale.
- c. These fossil indicate Early Devonian age



Tentaculitids bearing dark grey shale



## REBAK FORMATION

- a. Rebak Fm is well exposed in Pulau Rebak Besar, Pulau Rebak Kechil, Pulau Selat Senari & Teluk Mempelam in Pulau Langgun
- b. Rebak Fm consist of red & grey mudstone and shale with intercalation of sandstone.



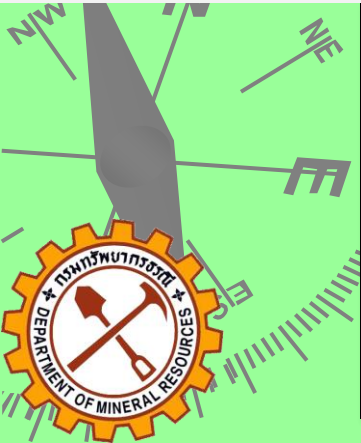
Red & grey sandstone sequence, Langgun Island



Sandstone outcrop at Rebak Besar Island



Selat Senari Islands consists of sandstone



# REBAK FORMATION



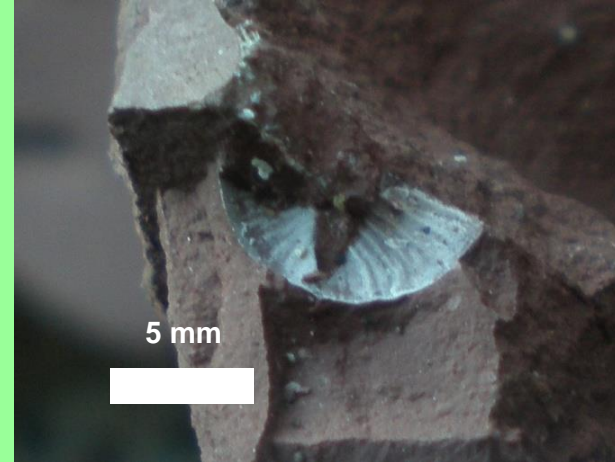
# REBAK FORMATION

At Pulau Rebak Besar



Mudstone bed on the western coast

At Pulau Langgun



Pygidium of small-sized trilobite



*Posidonomya* sp. found in the mudstone



*Posidonomya* sp. in red mudstone



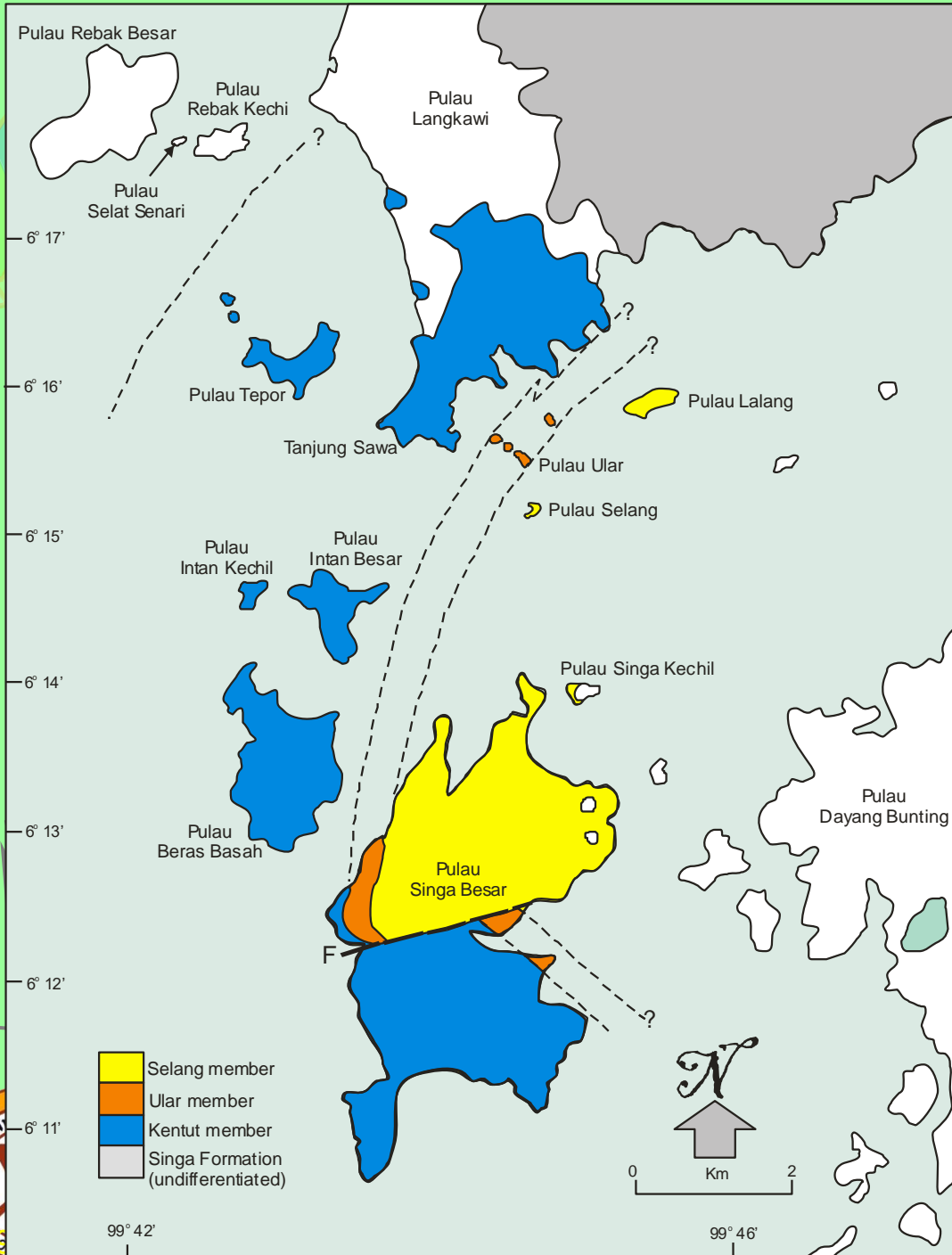
# SINGA FORMATION

| AGE     | ROCK UNITS      |               |                     |                     |   |                                       |
|---------|-----------------|---------------|---------------------|---------------------|---|---------------------------------------|
|         | MALAYSIA SIDE   |               | THAI SIDE           |                     | LANGKAWI-TARUTAO TRANSECT               |                                       |
| Permian | Singa Formation |               | Kaeng Krachan Group | Khao Chao Formation | Singa Formation/<br>Kaeng Krachan Group | Khao Chao Formation                   |
|         |                 | Selang Member |                     | Khao Phra Formation |   | Selang Member/Kh<br>ao Phra Formation |
|         |                 | Ular Member   |                     |                     |   | Ular Member                           |
|         |                 | Kentut Member |                     |                     |   | Kentut Member                         |



## SINGA FORMATION

- Singa Fm exposed at the east & south sides of Gunung Raya dome, extended to the southwest of Langkawi
- Khao Chao Formation ( $P_{kc}$ ) is exposed as roof pendants at Adang Island
- Singa Fm comprises predominantly grey to dark grey mudstone, siltstone & mudstone



# SINGA FORMATION



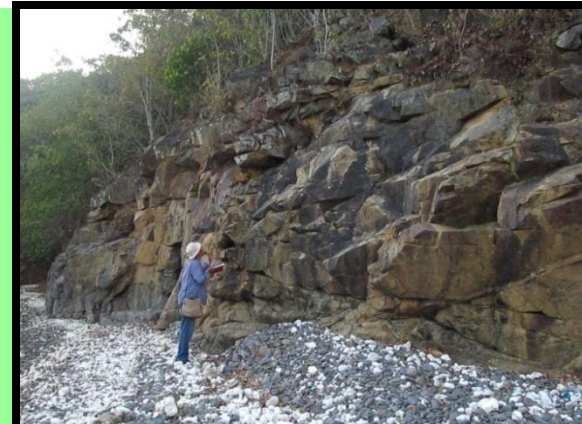
Well bedded dark grey mudstone  
Kentut member at Tepor Island



Thick-bedded sandstones Khao Chao  
Formation at Laem Tayong Baku, Adang  
Island



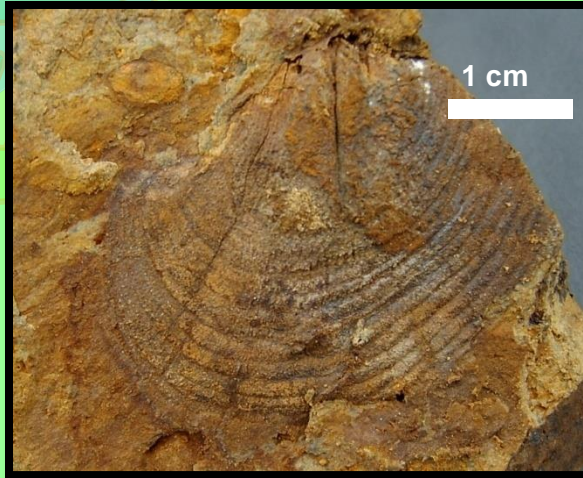
Well bedded dark grey mudstone and  
grey sandstone at Selang Island



Thick sequence mudstones in Khao  
Phra Formation, Burat Island



# SINGA FORMATION



: Bryozoa genus *Fenestella* at  
Kampung Sungai Itau



brachiopod *Spirelytha petaliformis* (Pavlova)  
discovered at Kampung Sungai Itau



U-shaped trace fossil in dark grey  
mudstone at Tepor Island



Thick-shelled, cold-water brachiopod  
*Sulciplea* sp. at Batu Asah, Langkawi



## CHUPING FORMATION

- a. Chuping Fm exposed at Kisap area in the western part of Langkawi & small islands such as Pulau Jong, Gubang Darat & Gubang Laut + western & northern sides of Pulau Dayang Bunting
- a. Thickness of Chuping Fm (Transect area) – 750 to 900m
- b. Chuping Fm – massive or thickly bedded, white to grey crystalline limestone (Setul Fm – grey to dark grey limestone)



# CHUPING FORMATION



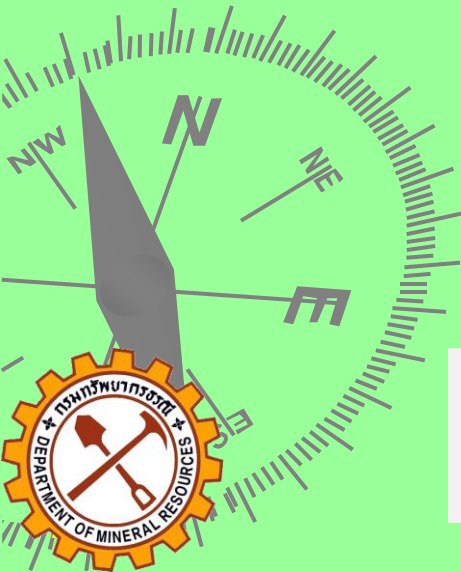
The limestone of the Chuping Formation at Singa Kechil Island



Prominent vessel-shaped Jong Island is made up of limestone of the Chuping Formation



Dayang Bunting Lake, a freshwater doline-lake formed on the limestone of the Chuping Formation at Dayang Bunting Island.



# SUPERFICIAL FORMATION

## PORT WELD MEMBER / AO SON FORMATION

Holocene mangrove deposits in the Beruas area, Perak. It is characterised by abundant of plant remains in the clay and silty layers.



Mangrove (*Rhizophora apiculata*) grows on the eastern of Pulau Dayang Bunting



Close-up view of the *Rhizophora apiculata* at Kampung Kilim area

# SUPERFICIAL FORMATION

## MATANG GELUGOR MEMBER / AO CHAK FORMATION

Matang Gelugor Member consists of unconsolidated beach deposits comprise clay, silt and sand with occasional gravel and shell fragments



Coconut tree (*Cocos nucifera*) at Kg Selat Bagan Nyior, Pulau Tuba

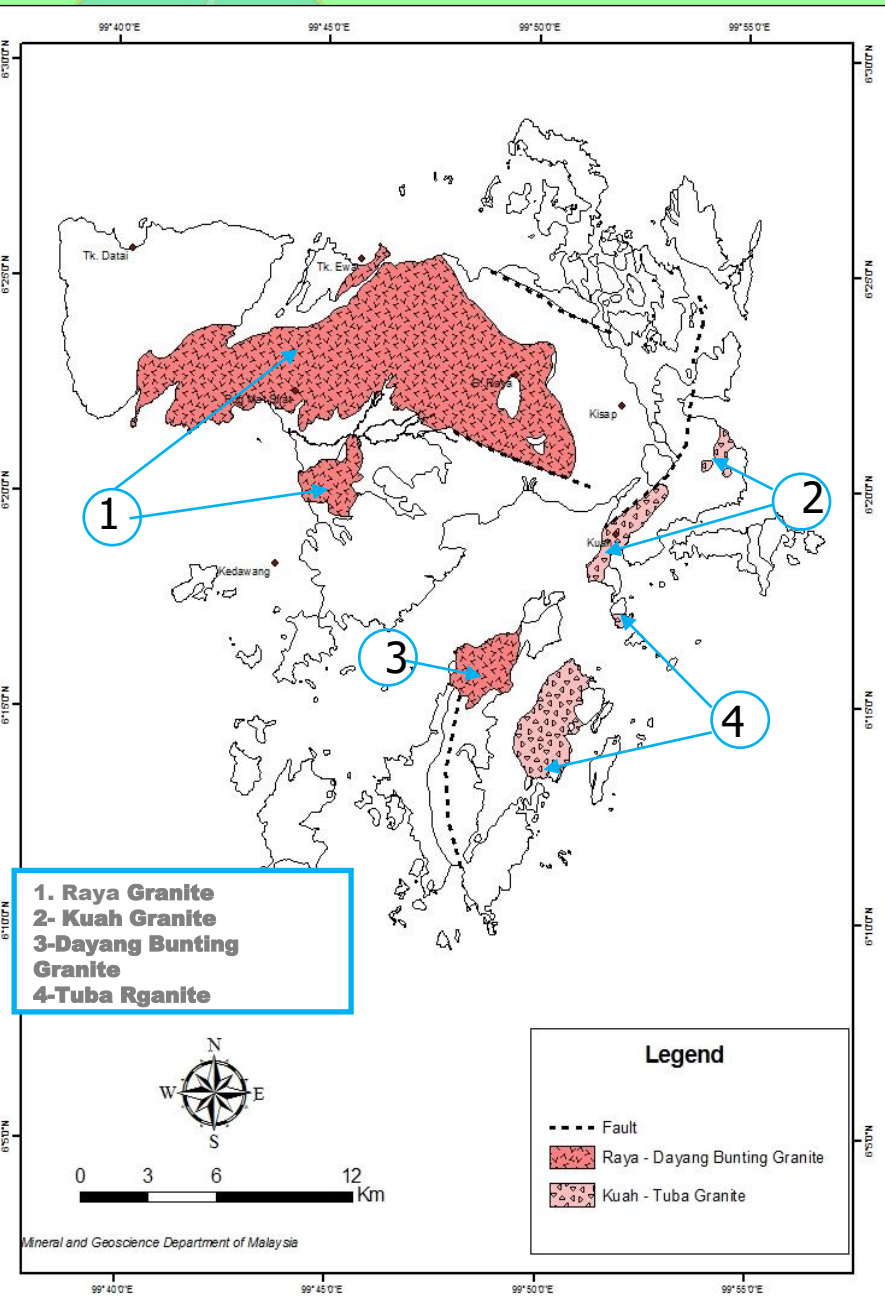


Padang Mat Sirat, Langkawi

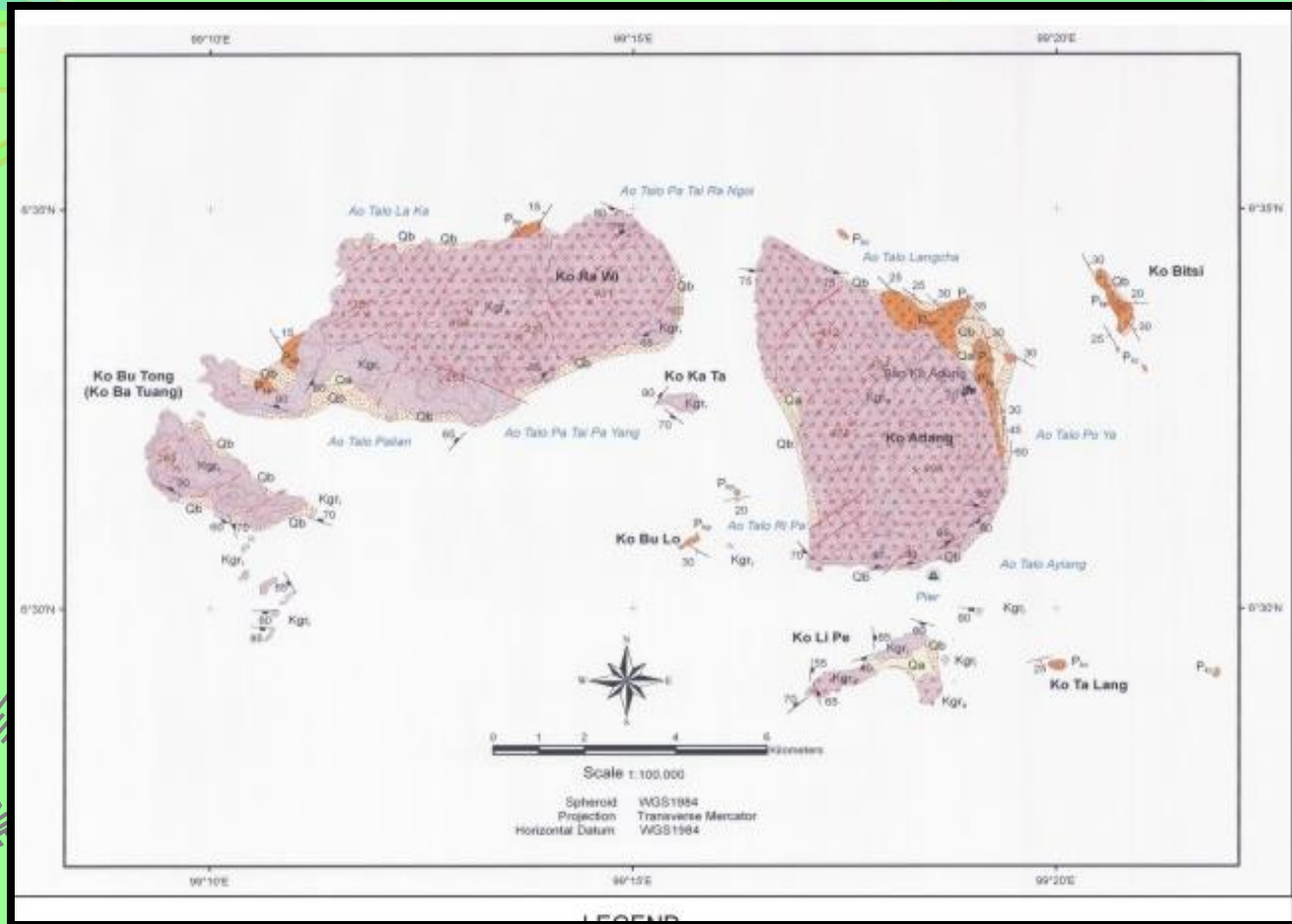


# GRANITE

|   |  |
|---|--|
| Setting   | Western Province                                       |
| Age<br>(Bignell and Snelling, 1977)               | Triassic   |
| Granite classification:<br>(Geochemical Analysis) | 1. Kuah-Tuba granite<br>2. Raya-Dayang Bunting granite |



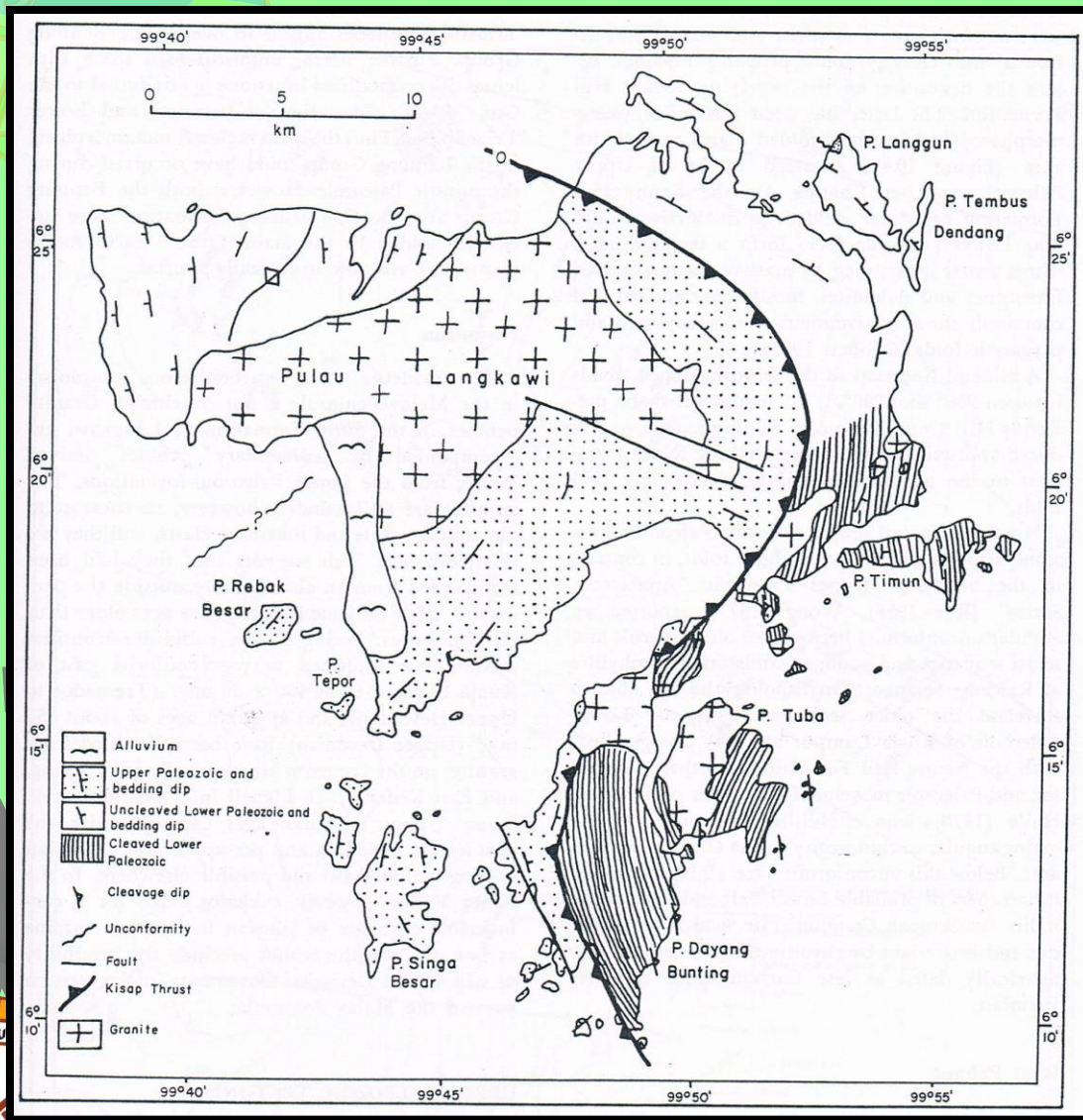
# GRANITE



The distribution of granite in the Adang-Rawi Islands (1- Adang Granite, 2- Rawi Granite)



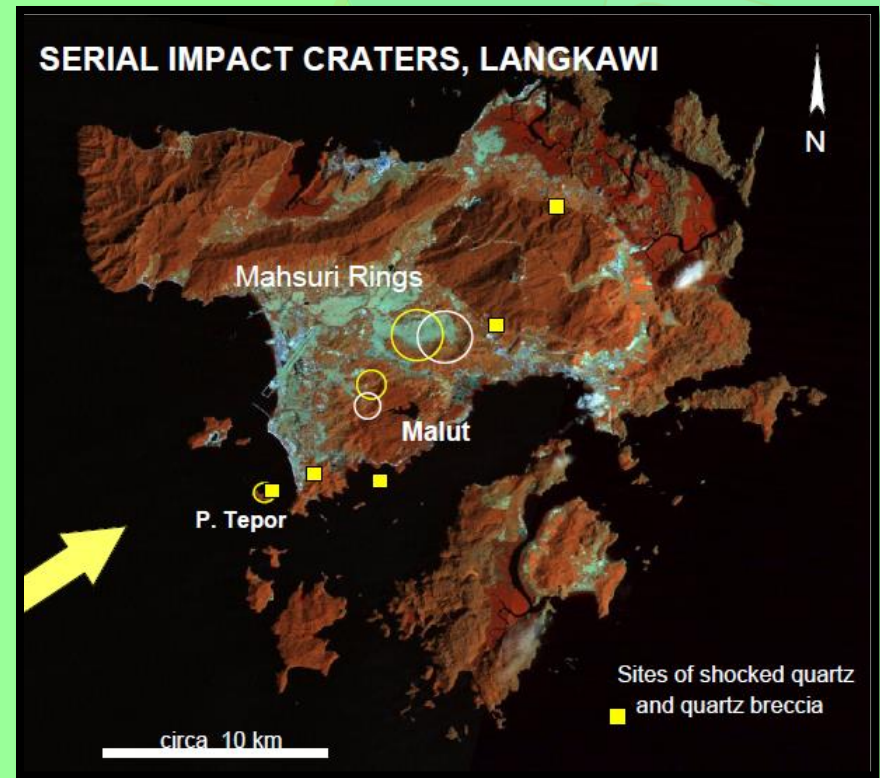
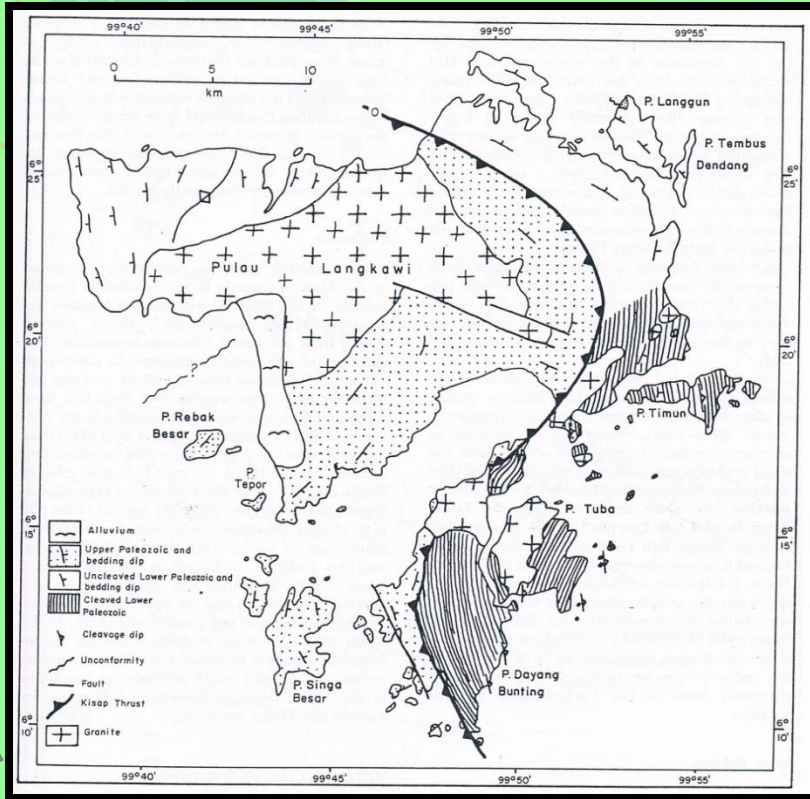
# STRUCTURAL GEOLOGY AND TECTONICS



## LANGKAWI

MAIN FAULT – KISAP  
FAULT

# STRUCTURAL GEOLOGY AND TECTONICS



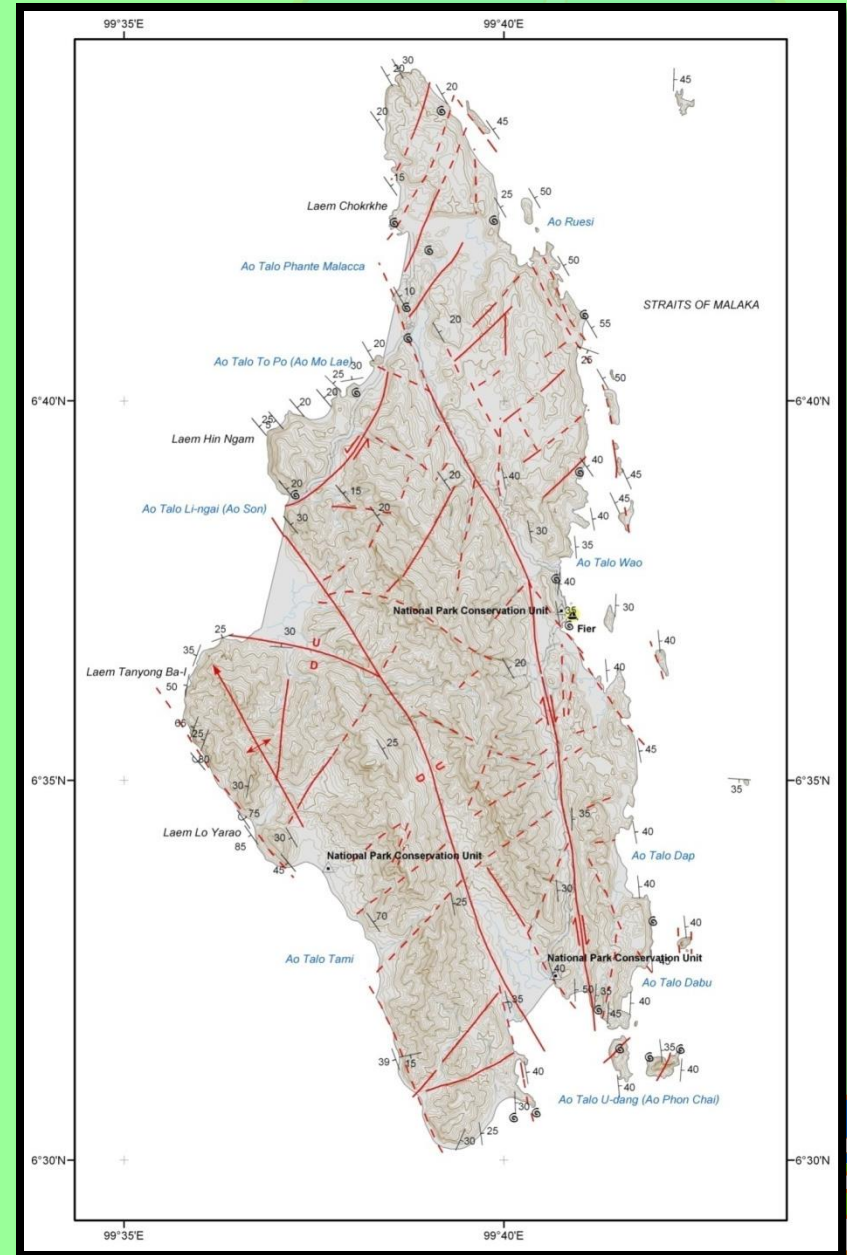
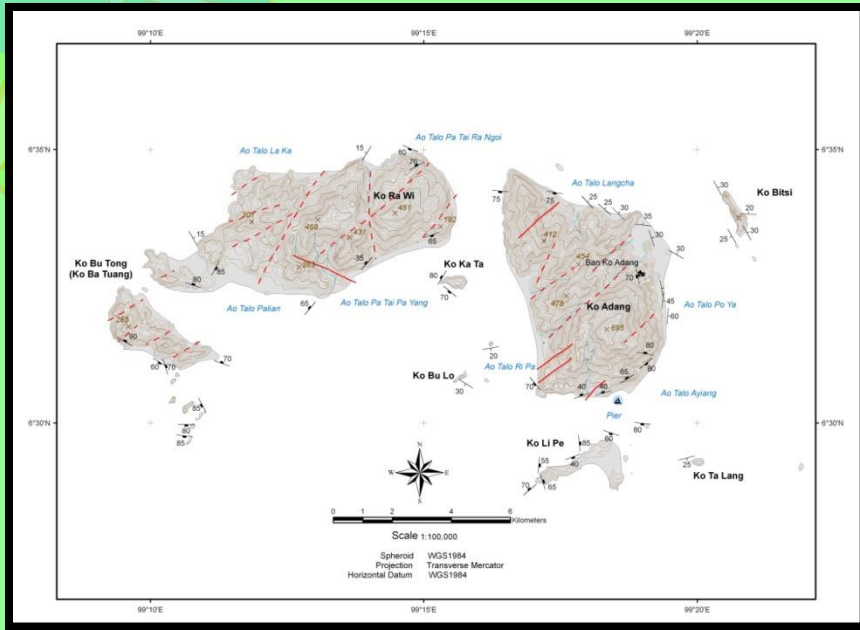
## LANGKAWI ISLAND

MAIN FAULT – KISAP  
FAULT

Location of expected meteorite impact areas (after Tjia, 2002)



# STRUCTURAL GEOLOGY AND TECTONICS



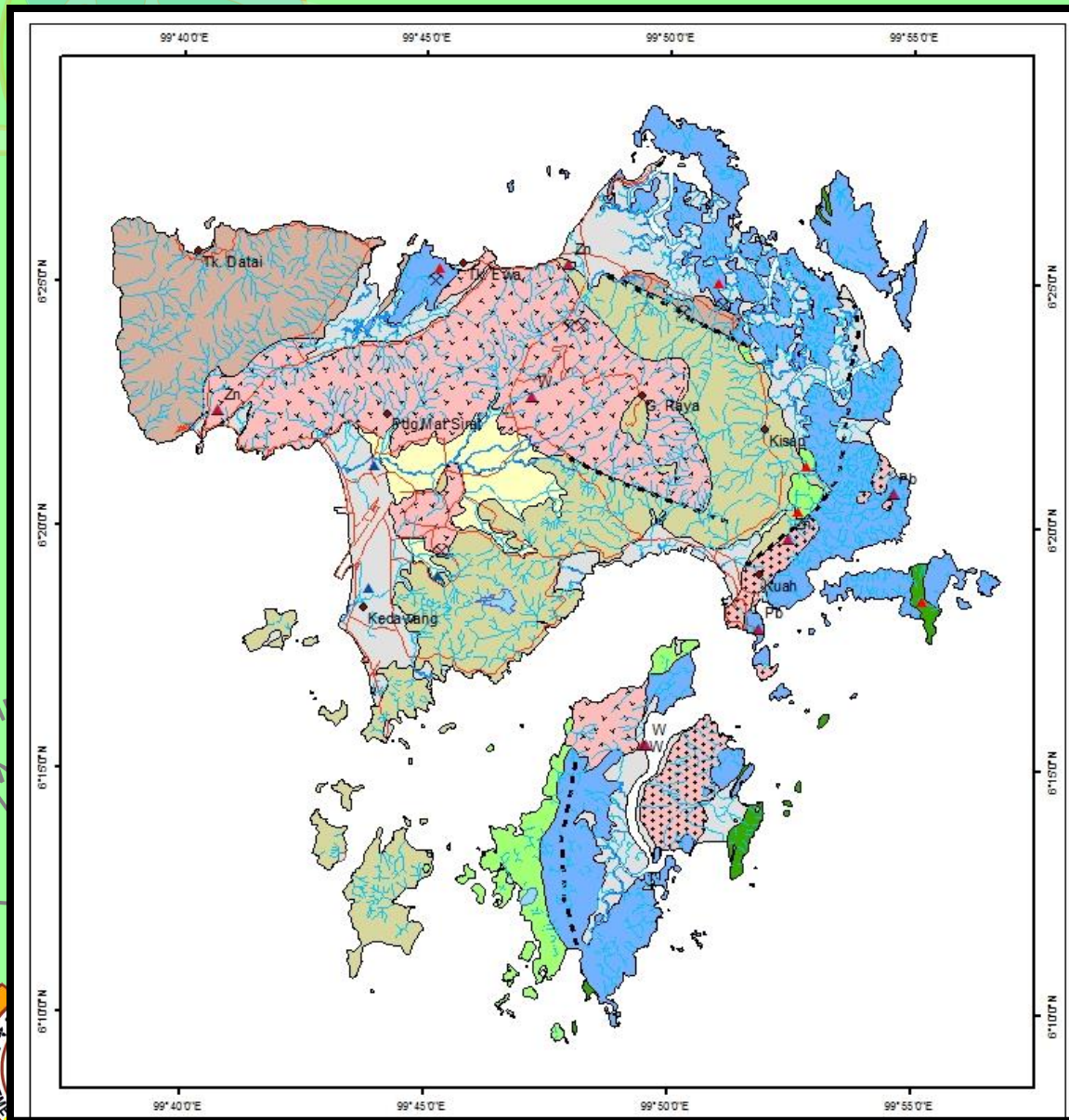
## TARUTAO ISLAND

MAIN FAULT – Ma  
Kham Fault, Talo Dang  
Fault, Mak Lot  
Fault, Rusi Fault

ADANG RAWI – Roof  
Pendant



# MINERAL RESOURCES

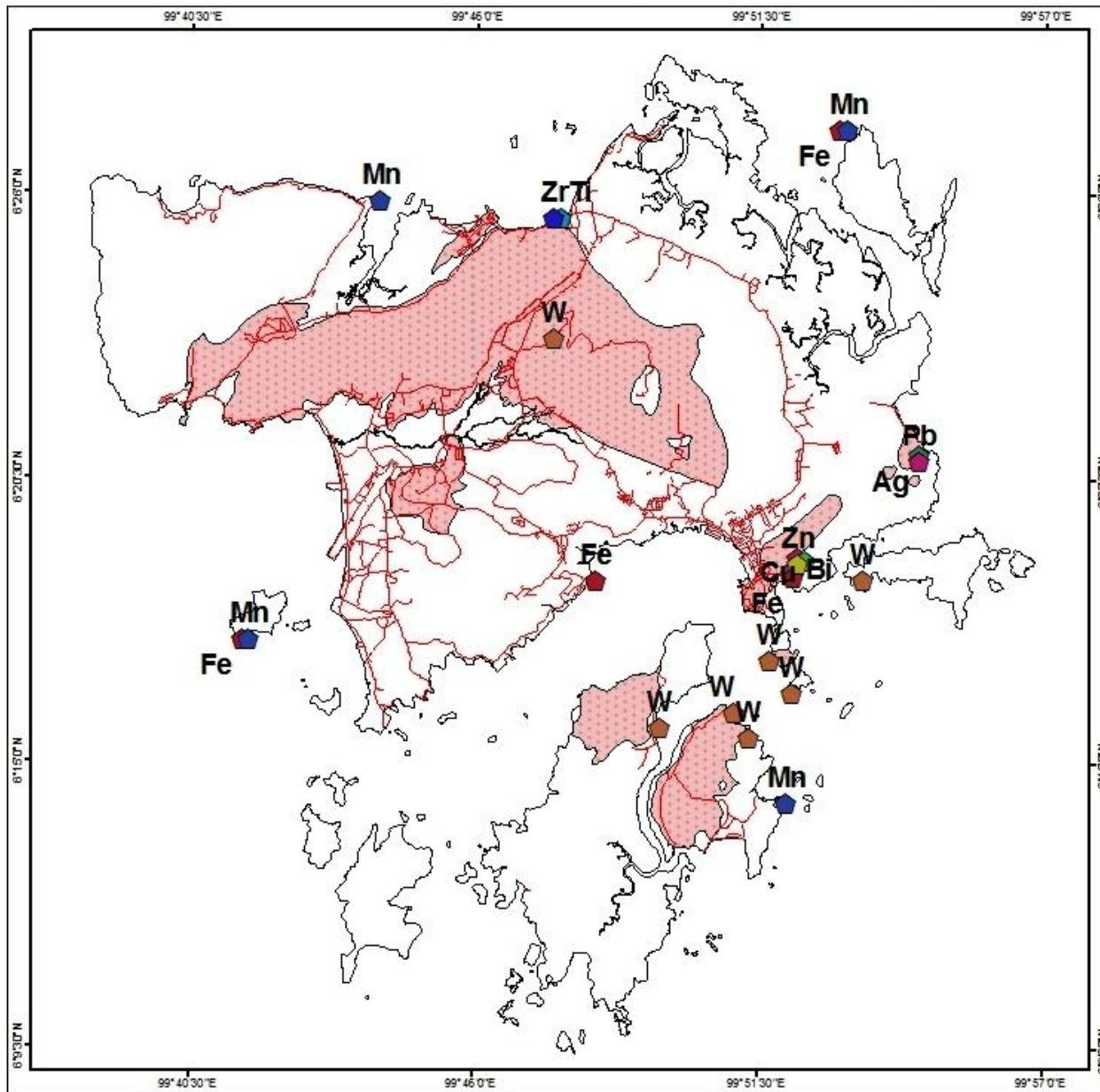


## LANGKAWI ISLAND

### POTENTIAL MINERAL

- 1) LIMESTONE
- 2) GRANITE AGGREGATE
- 3) SILICA SAND



# Distribution of Metallic Minerals in the Langkawi Islands

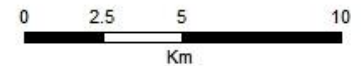


## Legend

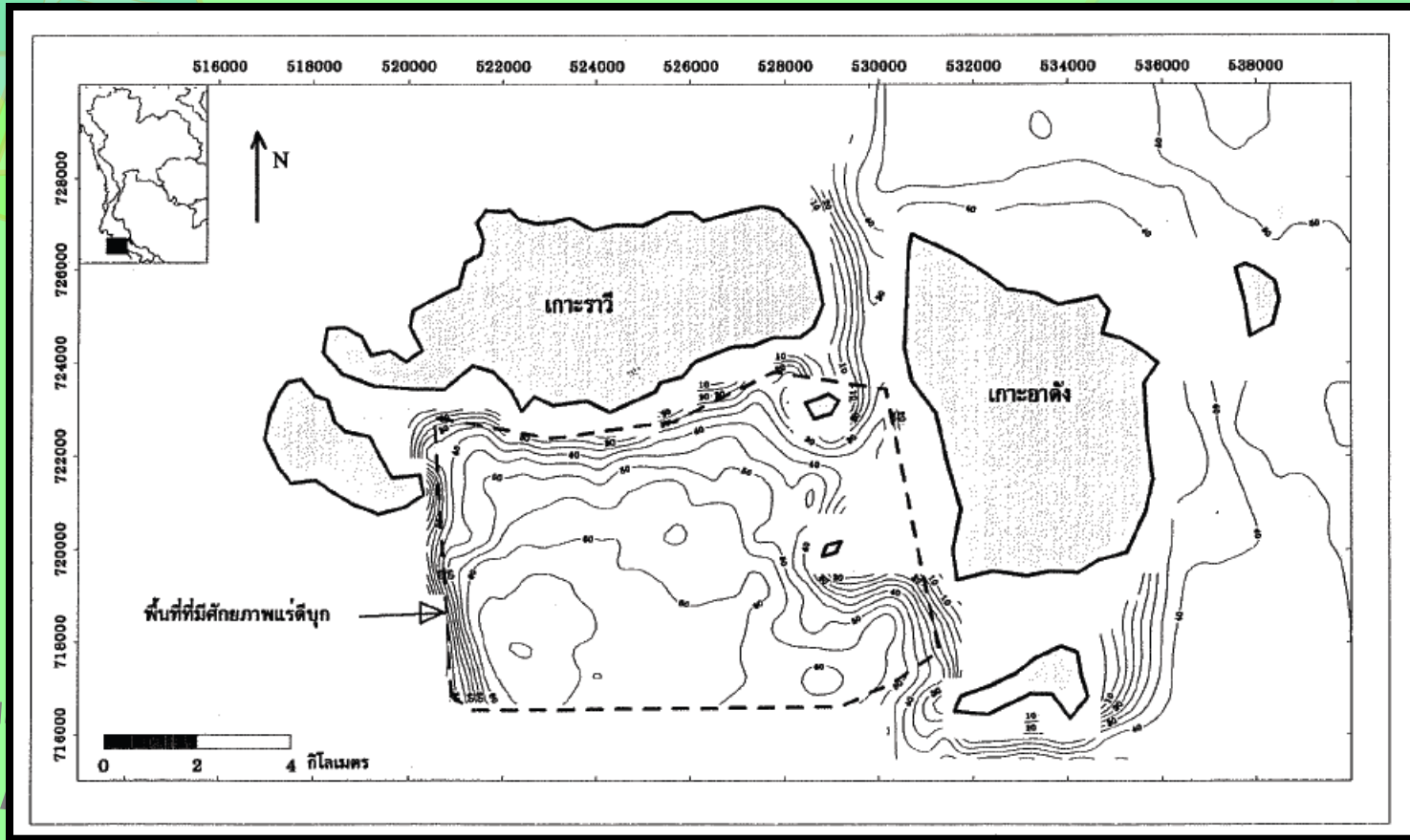
### Metallic Minerals

-  Ag, Silver
-  Bi, Bismuth
-  Cu, Copper
-  Fe, Iron
-  Mn, Manganese
-  Pb, Lead
-  Ti, Titanium
-  W, Tungsten
-  Zn, Zink
-  Zr, Zircon

-  Roads
-  Igneous Intrusion



# MINERAL RESOURCES



## TARUTAO ISLAND (ADANG RAWI)

Map showing the potential areas of Tin-deposits exceeds 50 km<sup>2</sup>. (0.035 to 0.242 kg/m<sup>3</sup>)



**THANK YOU  
KHOP KHUN KHRAP**

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