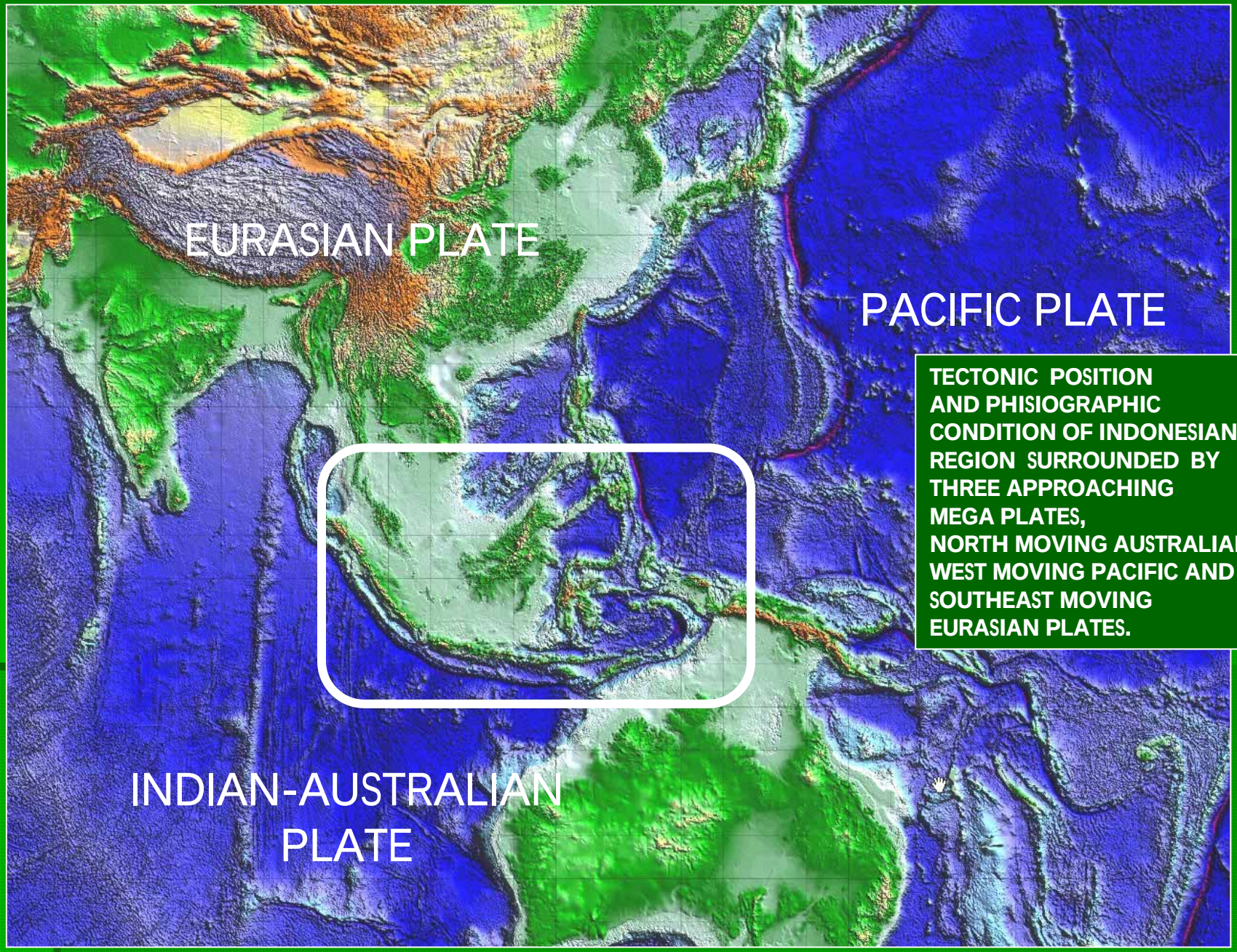
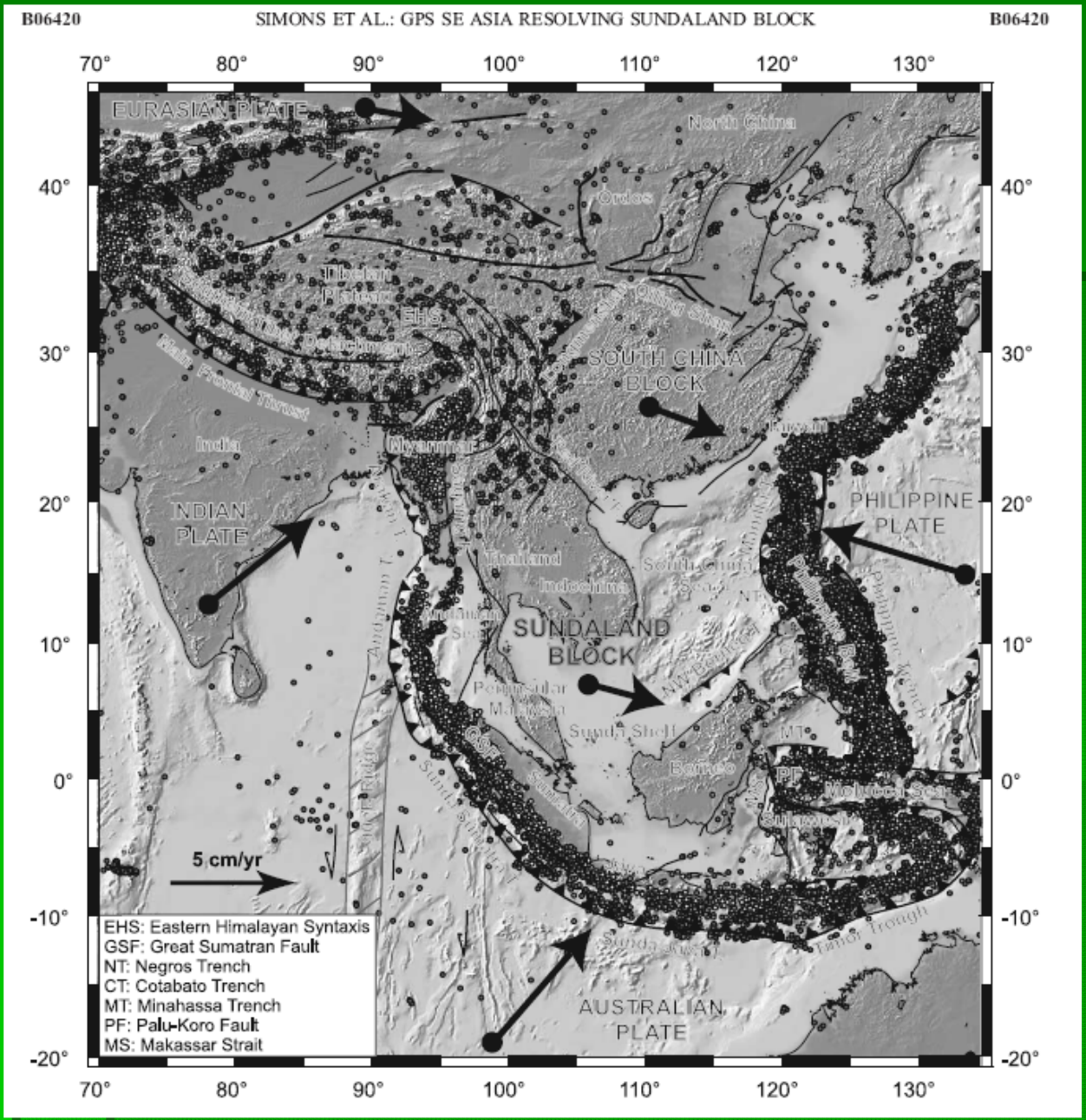
LUSI

- GEOLGICAL ANALYSIS
- SOCIAL IMPACT AND
- SUGGESTED TEMPORARY SOLUTION

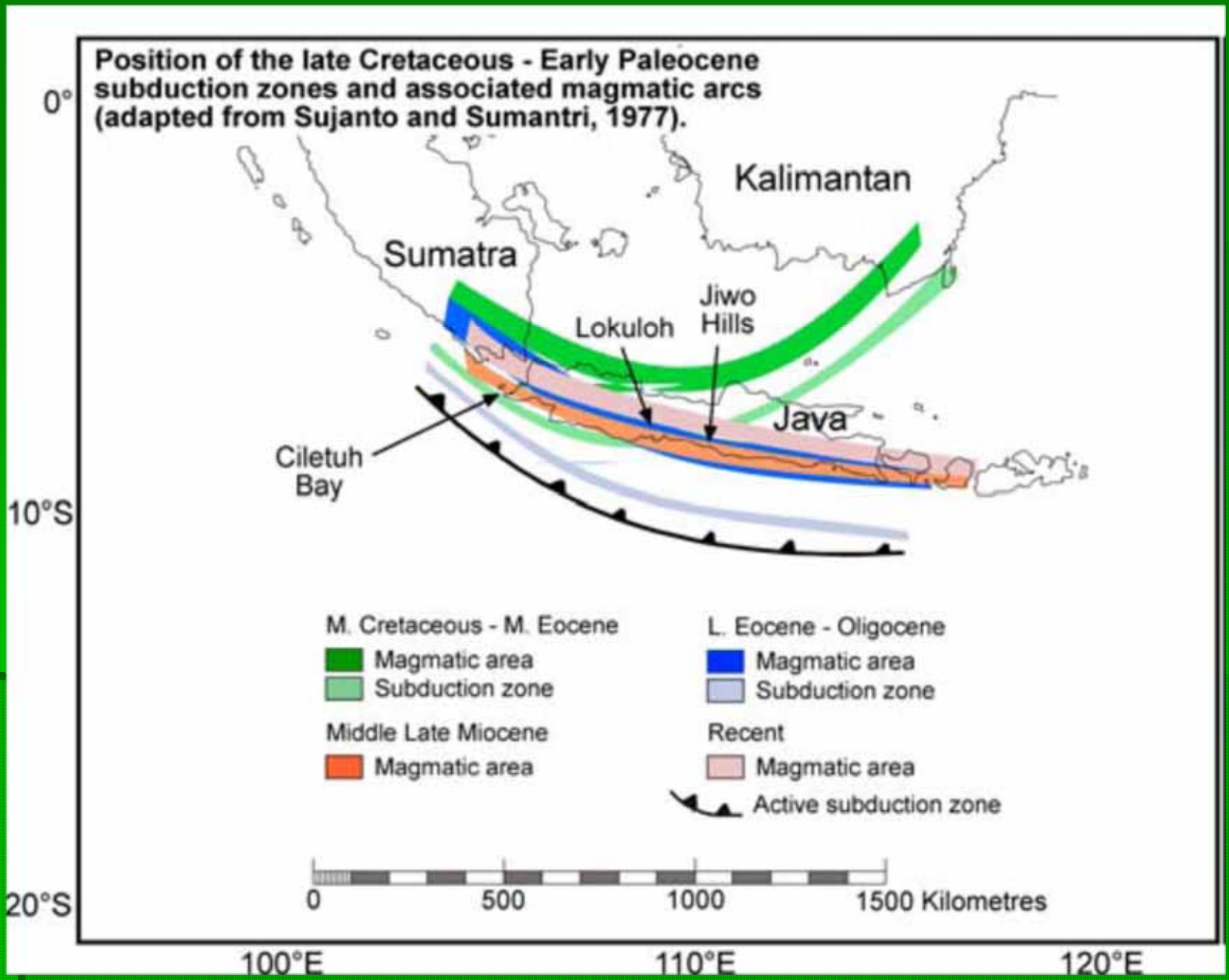


TECTONIC POSITION AND PHISIOGRAPHIC CONDITION OF INDONESIAN REGION SURROUNDED BY THREE APPROACHING MEGA PLATES, NORTH MOVING AUSTRALIAN, WEST MOVING PACIFIC AND SOUTHEAST MOVING EURASIAN PLATES.

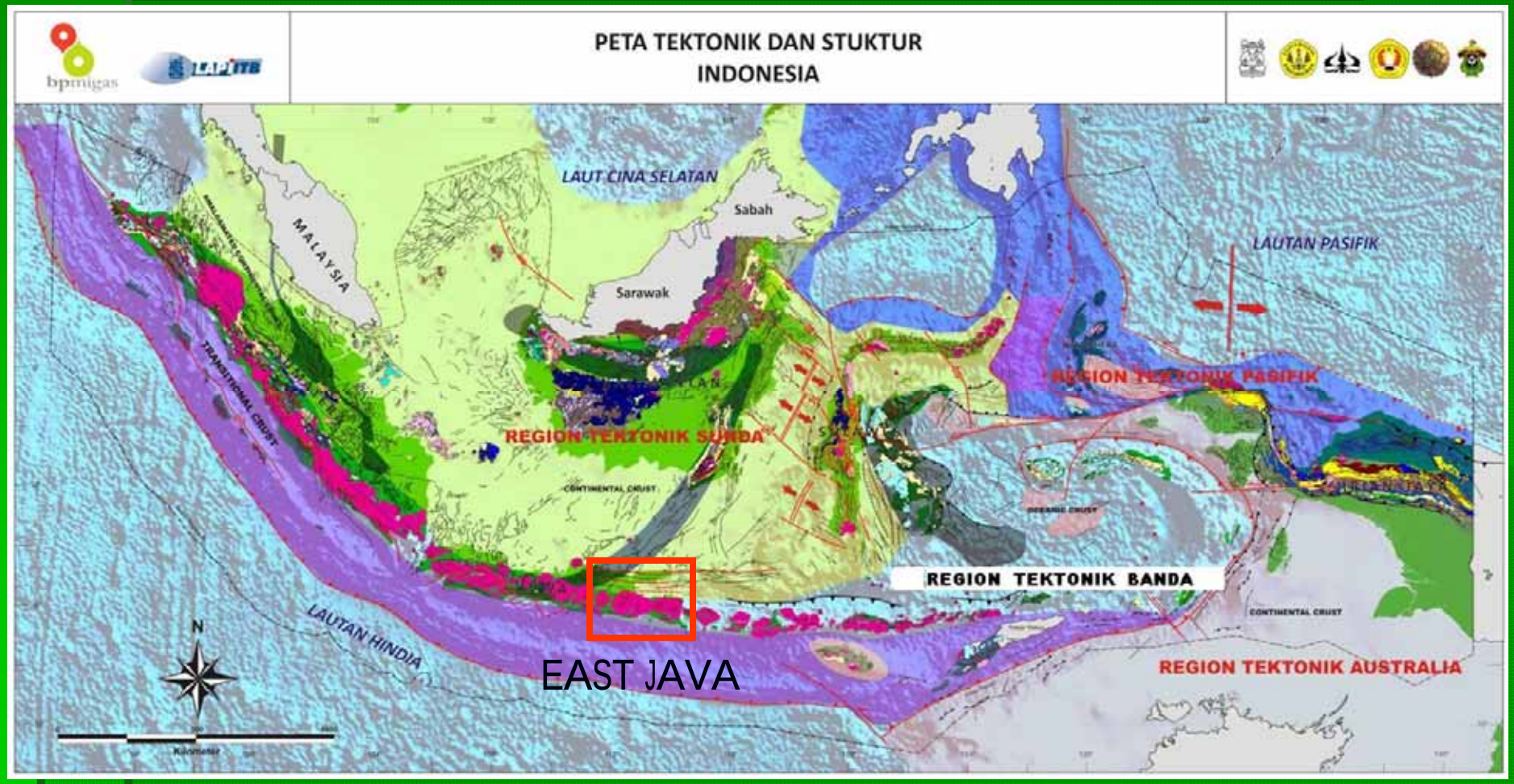


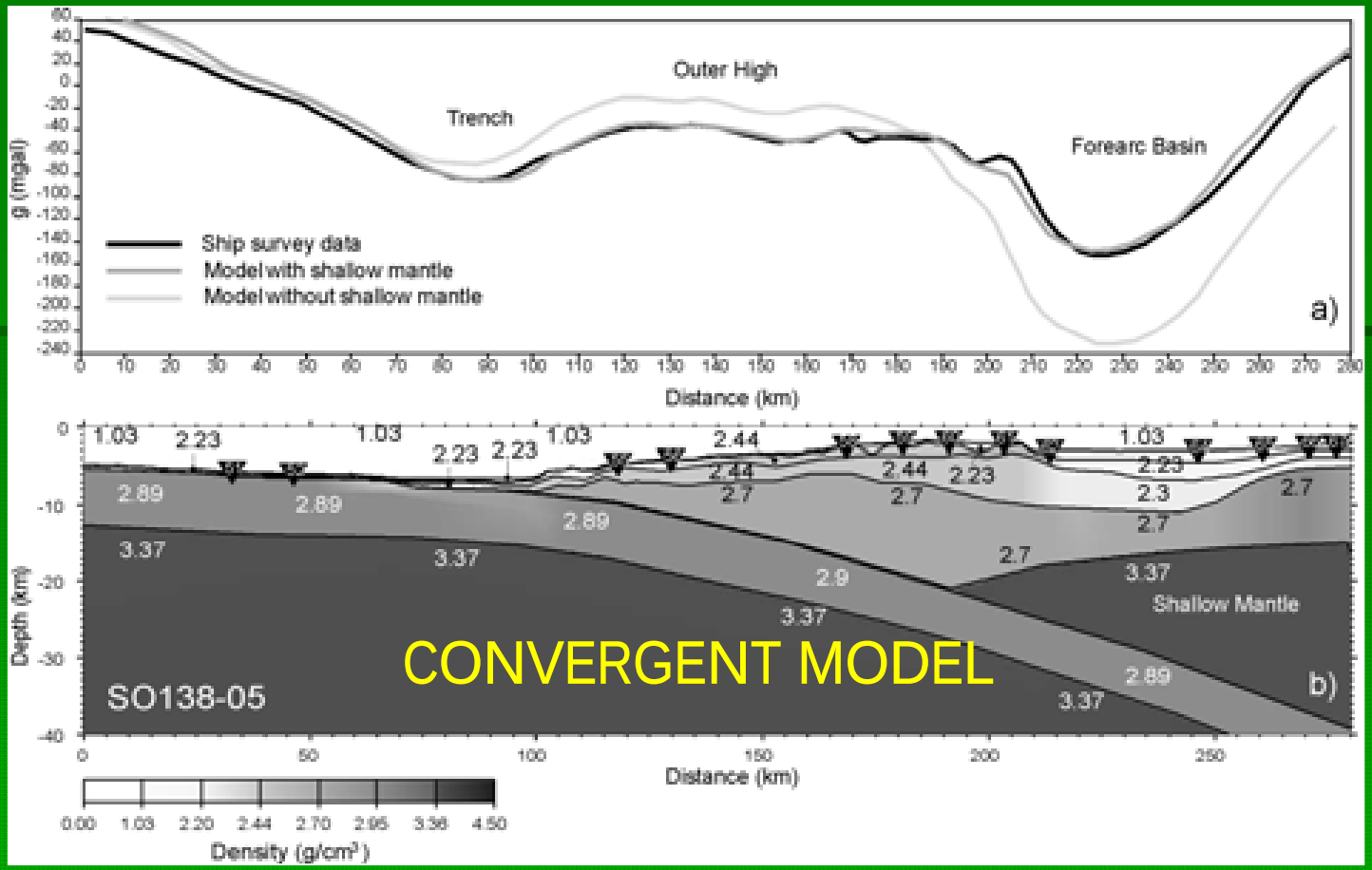
Tectonic setting of Java Island
is the result of convergent of 2 mega plate, the northeast moving Australian plate and Sunda plate in the north

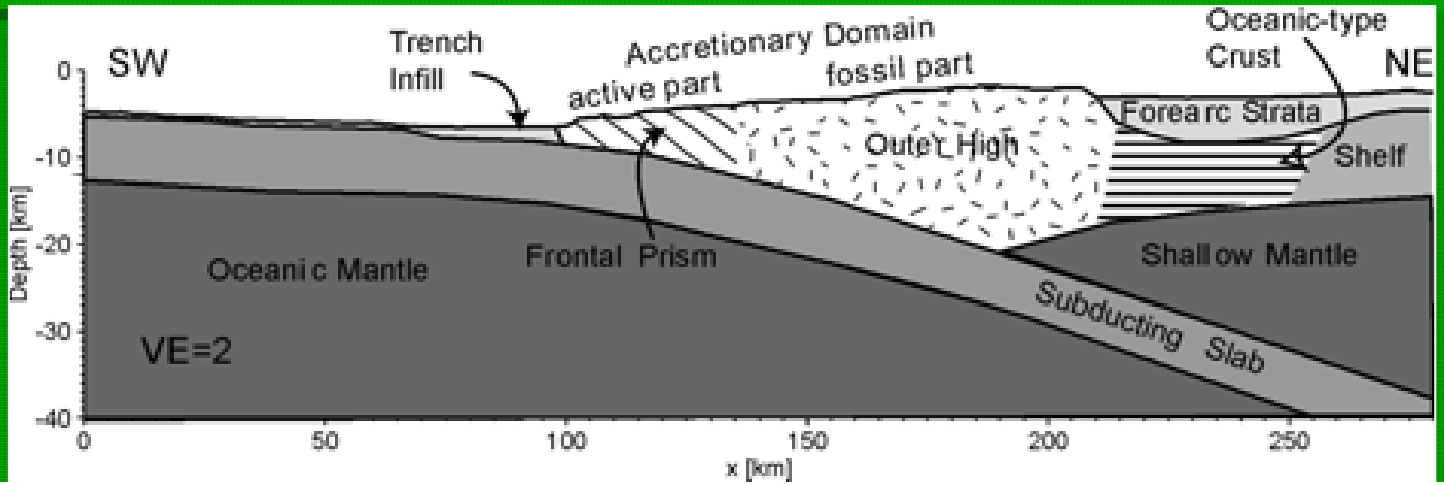
TECTONIC POSITION AND PHISIOGRAPHIC CONDITION OF INDONESIAN REGION SURROUNDED BY THREE APPROACHING MEGA PLATES, NORTH MOVING AUSTRALIAN, WEST MOVING PACIFIC AND SOUTHEAST MOVING EURASIAN PLATES.


Position of the late Cretaceous - Early Paleocene subduction zones and associated magmatic arcs (adapted from Sujanto and Sumantri, 1977).
0°
10°S
20°S
100°E
110°E
120°E
Kalimantan
Sumatra
Jiwo Hills
Lokuloh
Java
Ciletuh Bay
M. Cretaceous - M. Eocene
Magmatic area
Subduction zone
L. Eocene - Oligocene
Magmatic area
Subduction zone
Middle Late Miocene
Magmatic area
Recent
Magmatic area
Active subduction zone
0
500
1000
1500 Kilometres

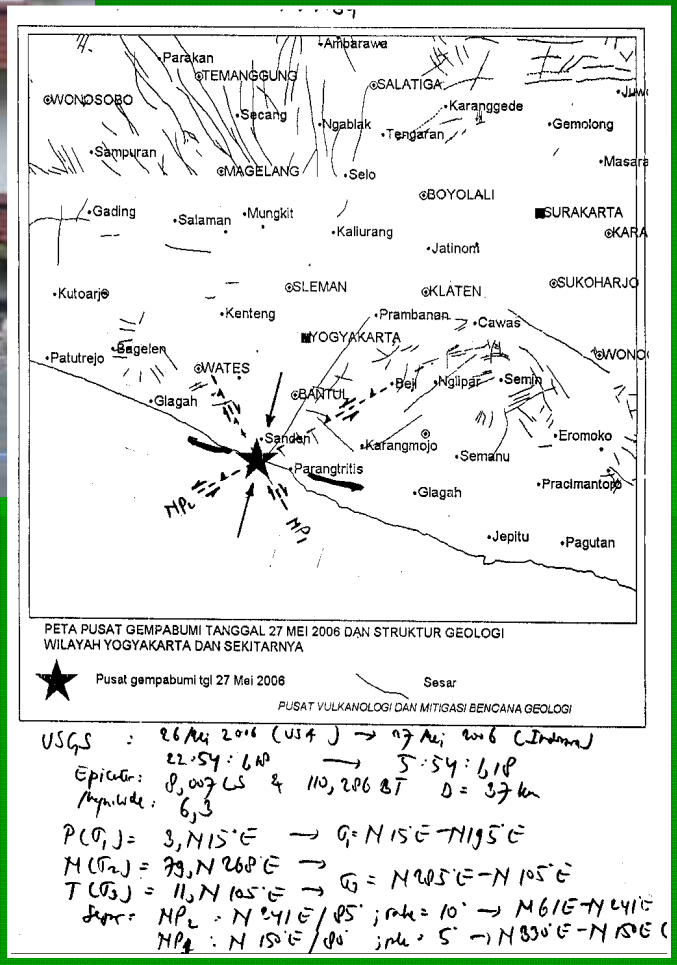
PRESENT TECTONIC MAP OF INDONESIA

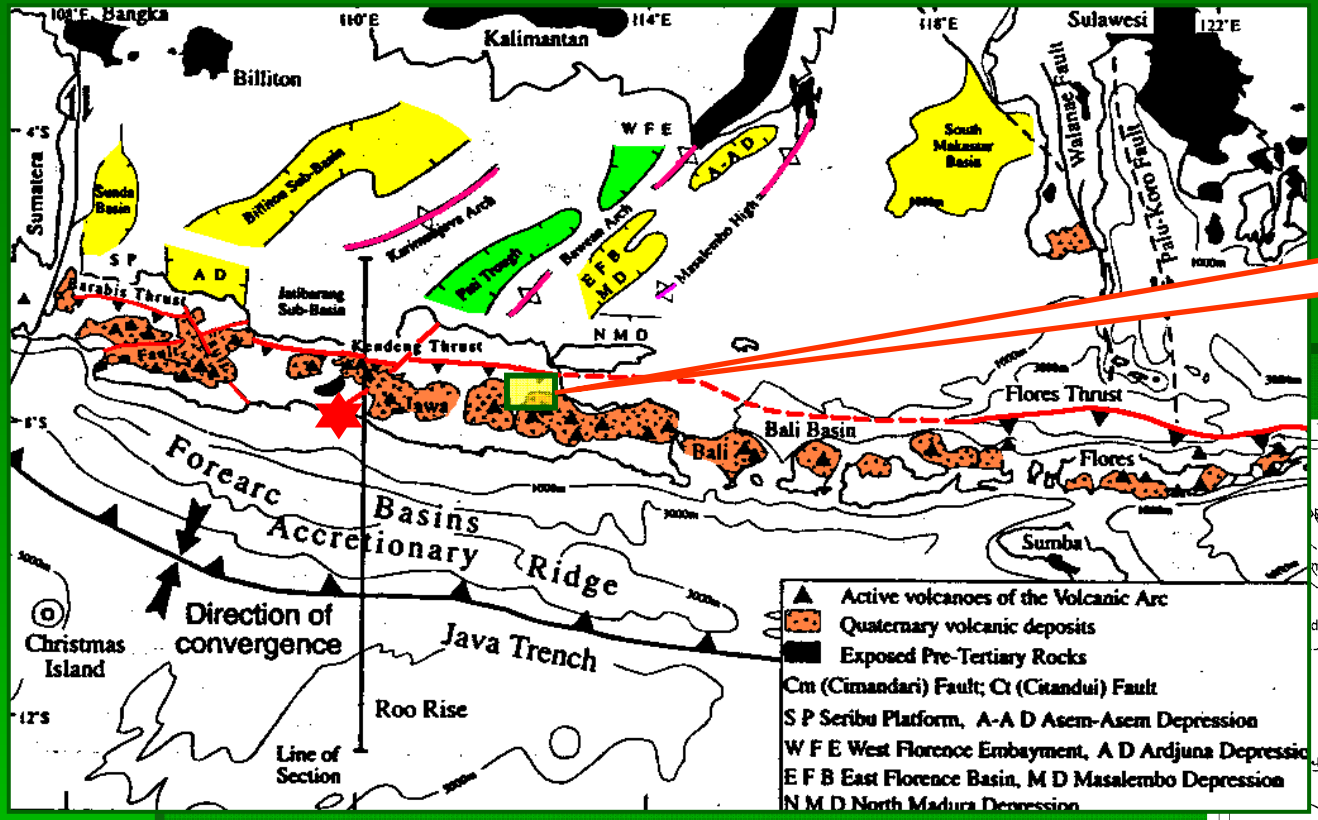



Outer High
Trench
Forearc Basin
g (mgal)
Ship survey data
Model with shallow mantle
Model without shallow mantle
a)
Distance (km)
Depth (km)
Shallow Mantle
CONVERGENT MODEL
SO138-05
b)
Distance (km)
Density (g/cm³)

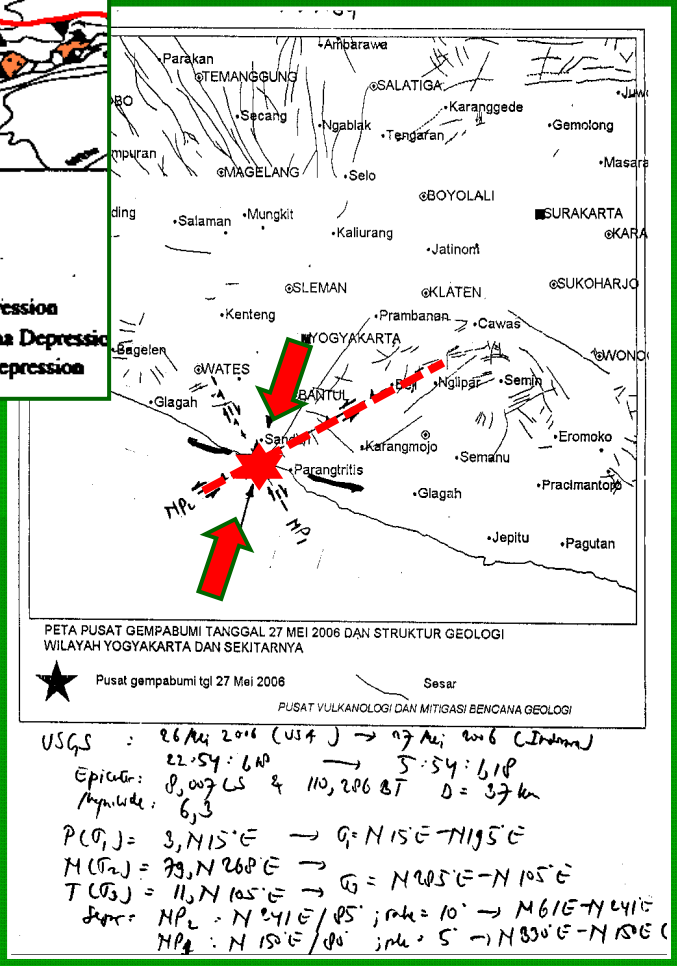

SW
Trench Infill
Accretionary Domain
active part
fossil part
Oceanic-type Crust
NE
Forearc Strata
Outer High
Shelf
Oceanic Mantle
Frontal Prism
Shallow Mantle
Subducting Slab
VE=2
Depth [km]
x [km]

Yogya earthquake
Friday May 27, 2006
at 5:43 AM local time





we are here



- 6.3 RS (strong)
- Killed 5.750 people
- USGS tensor solution (left lateral)

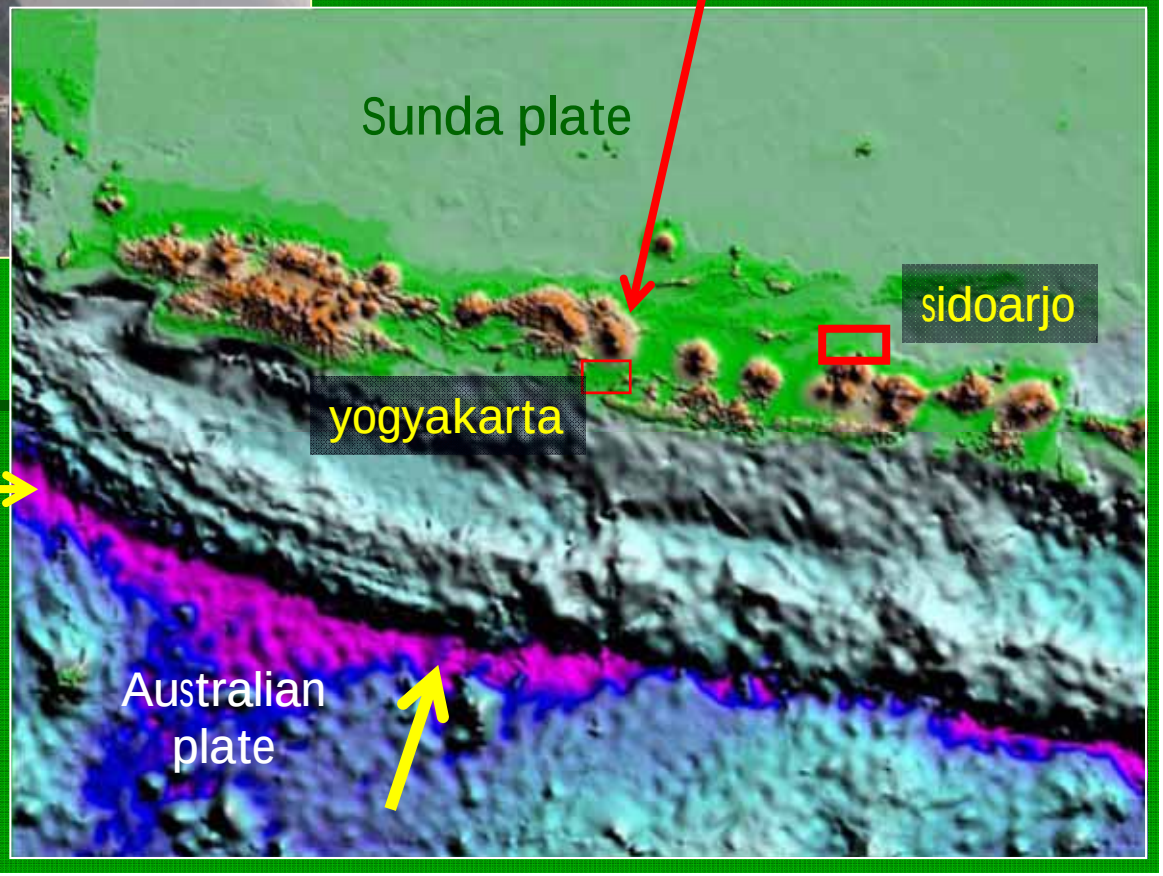
Yogya earthquake
Friday May 27, 2006
at 5:43 AM local time

Merapi volcano

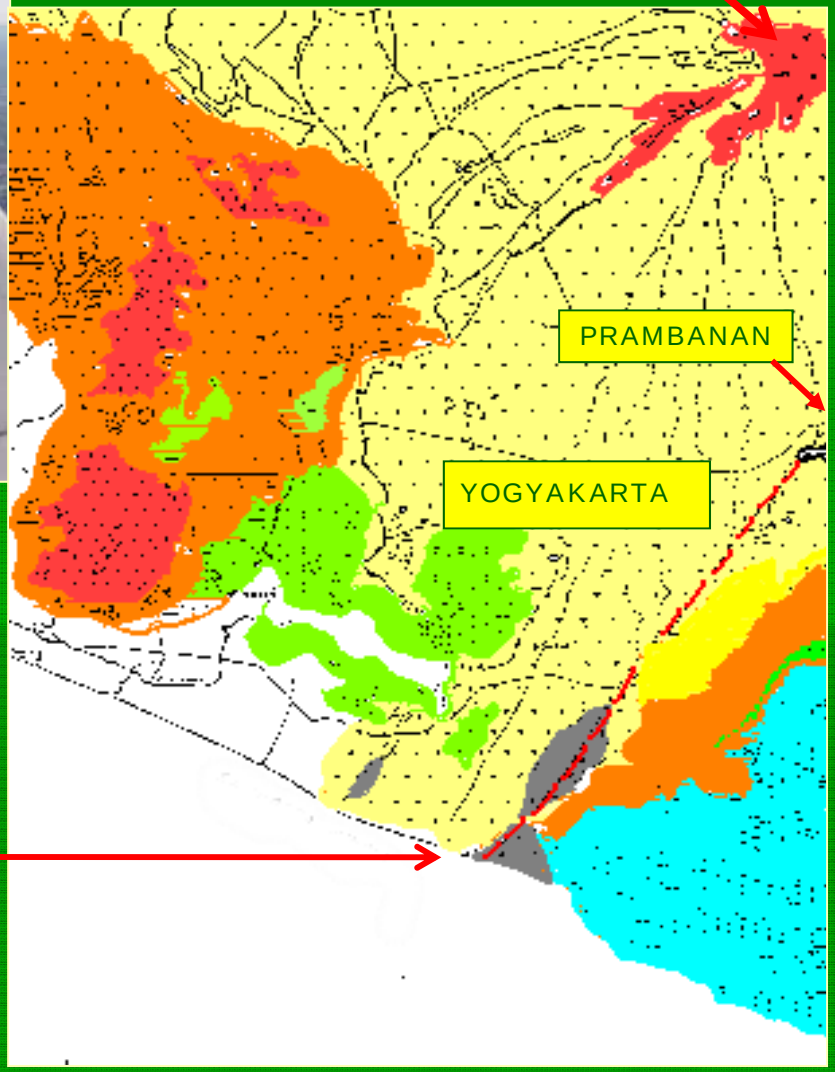
- regional plate tectonic setting of Java island

Java trench

plate motion vector



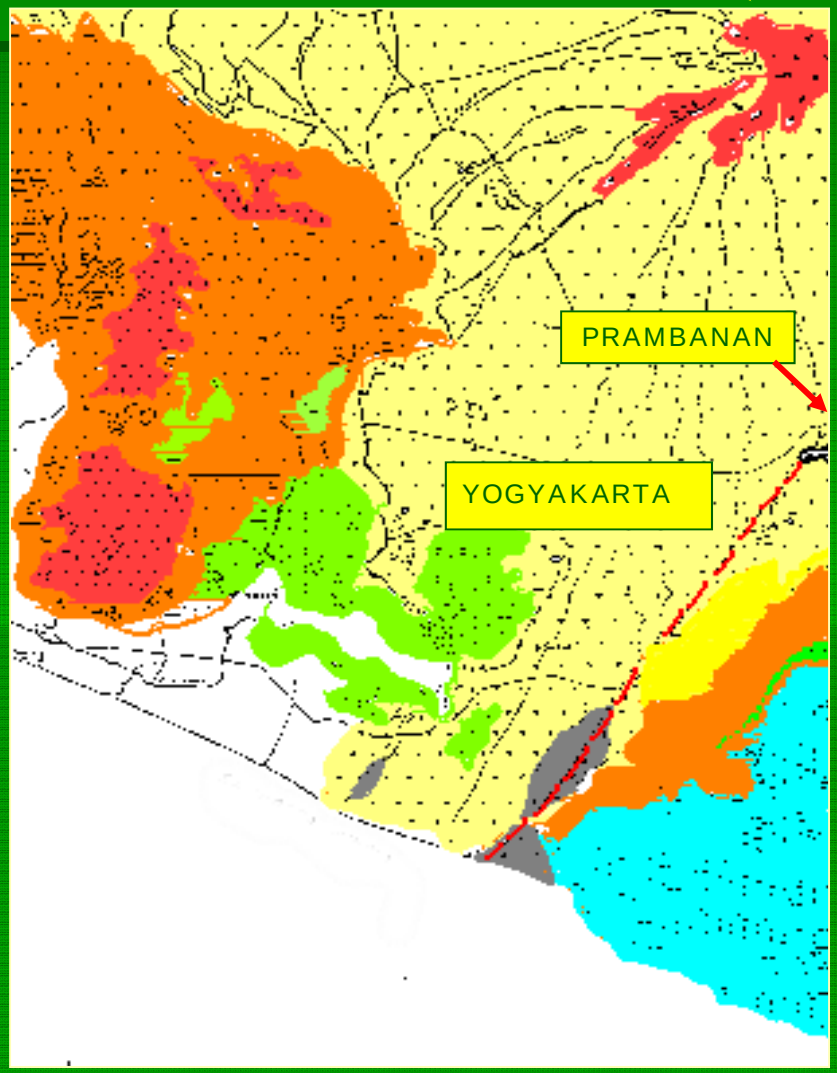
Merapi volcano



Geography and geologic map of yogyakarta region

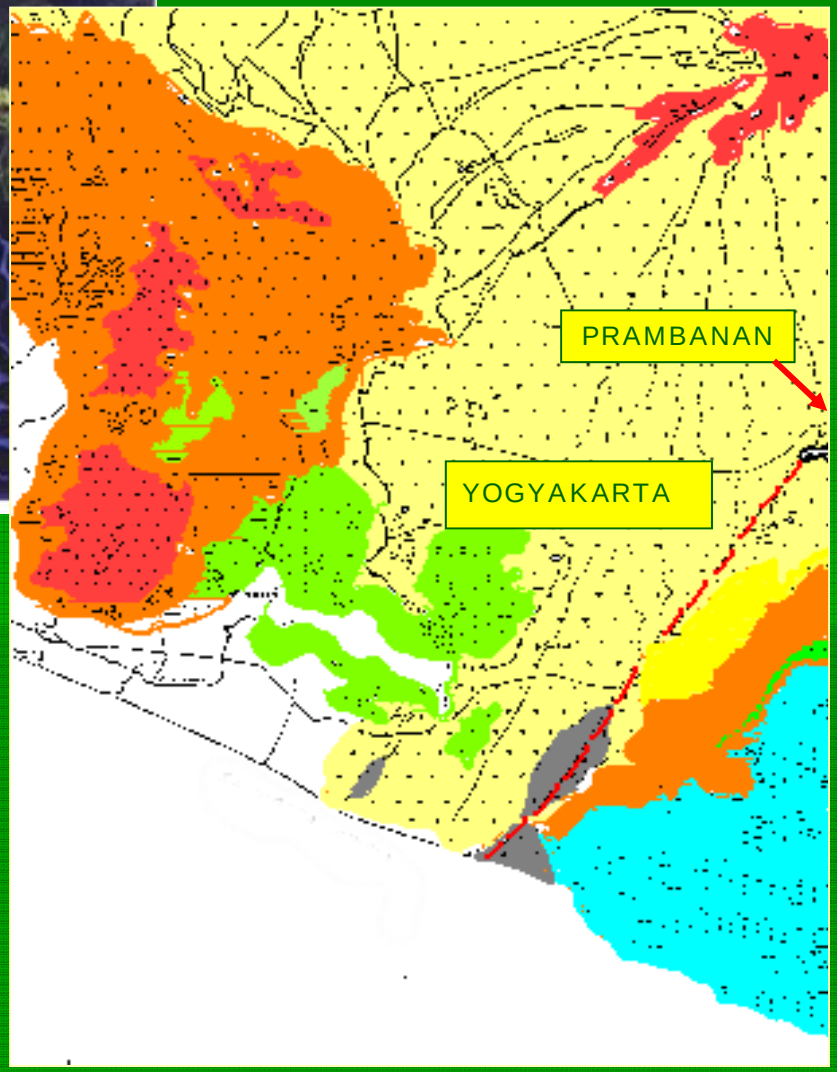
The NE-SW trending fault is indicated in this map as uncertain

increasing activity
of Merapi volcano



Yogya earthquake
Friday May 27, 2006
at 5:43 AM local time

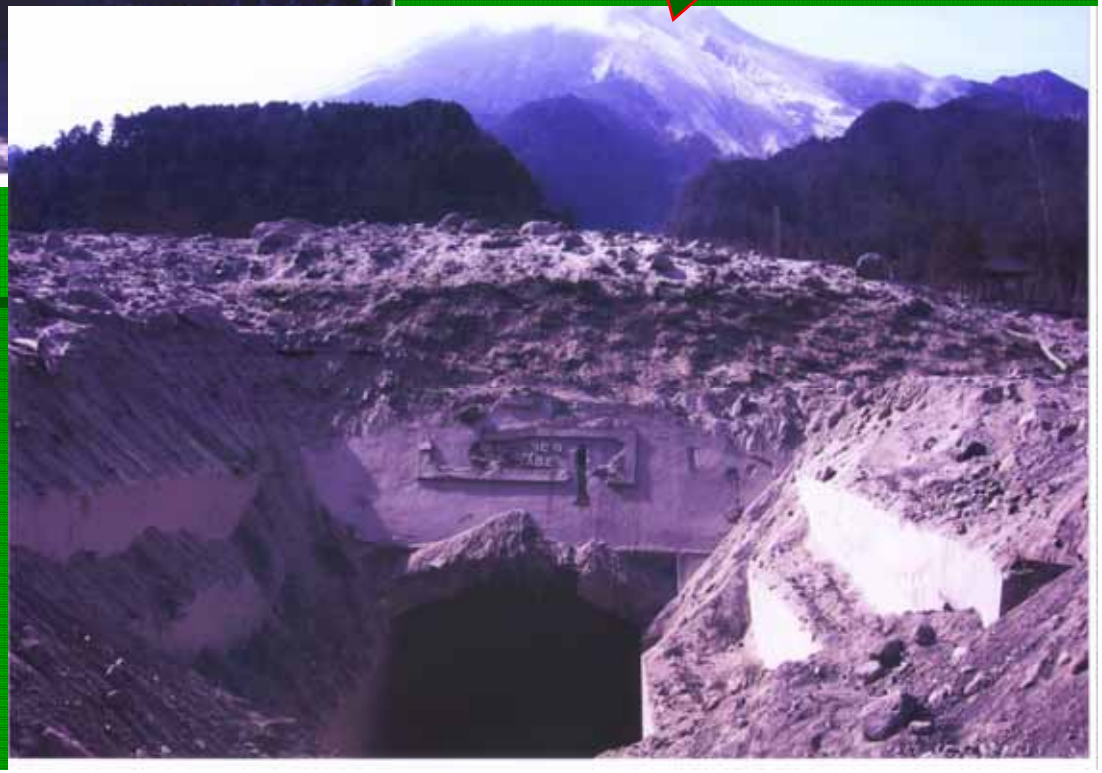
increasing activity
of Merapi volcano



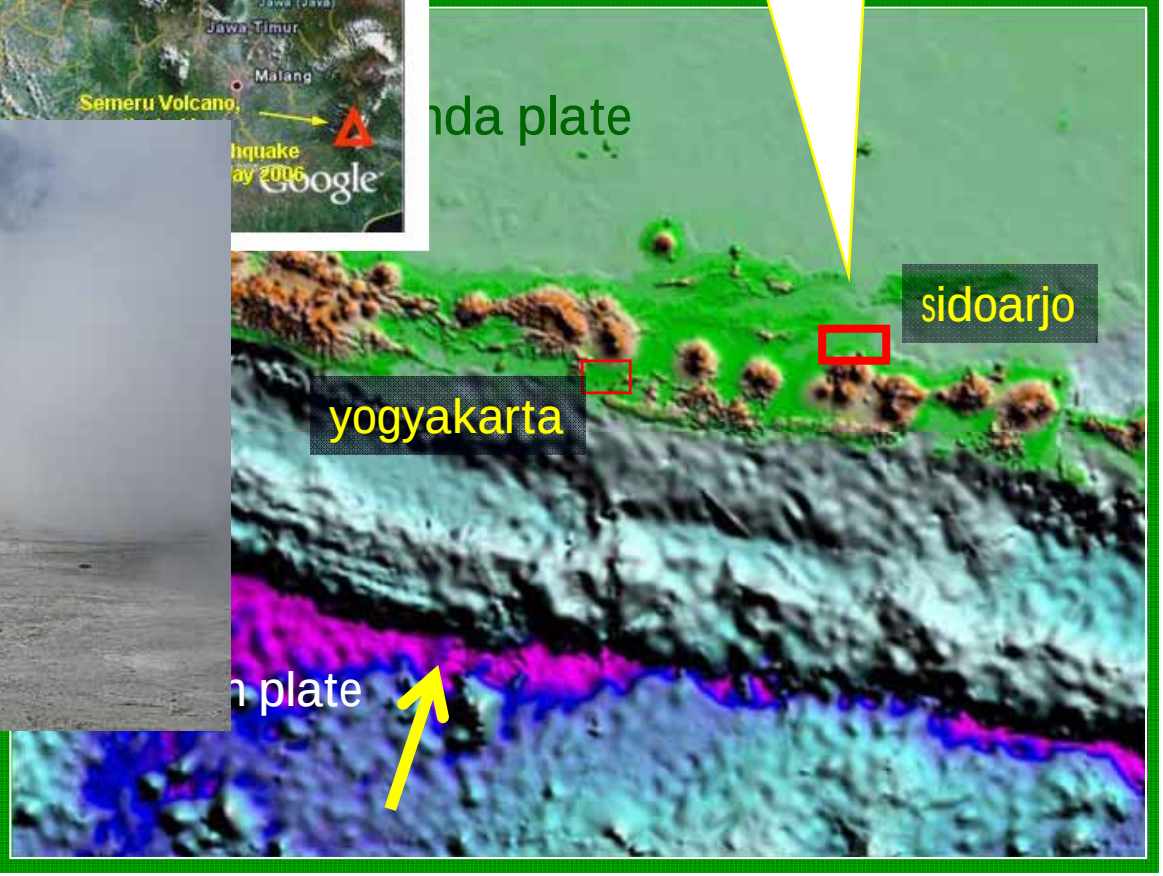
Yogya earthquake
Friday May 27, 2006
at 5:43 AM local time

increasing activity
of Merapi volcano

June 2006
paroxismal eruption
of Merapi

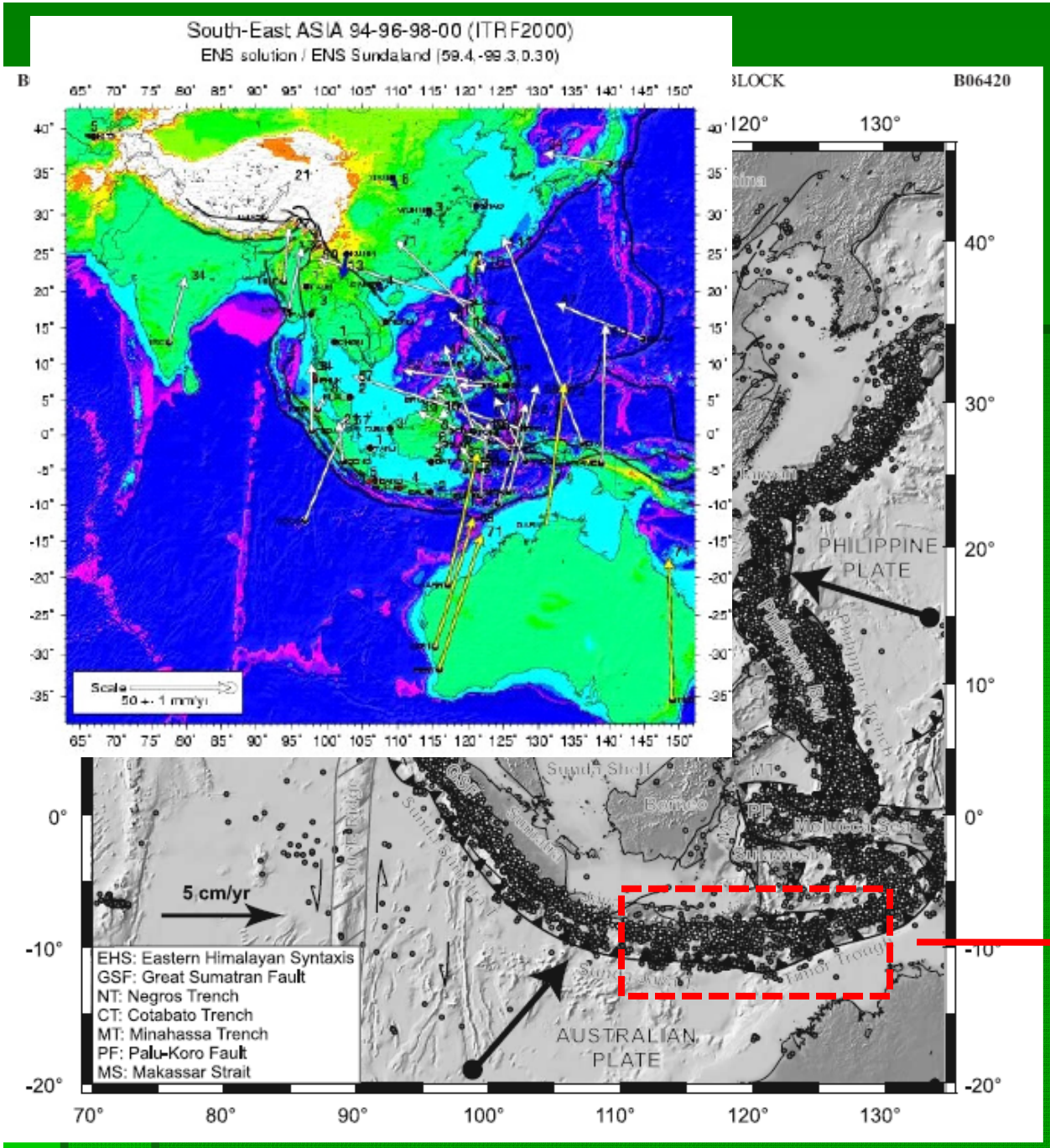


May 29 2006
mud, gas and hot water erupted at Sidoarjo



May 29 2006
mud, gas and hot water erupted at Sidoarjo

- merapi volcano and
- semeru reactivated

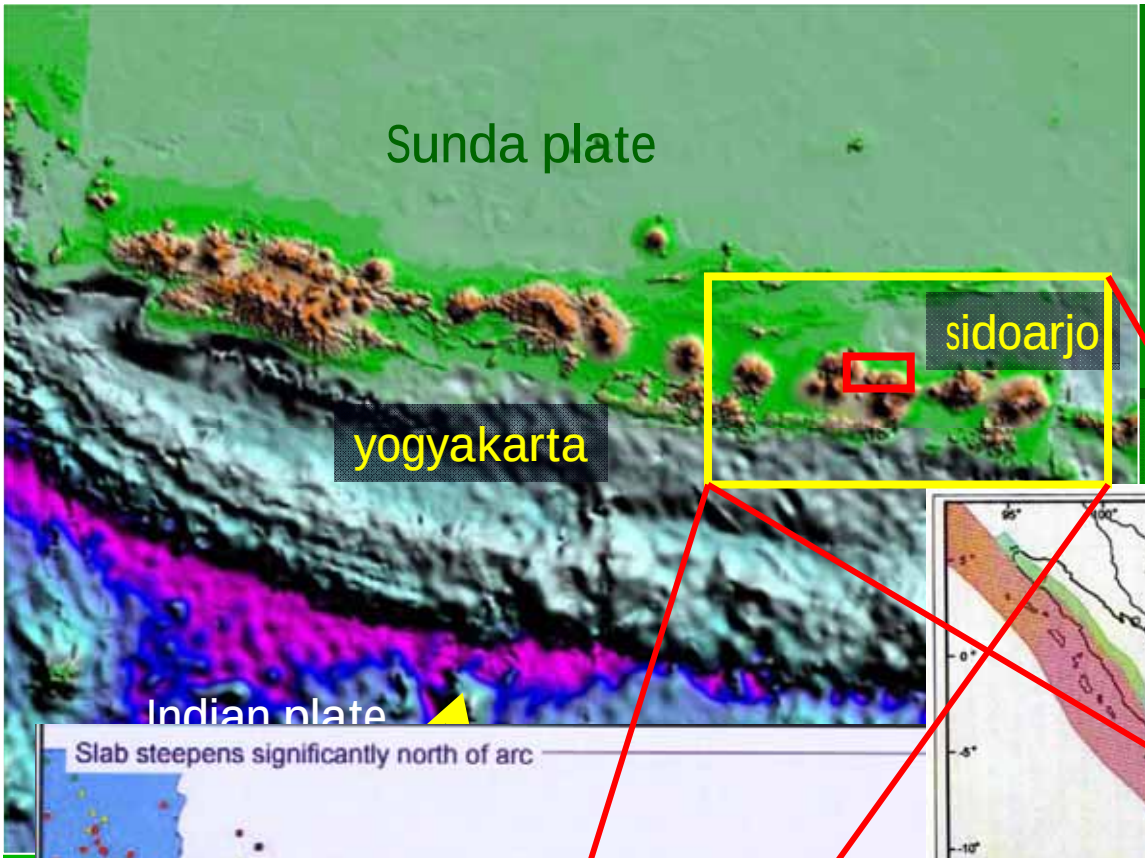


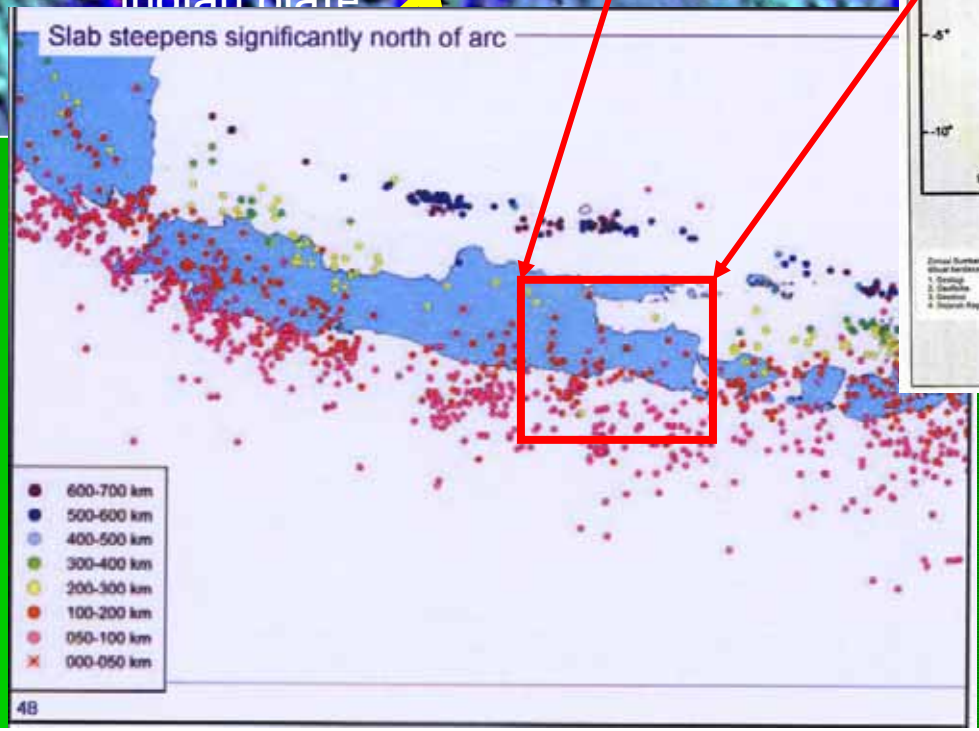
Tectonic setting of Java Island and East Java region

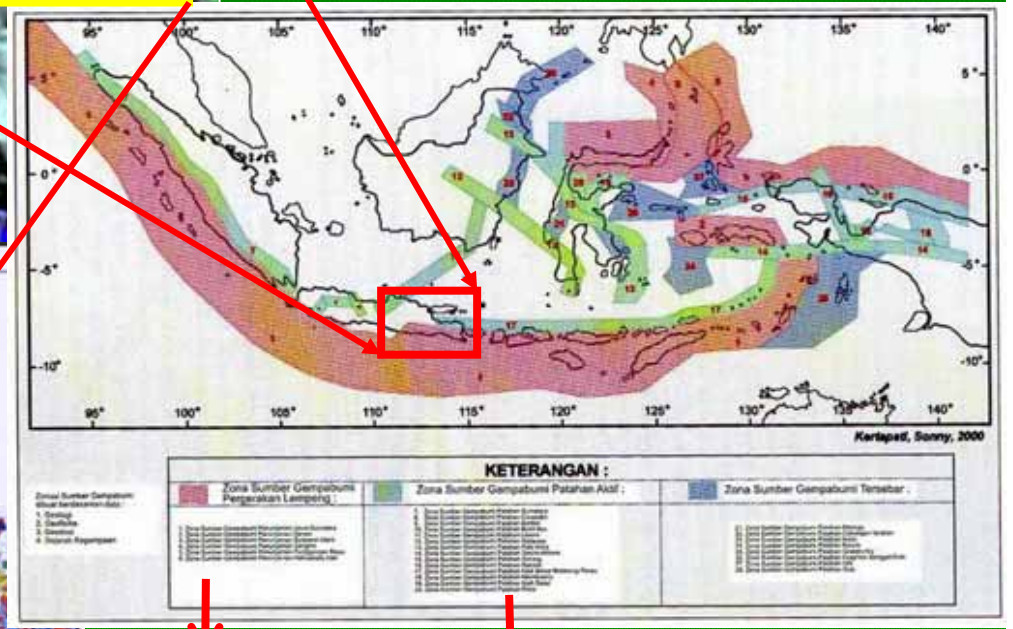
TECTONIC POSITION AND PHISIOGRAPHIC CONDITION OF INDONESIAN REGION SURROUNDED BY THREE APPROACHING MEGA PLATES, NORTH MOVING AUSTRALIAN, WEST MOVING PHILIPPINE AND SOUTHEAST MOVING EURASIAN PLATES.

JAVA ISLAND

Tectonic setting of Java Island and East Java region and distribution of epicentres



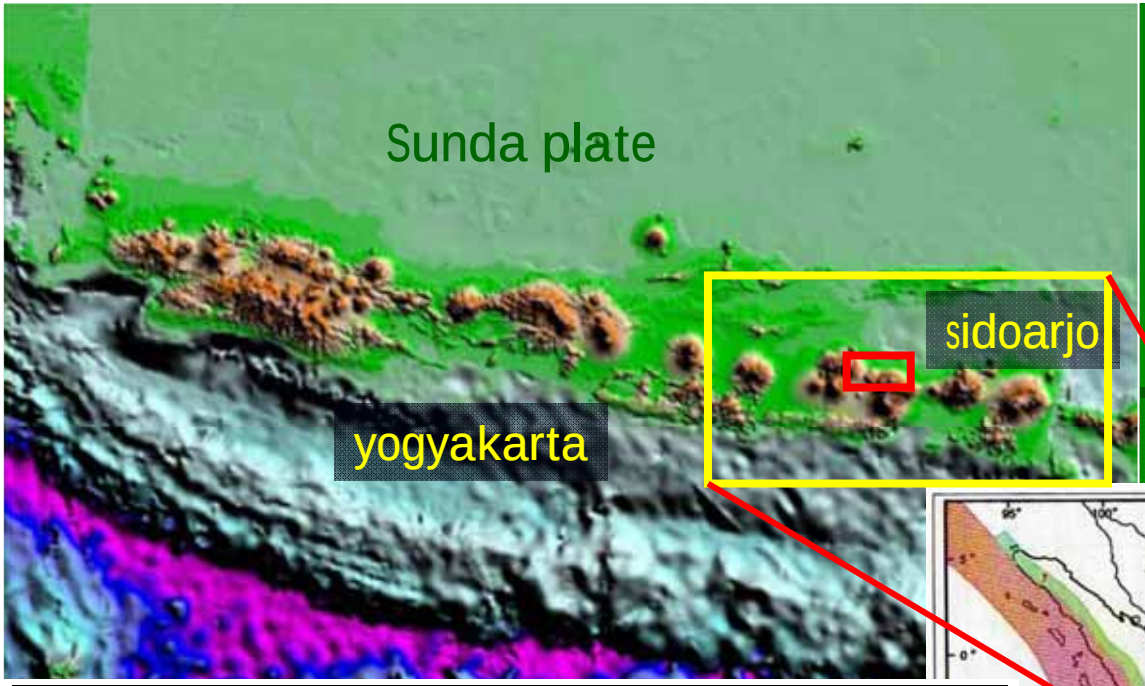




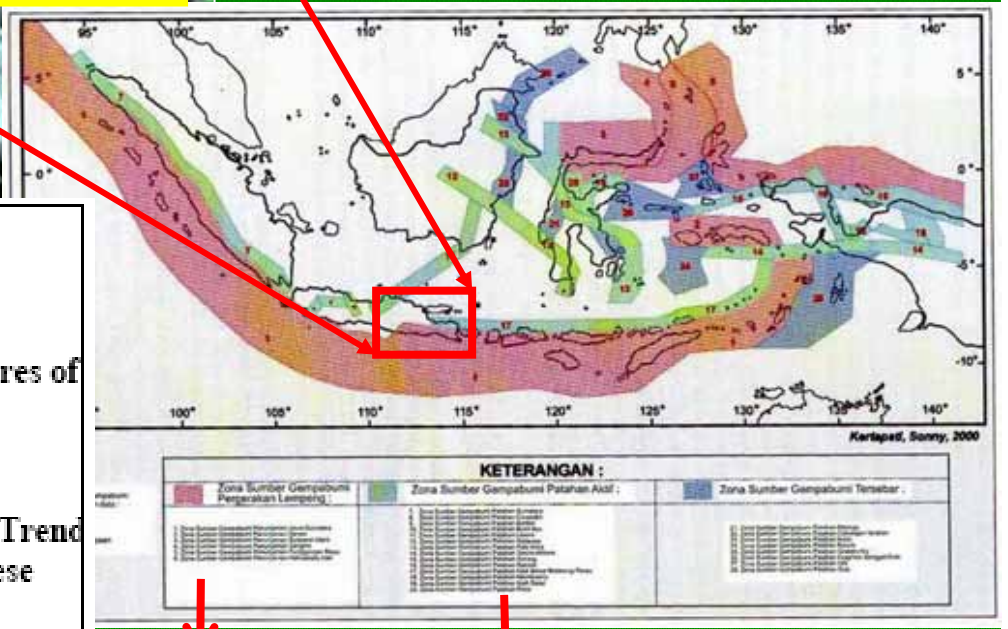
seismic zone related to plate movement

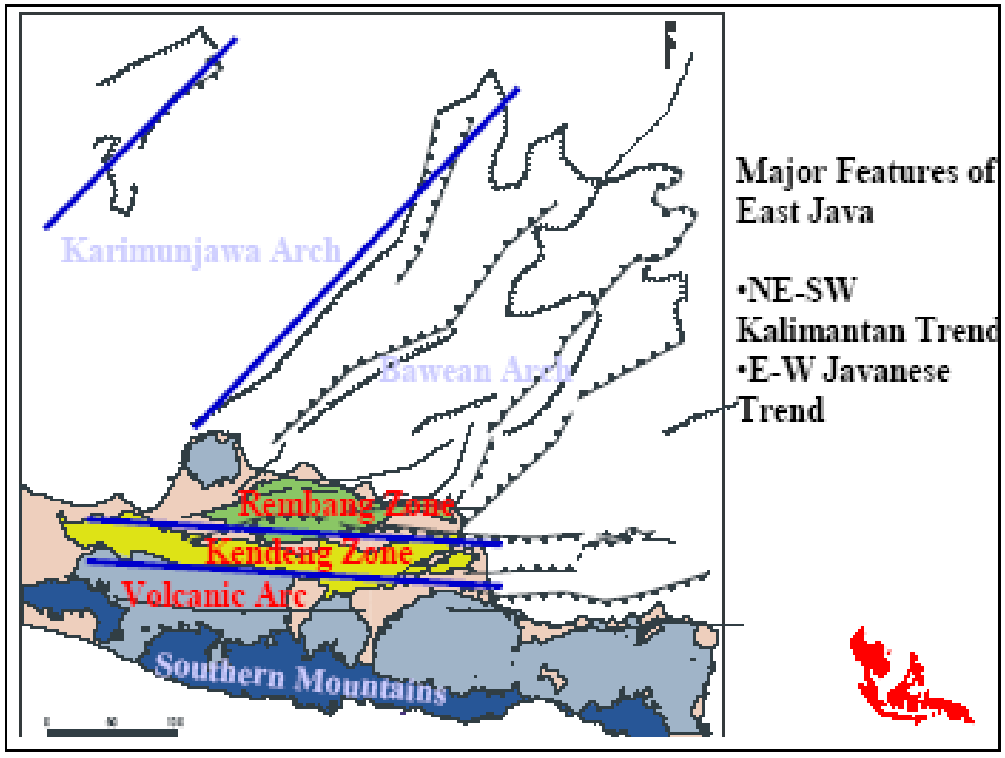
seismic zone related to active faults

East Java is a tectonic active region



Tectonic setting of Java Island and East Java region





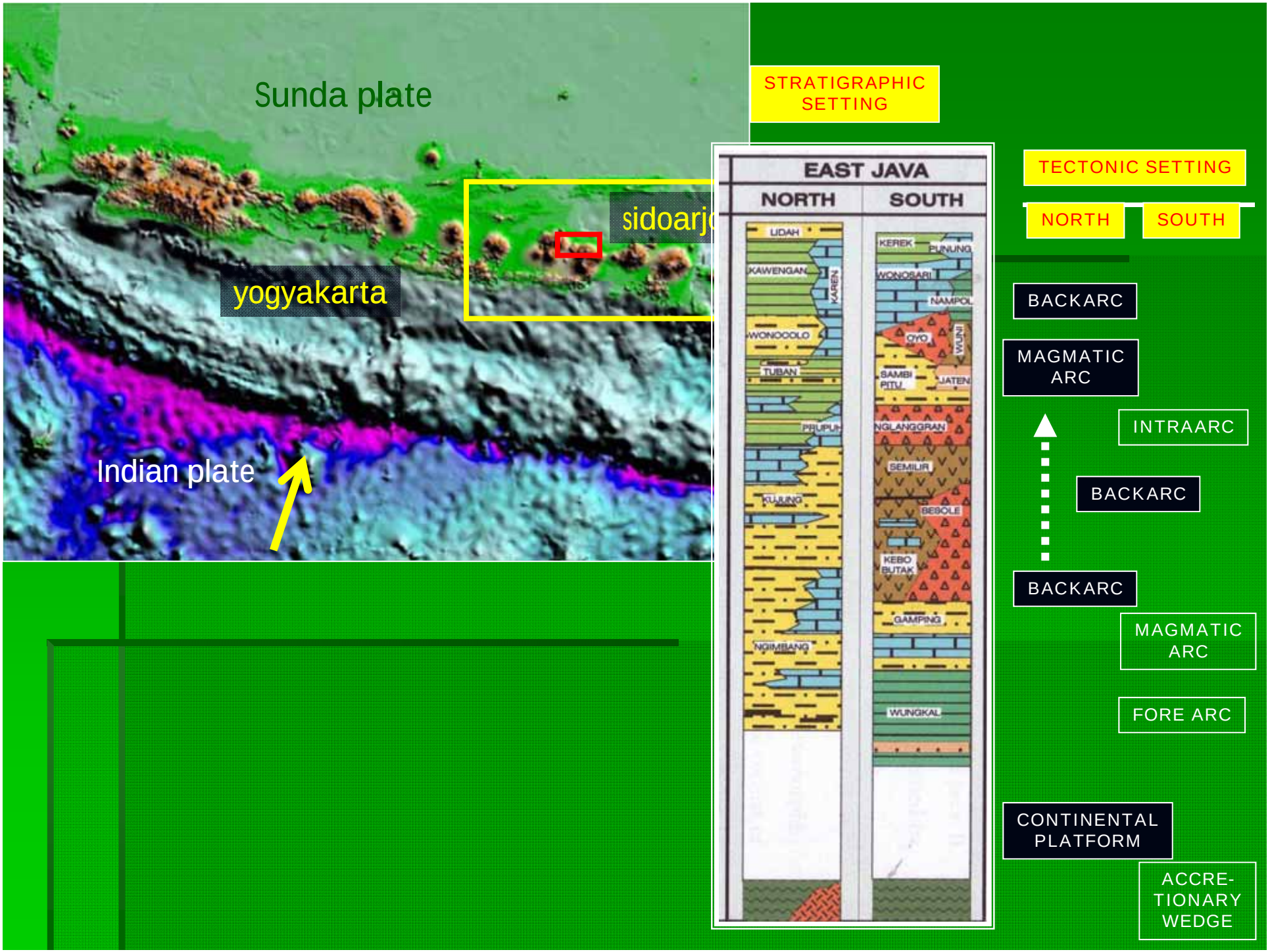
Major Features of East Java

- NE-SW Kalimantan Trend
- E-W Javanese Trend

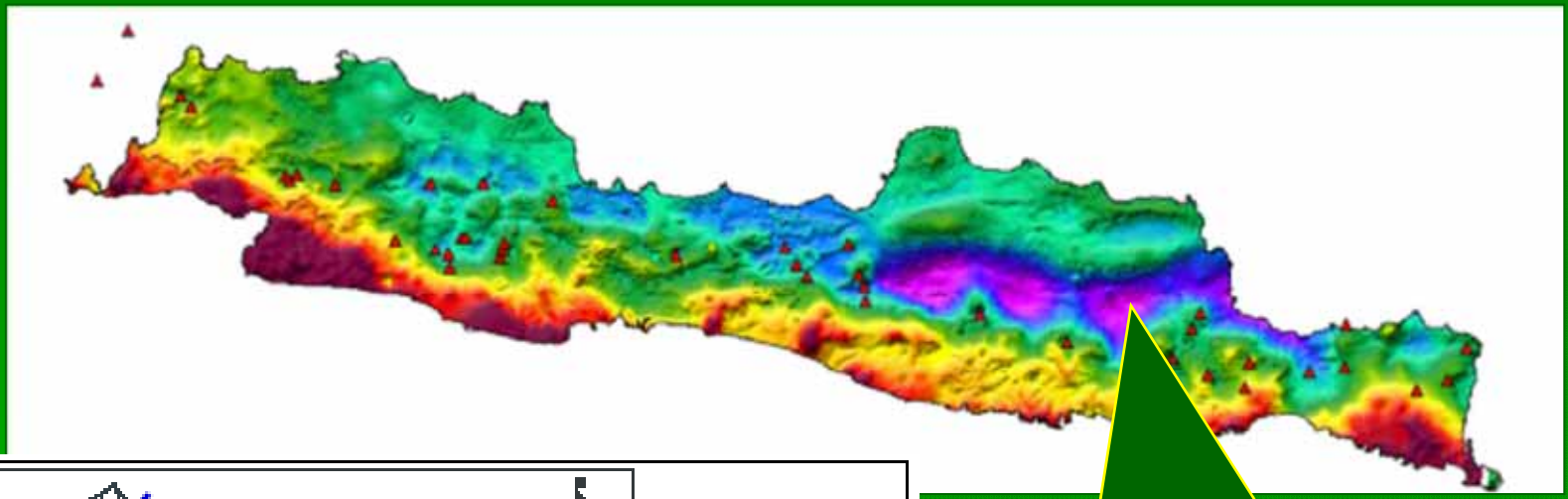
seismic zone related to plate movement

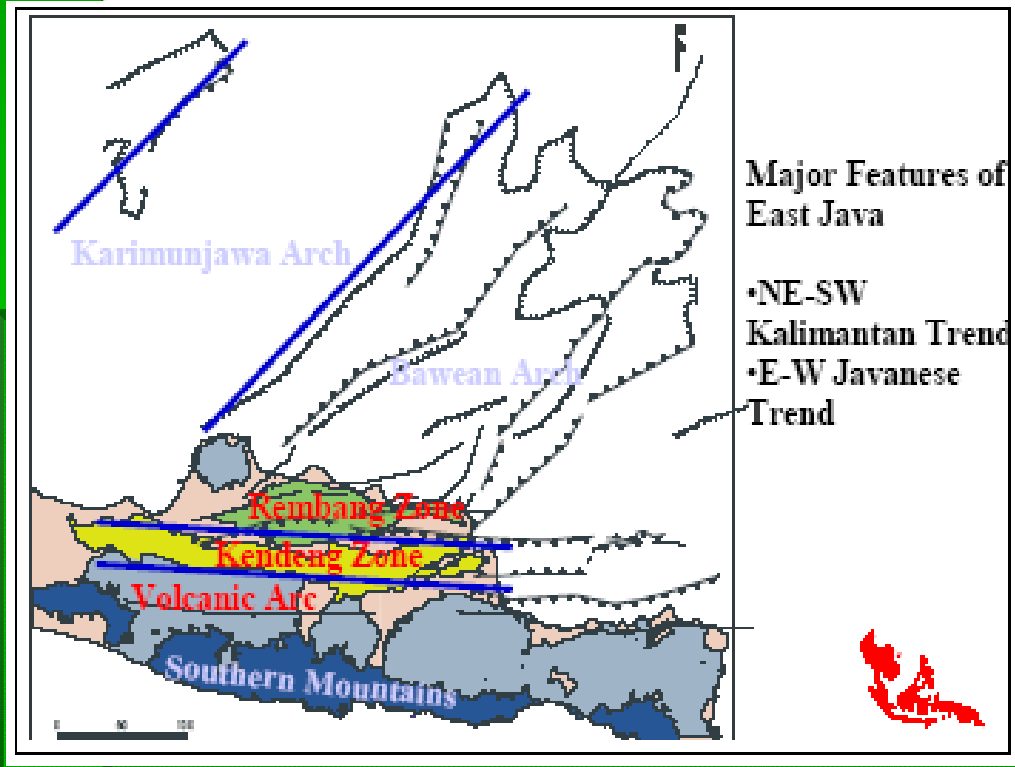
seismic zone related to active faults

East Java is a tectonic active region


Sunda plate
sidoarjo
yogyakarta
Indian plate
STRATIGRAPHIC SETTING
EAST JAVA
NORTH
SOUTH
UDAH
KAWENGAN
KAREN
WONOCOLO
TUBAN
PRUPUH
KUJUNG
NGIMBANG
KEREK
PUNUNG
WONOSARI
NAMPOL
CIYO
WUNI
SAMBI PITU
JATEN
NGLANGGRAN
SEMILIR
BESOLE
KEBO BUTAK
GAMPING
WUNGKAL
TECTONIC SETTING
NORTH
SOUTH
BACKARC
MAGMATIC ARC
INTRAARC
BACKARC
BACKARC
MAGMATIC ARC
FORE ARC
CONTINENTAL PLATFORM
ACCRE-TIONARY WEDGE

Tectonic setting of East java

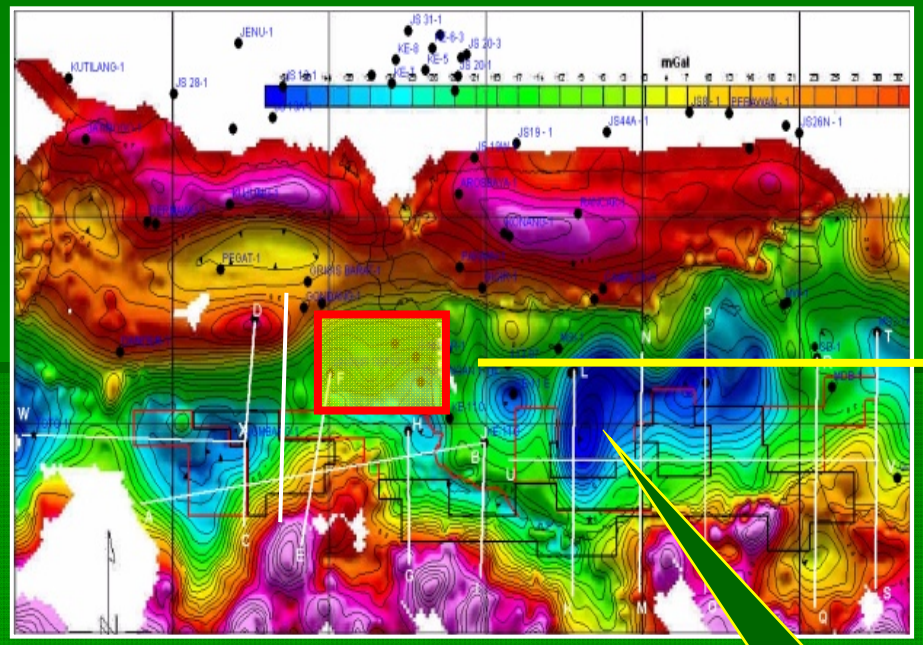




HALL R, 2002 : EAST JAVA

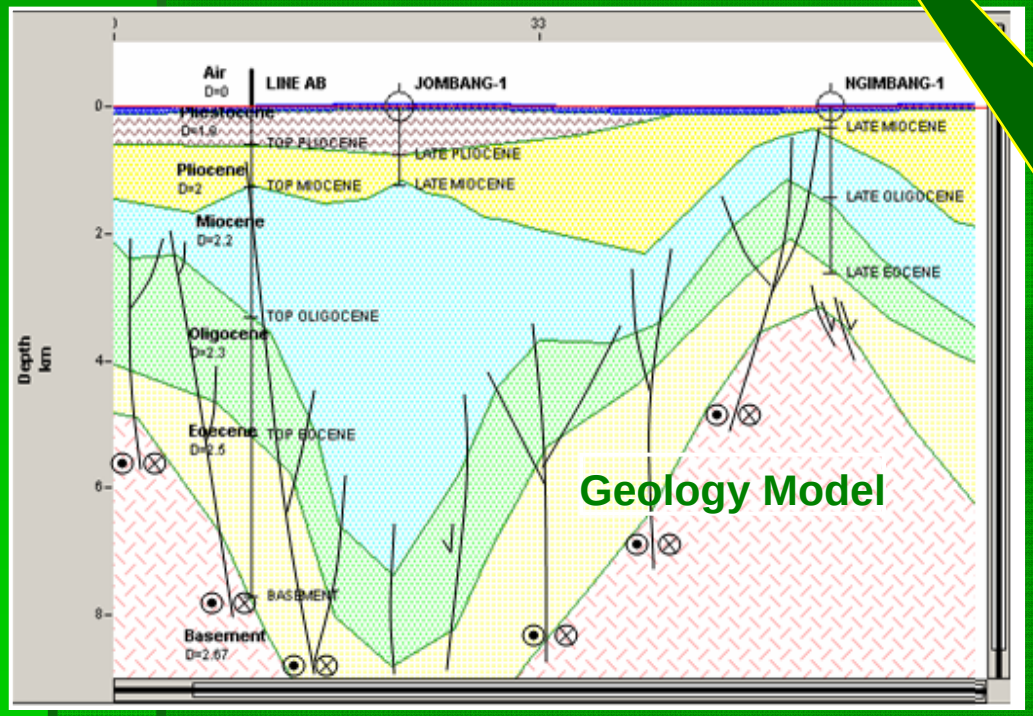
THERE ARE MANY FEATURES IN THIS REGION WHICH DO NOT FITT THE CONVENTIONAL MODELS :

- **VOLCANIC ACTIVITY BEGAN ERLIER THAN REPORTED**
- **CHARACTER NOT EXCLUSIVELY ANDESITIC**
- **BASINS DO NOT RIFT BASINS**
- **THEIR FILL HAS SOME UNUSUAL CHARACTERISTICS**



Tectonic setting of East java

Sidoarjo area

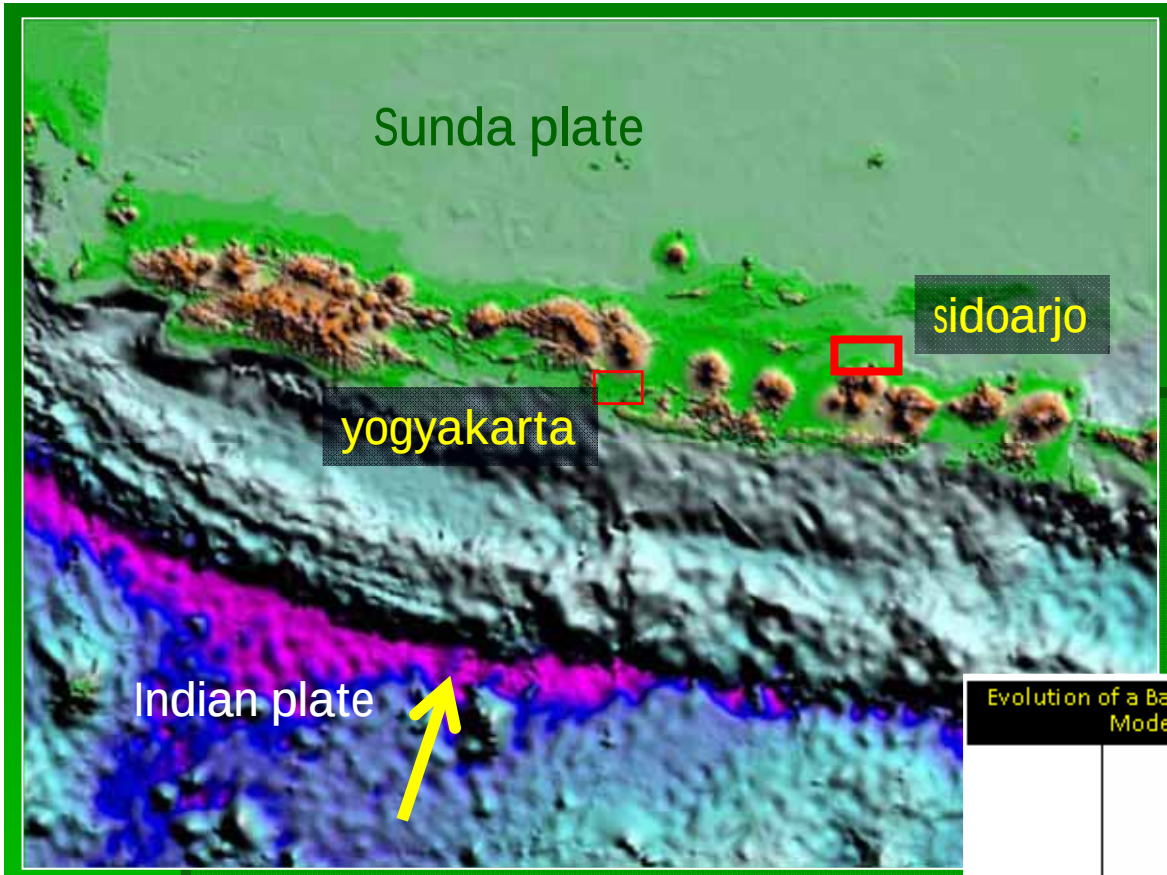


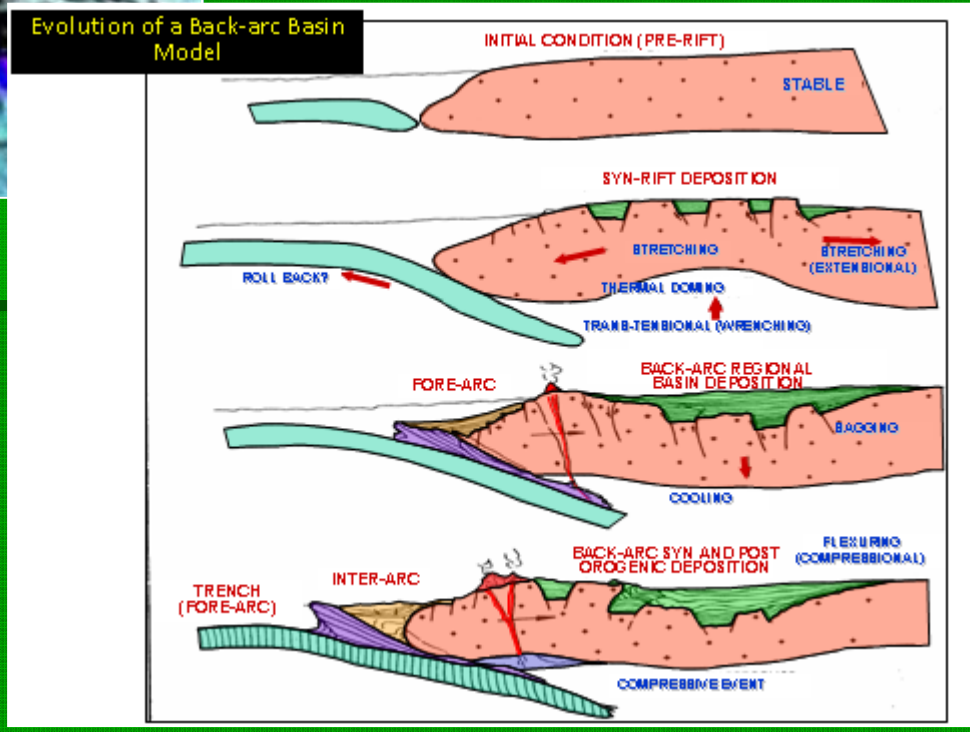
HALL R, 2002 : EAST JAVA

THERE ARE MANY FEATURES IN THIS REGION WHICH DO NOT FITT THE CONVENTIONAL MODELS :

- **VOLCANIC ACTIVITY BEGAN ERLIER THAN REPORTED**
- **CHARACTER NOT EXCLUSIVELY ANDESITIC**
- **BASINS DO NOT RIFT BASINS**
- **THEIR FILL HAS SOME UNUSUAL CHARACTERISTICS**

(LAPINDO 2006)





tectonic movements induced by plate subduction, resulted in reactivation of existing faults and released of energy which is the source of earthquake, volcanism and other geological phenomena

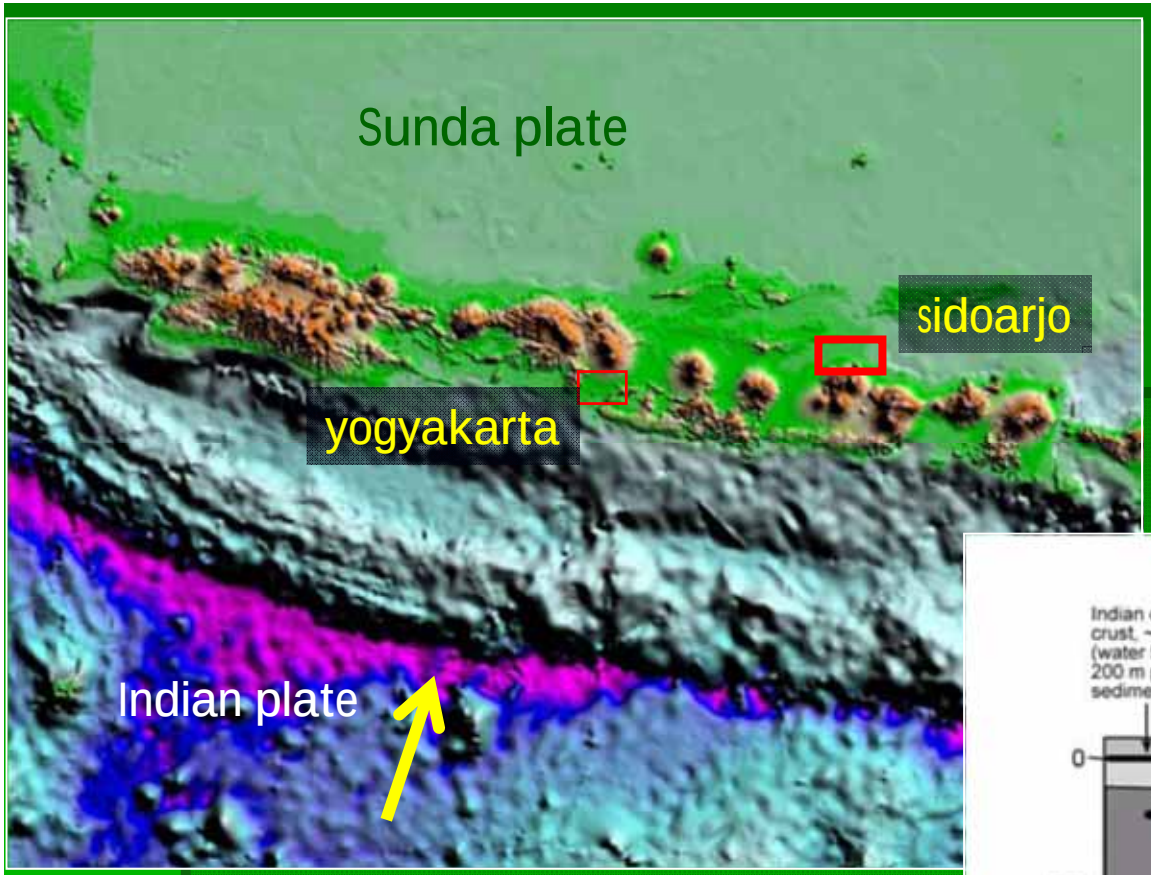
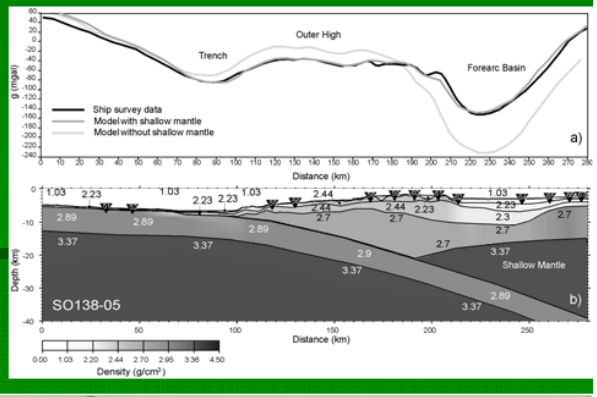
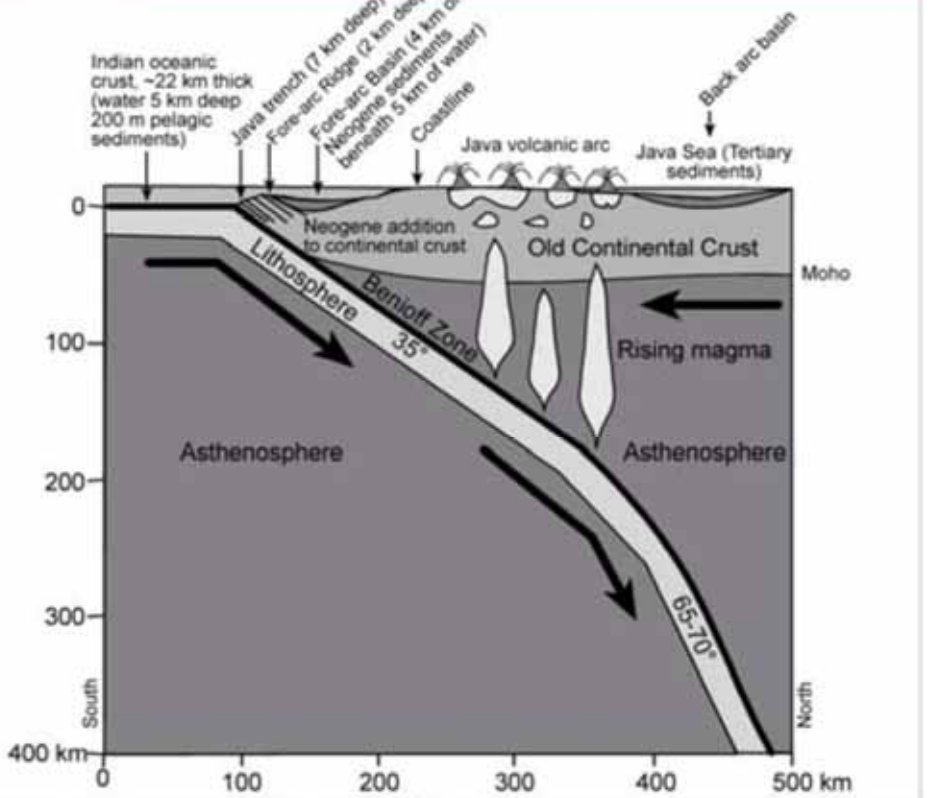


PLATE TECTONIC MODEL AND GRAVITY ANOMALY

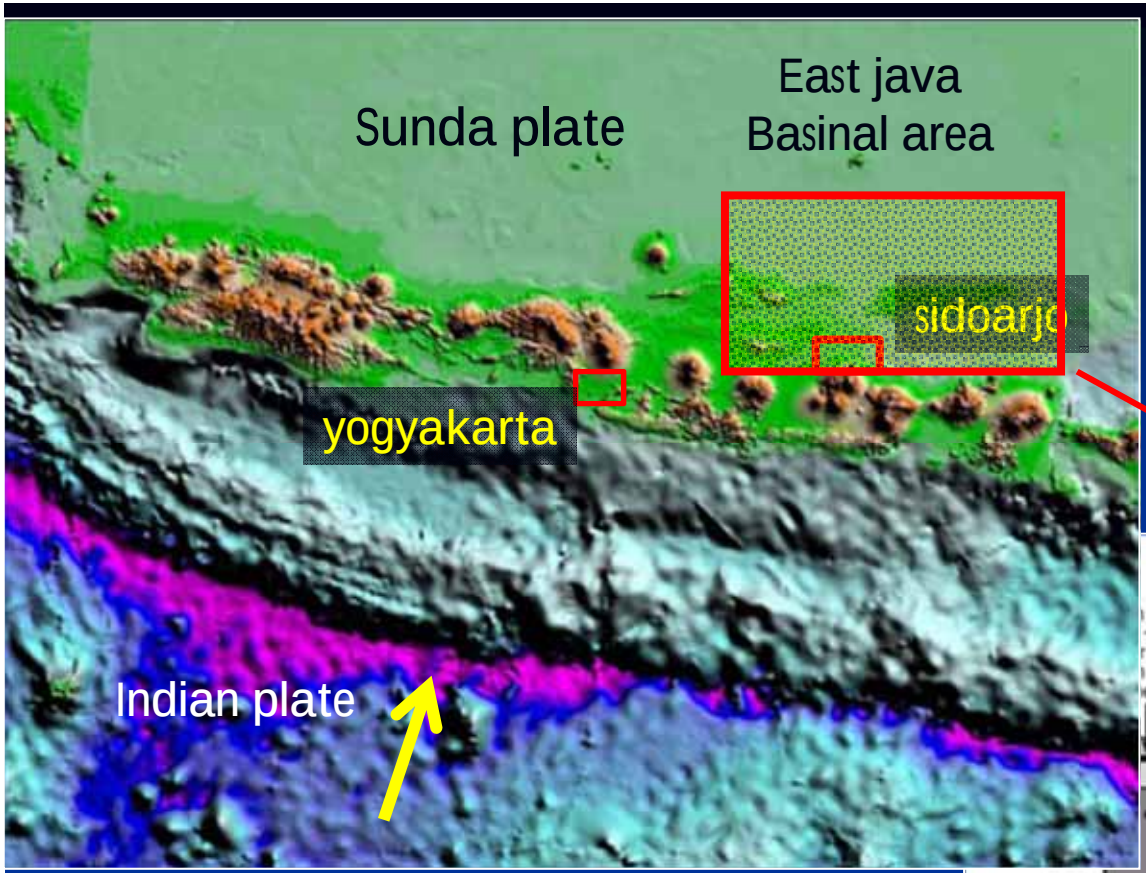


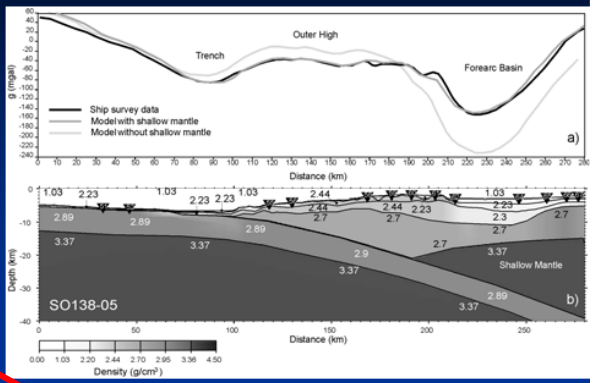
GENERALISED CROSS SECTION

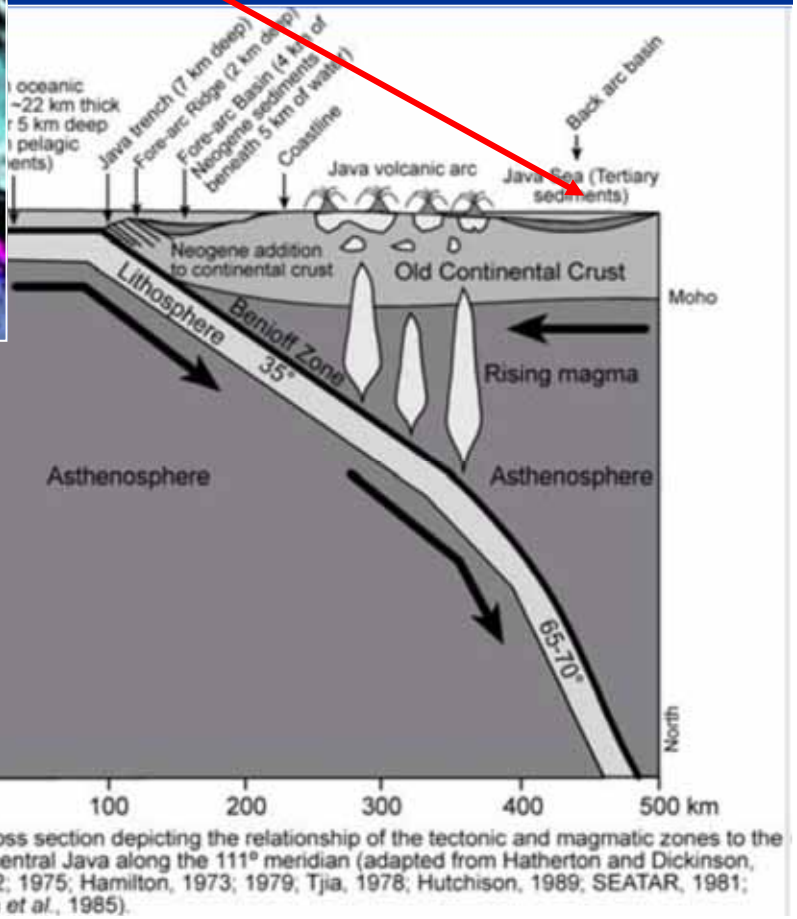
tectonic movements induced by plate subduction, resulted in reactivation of existing faults and released of energy which is the source of earthquake, volcanism and other geological phenomena



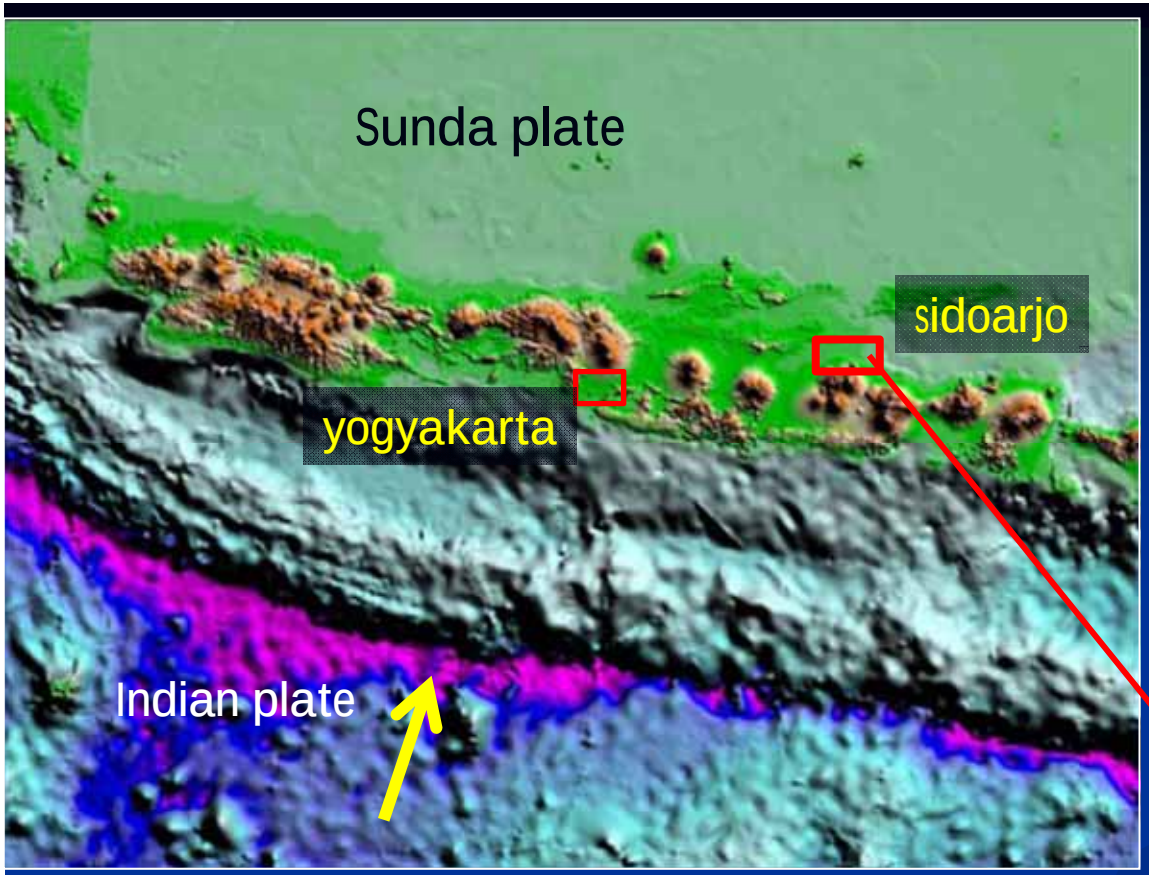
A generalised cross section depicting the relationship of the tectonic and magmatic zones to the Benioff Zone in central Java along the 111° meridian (adapted from Hatherton and Dickinson, 1969; Katili, 1972; 1975; Hamilton, 1973; 1979; Tjia, 1978; Hutchison, 1989; SEATAR, 1981; Koesoemadinata *et al.*, 1985).

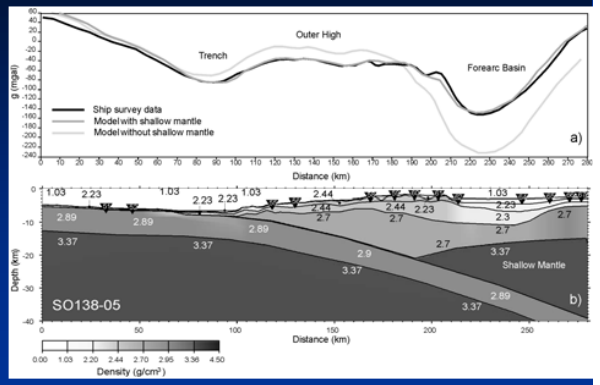




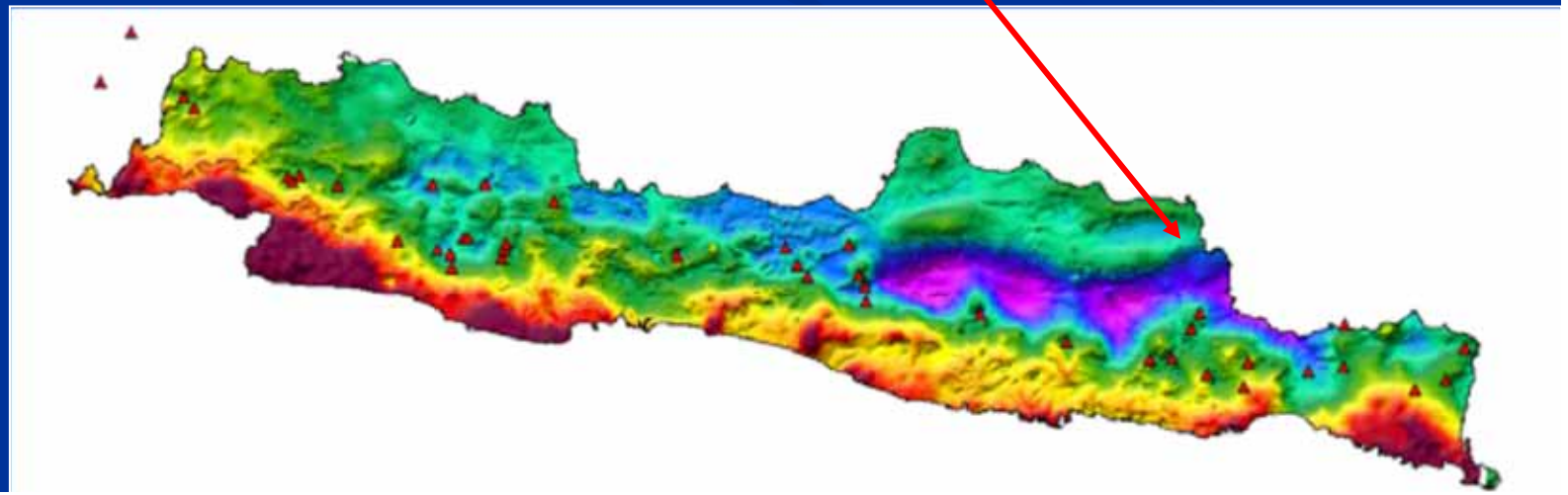


A generalised cross section depicting the relationship of the tectonic and magmatic zones to the Benioff Zone in central Java along the 111° meridian (adapted from Hatherton and Dickinson, 1969; Katili, 1972; 1975; Hamilton, 1973; 1979; Tjia, 1978; Hutchison, 1989; SEATAR, 1981; Koesoemadinata *et al.*, 1985).

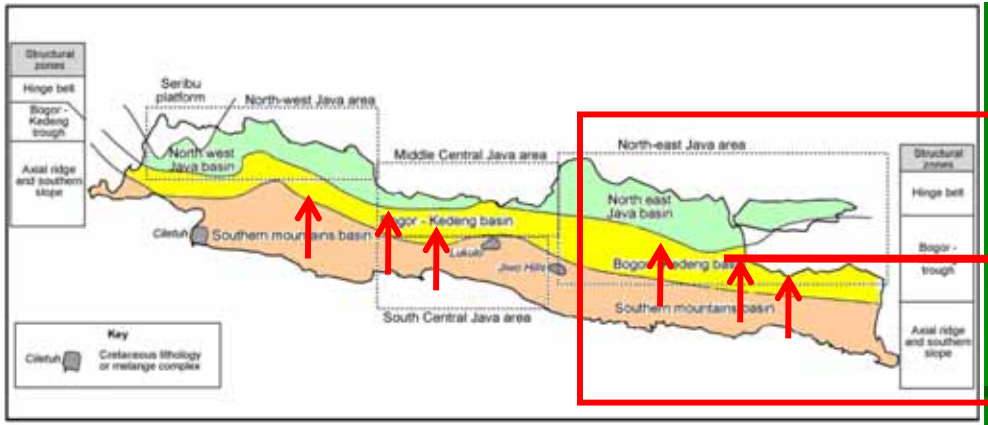




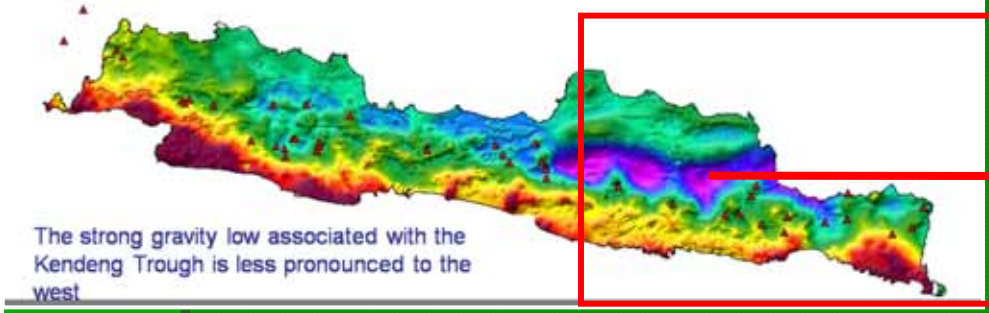
Extremely low gravity anomaly



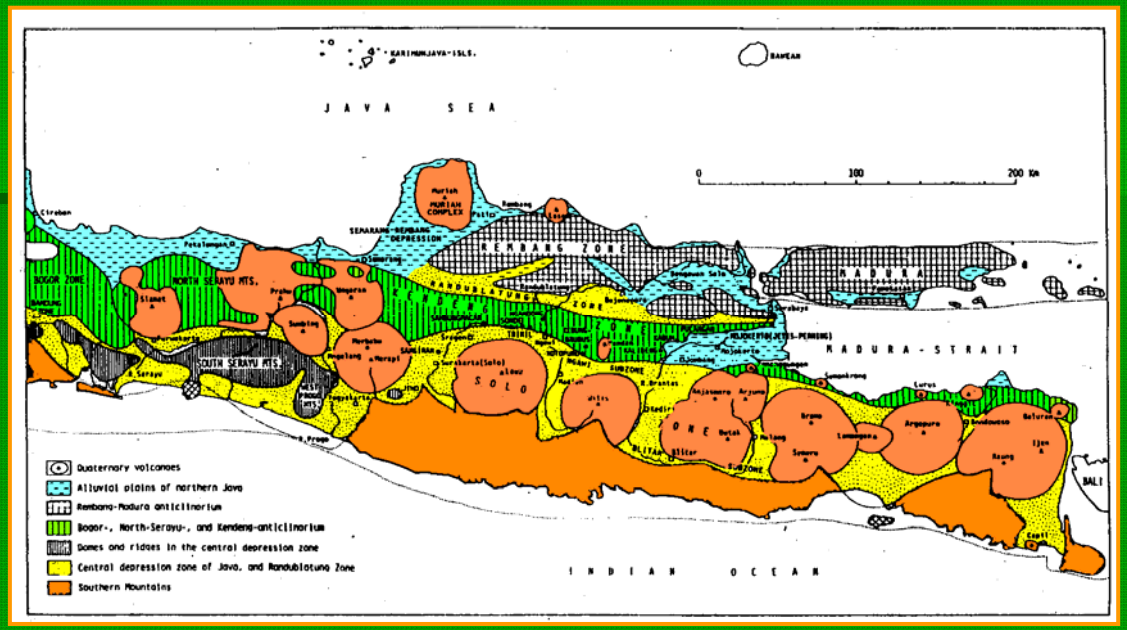
PHYSIOGRAPHIC UNITS OF JAVA AND REGIONAL GEOLOGY



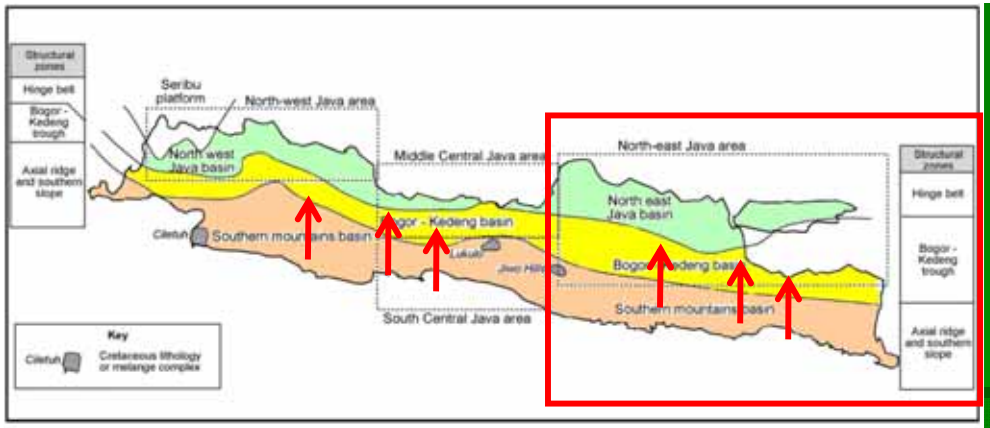
"BOGOR-KENDENG" ZONE, A TECTONIC DEPRESSION IN THE CENTRAL PART OF JAVA ISLAND,
COMPRISING OF RESTRICTED SEDIMENTARY BASINS WITH RAPID SEDIMENT FILL DERRIVED FROM THE EXTINC AND ACTIVE VOLCANOES IN THE SOUTH

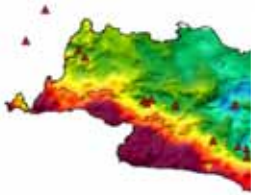


IN THE EASTERN PART OF JAVA,
THE KENDENG BASIN SHOWS A SIGNIFICANT GAVITY LOW, WHICH CAN BE INTERPRETED AS CONSISTING OF VERY THICK RELATIVELY LOW DENSITY SEDIMENTARY SEQUENCE

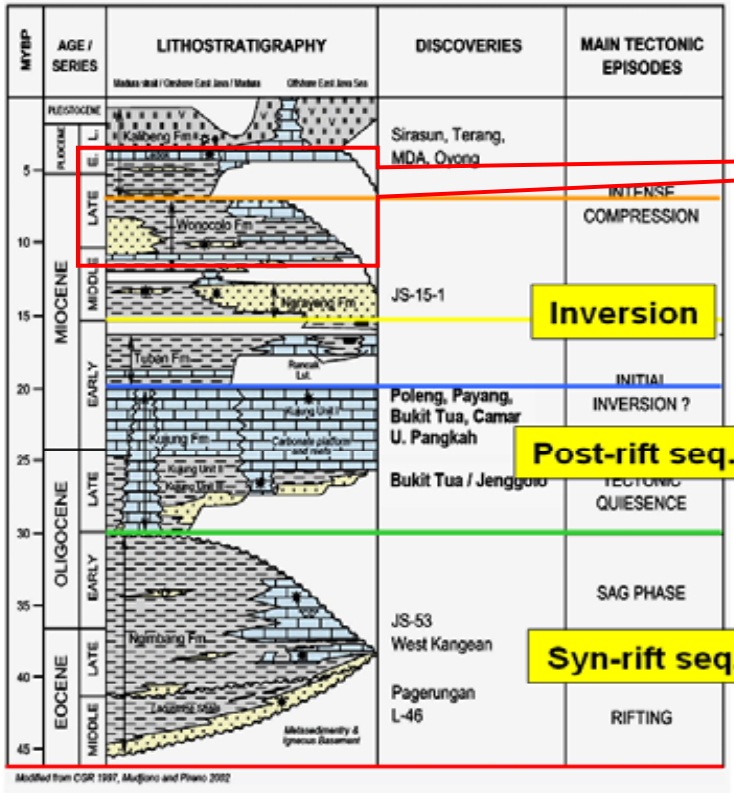


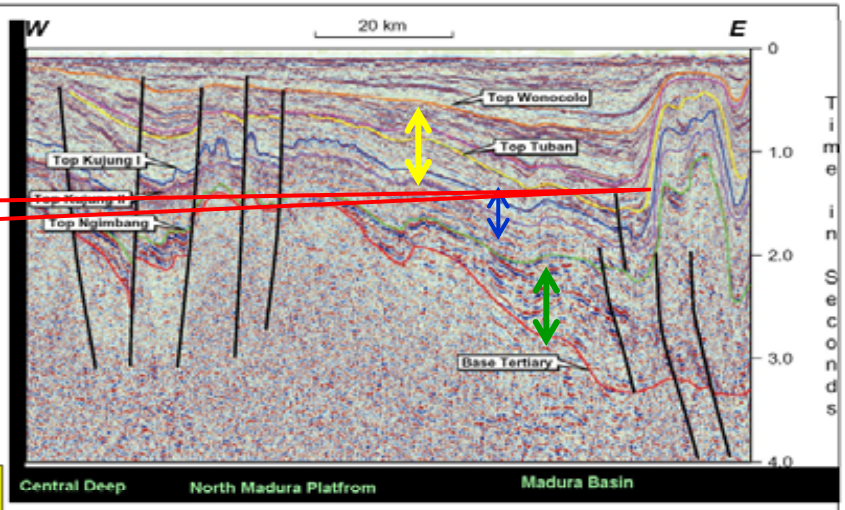
TECTONO-STRATIGRAPHIC SECTION OF EAST JAVA BASIN

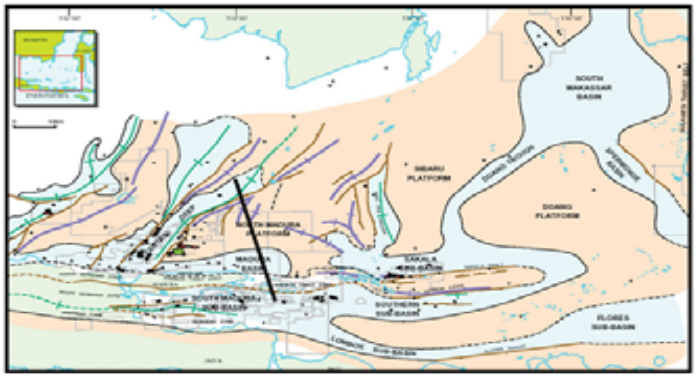




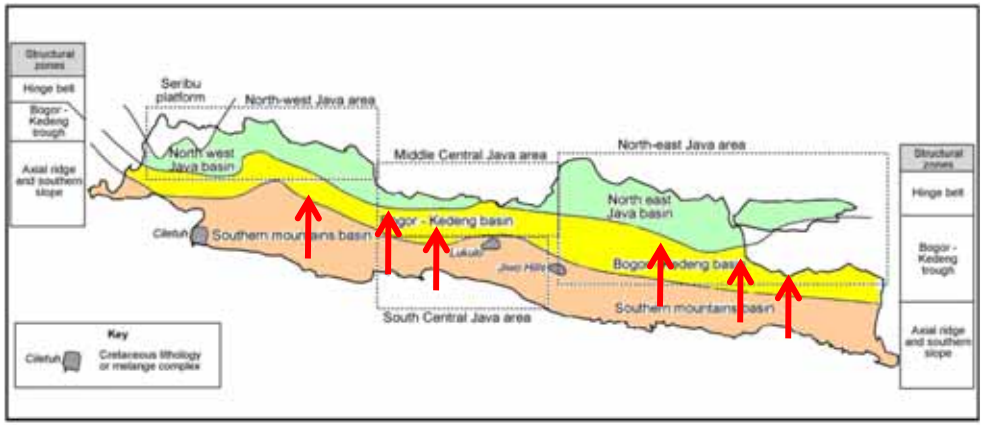
The strong gravity low as
Kendeng Trough is less
west



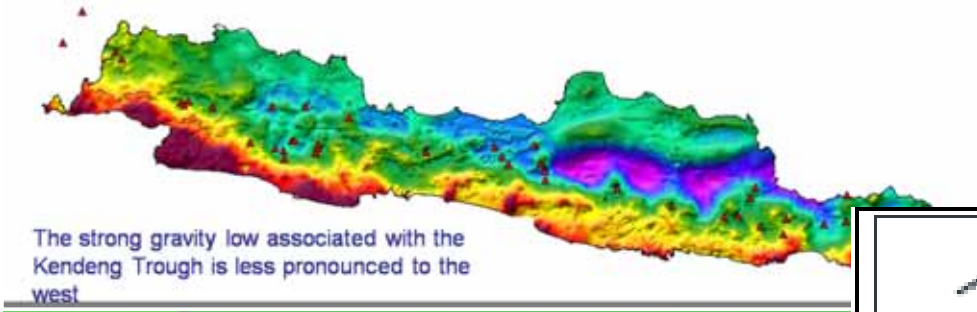




-HC produced from several strat. sequences
-"Multiple petroleum system"



STRUCTURAL PATTERN OF EAST JAVA BASIN

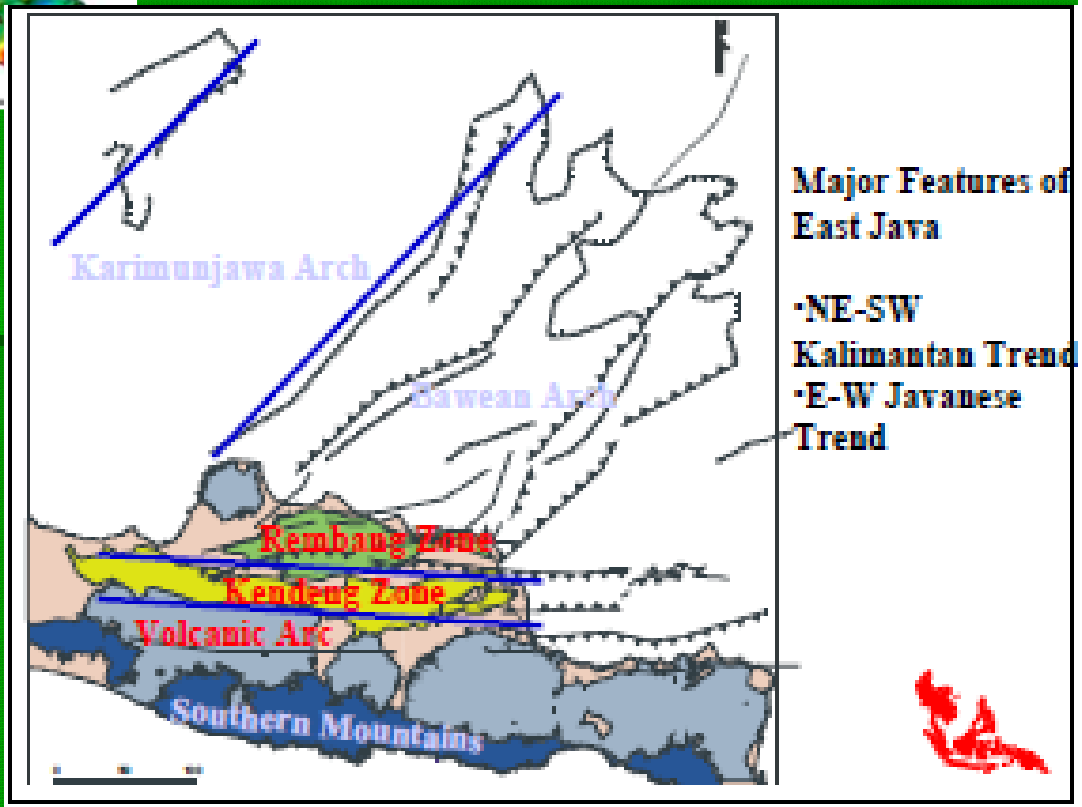


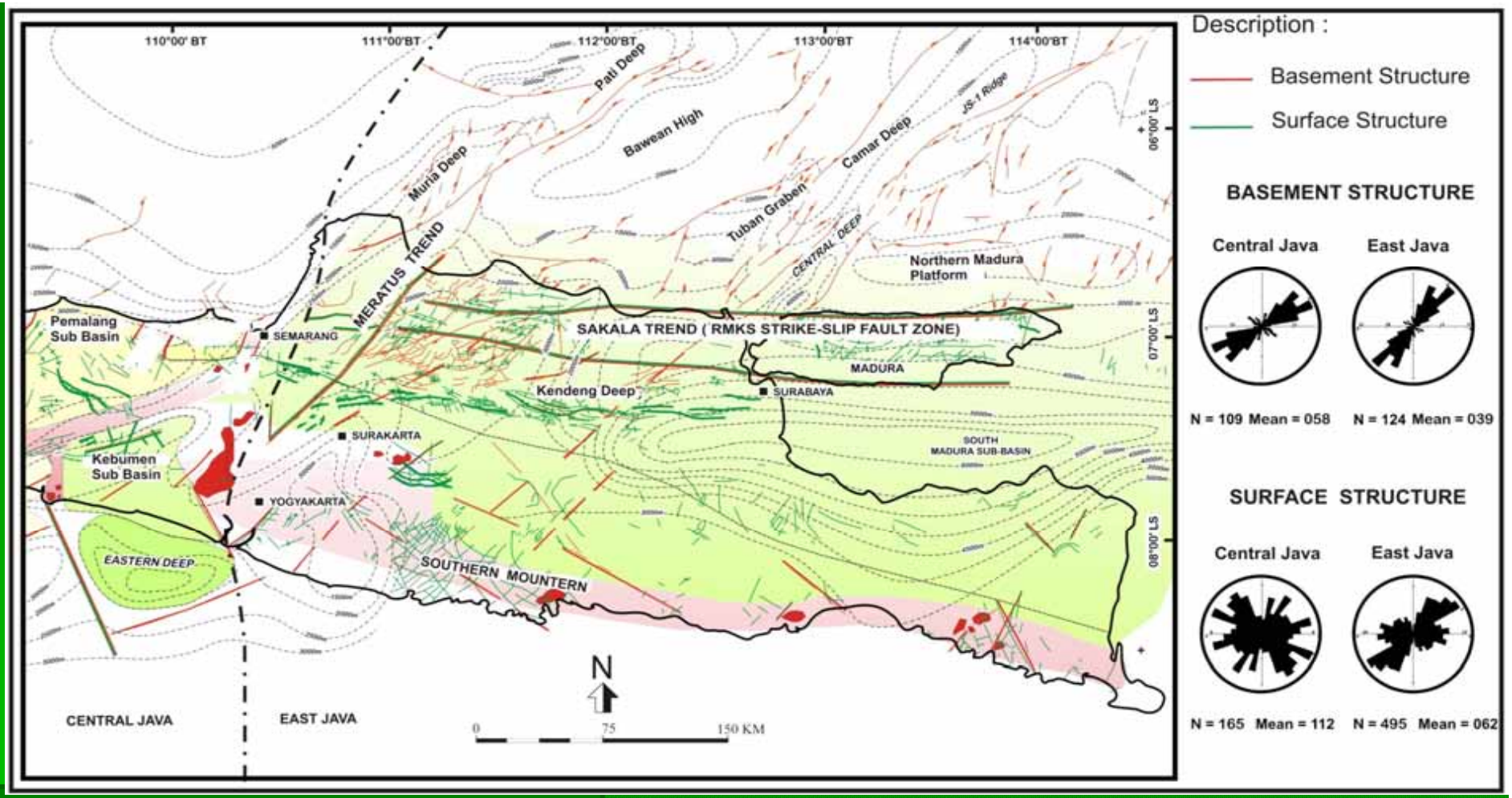
The strong gravity low associated with the Kendeng Trough is less pronounced to the west

2 SETS OF FAULT PATERN CHARACTERIZED THE STRUCTURAL GRAIN OF THE BASIN:

1 THE NE-SW PRE-TERTIARY PATTERN AND

2. THE E-W TERTIARY PATTERN

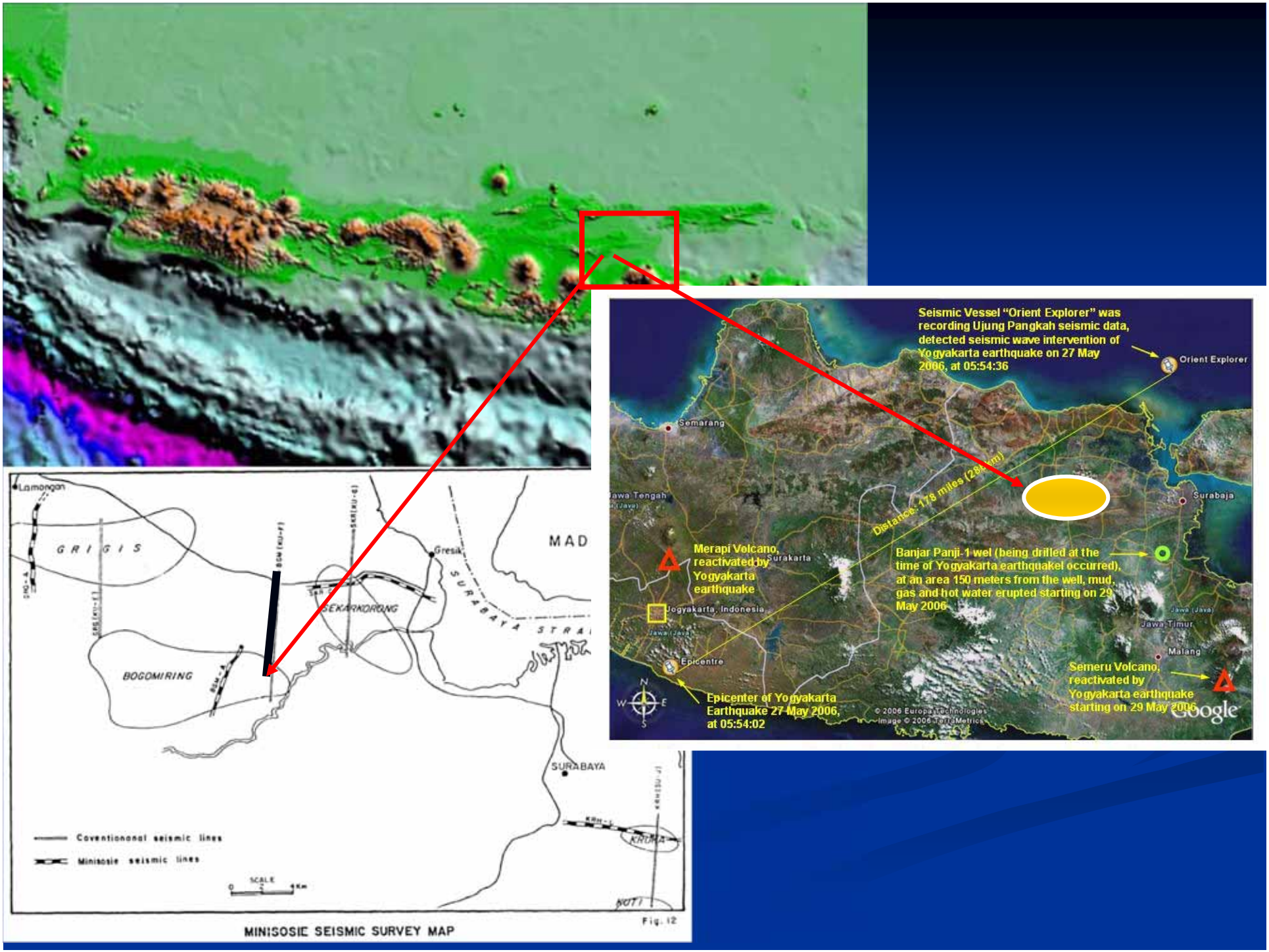


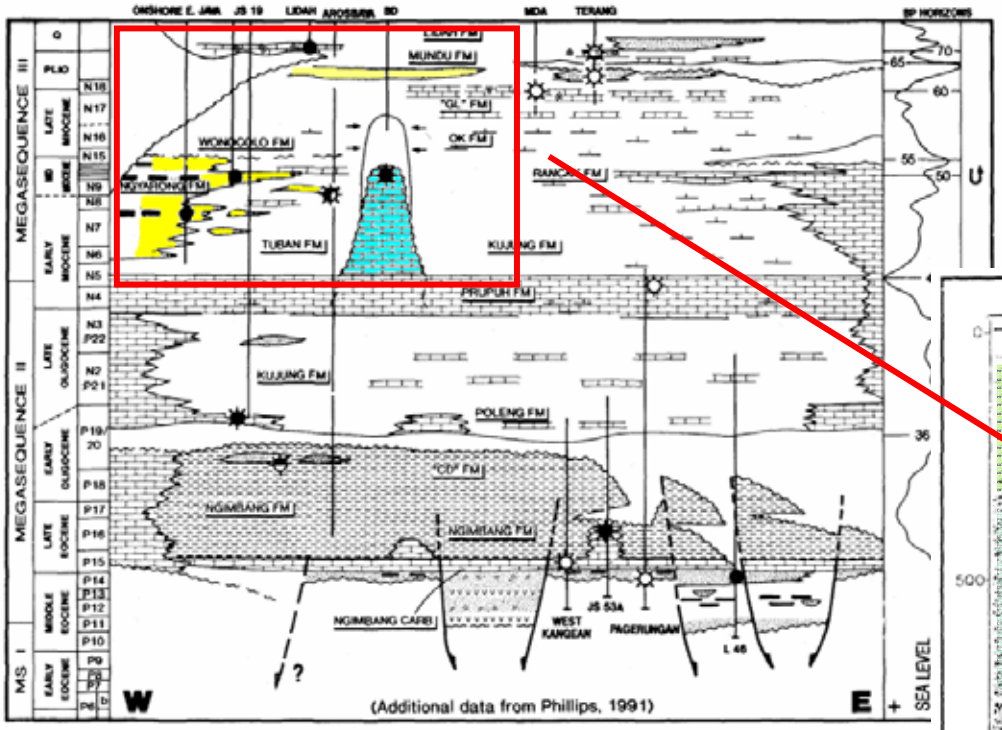


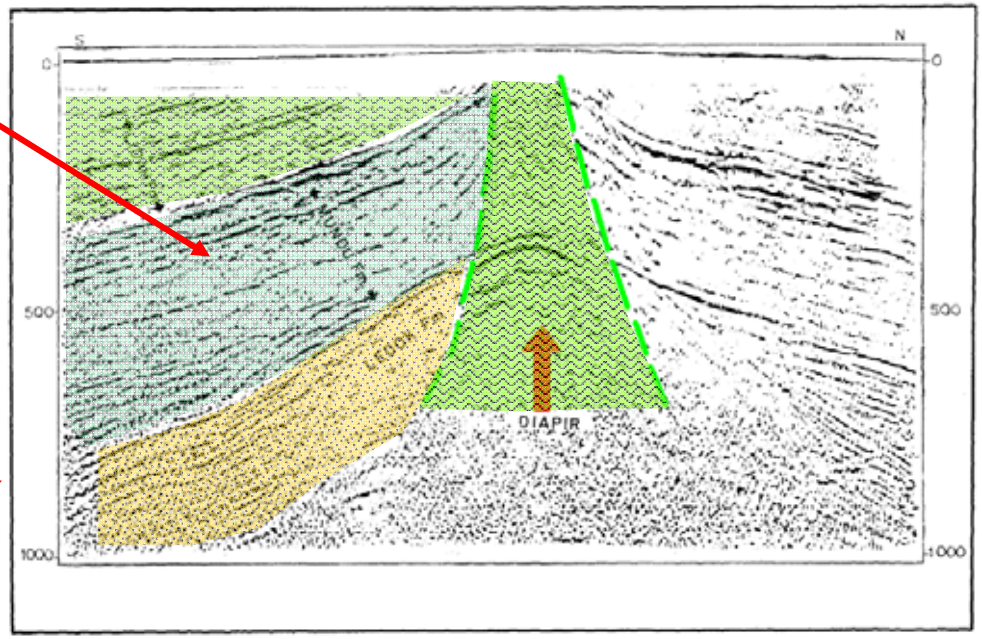
2 SETS OF FAULT PATERN CHARACTERIZED THE STRUCTURAL GRAIN OF THE BASIN:

1 THE NE-SW PRE-TERTIARY PATTERN AND

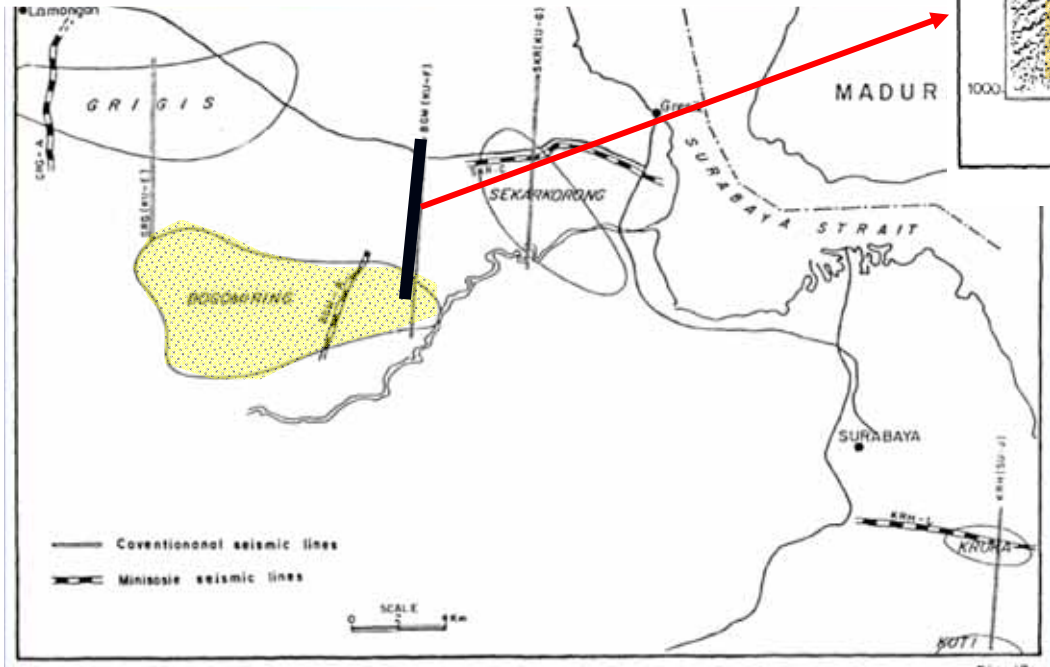
2. THE E-W TERTIARY PATTERN


Seismic Vessel "Orient Explorer" was recording Ujung Pangkah seismic data, detected seismic wave intervention of Yogyakarta earthquake on 27 May 2006, at 05:54:36
Orient Explorer
Semarang
Distance: 118 miles (284 km)
Surabaya
Merapi Volcano, reactivated by Yogyakarta earthquake
Surakarta
Banjar Panji-1 wel (being drilled at the time of Yogyakarta earthquakel occurred), at an area 150 meters from the well, mud, gas and hot water erupted starting on 29 May 2006
Jogyakarta, Indonesia
Jawa Timur
Malang
Epicentre
Semeru Volcano, reactivated by Yogyakarta earthquake starting on 29 May 2006
Epicenter of Yogyakarta Earthquake 27 May 2006, at 05:54:02
Google
Lamongan
GRIGIS
BOGOMIRING
SEKARNGRONG
Gresik
SURABAYA
KRUKA
Coventionoal seismic lines
Minisosie seismic lines
SCALE
MINISOSIC SEISMIC SURVEY MAP
Fig. 12



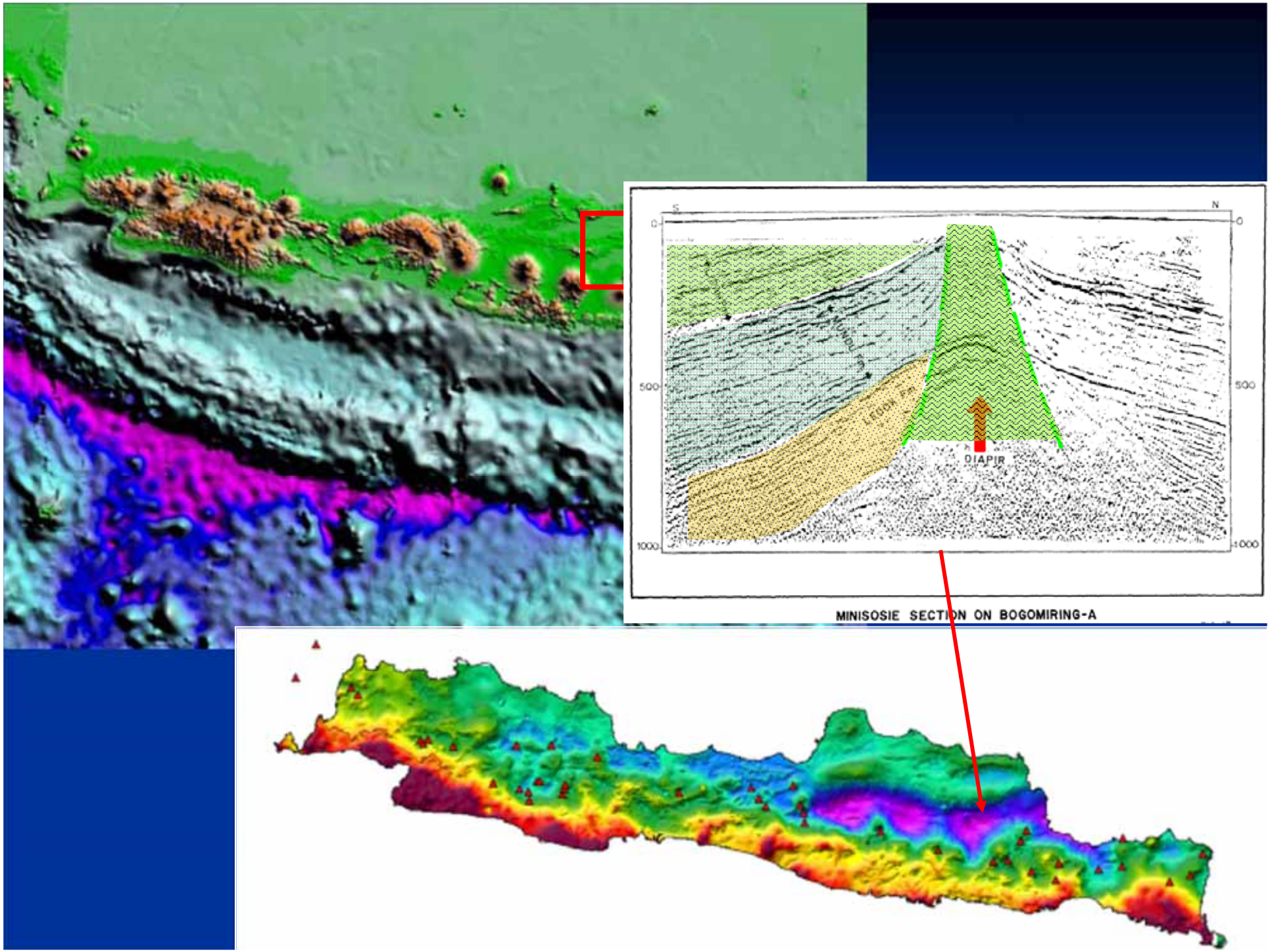


MINISOSIE SECTION ON BOGOMIRING-A

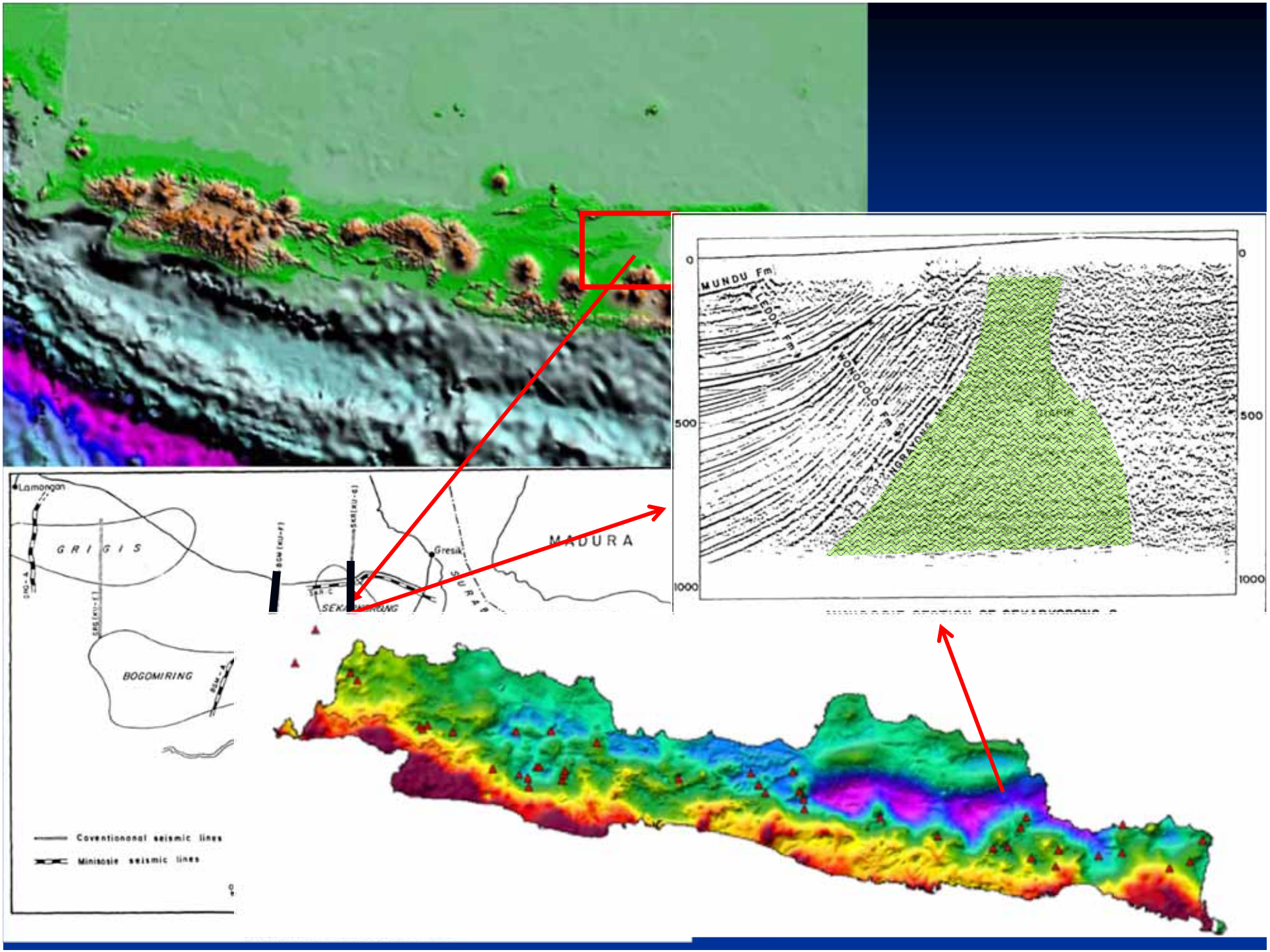


MINISOSIE SEISMIC SURVEY MAP

Fig. 12

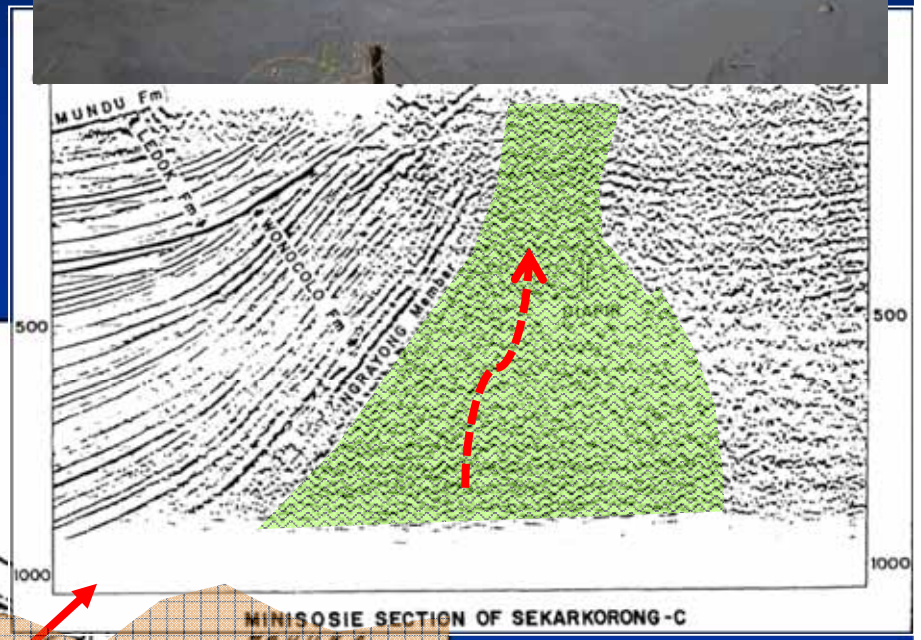


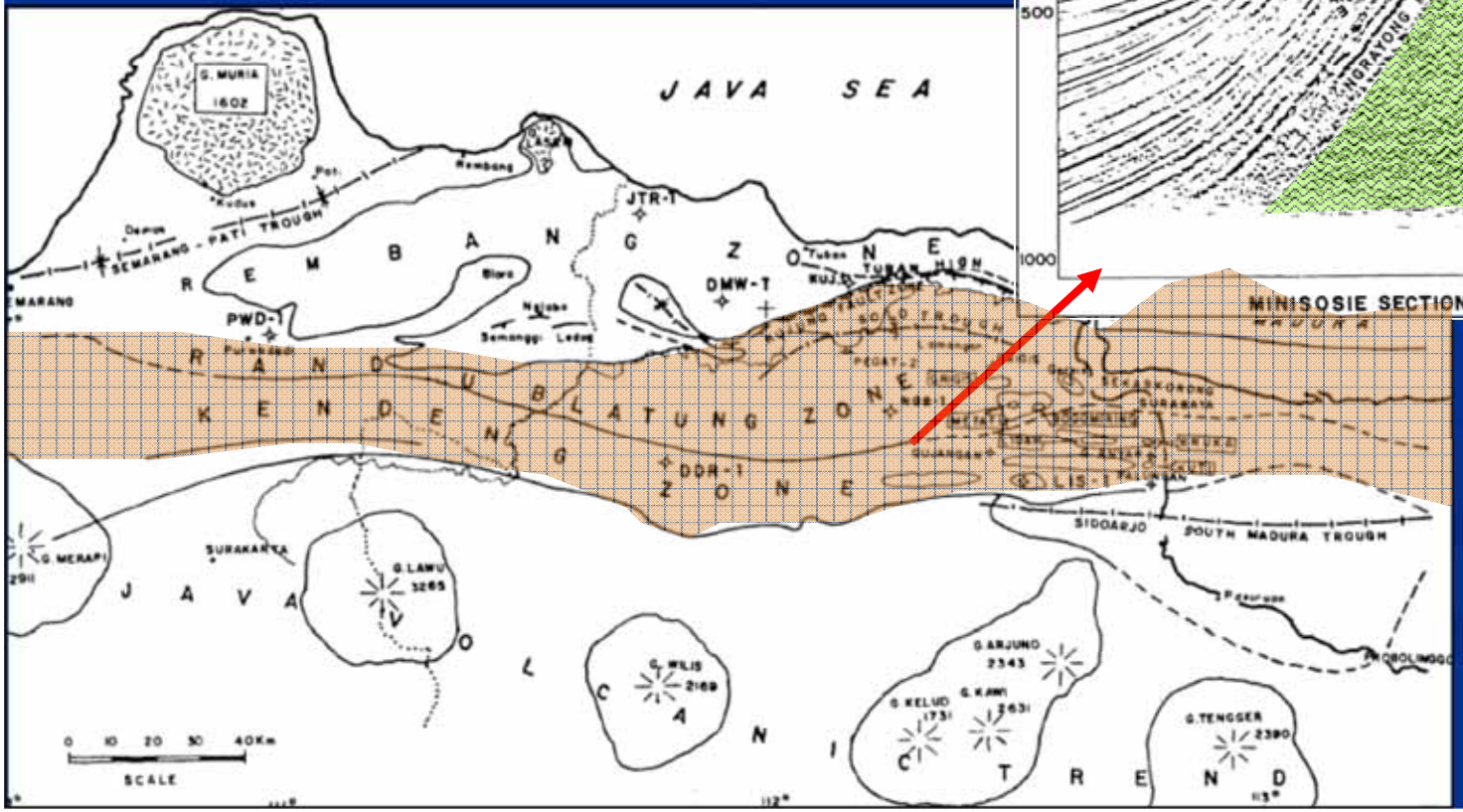
MINISOSIE SECTION ON BOGOMIRING-A


MUNDU Fm
0
500
1000
Lamongan
GRIGIS
Gresik
MADURA
BOGOMIRING
Coventionoal seismic lines
Minisosie seismic lines

THE KENDENG ZONE IS CHARACTERIZED BY A COMPLEX STRUCTURAL GRAIN, BOUNDED BY ACTIVE AS WELL AS (SAKALA FLT) IN-ACTIVE FAULTS PATTERN

Piercement of diapir and extrusion of mud, hot water and gas is common

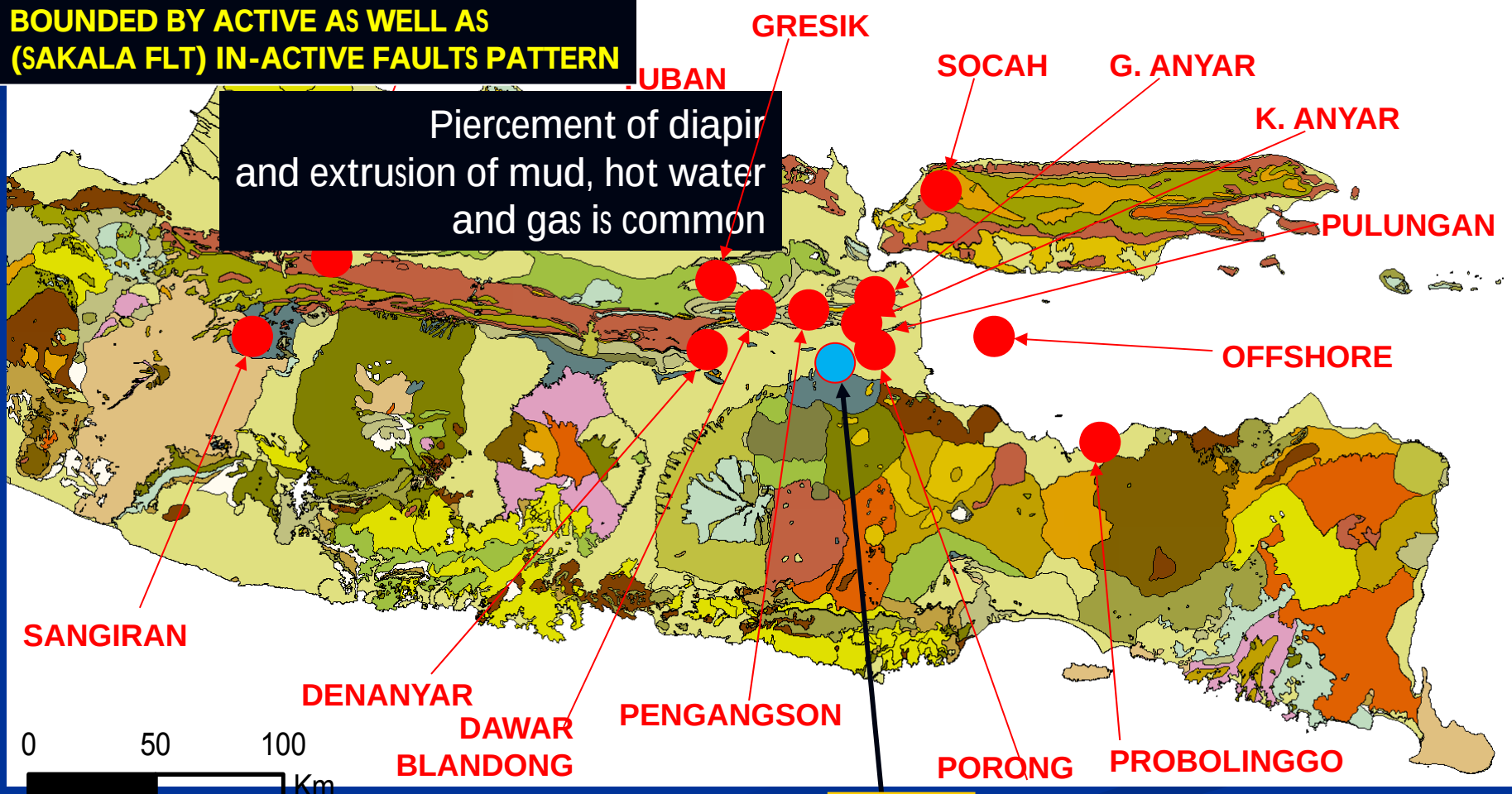




Distribution of Mud Volcanoes in East Java

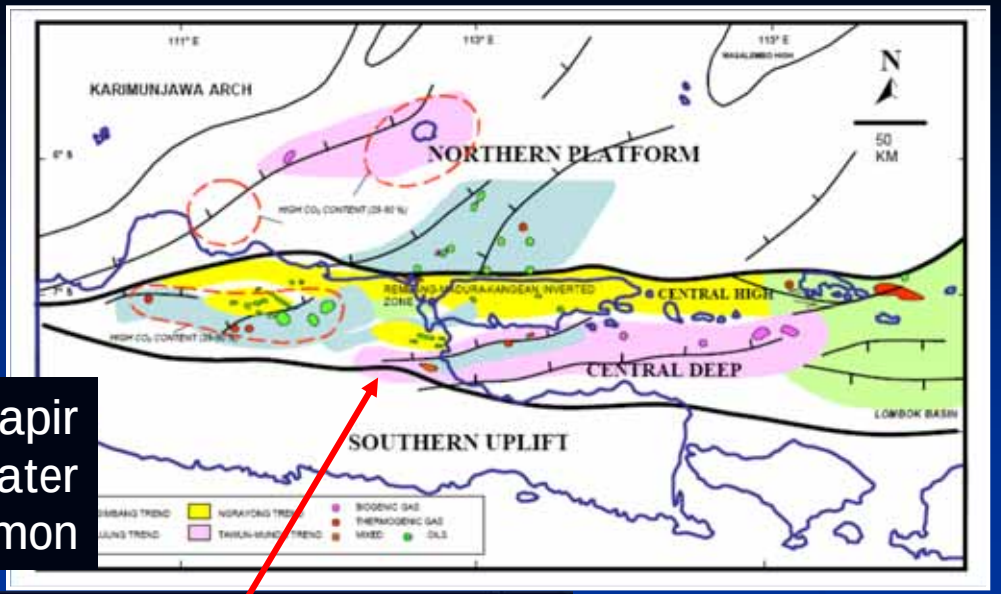
THE KENDENG ZONE IS CHARACTERIZED BY A COMPLEX STRUCTURAL GRAIN, BOUNDED BY ACTIVE AS WELL AS (SAKALA FLT) IN-ACTIVE FAULTS PATTERN

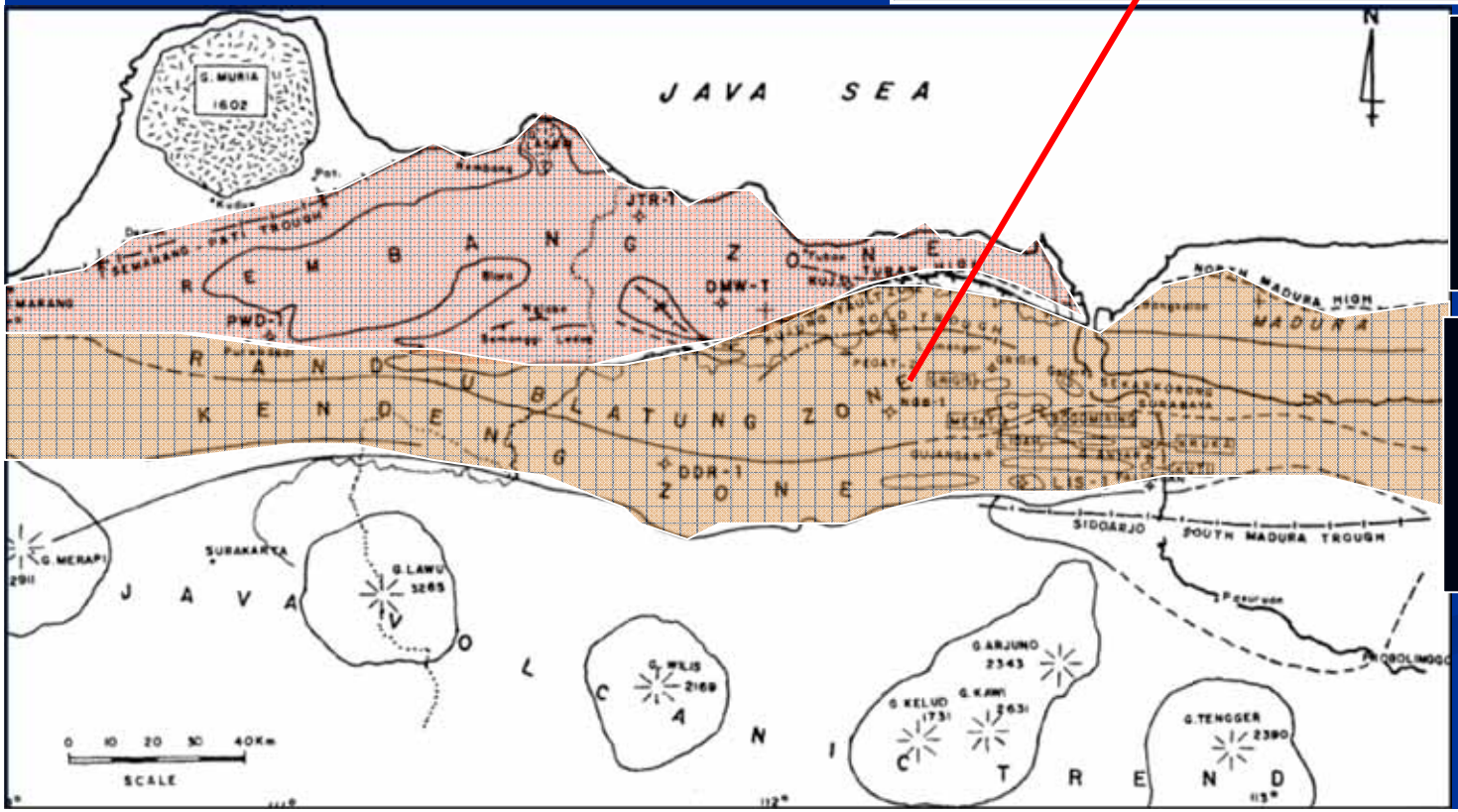
Piercement of diapir and extrusion of mud, hot water and gas is common



THE KENDENG ZONE IS CHARACTERIZED BY A COMPLEX STRUCTURAL GRAIN, BOUNDED BY ACTIVE AS WELL AS (SAKALA FLT) IN-ACTIVE FAULTS PATTERN

Piercement of diapir and extrusion of mud, hot water and gas is common





Less deformed Rembang zone: Is a tectonic active transition zone

Kendeng Zone : Appears to be affected by episode of thrusting

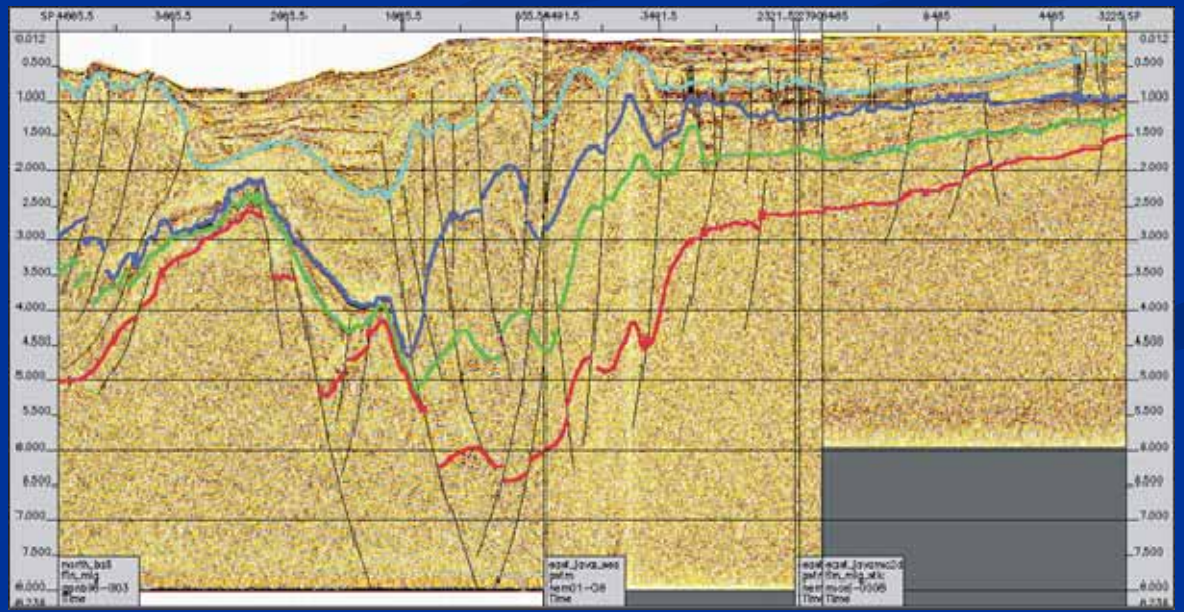
THE KENDENG ZONE IS CHARACTERIZED BY A COMPLEX STRUCTURAL GRAIN, BOUNDED BY ACTIVE AS WELL AS (SAKALA FLT) IN-ACTIVE FAULTS PATTERN

Piercement of diapir and extrusion of mud, hot water and gas is common

Southern Basin Ball Thrust

Central High Sakala Fault Zone

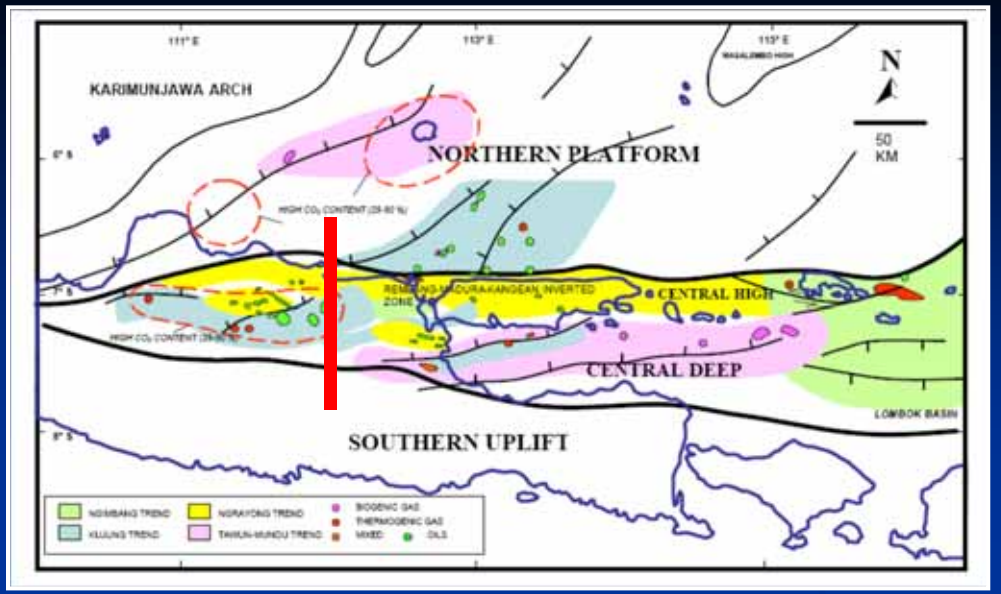
Northern Platform

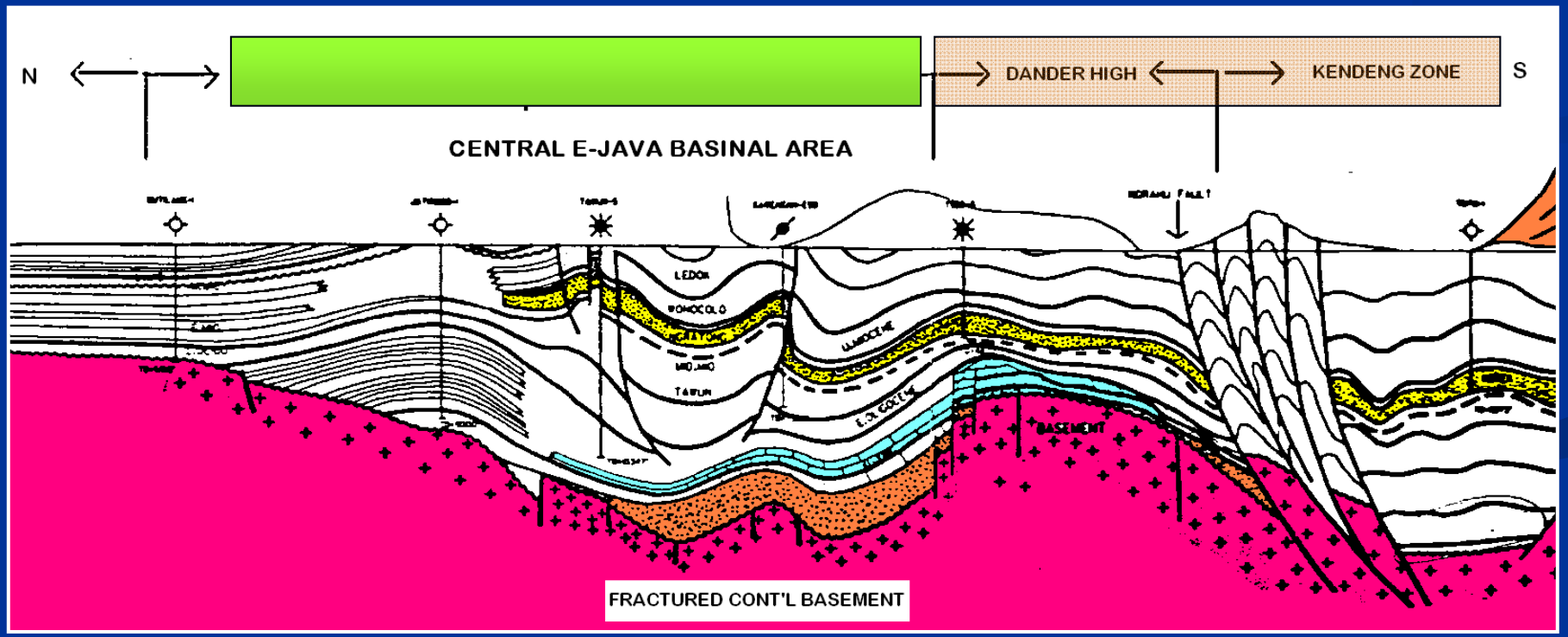


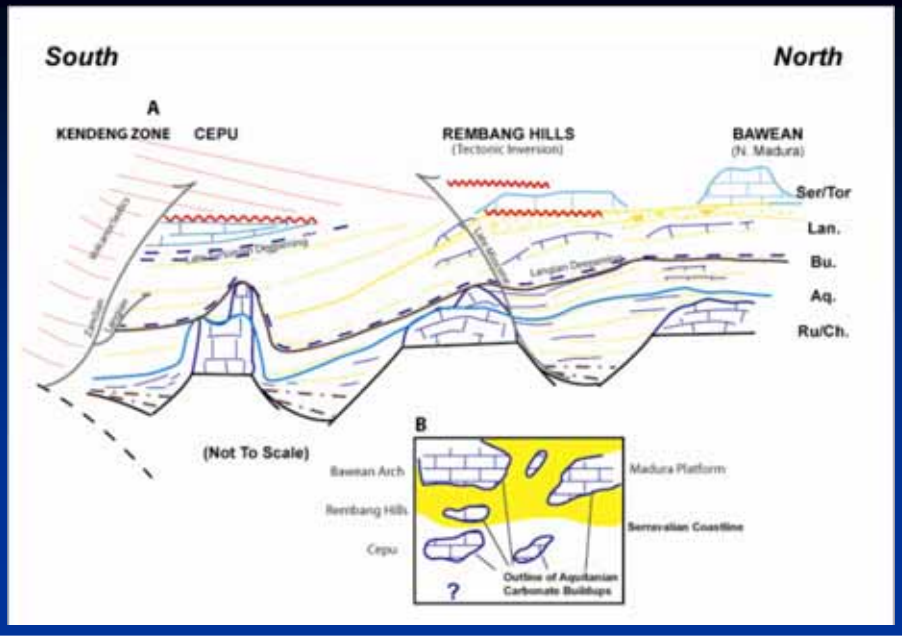
SEISMIC EXPRESSION THROUG CENTRAL DEEP SHOWS INTENSIVE DEFORMATION AND DIAPIR STRUCTURES

THE KENDENG BASIN IS CHARACTERIZED BY A COMPLEX STRUCTURAL GRAIN, BOUNDED BY ACTIVE AS WELL AS (SAKALA FLT) IN-ACTIVE FAULTS PATTERN

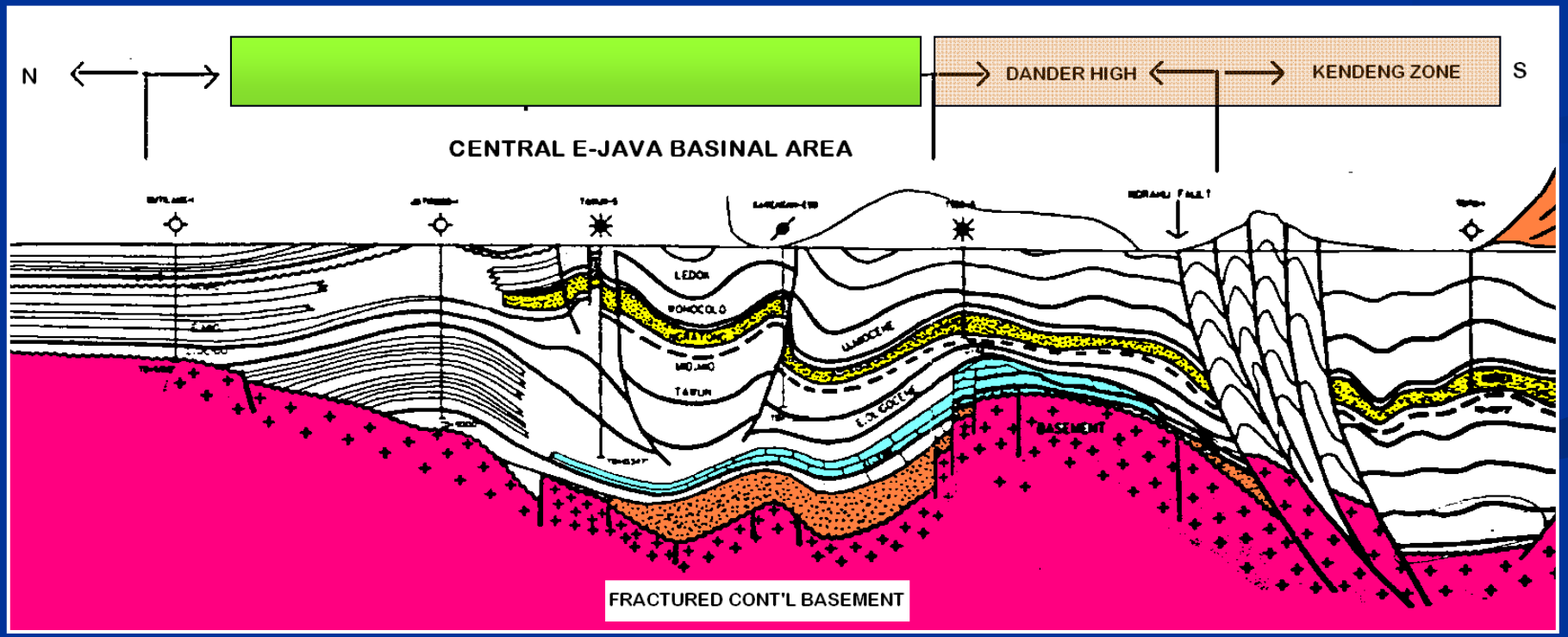
N-S CROSS SECTION ACCROS KENDENG ZONE DEPICTING INTENSIVE COMPRESSION IN THE SOUTH

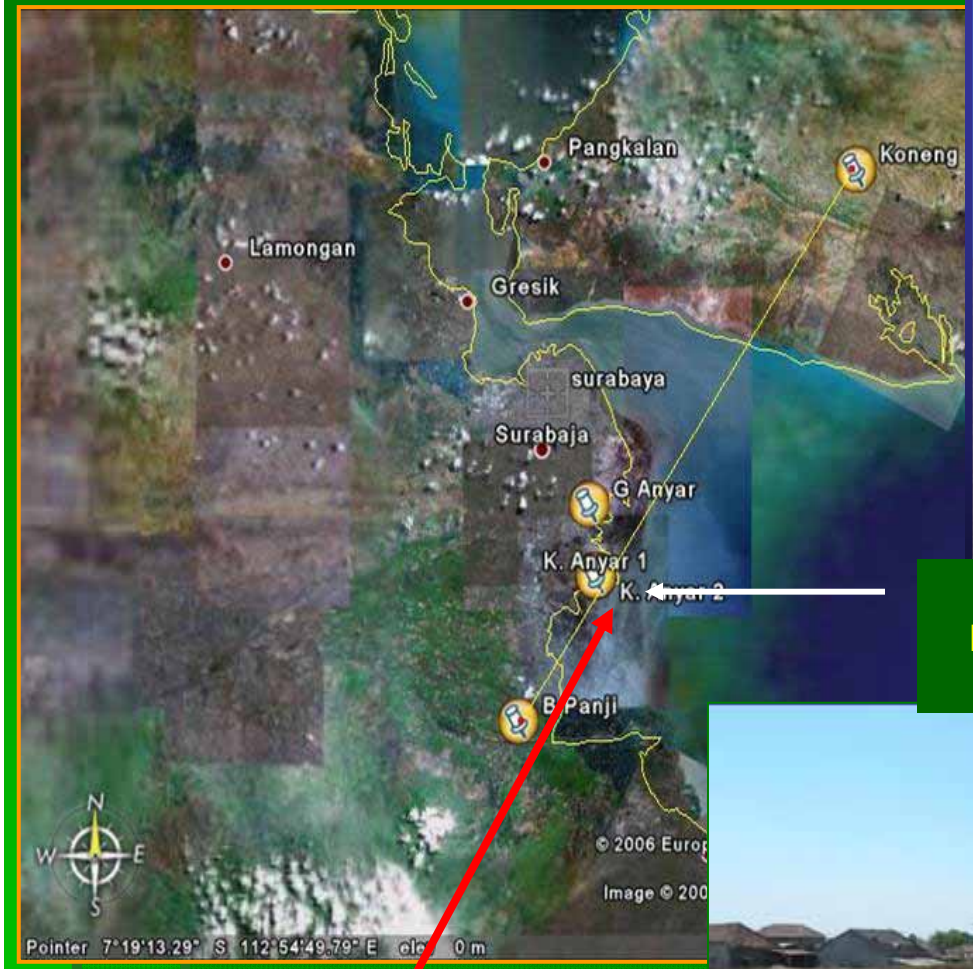






Toni Simo et al IPA 2011





KALANG ANYAR
MUD VOLCANO

EXAMPLE FROM
KALANG ANYAR – A DORMANT MUD VULCANO – SIDOARJO (EAST JAVA);

EXAMPLE FROM
KALANG ANYAR – A DORMANT MUD VULCANO – SIDOARJO (EAST JAVA);

KALANG ANYAR
MUD VOLCANO

B.Istadi (2006)

The presence of large exotic blocks cosisting of sandstones and limestones and sheared shales surrounding the mud volcanoes indicate inactive (dormant) diapir through which the mud volcanoes extrude

EXAMPLE FROM
GUNUNG ANYAR – A DORMANT MUD VULCANO – SIDOARJO (EAST JAVA);
A DARK BLACK SOIL WITH STRONG OIL SMELL.

the source of a mud volcano
may be a subsurface layer
or diapir of highly plastic,
and probably undercompacted
mud or shale.

mud volcanoes also commonly
appear to be related to fracture,
faulting or sharp folding
in the earthcrust

WHICH IS A TECTONIC PROCESS

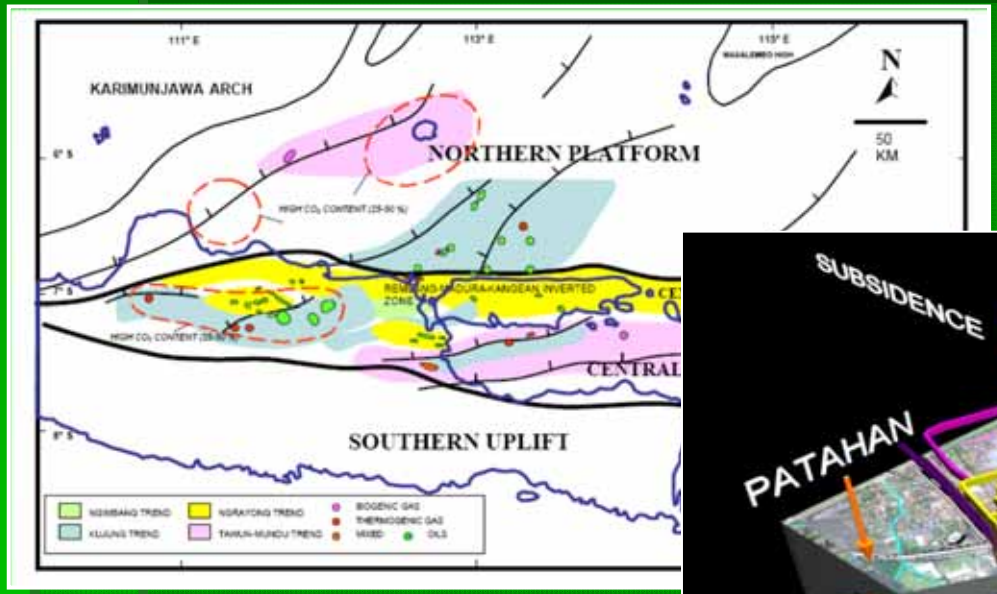
**A SCIENTIFIC BASE AS A TOOL
TO EXPLAIN THE PHENOMENA;
A BRANCH OF GEOLOGY THAT SEEKS
TO EXPLAIN OBSERVED PATTERNS
OF DEFORMATION AND SEISMICITY
IN THE OUTER SHELL OF THE EARTH**

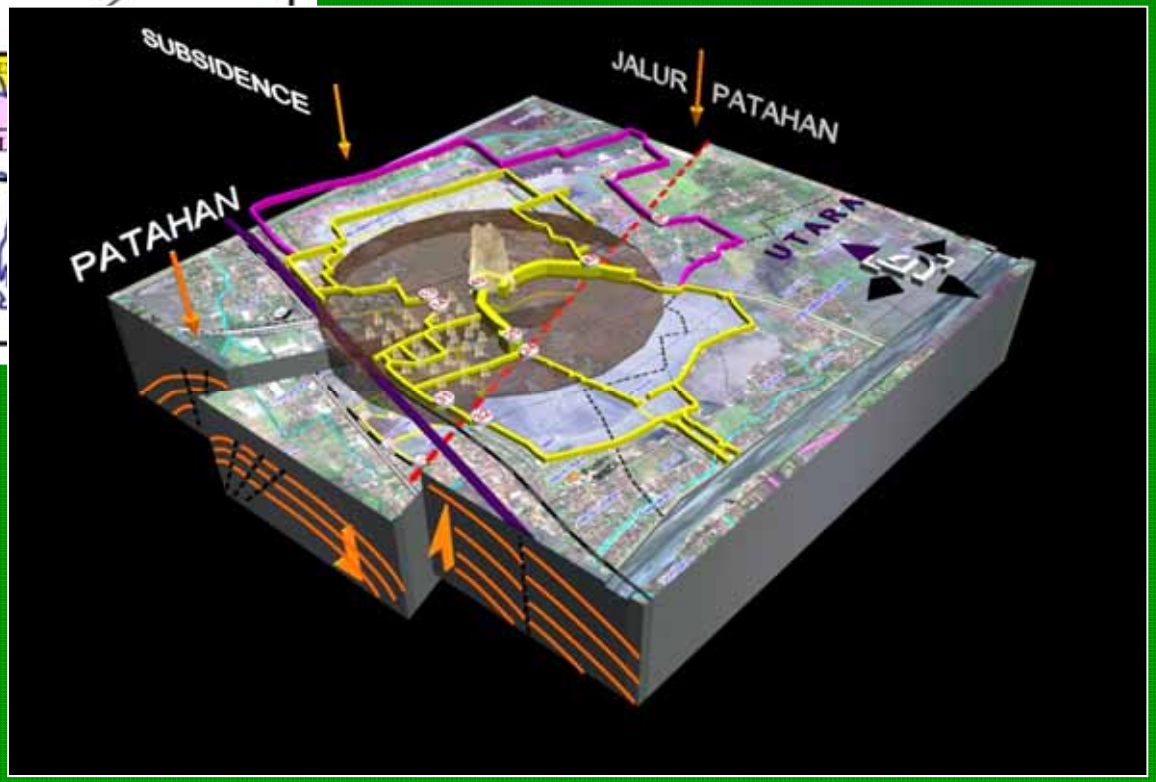
general conclusion

1

REACTIVATION OF FAULTS IN KENDENG BASIN DUE TO PLATE MOVEMENT (TECTONIC) CREATE EARTH QUAKE (ENERGY RELEASE) RELATED TO FAULTING, AND

EXTRUSION OF MOBILE CLAY FROM THE DEEPER PART OF THE BASIN





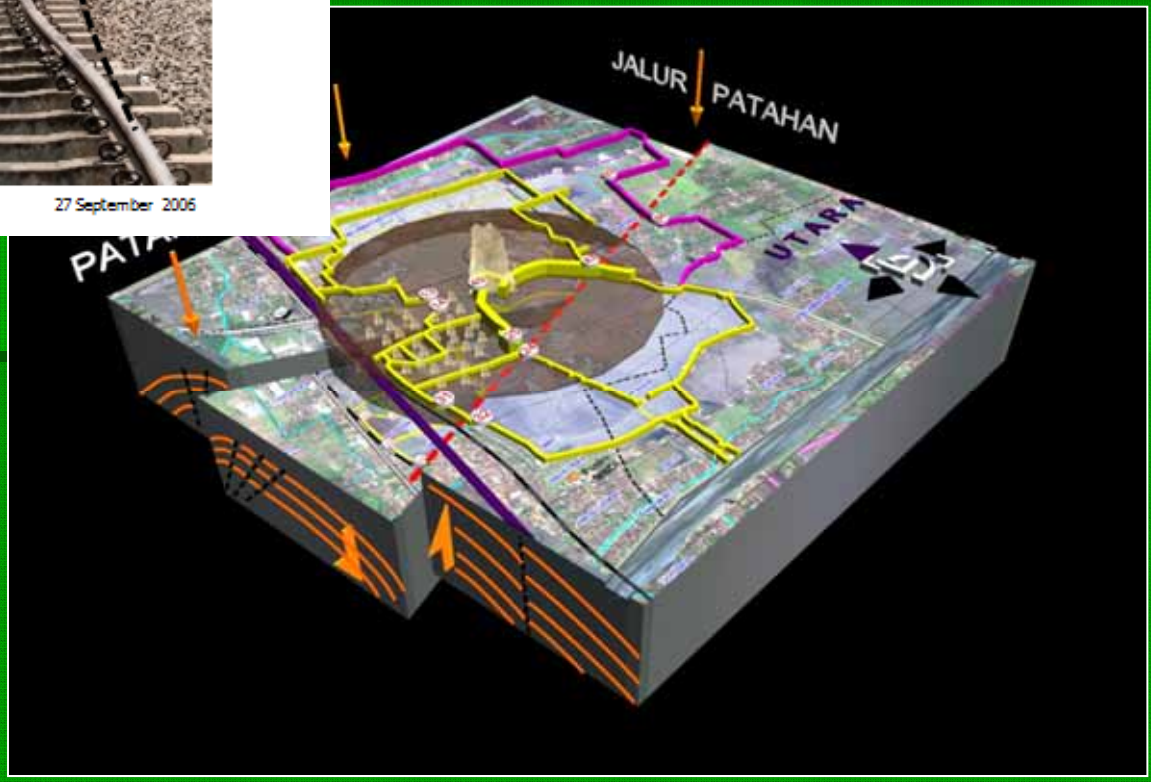
Pergerakan rel kereta (lateral dextral) pada KM 39.2

- Pergerakan rel kereta terjadi setidaknya 2 kali, melebihi gerakan yang disebabkan oleh subsidence menunjukan adanya reaktifasi sesar
- Pergerakan subsidence dan horizontal kumulatif berdasarkan GPS monitoring pada bulan September 06 maximum 25 cm.

27 September 2006

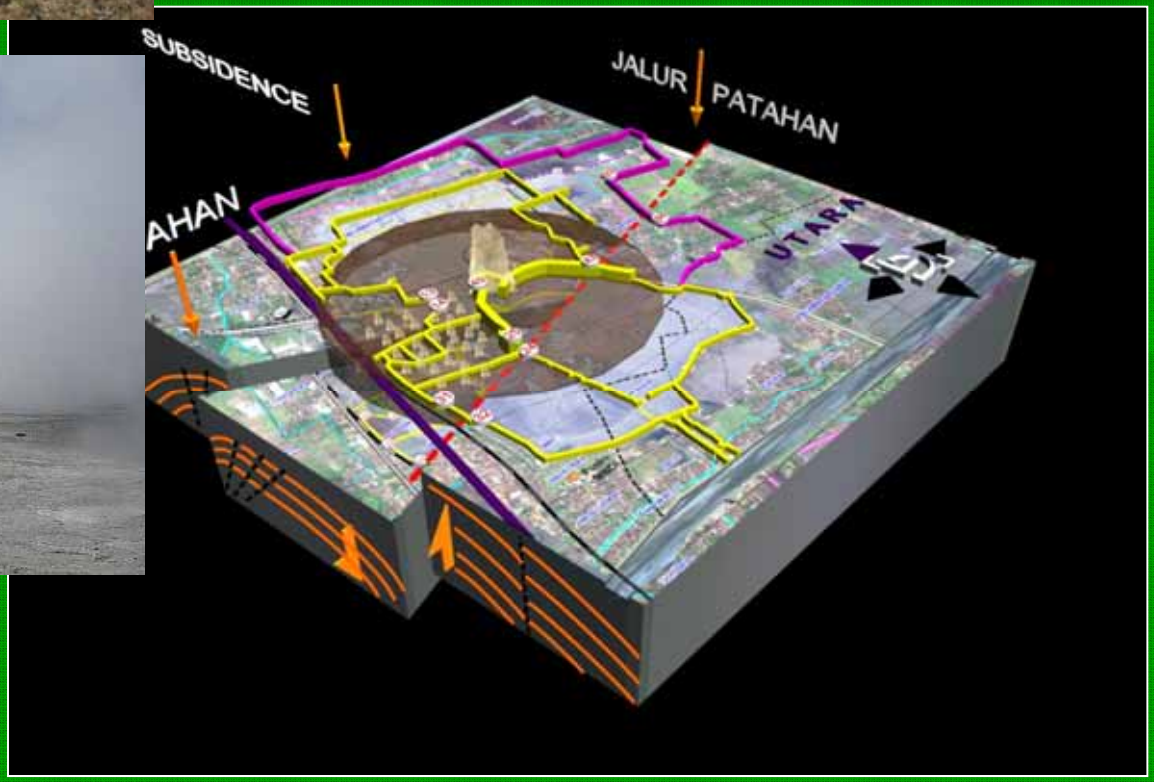
REACTIVATION OF FAULTS IN KENDENG BASIN DUE TO PLATE MOVEMENT

CREATE EARTH QUAKE (ENERGY RELEASE) RELATED TO FAULTING AND, EXTRUSION OF MOBILE CLAY FROM THE DEEPER PART OF THE BASIN



REACTIVATION OF FAULTS IN KENDENG BASIN DUE TO PLATE MOVEMENT CREATE EARTH QUAKE (ENERGY RELEASE) RELATED TO FAULTING AND,

EXTRUSION OF MOBILE CLAY FROM THE DEEPER PART OF THE BASIN SINCE MANY-2 YEARS



REACTIVATION OF FAULTS IN KENDENG BASIN DUE TO PLATE MOVEMENT CREATE EARTH QUAKE (ENERGY RELEASE) RELATED TO FAULTING AND, EXTRUSION OF MOBILE CLAY FROM THE DEEPER PART OF THE BASIN SINCE MANY-2 YEARS

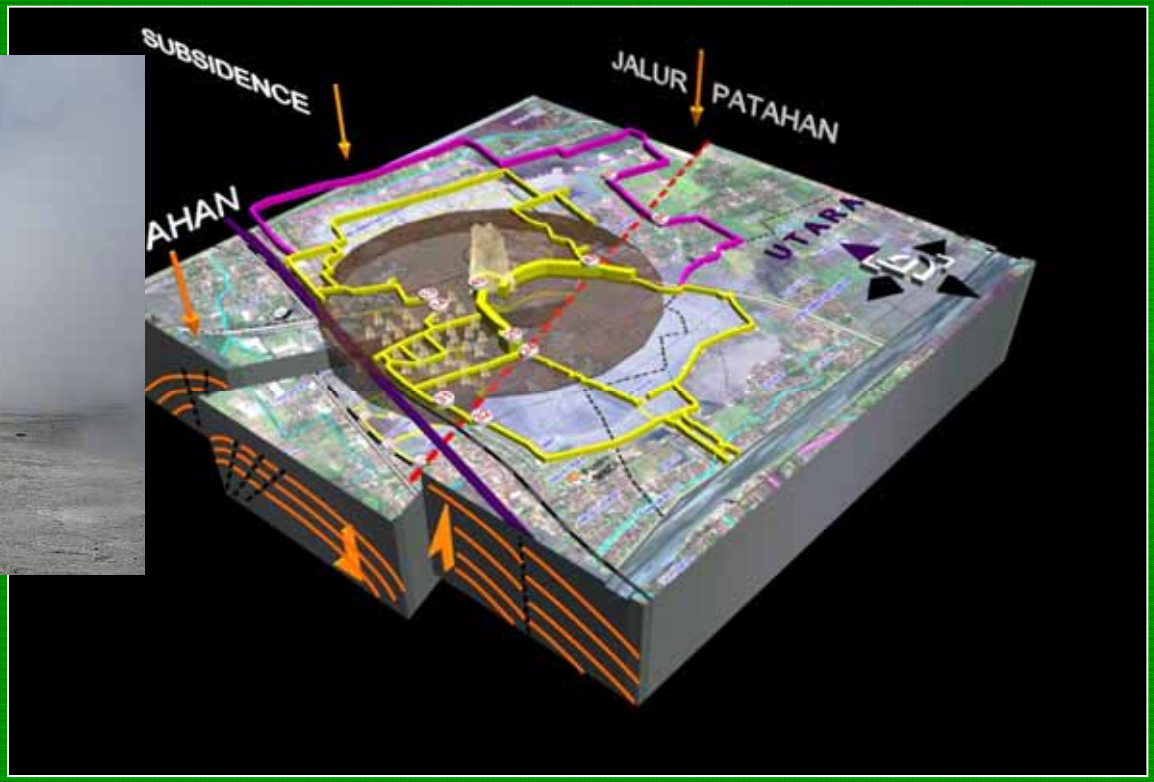
PEOPLE STAY AND BUILT HOUSES ON TOP OF MUD VOLCANO

B.Istadi (2006)

2

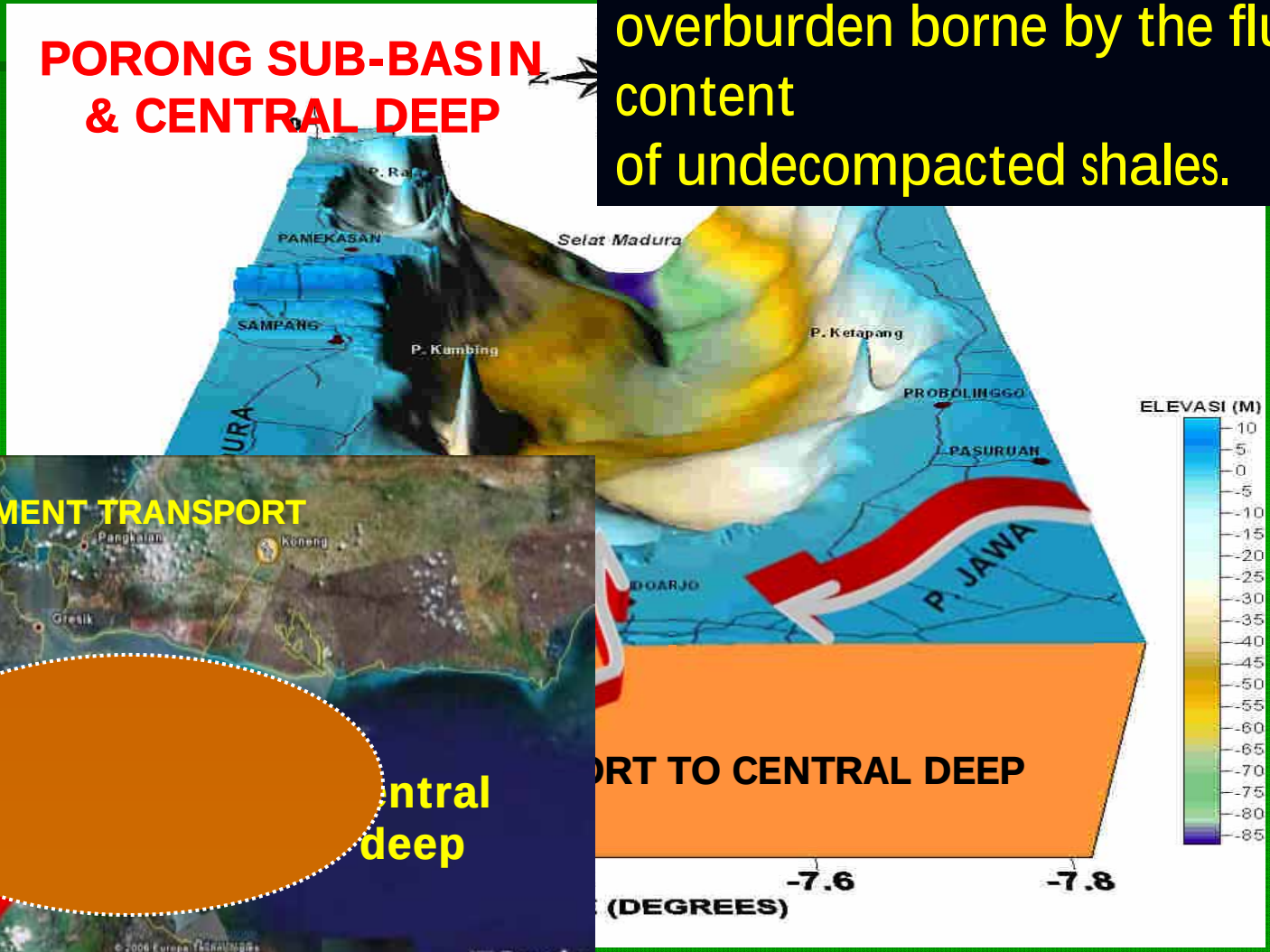
The possible mechanism for the piercement of the diapir is assumed that the diapir are laterally constrained.

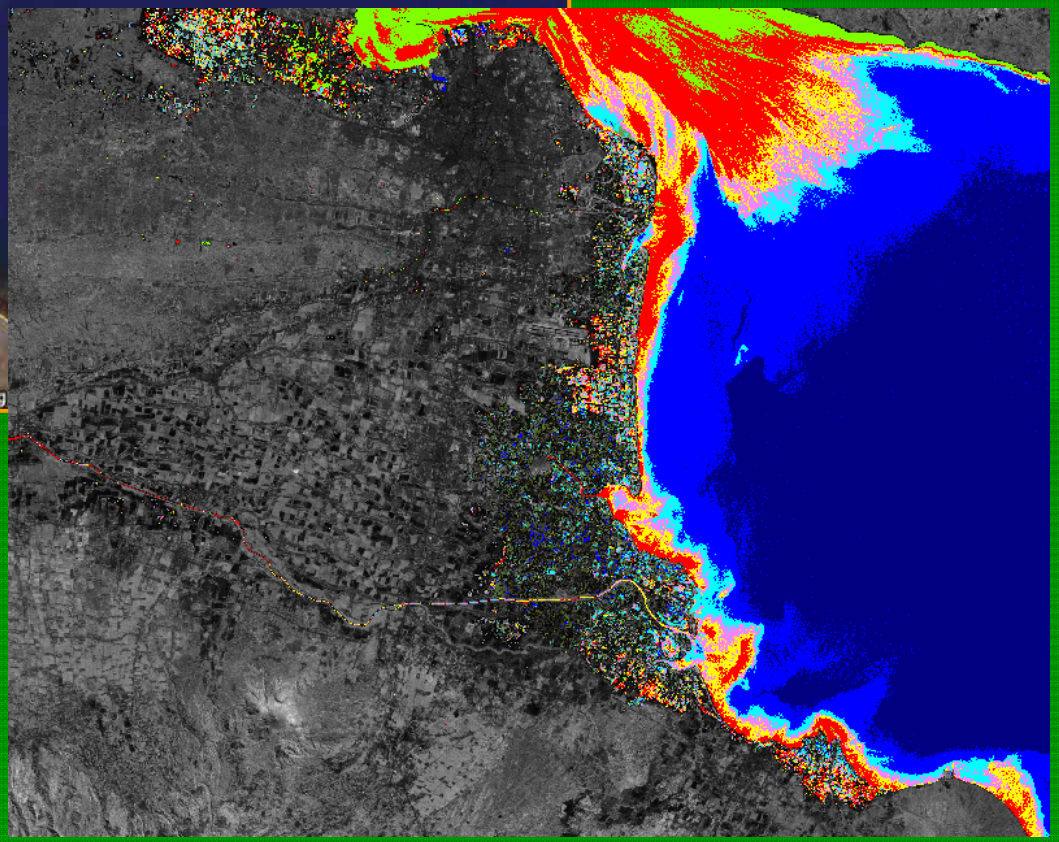
It is also suggested that the formation and fill of the basin was verry rapid



3

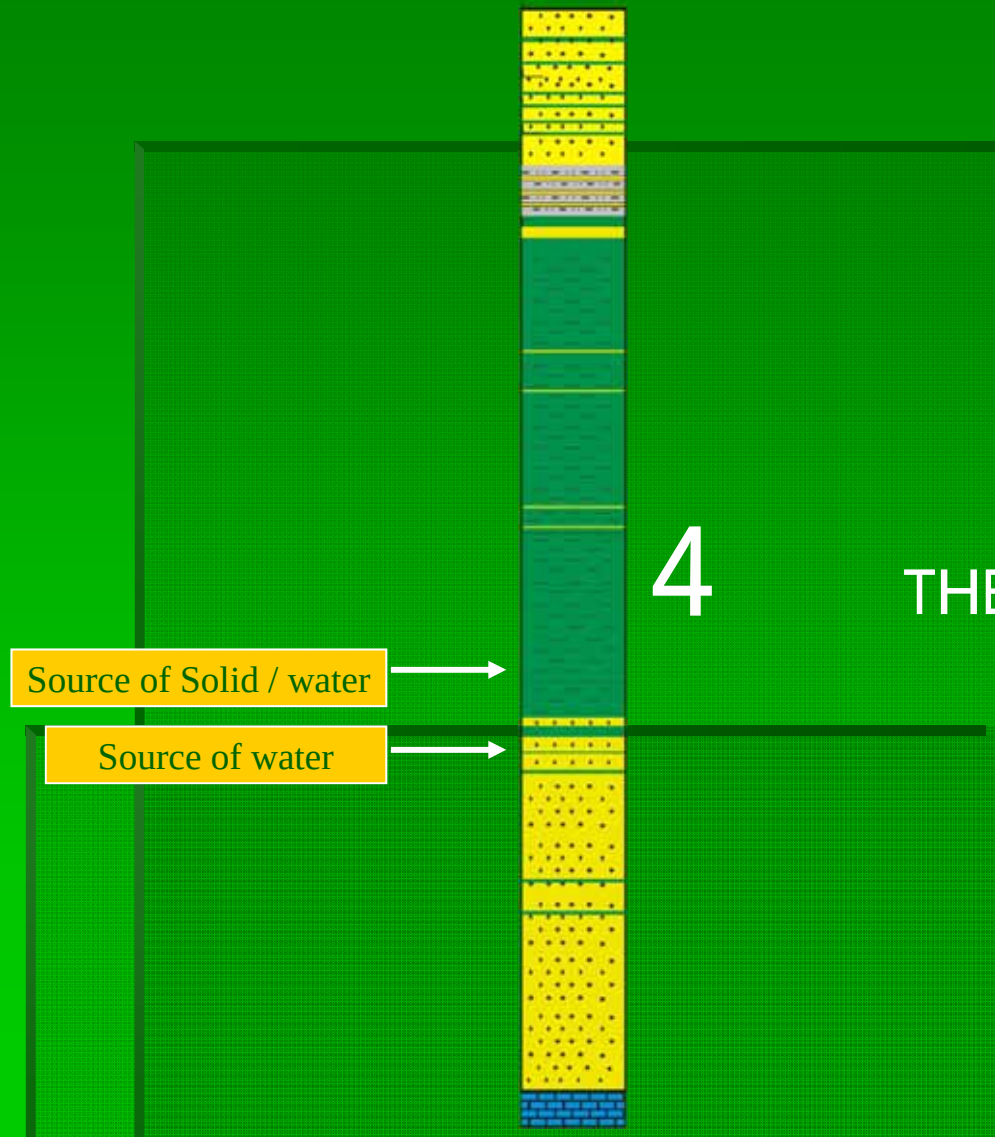
The motivating force responsible for a mud volcano is, in part, simply also the weight of rock overburden borne by the fluid content of undecompacted shales.

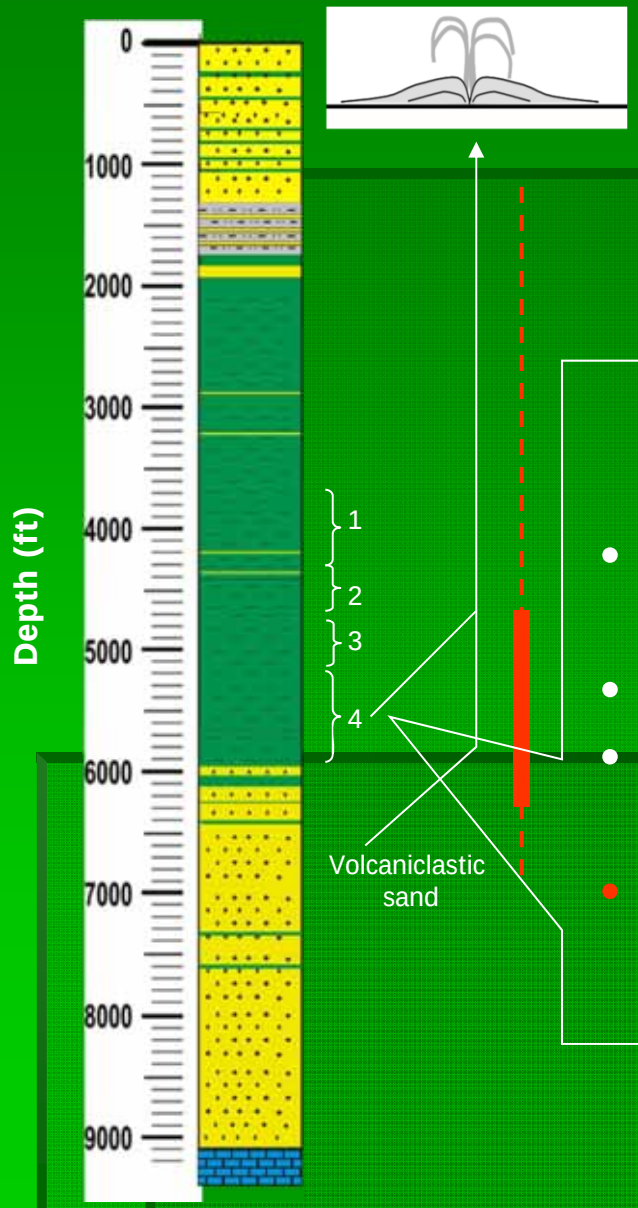




PORONG SUB-BASIN
REPRESENTING LARGE
ANCIENT DELTA

4 THE SOURCE OF MUD :

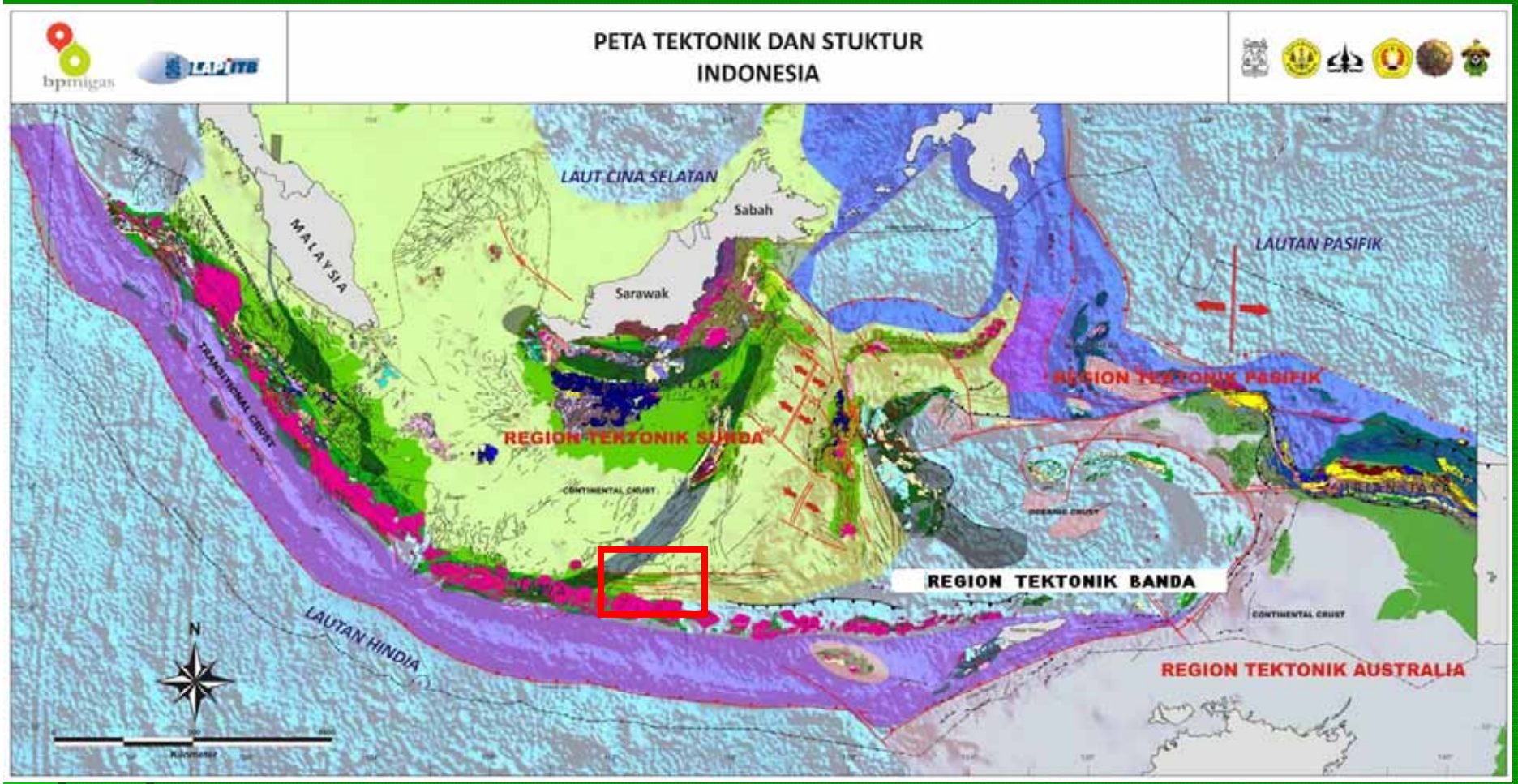




- **LUSI** fluids correspond to **group 4** (5300-6000 ft)
- Foram + nannofossil section **4000-6000 ft**
- **Thermal maturity** suggest input from 5100 – 6300 ft
- **The presence of Volcaniclastic sand**

Modified from B.Istadi (2006)

COMPLEX TECTONIC SETTING AND EVOLUTION OF EAST JAVA REGIONS



COMPLEX TECTONIC SETTING AND EVOLUTION OF EAST JAVA REGIONS

MIGHT BE THE MAIN FACTOR TO INITIATE DIAPIRIC EXTRUSION IN KENDENG BASIN

COMPLEX TECTONIC SETTING AND EVOLUTION OF EAST JAVA REGIONS

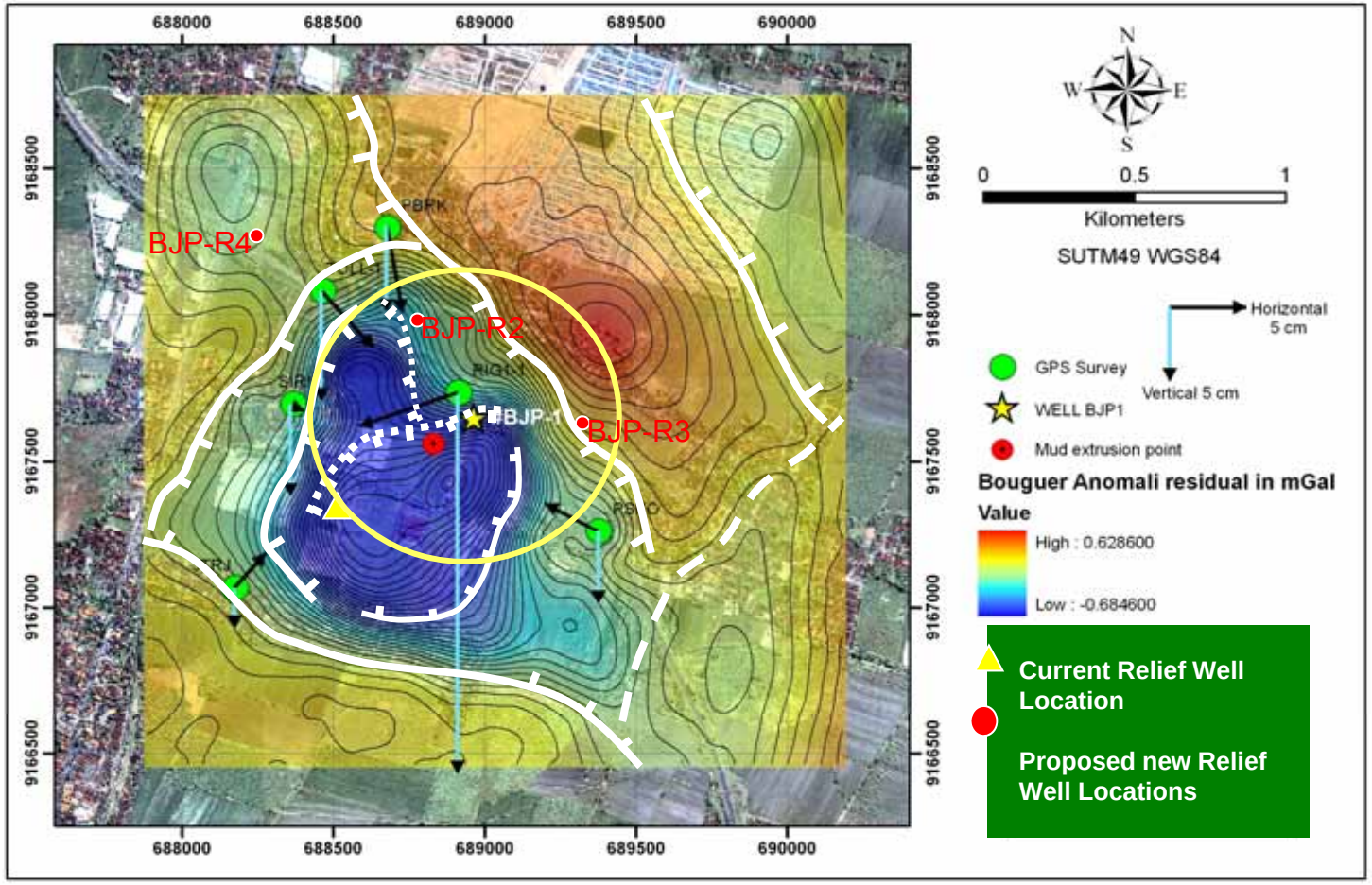
A COMBINATION OF RAPID BURIAL AND TECTONIC COMPRESSION MAY RESULTED IN OVERPRESSING WHICH INDUCE PIERCEMENT OF DIAPIR AND FORMED MUD VOLCANOES

- It is likely that the redistributed stress and strain in several parts of East Java region due to tectonic activity caused
- reactivation of fractures and faults, affecting the fluid pressure and permeability of the shale and ultimately triggered
- the eruption through the already overpresed subsurface,

SOCIAL IMPACT

1. Mud volcanoes produce localized permanent deformation such as collapse features from sudden extrusion during eruption

Istadi (2006)



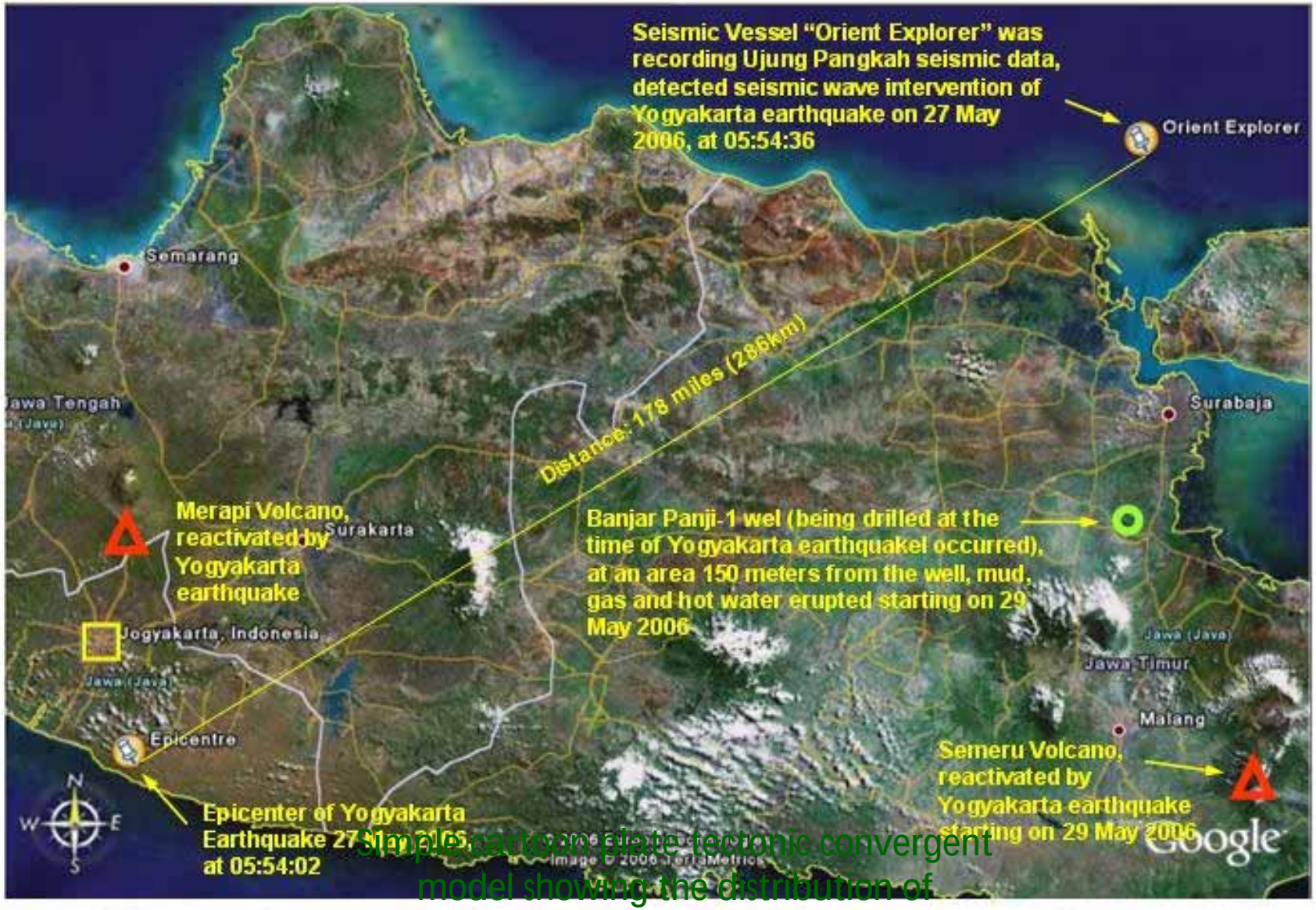
SOCIAL IMPACT

2. Mud volcanoes produce localized flooding of the surrounding area, of which the direction of flow is determine by geomorphic feature of the land

SOCIAL IMPACT

2. Mud volcanoes produce localized flooding of the surrounding area, of which the direction of flow is determine by geomorphic feature of the land

and can not be stopped permanently



Simple cartoon plate tectonic convergent model showing the distribution of earthquake epicentres


THANK YOU