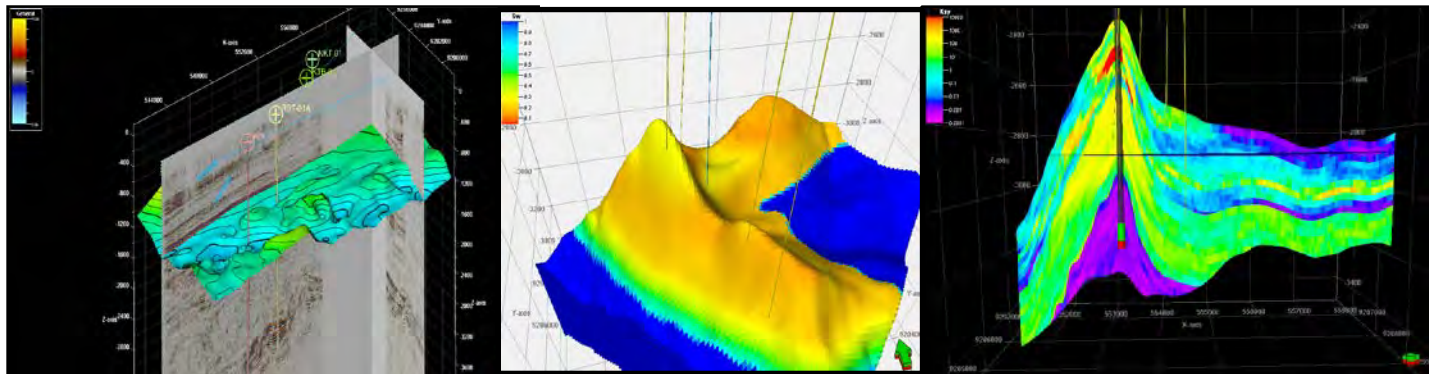


# OVERVIEW OF CCS PILOT STUDY AT GUNDIH FIELD, CENTRAL JAVA

Presented by

Benyamin Sapiie, Awali Priyono, Tutuka Ariadji, Wawan G.A. Kadir, Eko Widiyanto, Rachmat Sule, Fatkhan, Ariesty Asikin, Putri D. Ekowati



Seminar on Evaluation of CO<sub>2</sub> Storage Potential,  
Bandung Institute of Technology, Indonesia  
10-11 December 2012

# HISTORY OF THE STUDY

A collaboration effort that is conducted between:

- Institut Teknologi Bandung, Kyoto University,
- Pertamina UTC and Pertamina EP

Supported by

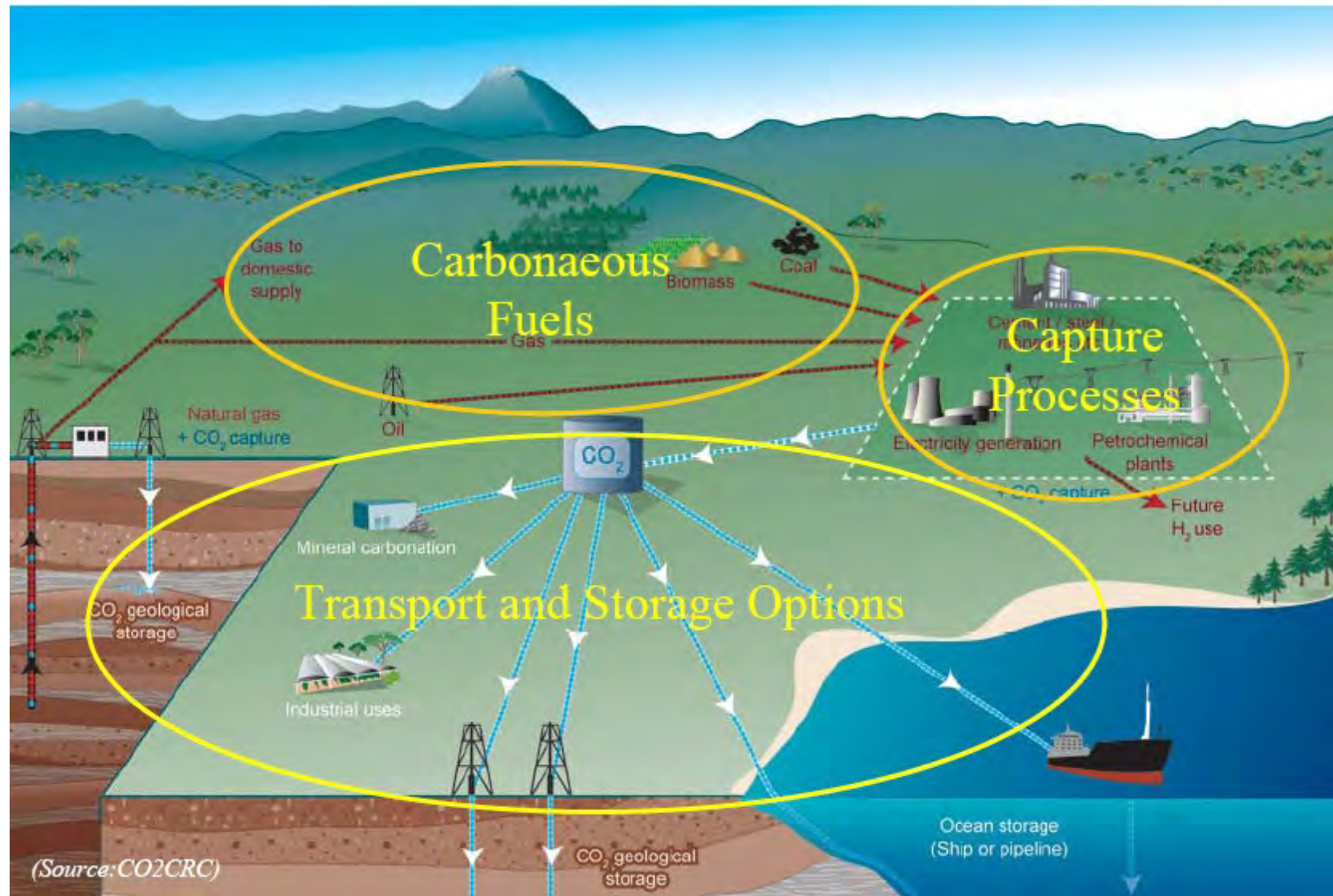
- Japan International Cooperation Agency (JICA) and
- Japan Science and Technology Agency (JST)



- **INTRODUCTION**
- **LOCATION OF CCS PILOT STUDY**
- **DATA AVAILABILITY**
- **REGIONAL GEOLOGY AND TECTONIC SETTING**
- **G&G CHARACTERISTIC OF CCS RESERVOIR TARGET**
- **TENTATIVE RESULTS**
- **FUTURE PLAN AND TARGET**
- **SUMMARY AND DISCUSSION**

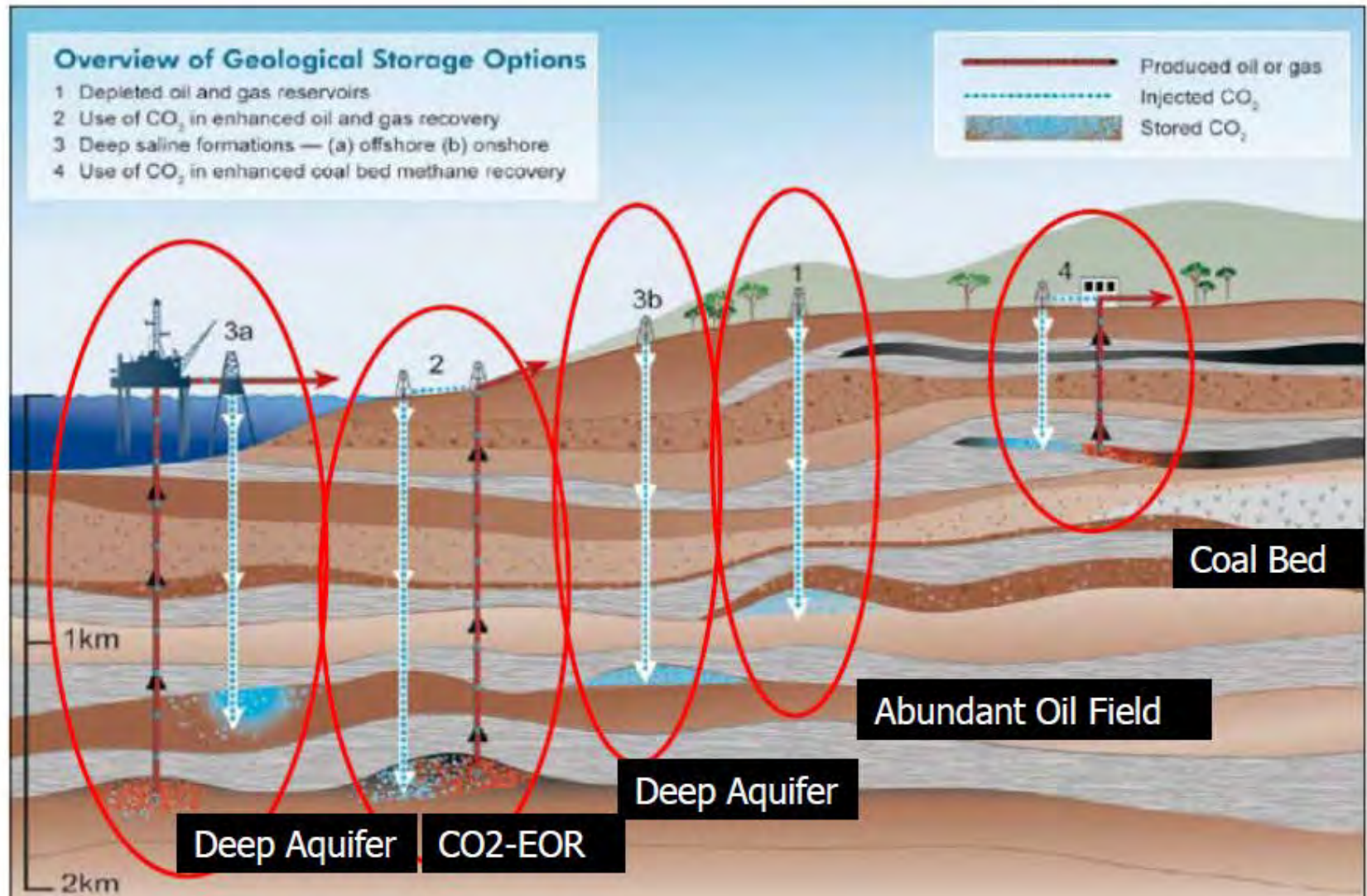
- ❖ The study concerns approximately 0.3 million ton of CO<sub>2</sub> emitted annually during production of natural gas in a gas field presently under development in the Gundih Area
- ❖ A pilot study for research and development of technologies for assessing both shallow and deep strata at sites of CO<sub>2</sub> injection.
- ❖ Essential for safe application of CO<sub>2</sub> sequestration technologies, and for monitoring of underground distribution and behavior of CO<sub>2</sub> through capacity development of organizations and human resources.

# GEOSEQUESTRATION (CCS) CONCEPT AND FLOW

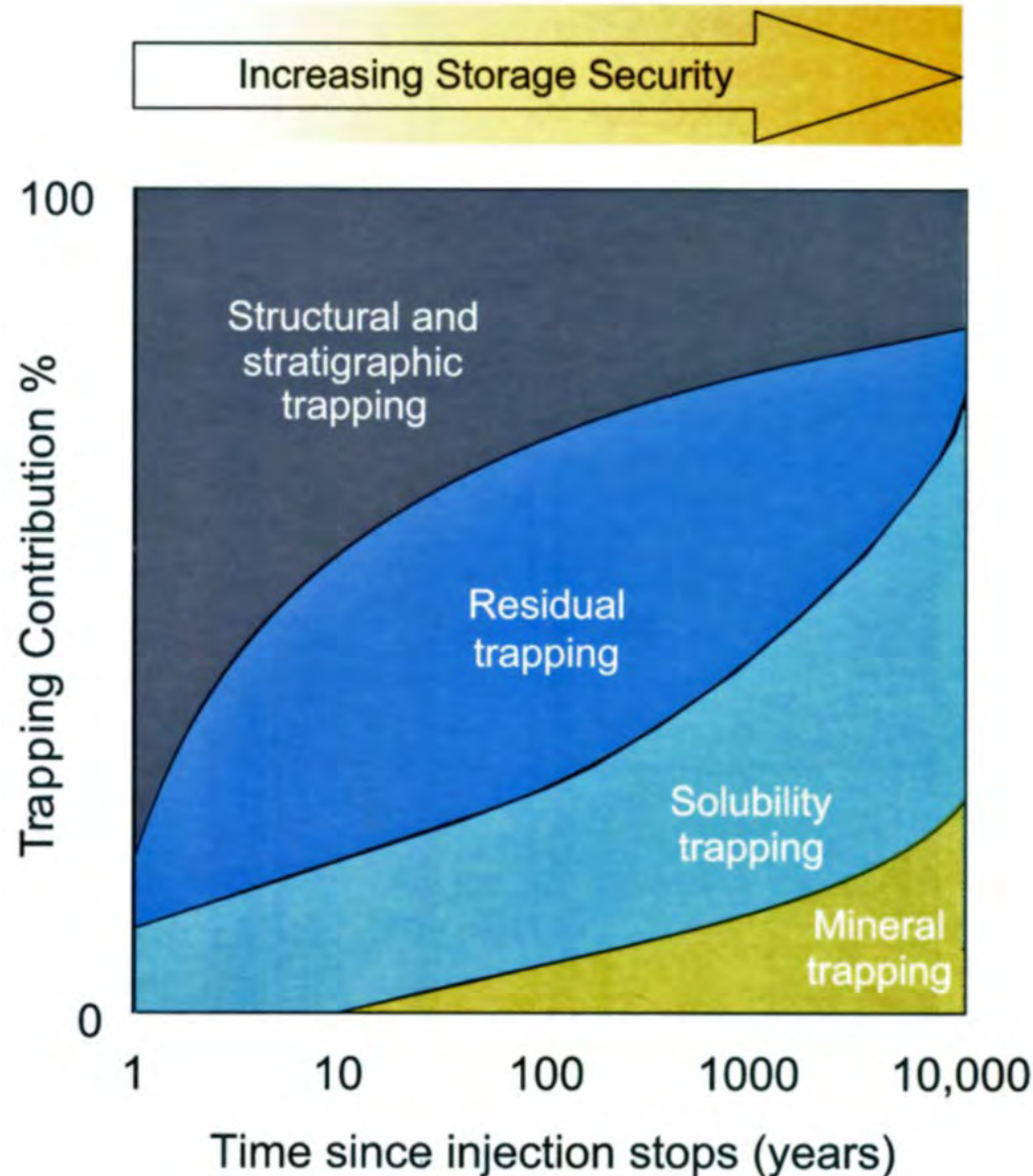




# Geological Sequestration

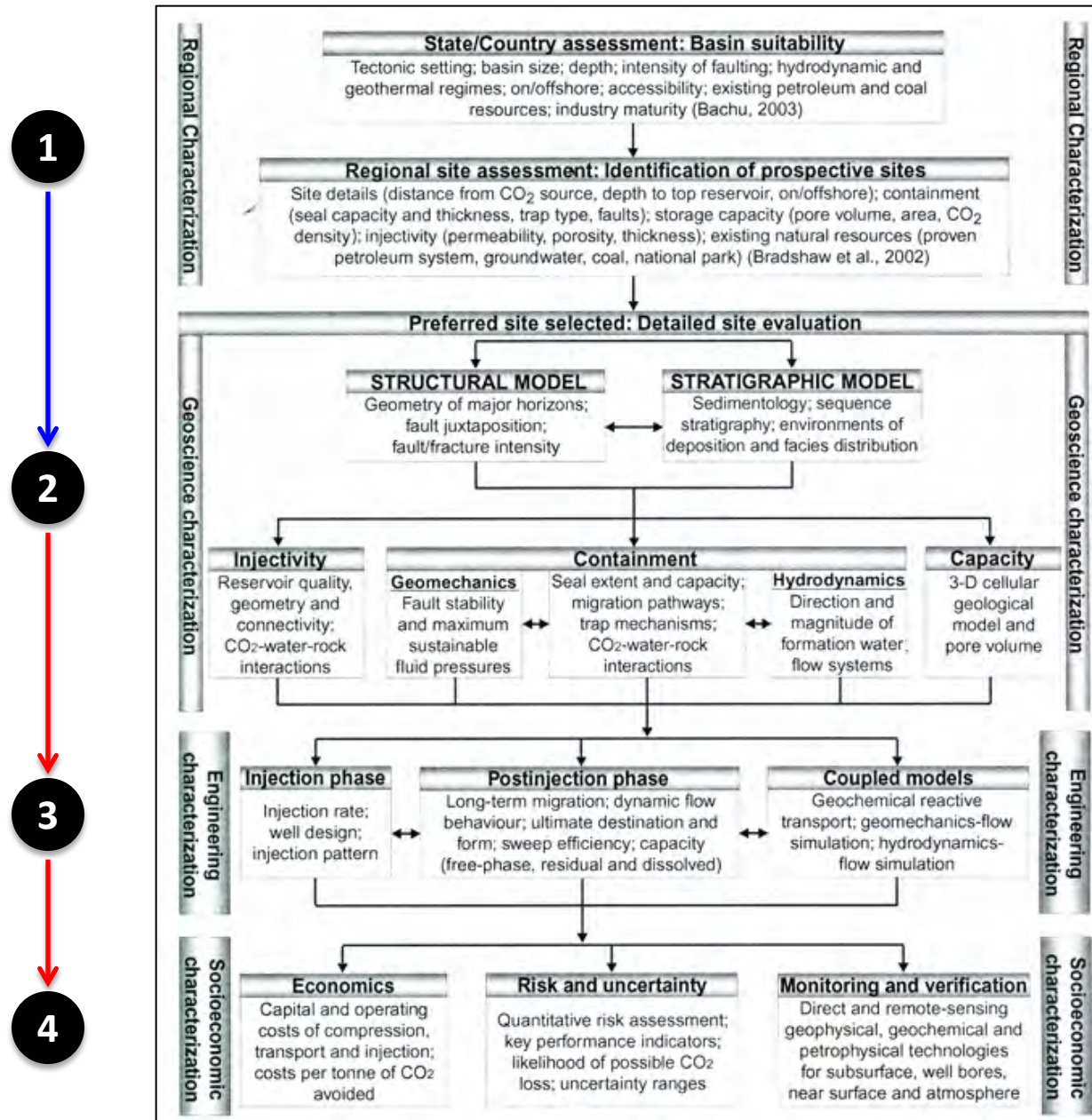


# TRAPPING MECHANISM AND STORAGE SECURITY

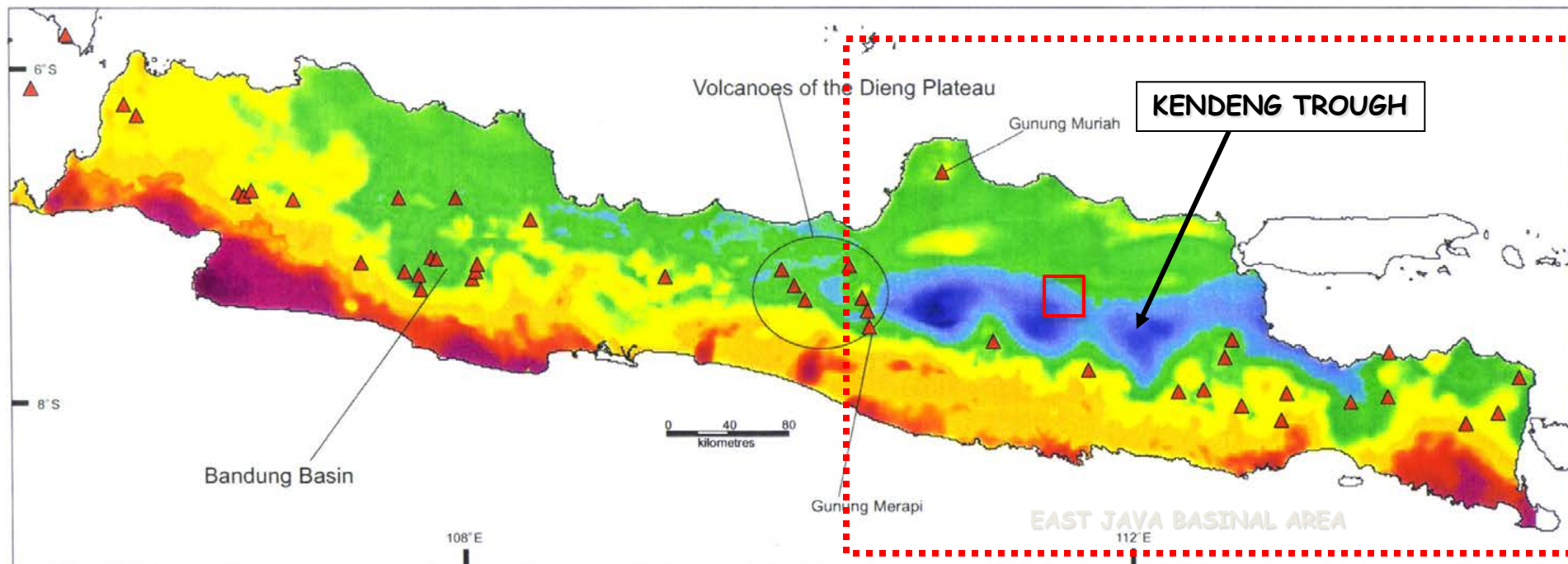
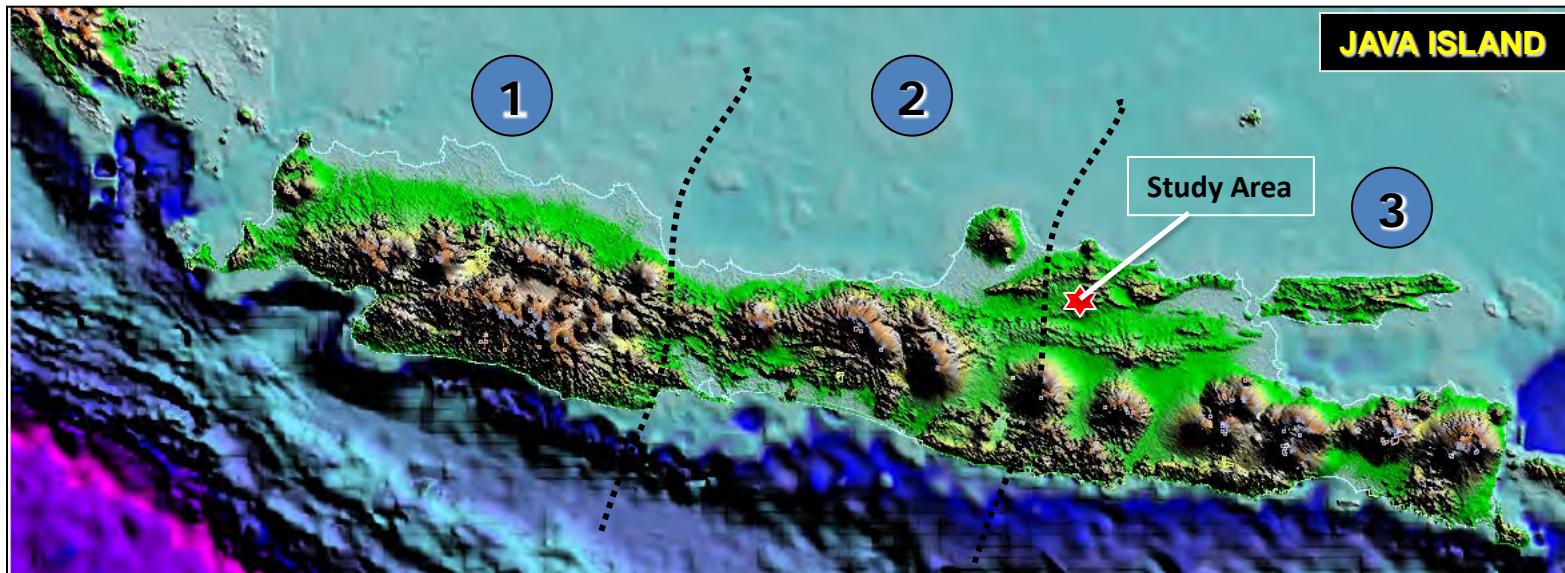




# SITE CHARACTERIZATION METHODOLOGY OF CCS

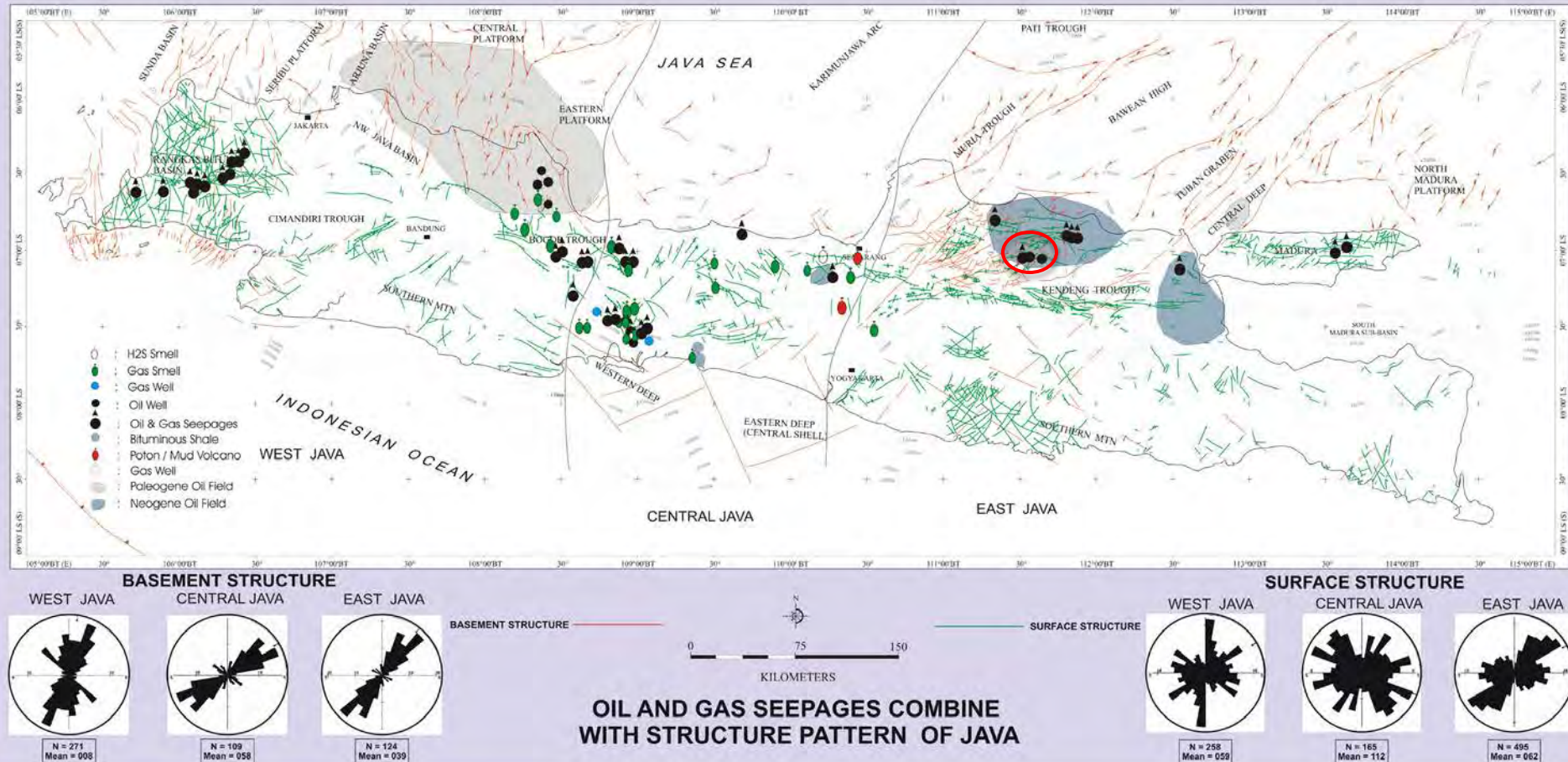




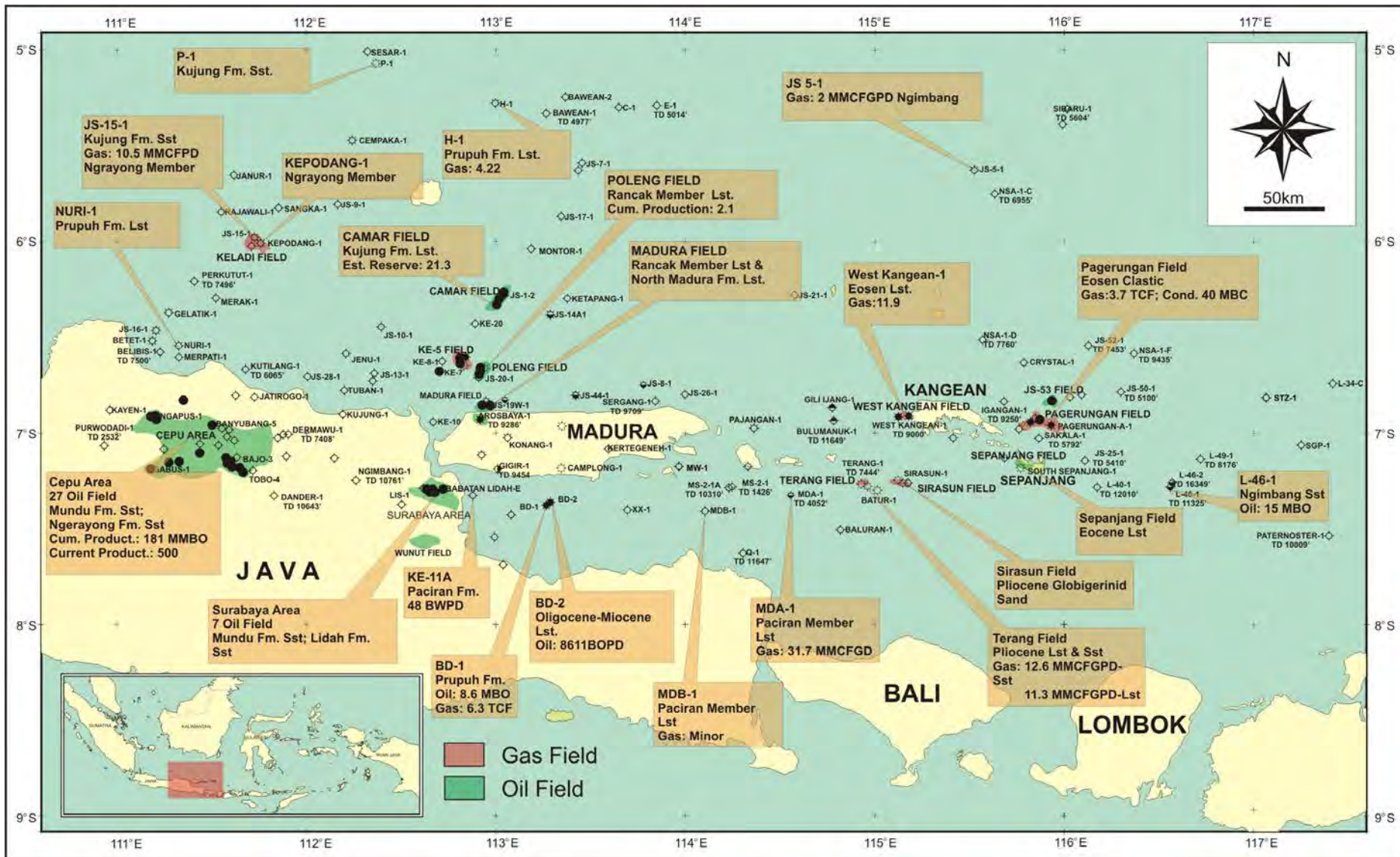




# REGIONAL STRUCTURES AND HYDROCARBON OCCURENCES

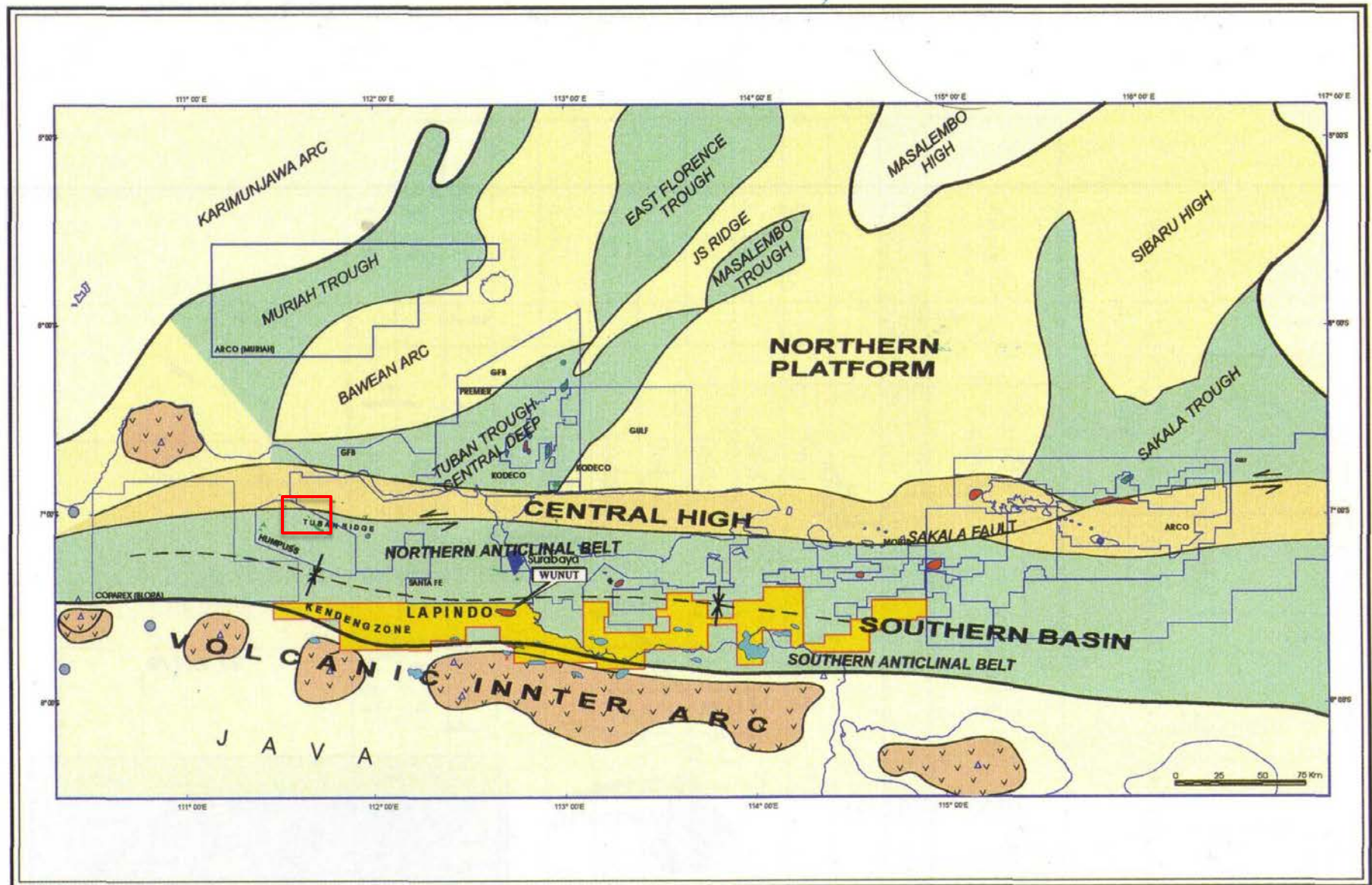


# HYDROCARBON OCCURENCES OF EAST JAVA REGION



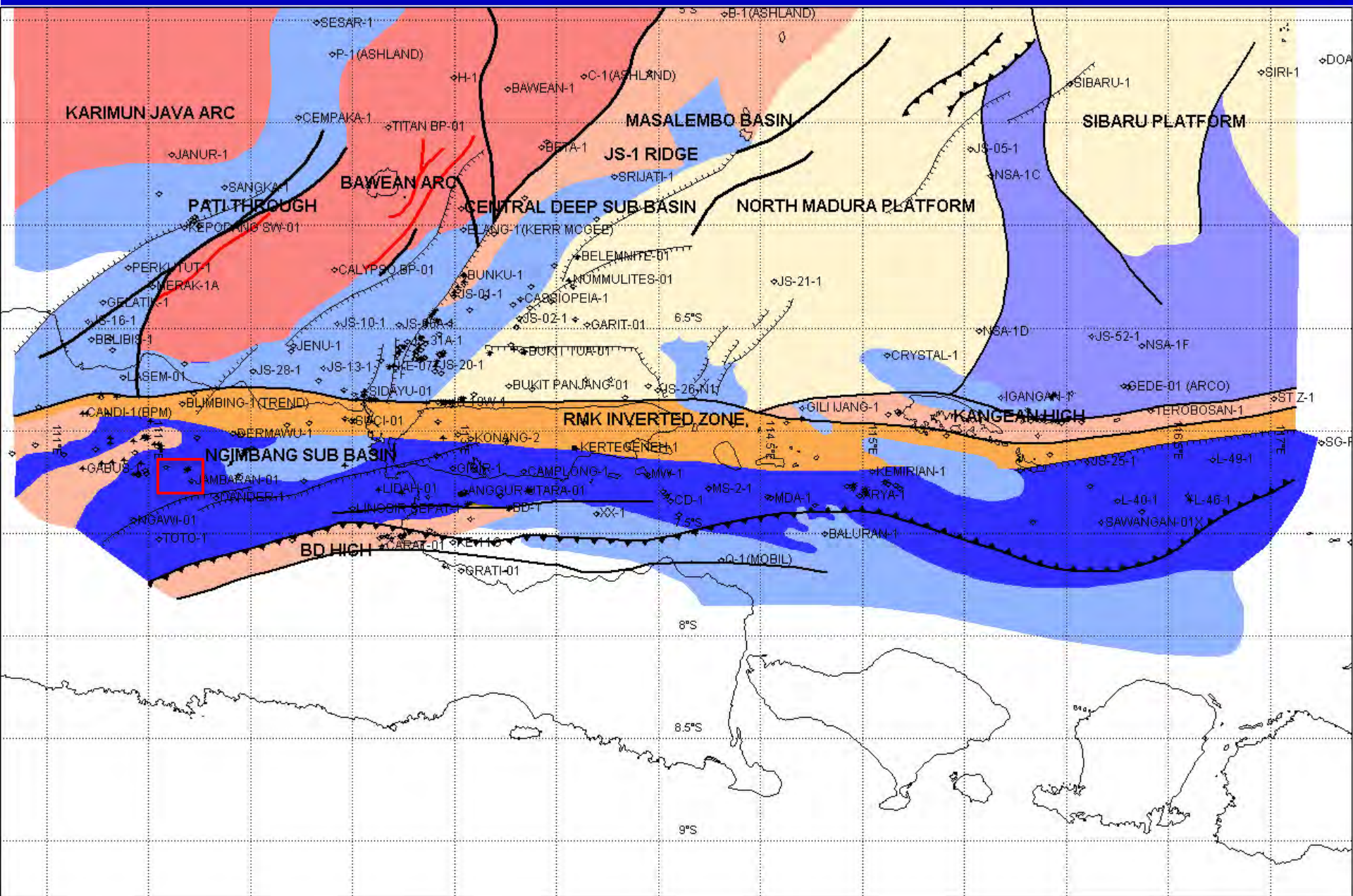


# TECTONIC ELEMENTS OF EAST JAVA BASINAL AREA



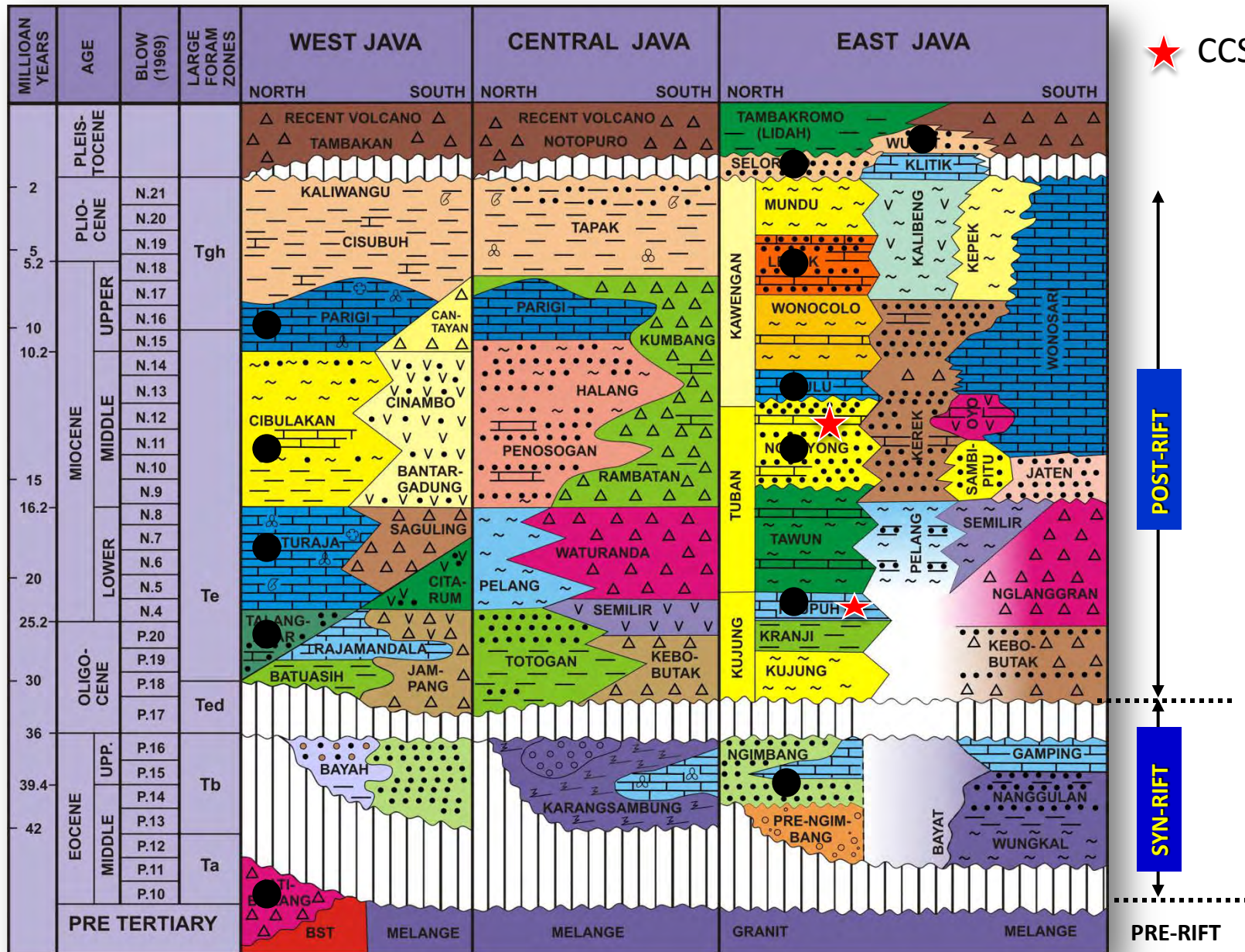


# TECTONIC ELEMENTS OF EAST JAVA BASINAL AREA



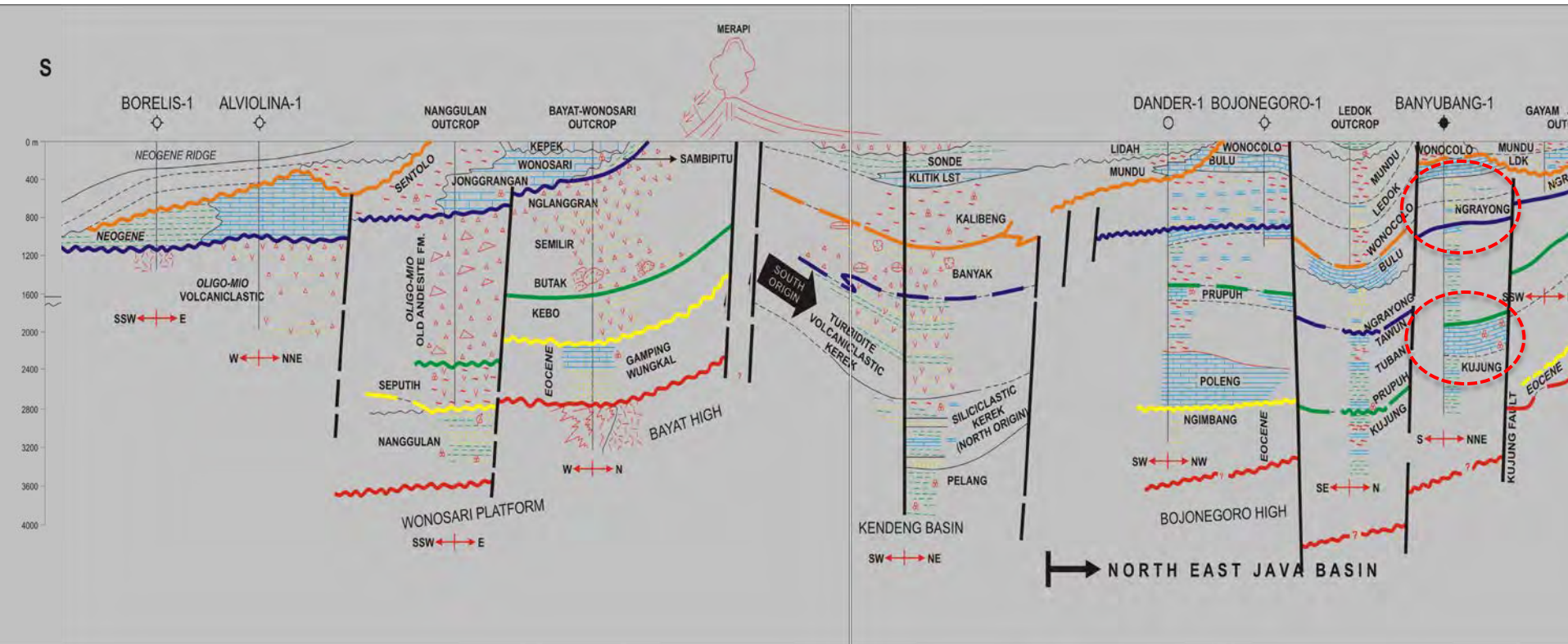


# STRATIGRAPHIC CORRELATION AND NOMENCLATURES OF JAVA ISLAND



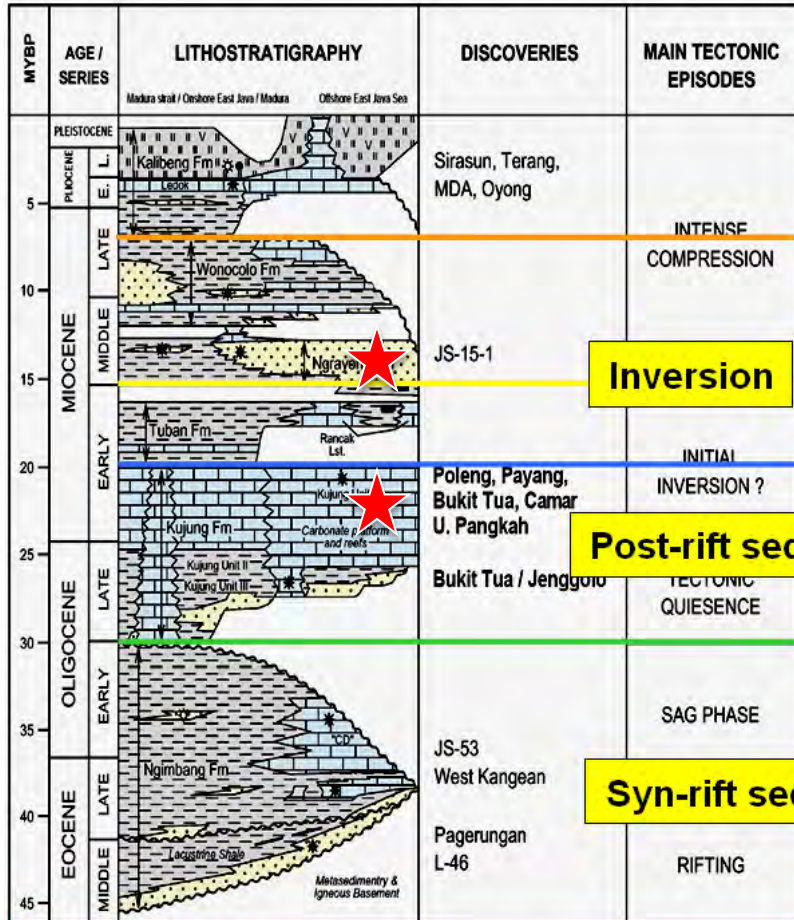


# N – S Central Java Cross Section

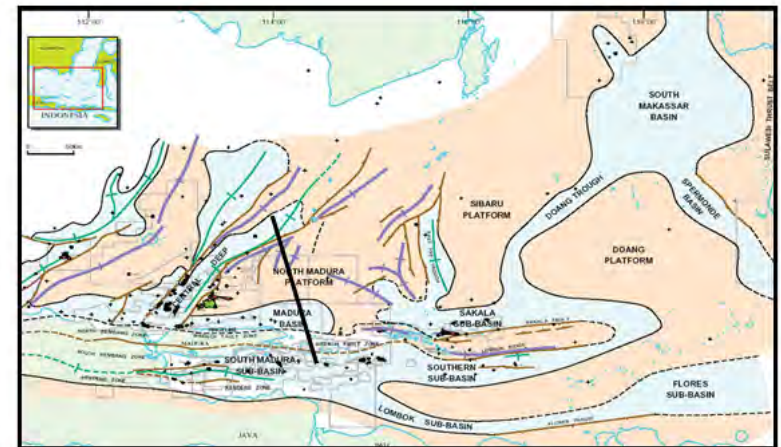
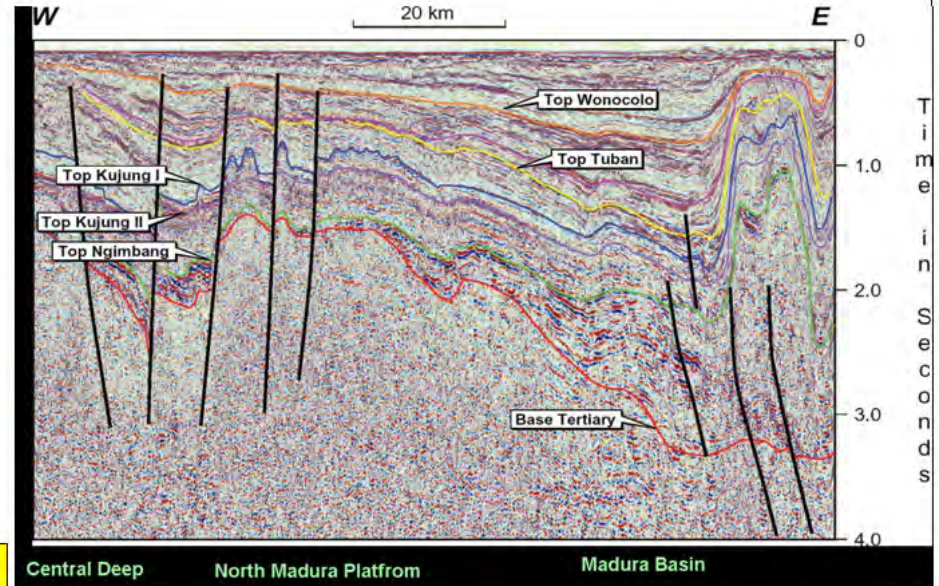




# TECTONIC EVOLUTION OF EAST JAVA REGIONS



Modified from CGR 1997, Mudjono and Pireno 2002



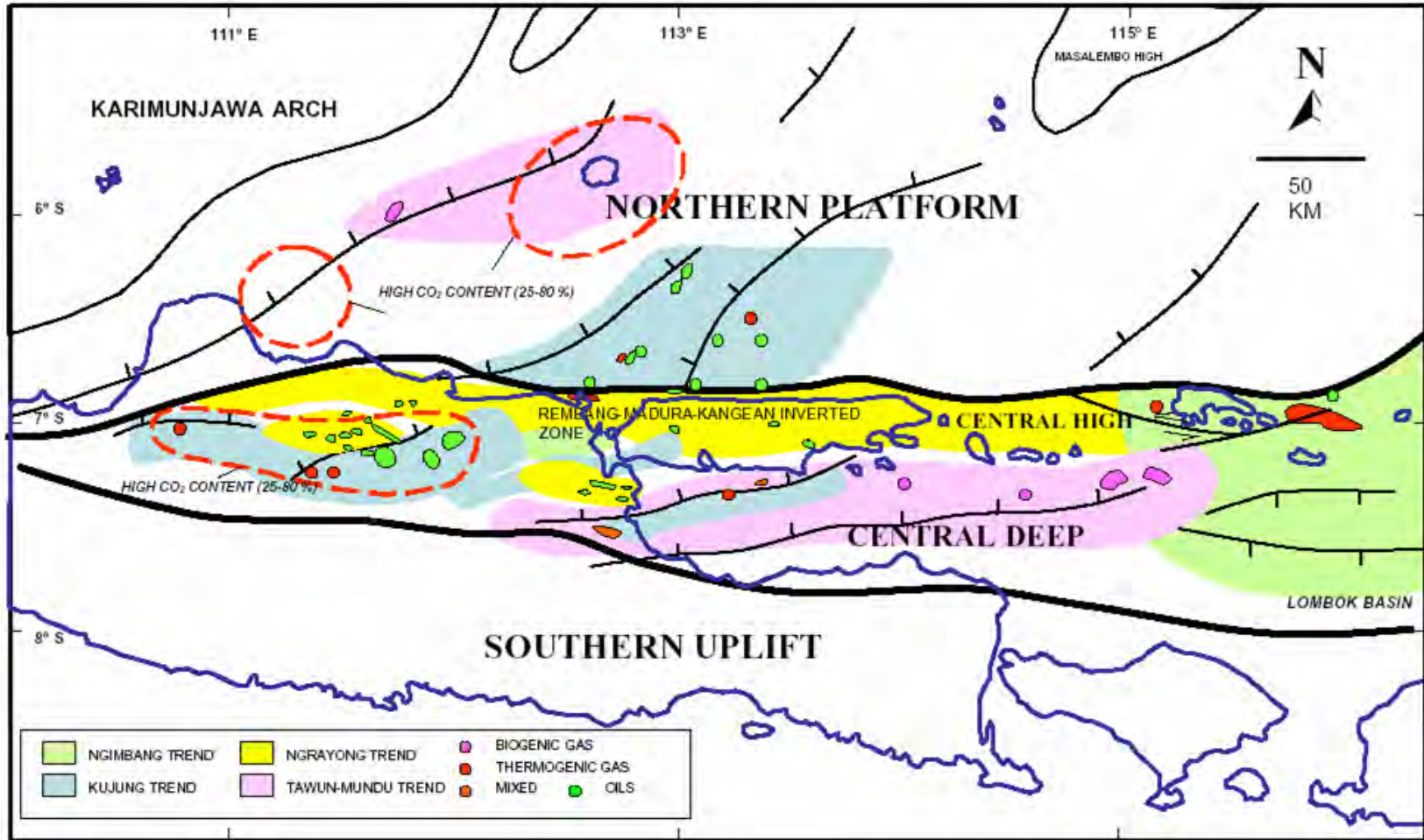
-HC produced from several strat. sequences

-“Multiple petroleum system”

★ CCS Reservoir Target



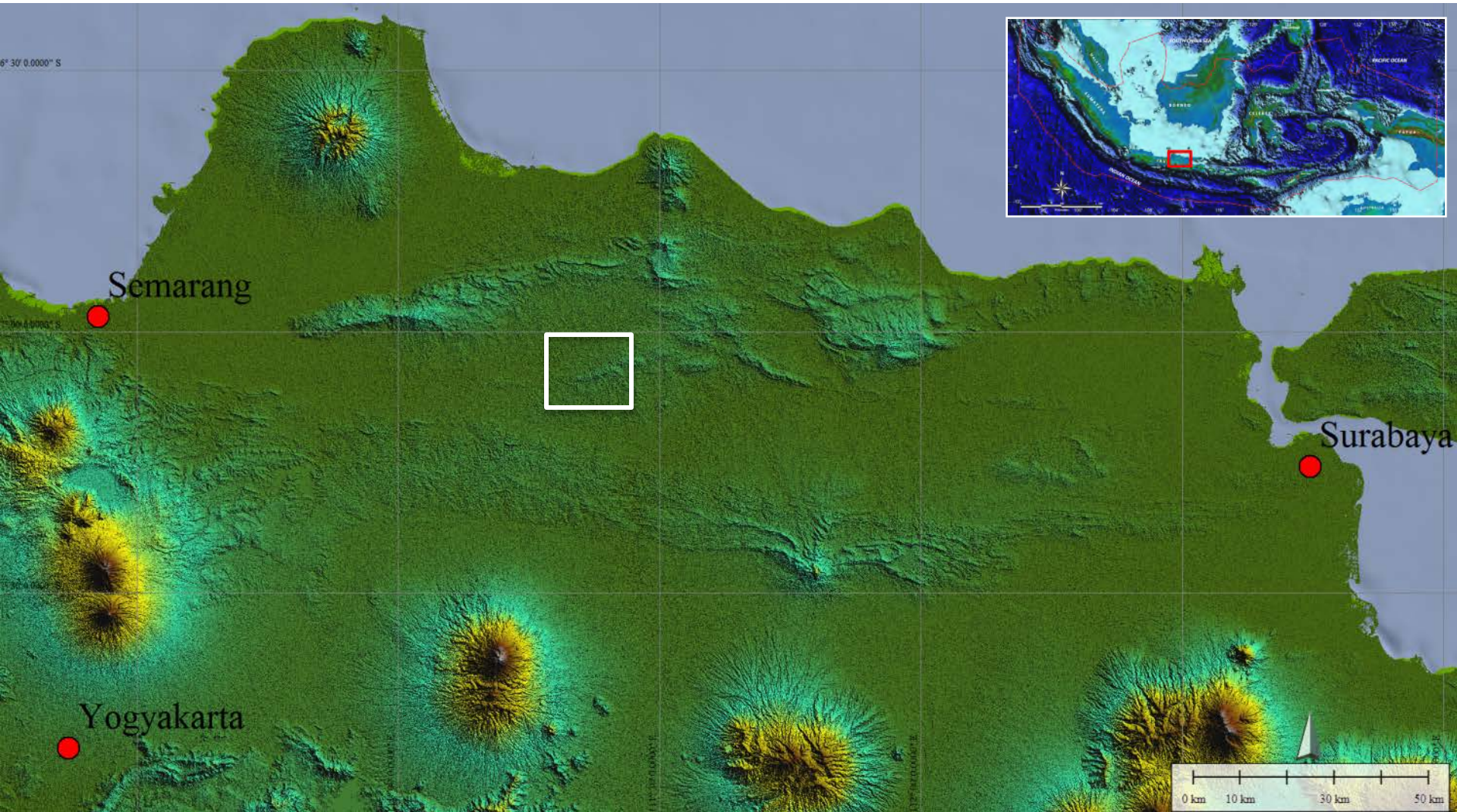
# CO<sub>2</sub> CONTENTS OF EAST JAVA BASINAL AREA



- Map showing trends of habitats of oil and gas in the East Java Basin.
- Four trends can be recognized containing oil, thermogenic and biogenic gas fields.
- The habitats are closely related with the geologic setting and petroleum system.  
(Satyana and Purwaningsih, 2007)

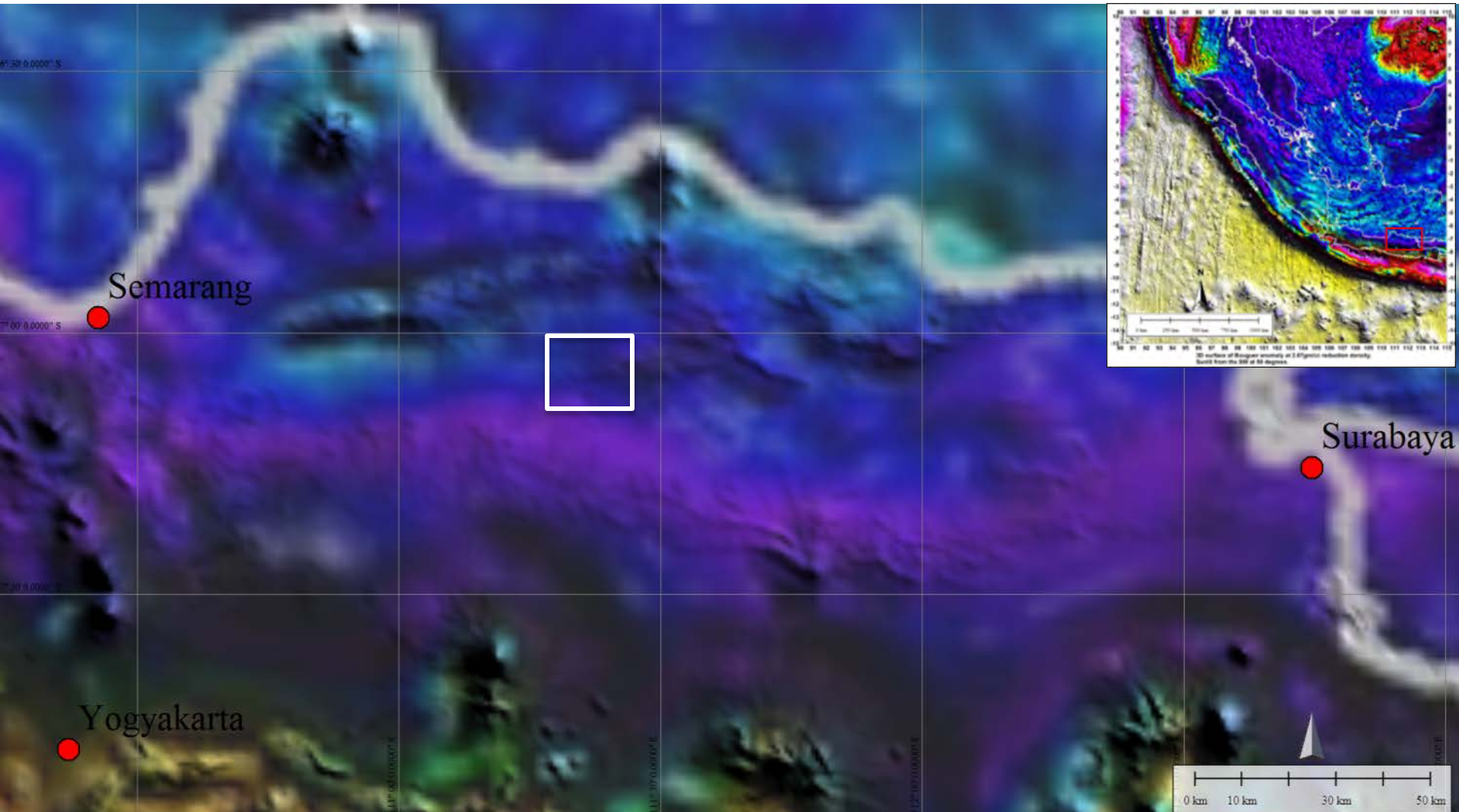


# LOCATION OF GUNDIH FIELD





# BOUGER ANOMALY GRAVITY MAP

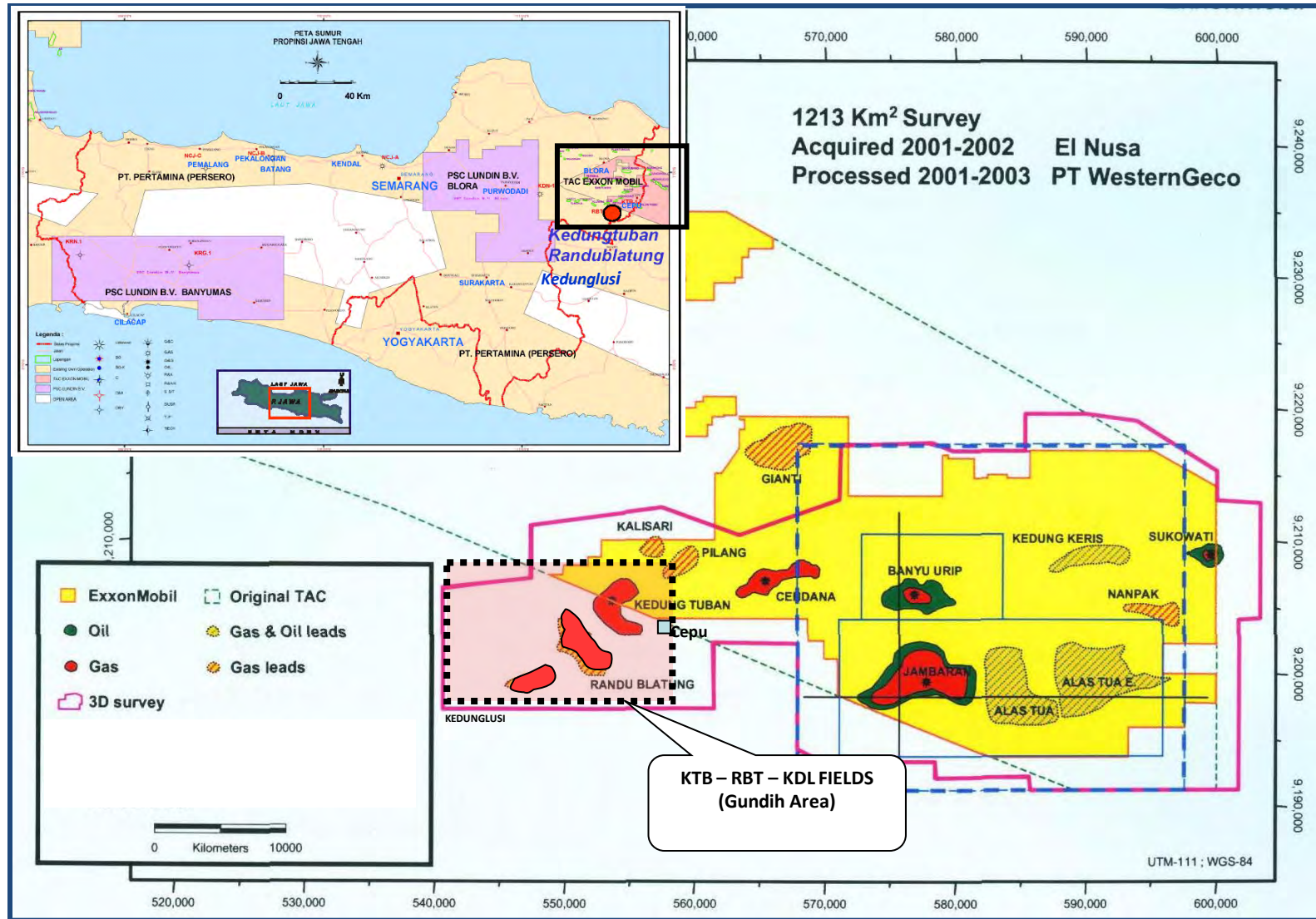


Source: <http://www.bandaarcgeophysics.co.uk/>

# LOCATION MAP OF GUNDIH AREA

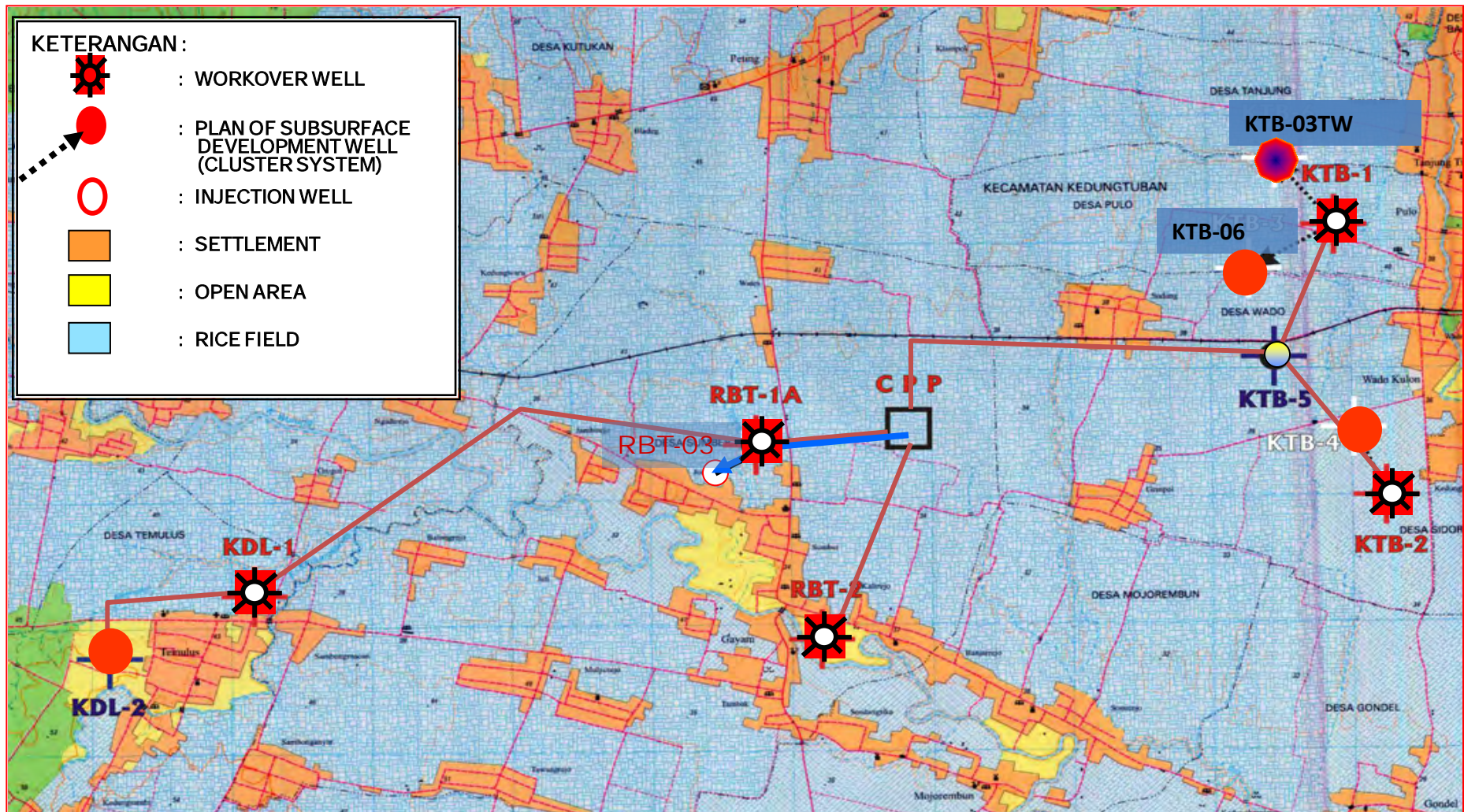


KTB (Kedung Tuban) – RBT (Randu Blatung) – KDL (Kedung Lusi) fields





## GEOGRAPHICAL MAP OF GUNDIH AREA



# FACT OF GUNDIH FIELD



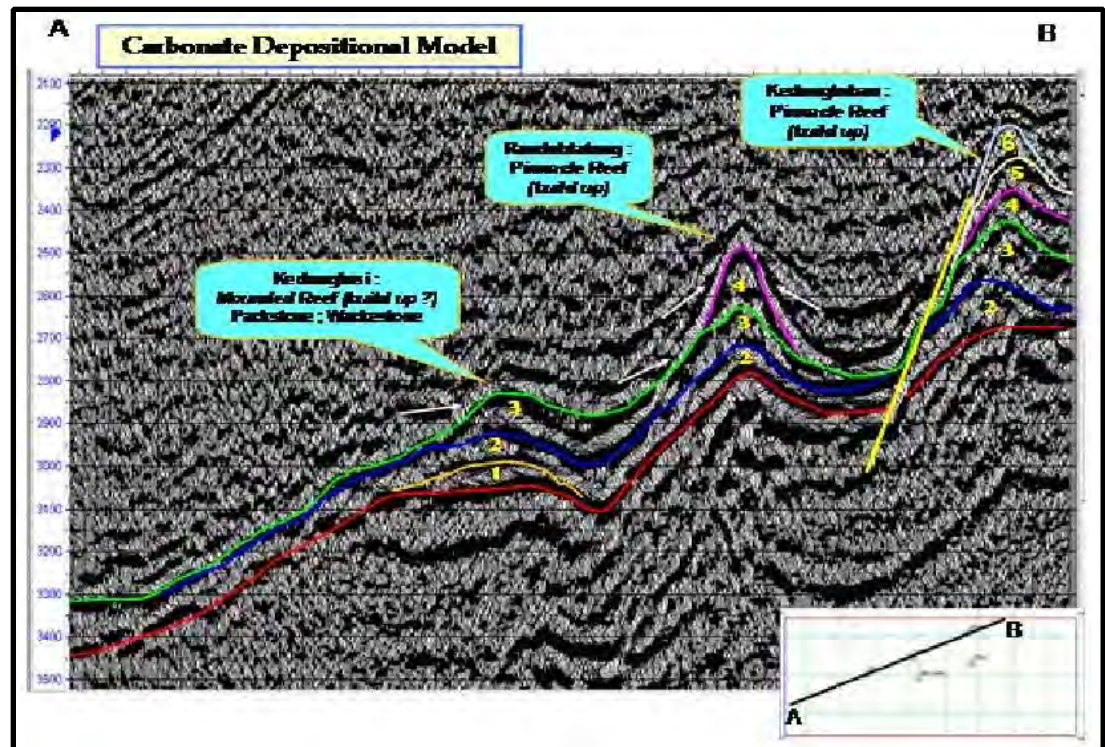
- Gundih field was operated by PT. Pertamina EP, which has **initial gas in place (IGIP) 435,96 BSCF** and could produce 62 MMSCFD in 12 years.
- **CO<sub>2</sub> content which generated directly from the field is 21%** from total gas, whereas if after through CPP (Central Processing Plant) the percentage of CO<sub>2</sub> produced is about 15% from total gas in this field (Kadir, 2012).
- PT. Pertamina EP provided 2D/3D seismic data and well data to evaluate subsurface GGR in this area.



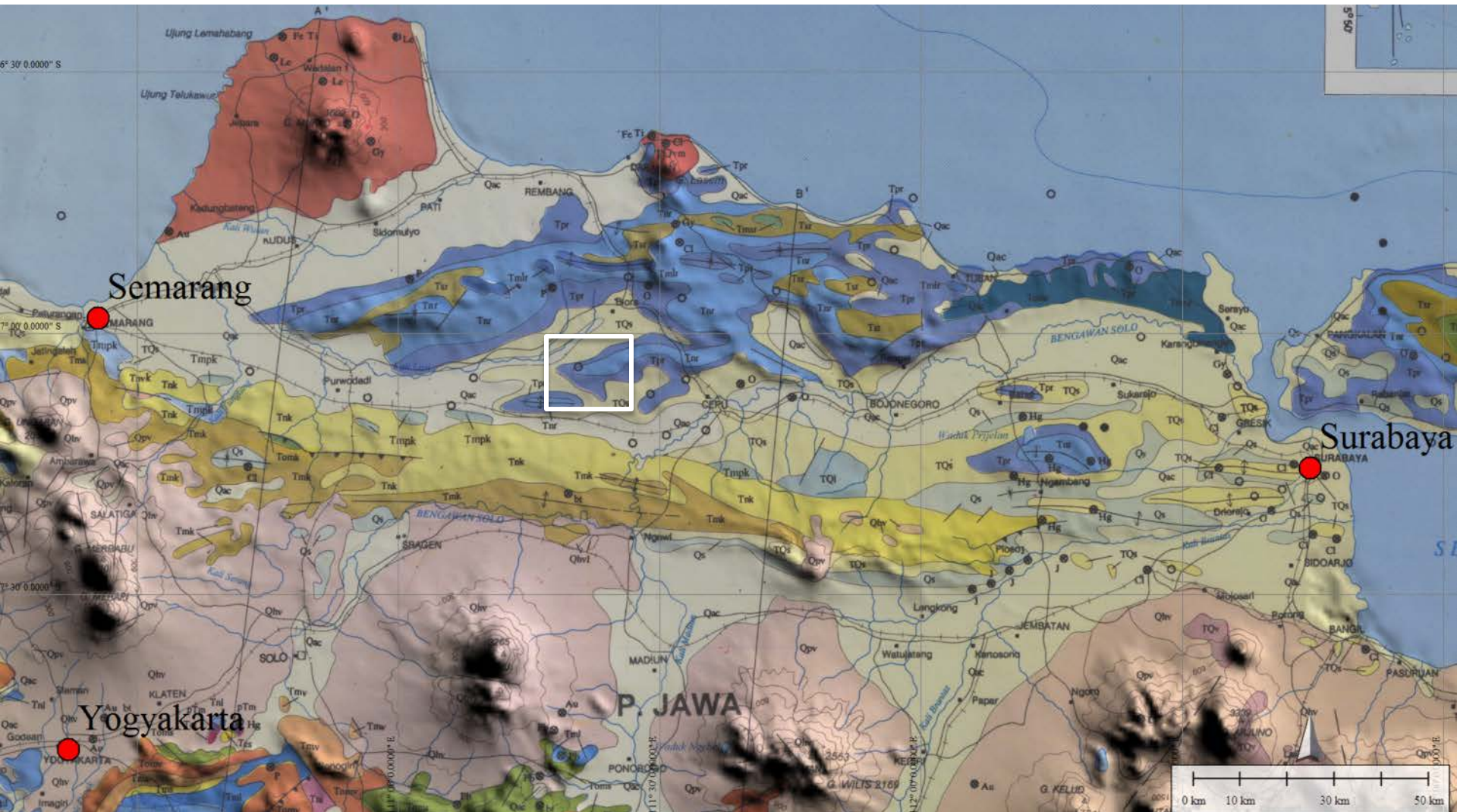
# Gundih Field

Reservoir which sought in this study is a shallow reservoir to facilitate the injection of CO<sub>2</sub>. This reservoir is laying above 3 main structures that have been proven to have gas reserves;

- Kedung Tuban,
- Randu Blatung,
- Kedung Lusi.



# Regional Scale Geological Map



Source: GRDC REGIONAL GEOLOGY MAP OF JAVA ISLAND



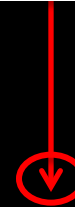
# Regional Scale Cross-section



N

S

Gundih Block

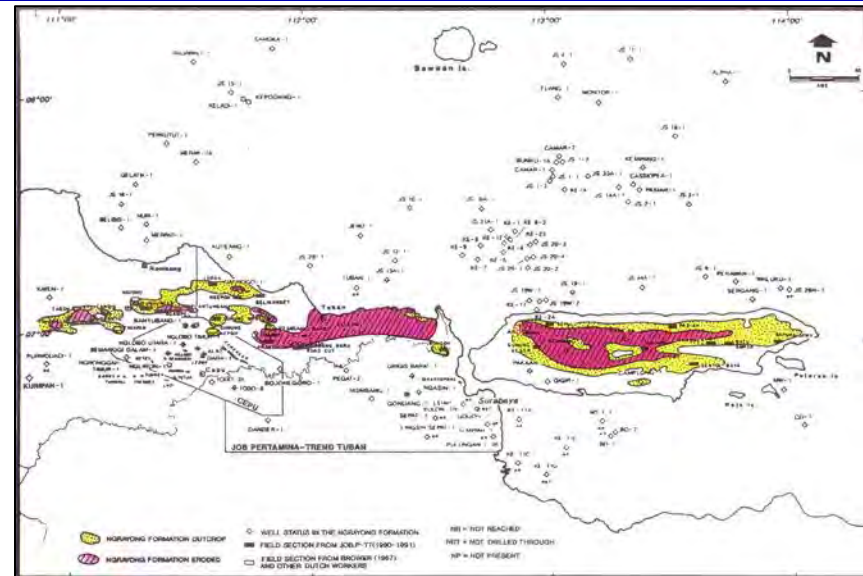
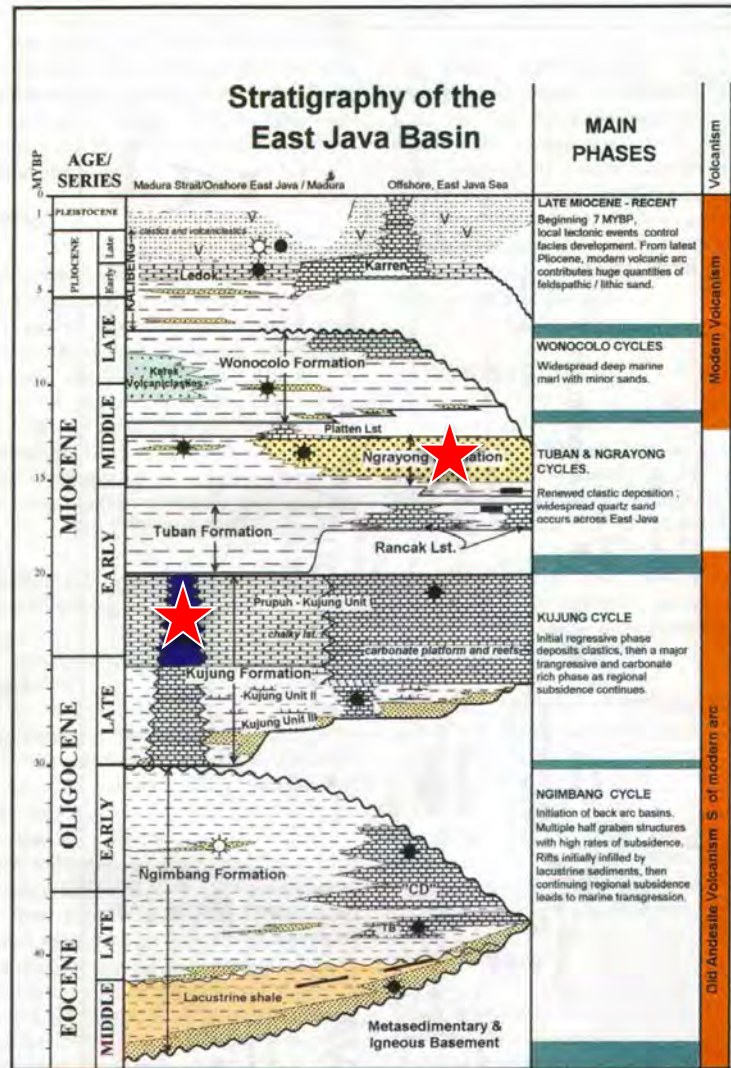


Ngaryong Sand

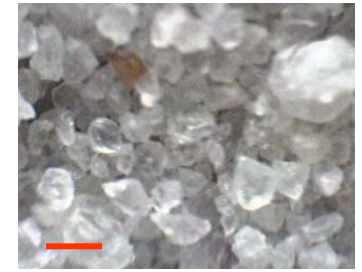
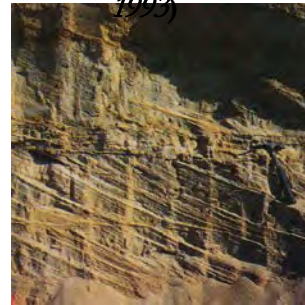
**KORELASI SATUAN PETA**  
**CORRELATION OF MAP UNITS**

UMUR AGE		CEKUNGAN BUSUR BELAKANG (BACKARC BASIN)				BUSUR GUNUNGAPI (VOLCANIC ARC)			
		LAJUR (ZONE) KARDUMUR JAWA BAWEAN	VULKANIK ALKALI ALKALINE VOLCANIC	LAJUR (ZONE) REMBANG	LAJUR (ZONE) KENDONG	LAJUR GUNUNGAPI TENGAH CENTRAL VOLCANIC ZONE	LAJUR PEGUNUNGAN SELATAN SOUTHERN MOUNTAIN ZONE		
KUARTER QUATERNARY	HOLOSEN HOLOCENE	Qsc	Qac	Qsc	Qsc	Qsc	Qsc	Qsc	
	PLISTOSEN PLEISTOCENE	Ql	Qp	Ql	Qs	Ql	Qp	Ql	
TERASIER TERTIARY	PLIOSEN PLIOCENE	Tm	Tp	Tp	Tm	TQl	TQs	TQs	
	MIOSEN MIOCENE			Tp	Tm				
		Akhir Late			Tp	Tm			
		Tengah Middle			Tp	Tm			
	OLIGOSEN OLIGOCENE			Tp	Tm				
		Akhir Late			Tp	Tm			
		Tengah Middle			Tp	Tm			
	EOKSEN EOCENE			Tp	Tm				
		Akhir Late			Tp	Tm			
		Tengah Middle			Tp	Tm			
PALEOSEN PALEOCENE			Tp	Tm					
	Akhir Late			Tp	Tm				
PRA-TERSIER PRE-TERTIARY				Tp	Tm				
				Tp	Tm				

# NGRAYONG FORMATION – SHALLOW TARGET



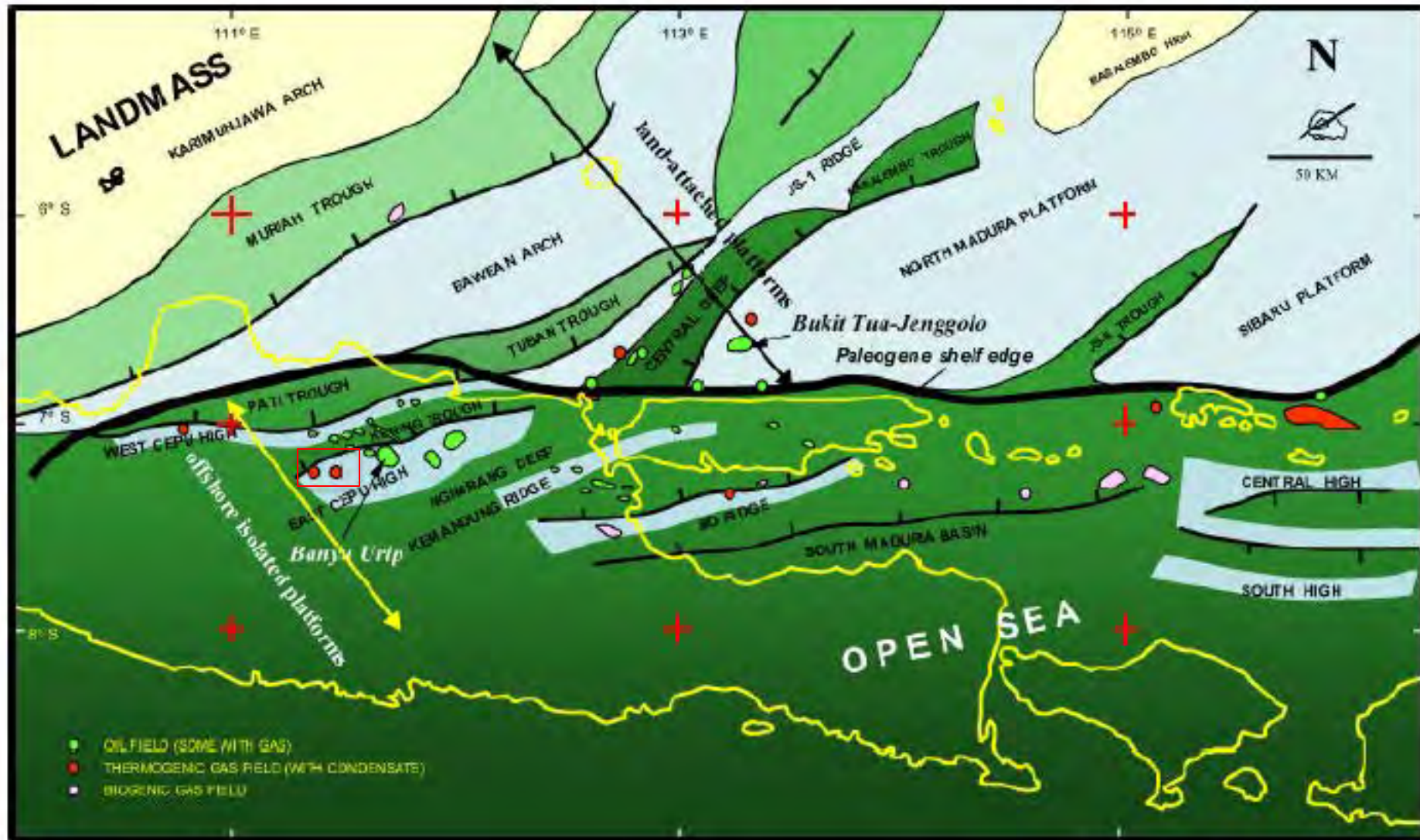
Outcrop distribution of the Ngrayong Formation (Ardhana, 1993)



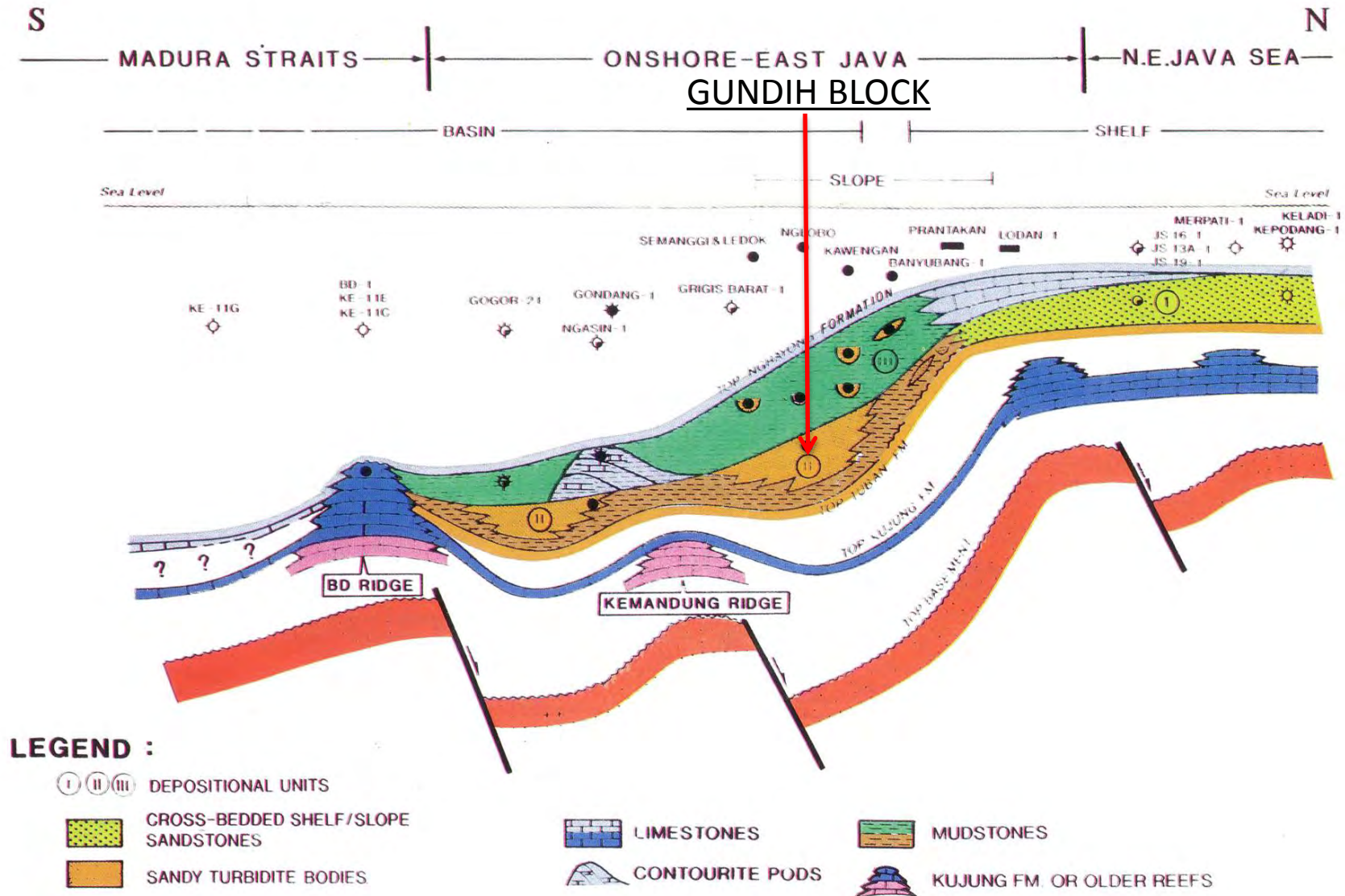
CCS Reservoir Target



# PALEOGEOGRAPHY OF NGRAYONG SAND



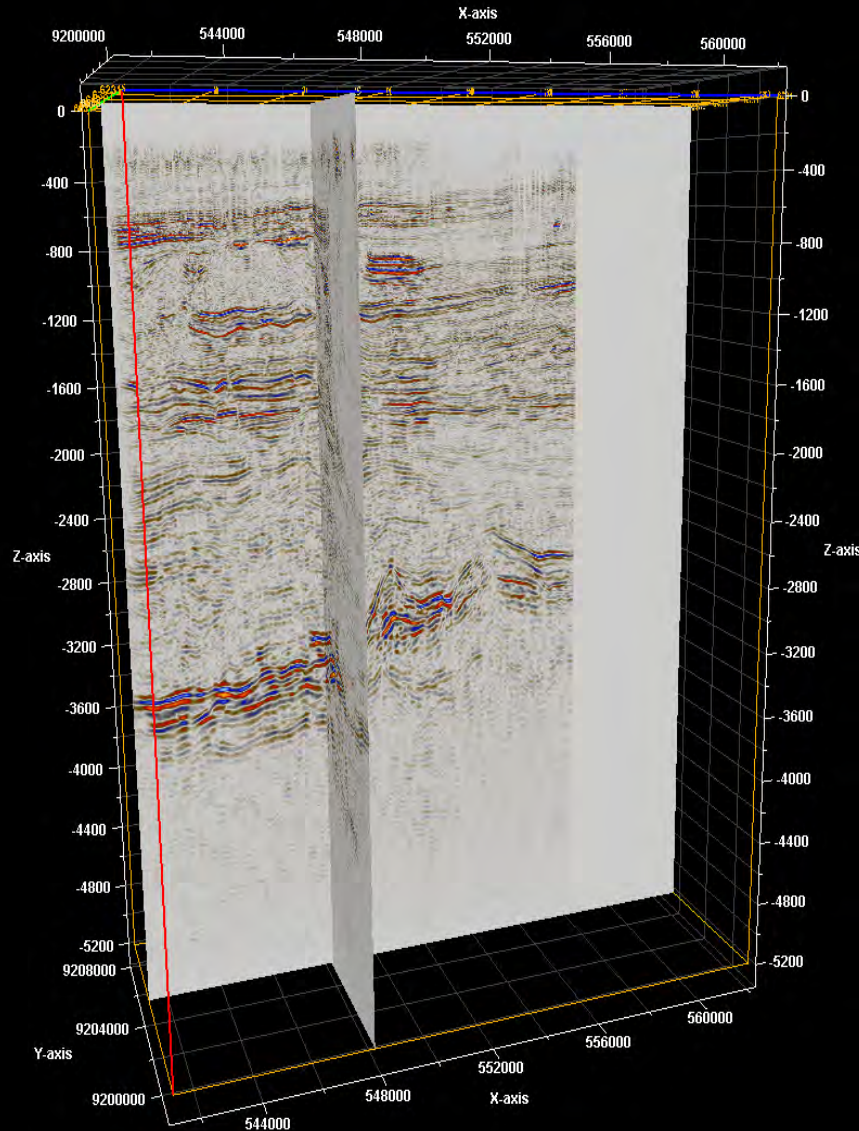
# Ngrayong Formation – Depositional Model (Ardhana, 1993)







# 3D Seismic Data



Area:

197 km<sup>2</sup>

- First trace FFID: 2000
- Last trace FFID : 2838
- First trace SP: 12379
- Last trace SP : 12553
- First trace CDP : 200006232
- Last trace CDP : 283806406

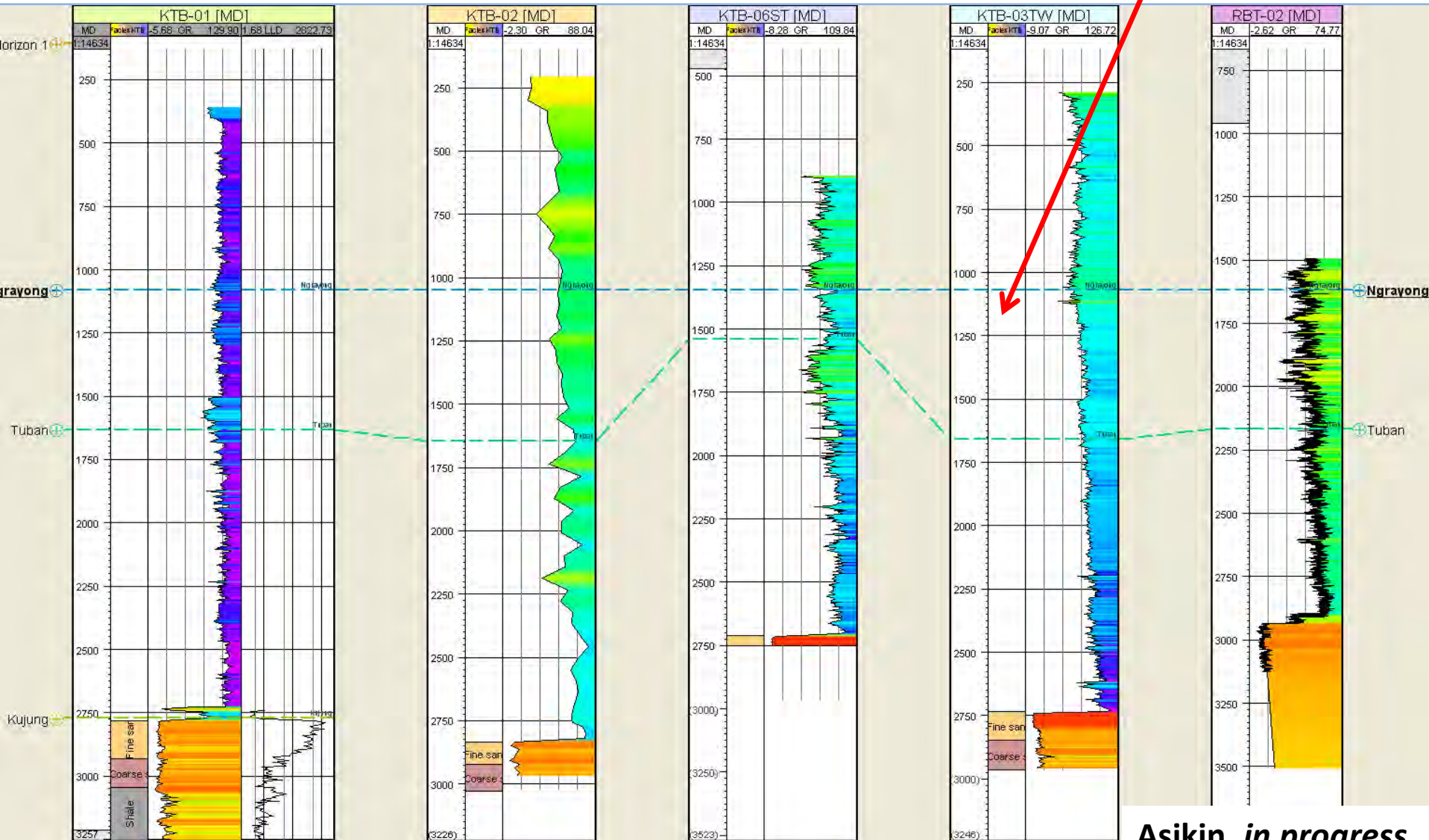




# Well Correlations

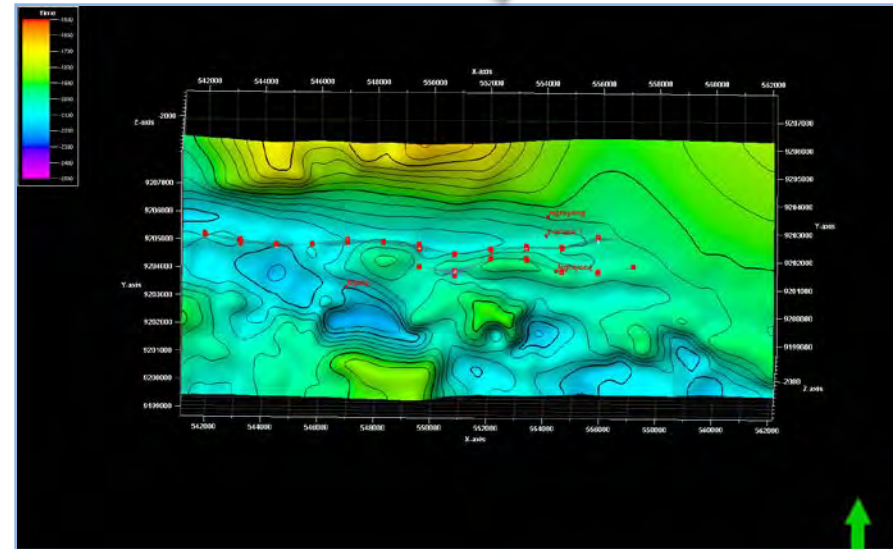
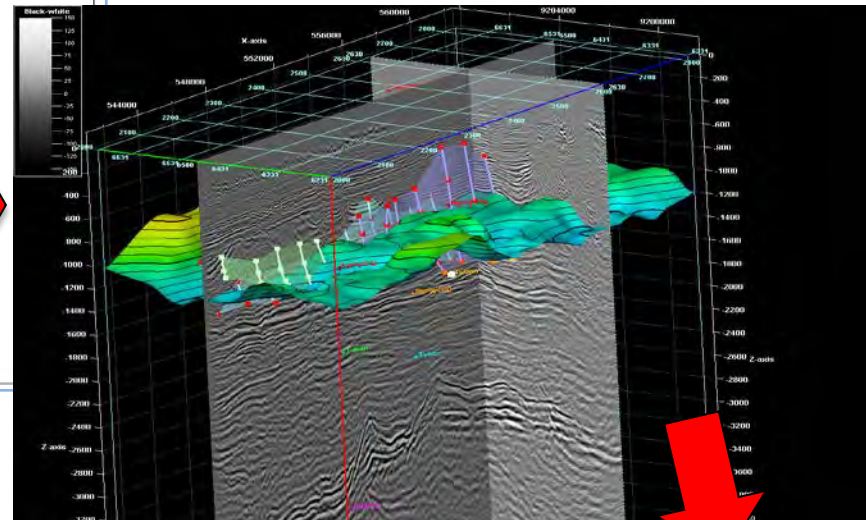
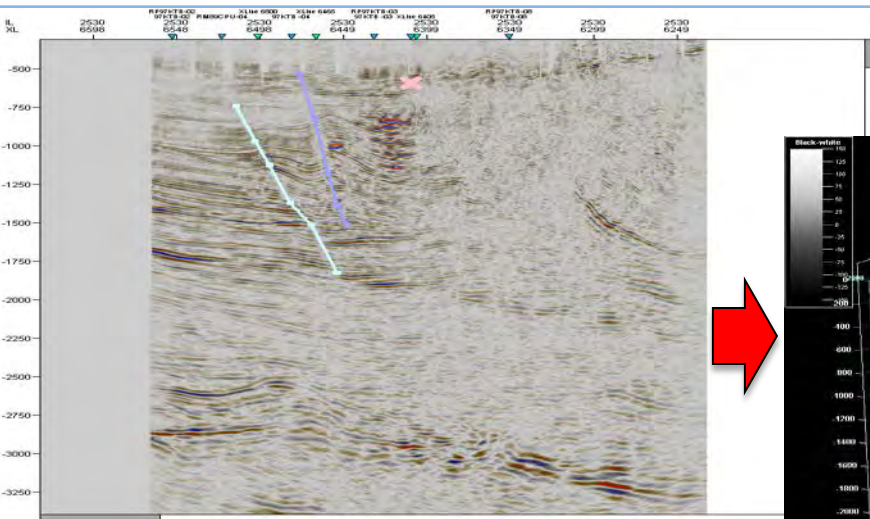


**Ngrayong Formation**



*Asikin, in progress*

# GEOLOGICAL MODELING



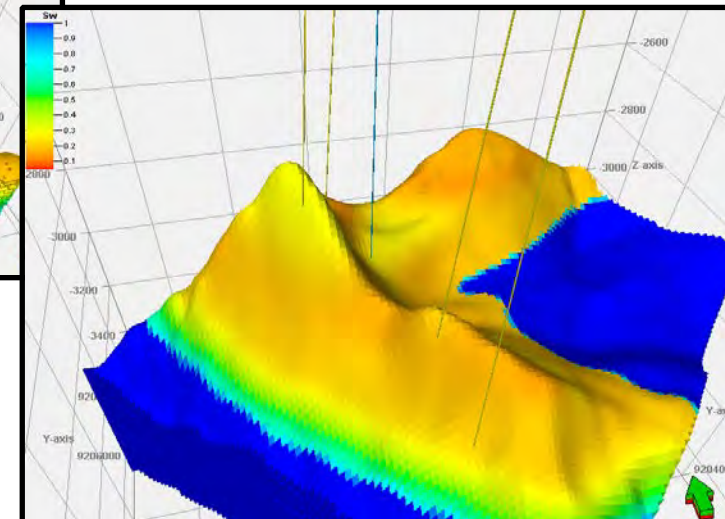
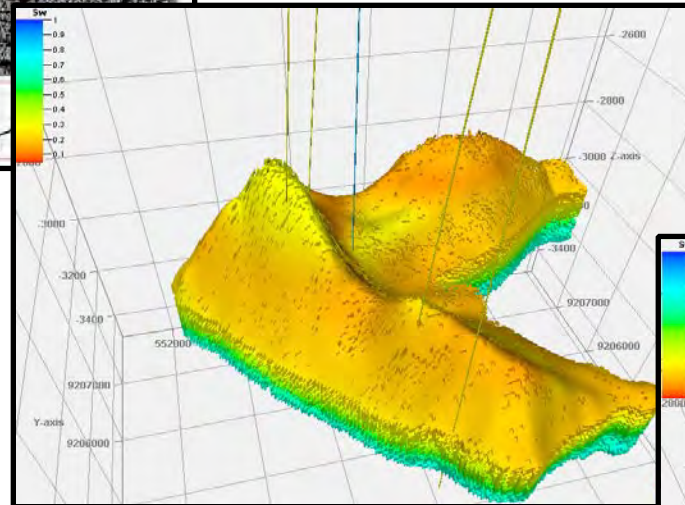
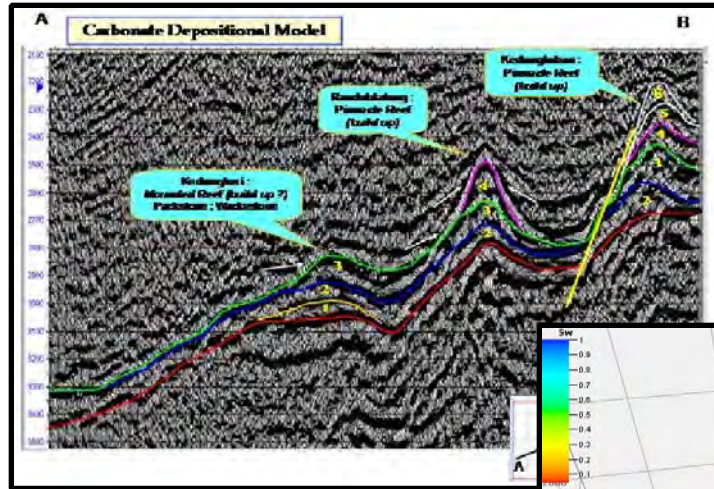
*Asikin, in progress*



# Reservoir Simulation Methodology



Stratigraphic & structural modeling -> geological model -> reservoir simulation model



Ekowati, *in progress*

# Injection Scenarios

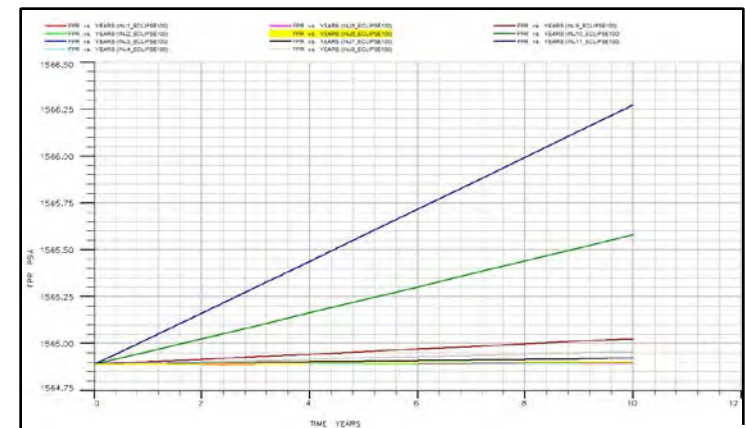
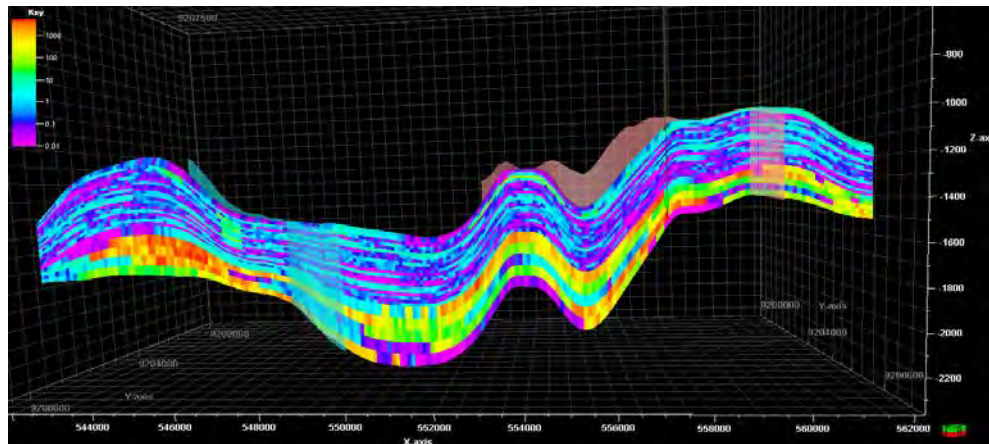


## ← Roll out plan: 2015 – 2025

← Injection plan: inject up to 10,000 tonCO<sub>2</sub> in 10 years in deep storage (Kujung Fm.) and shallow storage (Ngrayong Formation)

← CO<sub>2</sub> supply: at various rate  
(500 ton CO<sub>2</sub>/year - 0.1 MtonCO<sub>2</sub>/year)

Case	Rate in 1 year (tonCO <sub>2</sub> )	Rate in 1 day	
	(tonCO <sub>2</sub> )	(tonCO <sub>2</sub> )	(sm <sup>3</sup> /d)
1	500	1.39	772.5
2	600	1.67	927
3	700	1.94	1081.5
4	800	2.22	1236
5	900	2.50	1390.5
6	1000	2.78	1545
7	2500	6.94	3862.5
8	5000	13.89	7725
9	10000	27.78	15450
10	50000	138.89	77250
11	100000	277.78	154500





# Tentative Results



- Ngrayong Formation in Gundih field doesn't have a big closure to inject CO<sub>2</sub>. The formation has an open structure to the north that will have a possibility to migrate the injection of CO<sub>2</sub> (Asikin, 2012).
- Kujung Formation does not provide sufficient storage capacity. With optimum injection surface rate of 960 tonCO<sub>2</sub>/year @ P<sub>initial</sub> = 940 psia, maximum total gas injection is 7000 tonCO<sub>2</sub> in 10 years with negligible increase in pressure value (Ekowati, 2012).
- Ngrayong Formation provides sufficient storage capacity. With injection surface rate of 1,000 tonCO<sub>2</sub>/year, total gas injection could reach 10,000 tonCO<sub>2</sub> in 10 years with negligible increase in pressure value (Ekowati, 2012).
- However, uncertainty factor is still large since many assumptions are used to generate the model properties. There is a possibility that injection at Ngrayong Formation will be leak to the surface or charging into Caluk structure through the northern fault.
- Future works will concentrate in determining possible location in the northern part of Gundih Field with most likely residual trapping mechanism.

# THANK YOU



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10-11 December 2012