The Potential and importance of Chinese Offshore Basins for CO2 Geological Storage

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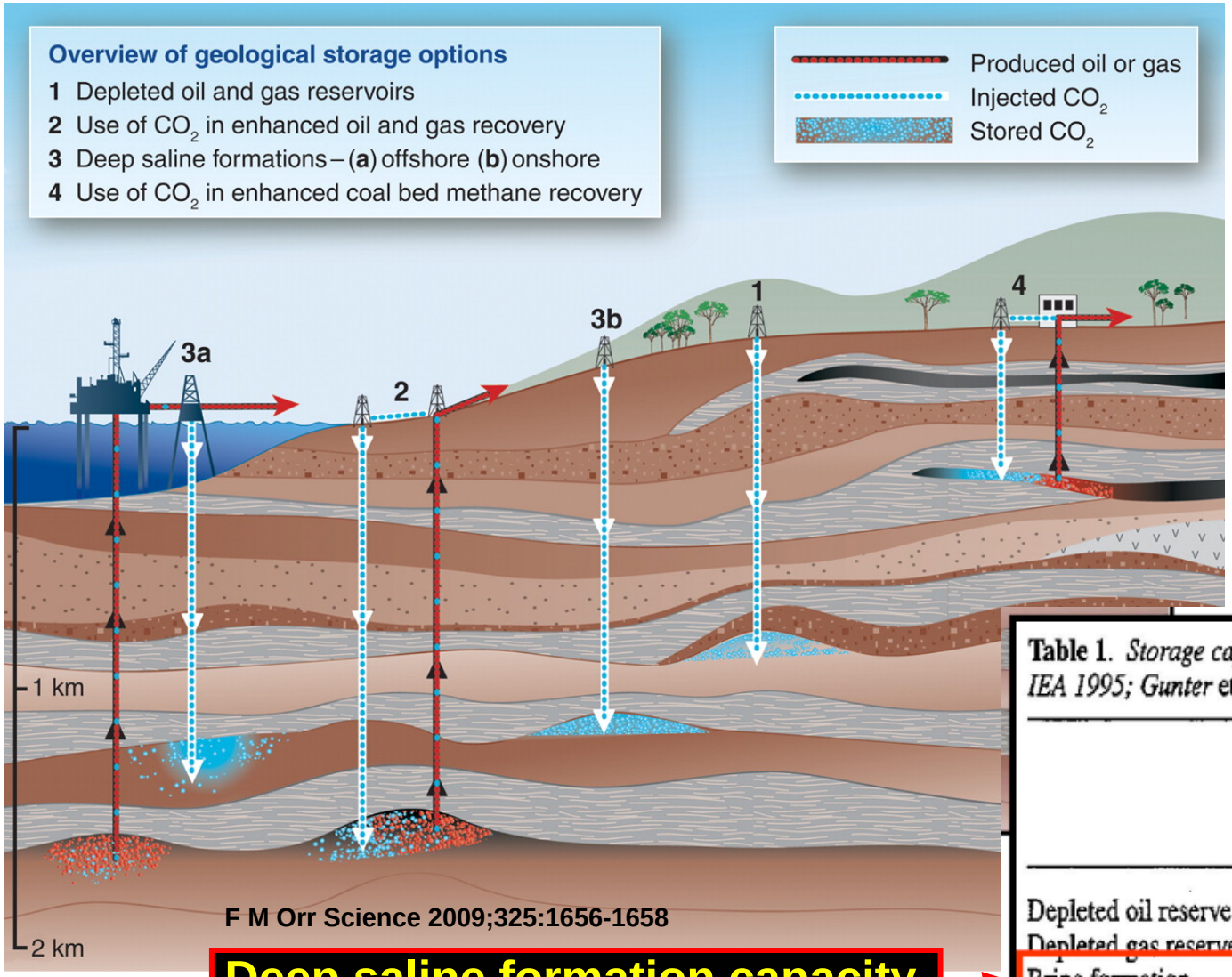
Outline

1. **Overview of CO2 storage in Offshore Basins**
2. **Chinese offshore sedimentary basins**
3. **The importance of offshore CO2 storage for China**
4. **CO2 storage potential and early opportunities in Chinese offshore basins**

1. Necessity and importance of CO2 Storage in Saline



F M Orr Science 2009;325:1656-1658

Deep saline formation capacity is biggest
深部盐水层封存量最大

埋存方式：

1.枯竭油气藏

2.CO2油气增产

3.深部盐水层

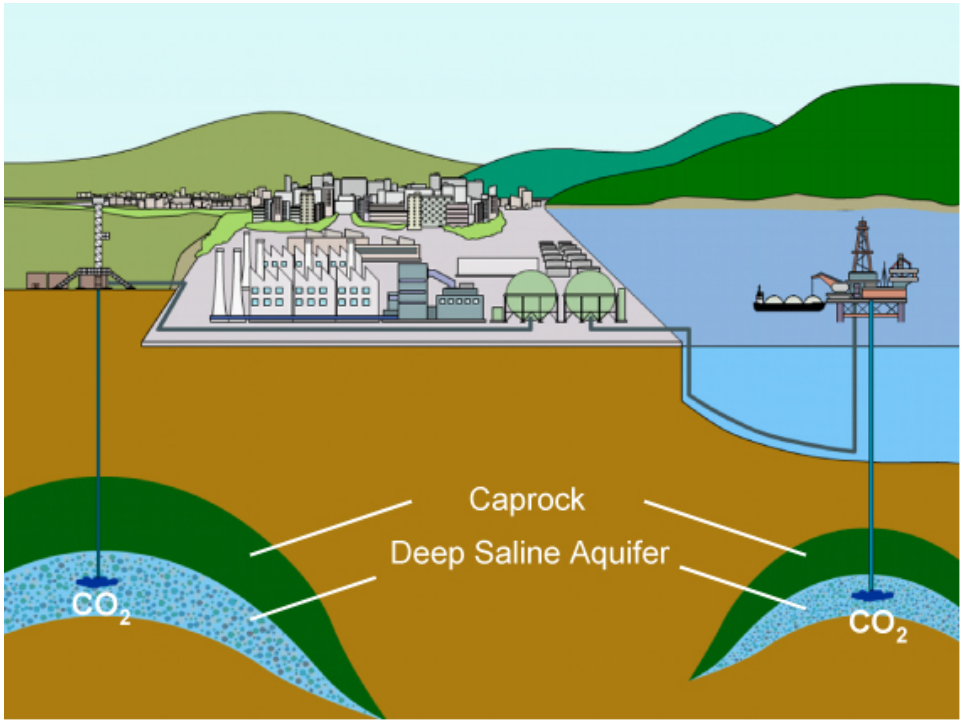
海域(3a),陆上(3b)

4. CO2煤层气增产

Table 1. *Storage capacity in sedimentary basins (from IEA 1995; Gunter* et al. *1998; Stevens* et al. *1999)*

	Global capacity (GTC)	US capacity (GTC)	Canada capacity (GTC)
Depleted oil reserve	40–190	10–14	0.6
Depleted gas reserve	140–310	20–30	4
Brine formation	87–2700	1–130	>10
Unminable coal	5–40	4–5	4

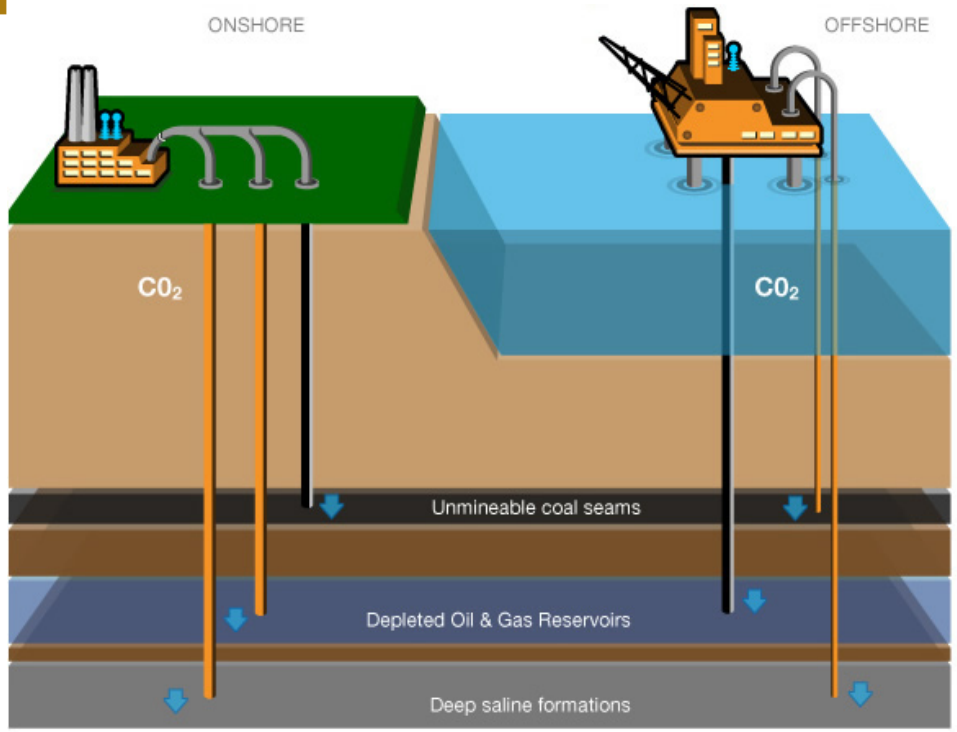
GTC, Giga Tonnes carbon 十亿吨



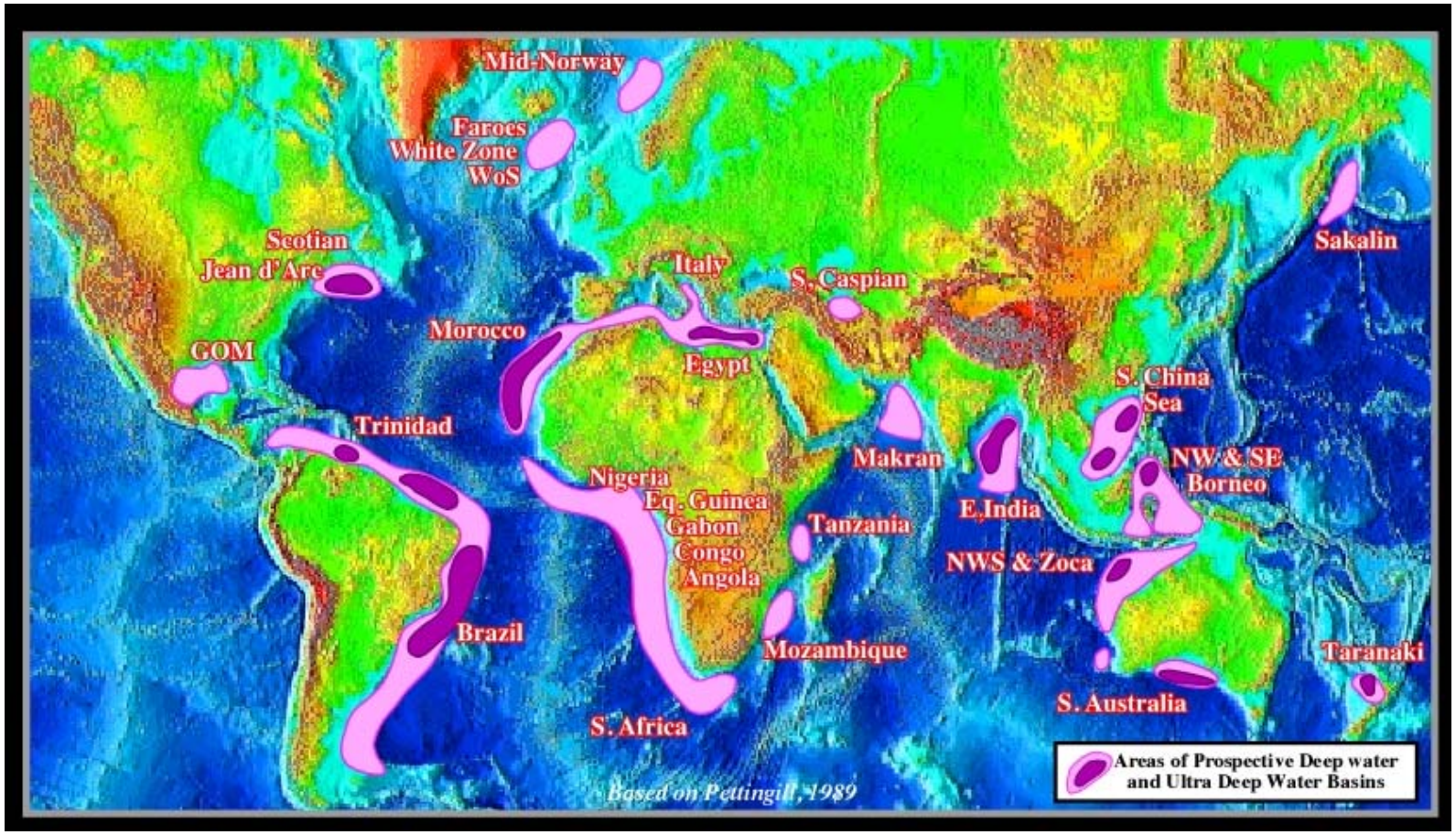
What is offshore geological storage?

1.Offshore basins are unattached to onshore, the rocks in the offshore basin may not occur onshore at all

2.Onshore basin extend offshore under shallow seas;

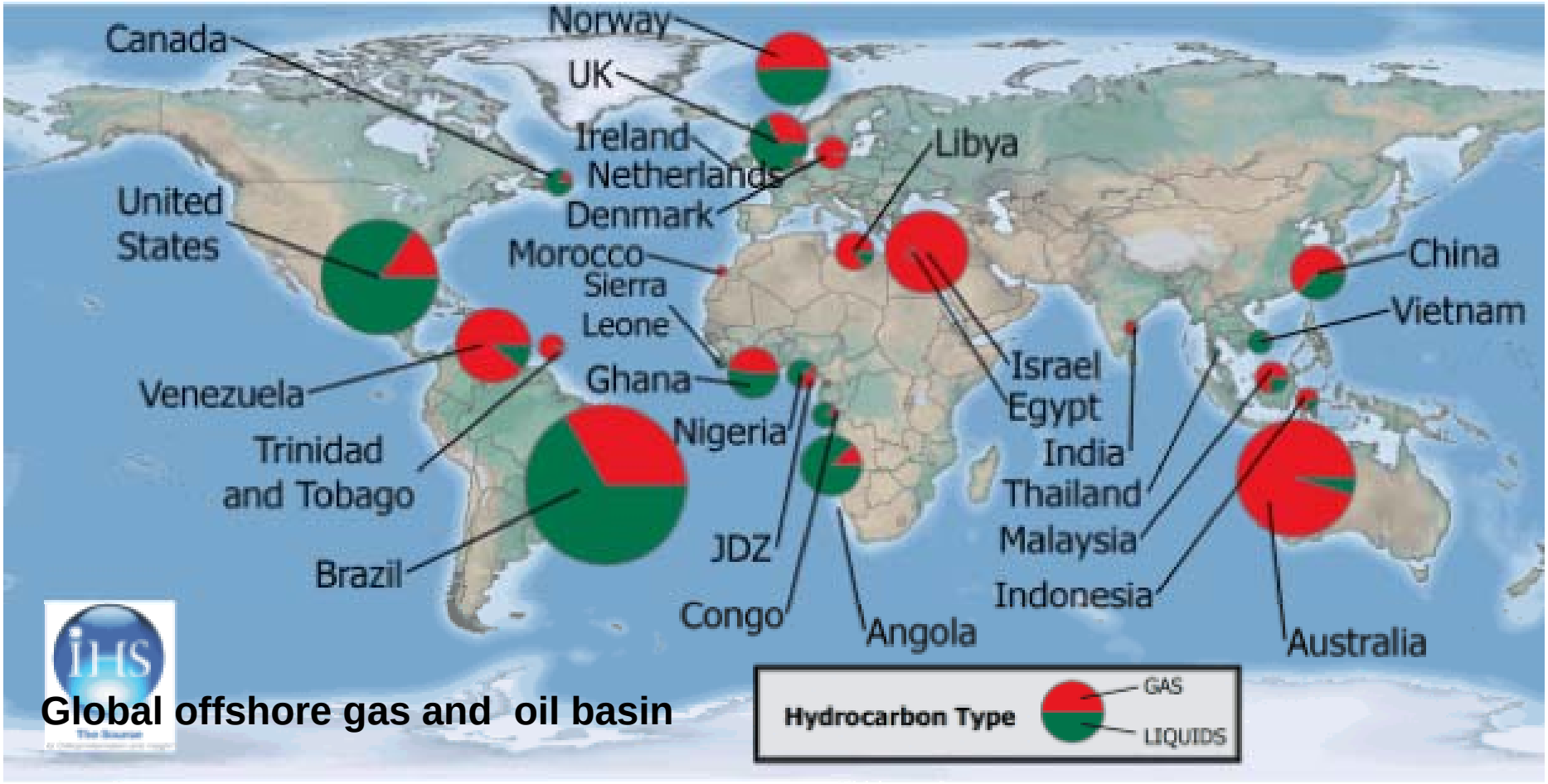


Potential of offshore basins



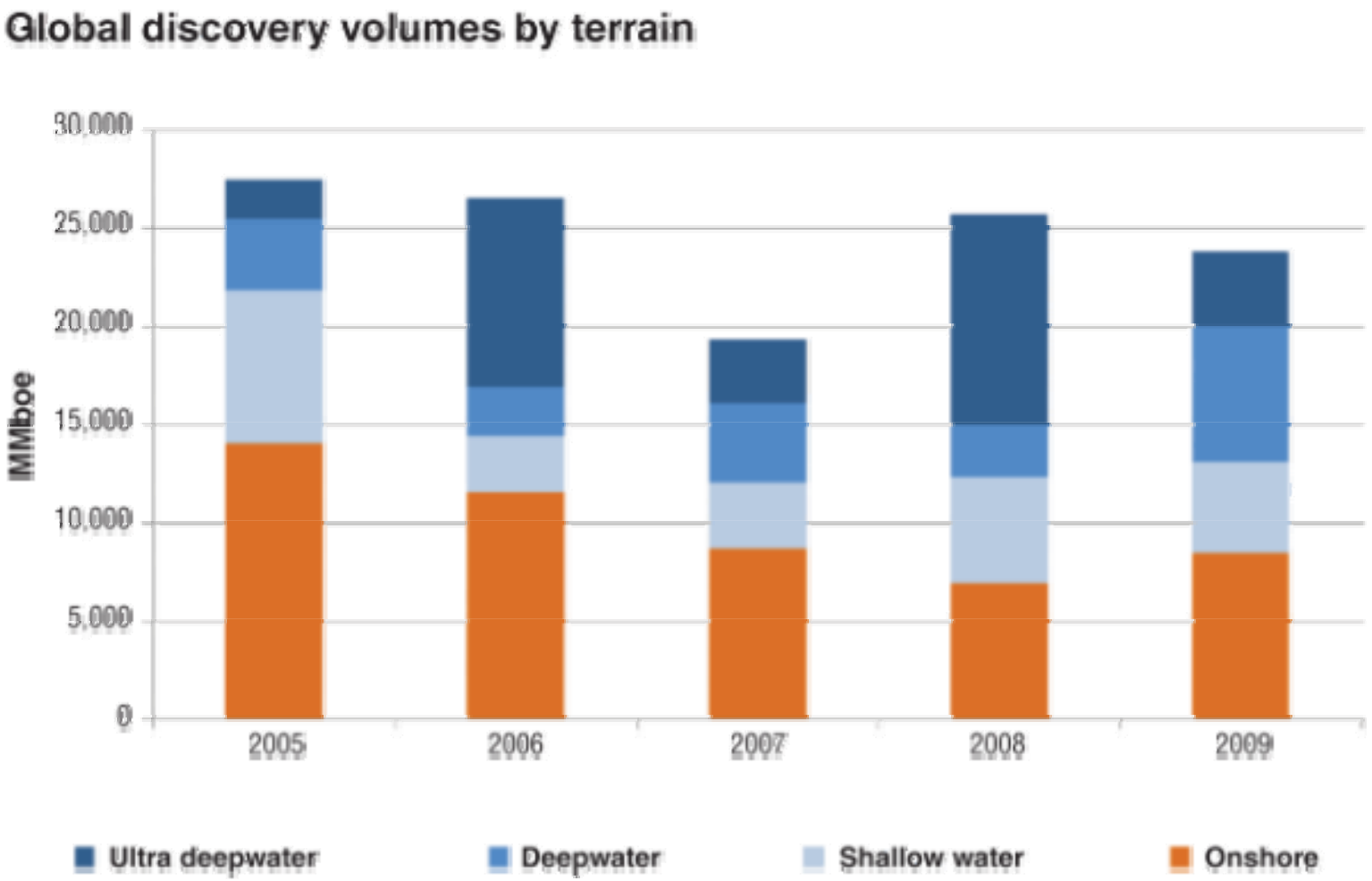
There are plenty of offshore basins on the continental shelf around the world; Including shallow water (SW) <= 400 m (1,312 ft), 400 m < deepwater (DW) <= 1,500 m (4,921 ft), and ultra deepwater (UDW) > 1,500 m;

Potential of offshore basins



Global offshore gas and oil basin

Many offshore basins on the continental shelf of countries around the world hold large resereves of oil and gas.

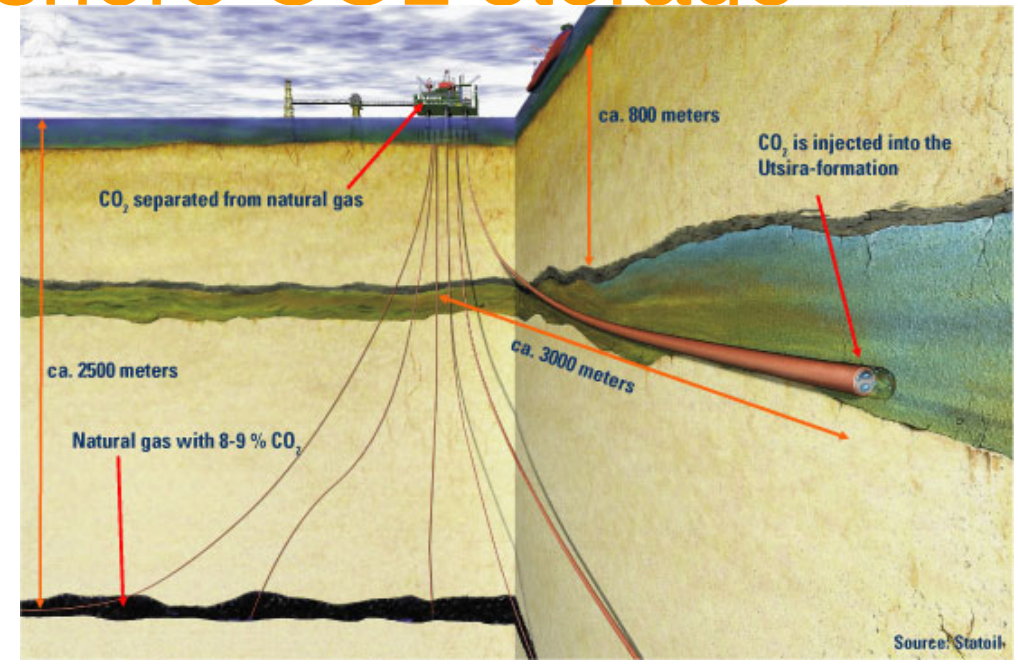


Basins which hold oil and gas reserves are generally accepted to have the best potential for CO2 storage, so many offshore basins can be expected to have a high potential for CO2 storage

Offshore vs. onshore CO2 storage

Merits:

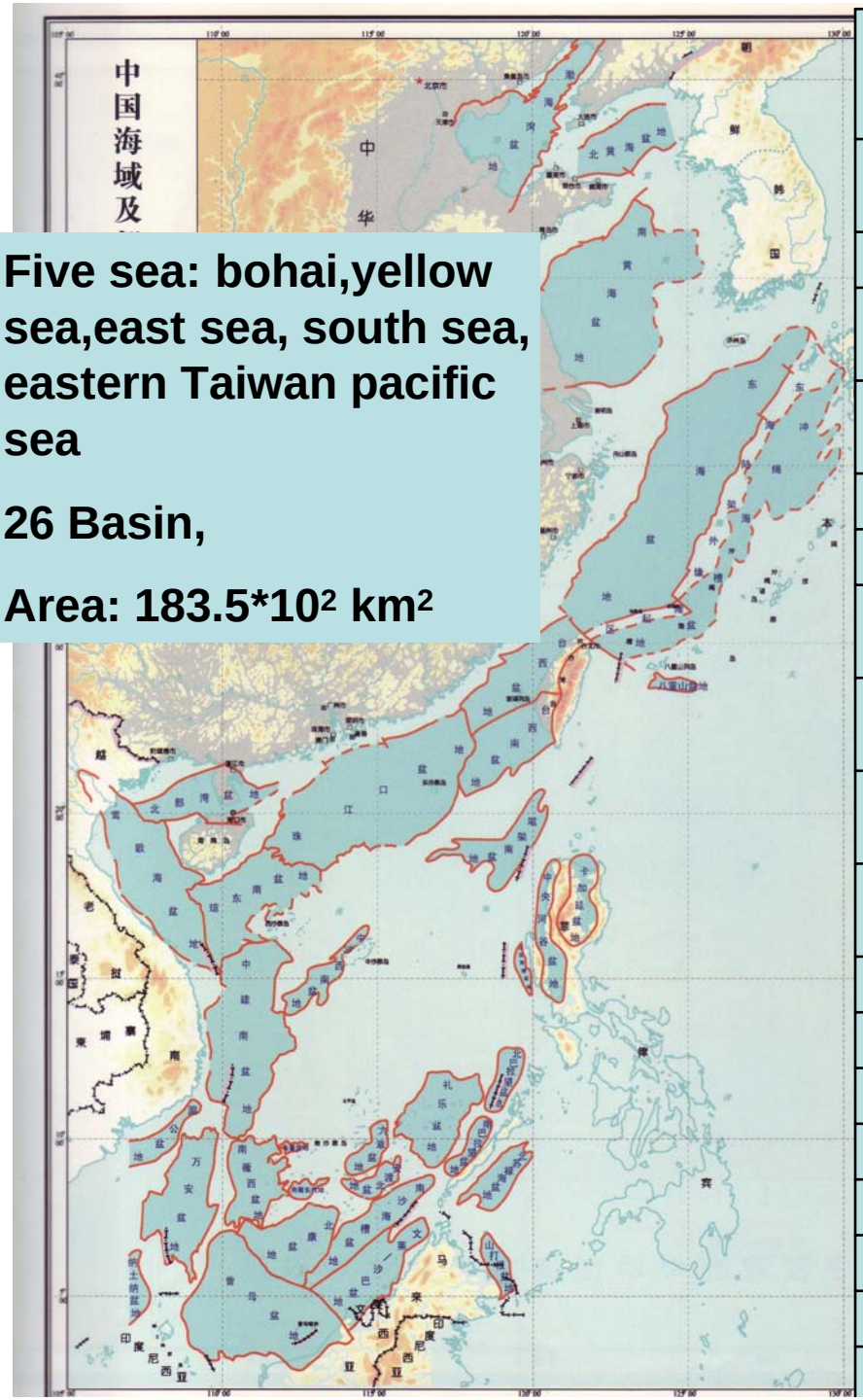
- Land saving;
- No damage to ground water;
- Low environmental impact;
- Around the world the offshore basins often have better geological characteristics for storage



Defects:

- Because of the water above them, the marine engineering challenges can be much greater for exploration as well as CO2 storage;
- High cost of infrastructure, operation, and monitoring.

Chinese offshore sedimentary basins

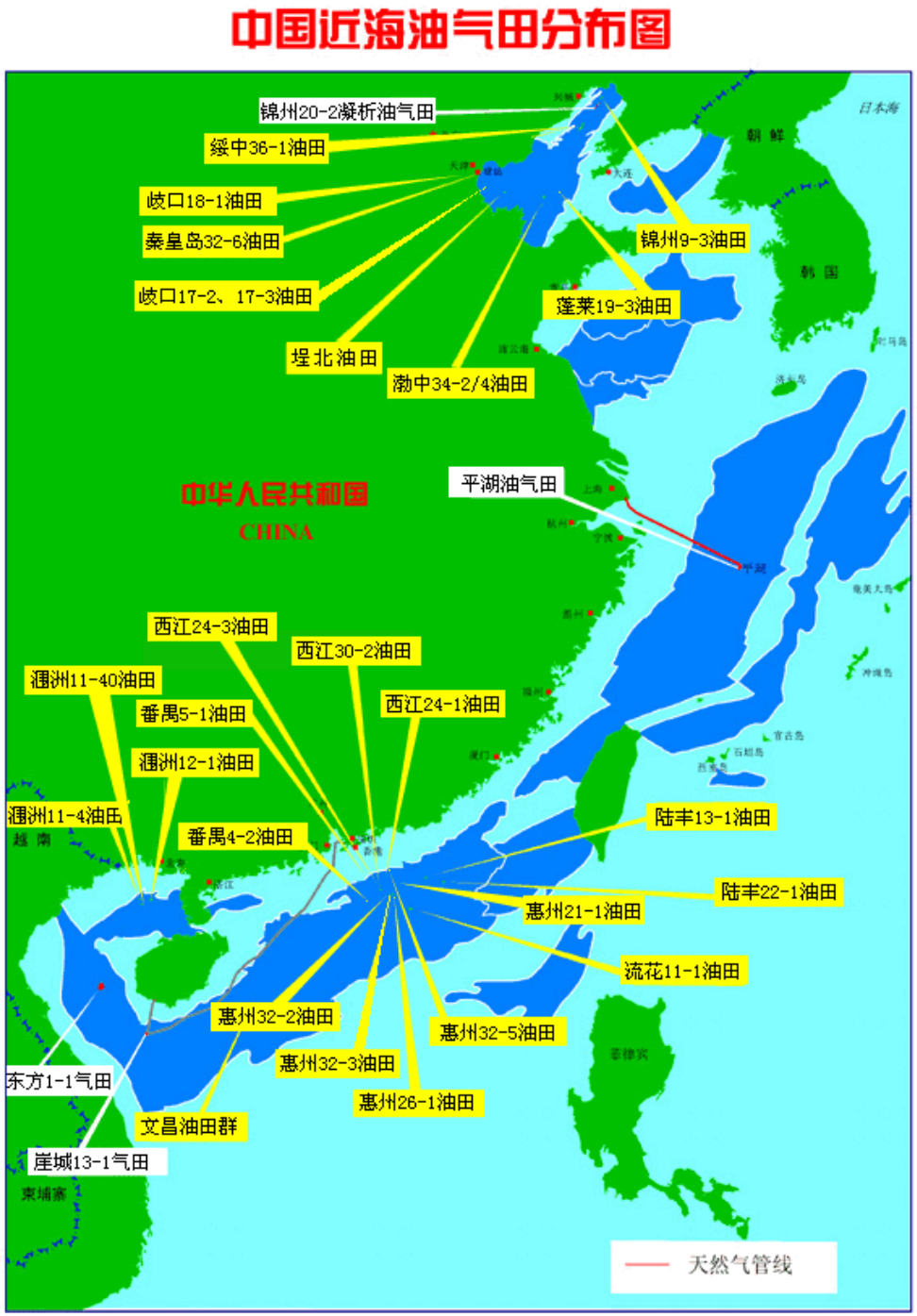


Five sea: bohai,yellow sea,east sea, south sea, eastern Taiwan pacific sea

26 Basin,

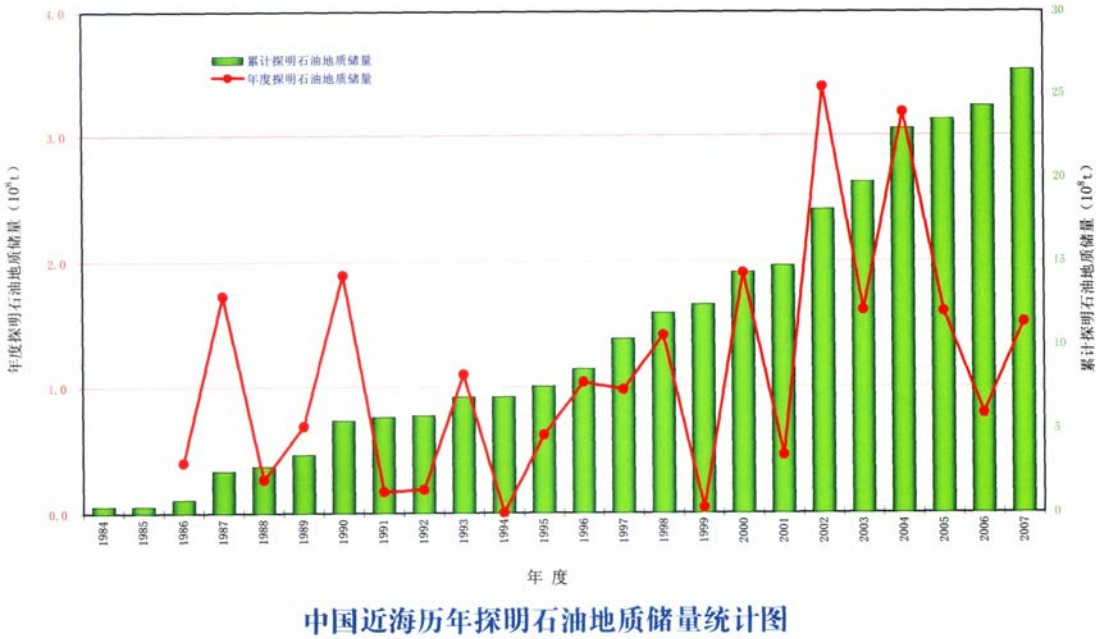
Area: 183.5*10² km²

盆地	面积（平方千米）	沉积岩厚度	第二次资源评价(油：万t，气亿m3)	地层
渤海湾盆地 (海域)	195,000(77,000)	1000	油40.29，气12200	N+E
北黄海盆地	15,000	5000	油1.4	J+R
南黄海盆地	85,000	7000-8200	油5.5，气800	K2+R+Q
东海盆地	241,300	12000	油53.79，气24600	J-R
台西盆地（海域）	65,540	12000	油7.3	K+R
台西南盆地（海域）	55,660	10000	油3.3	K+R
珠江口盆地	202,800	10000	油67.95，气13000	R
北部湾盆地	36,350	9000	油16.7，气1500	R
琼东南盆地	41,300	15500	油20.02，气35700	R
莺歌海盆地	98,700	10000	油29.71，气50500	R
中建南盆地	140,000	9000		R
万安盆地	112,340	10500	油97	E-Q
曾母盆地	208,710	13500	油13.2	E-Q
北康盆地	43,200			
南薇西盆地	25,000			
南沙海槽盆地	33,680			
礼乐盆地	55,000			
总计	1,319,370			



Offshore basins on the continental shelf of China hold many Oil and Gas Fields .

oil and gas fields: 121
structural traps :117

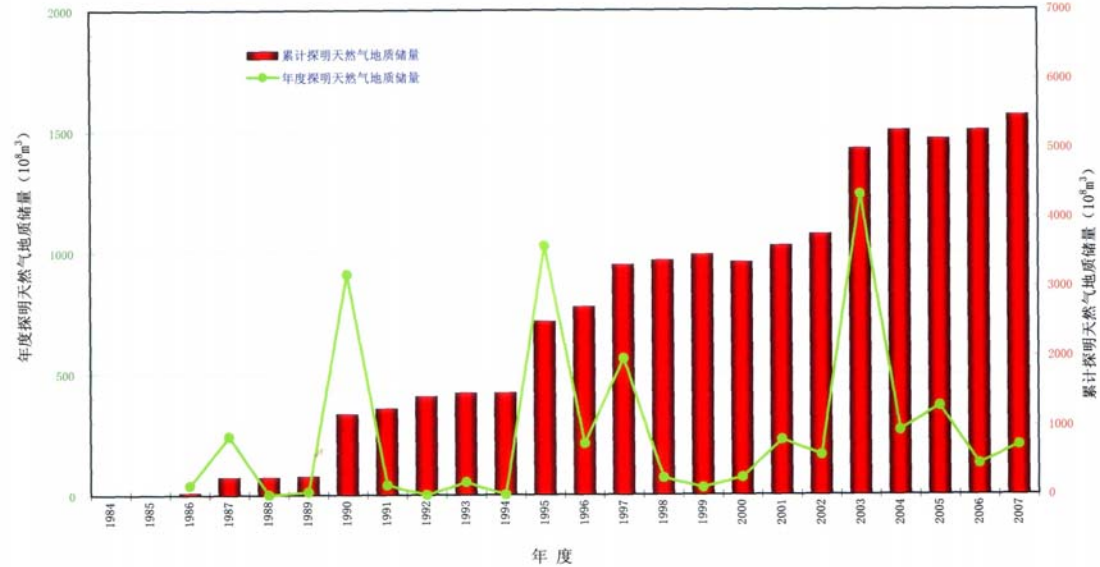


中国近海历年探明石油地质储量统计图

proven total geological reserves 累计探明地质储量

Oil 石油：**33.56*10^{8}t**

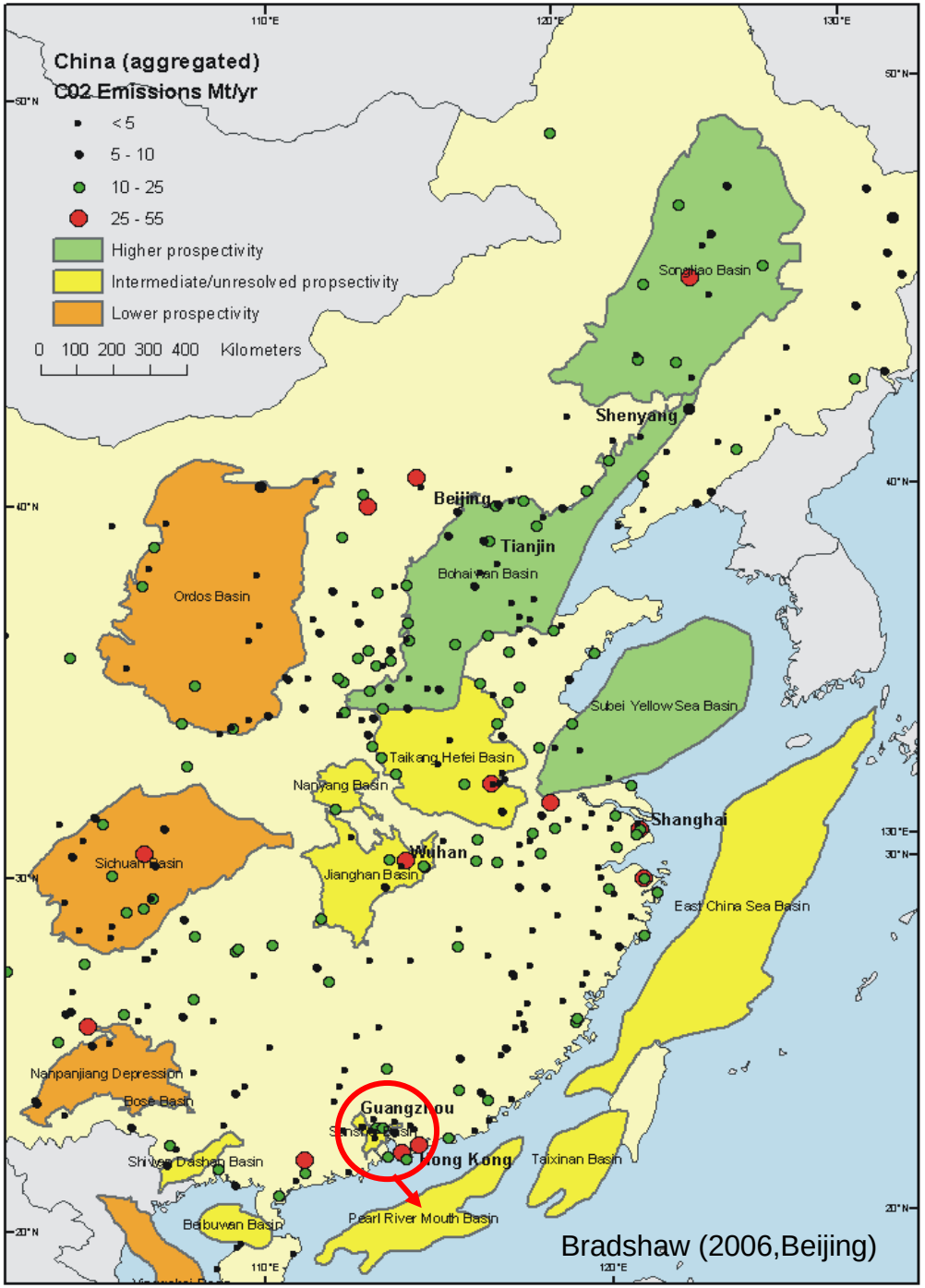
Gas天然:**5853.32*10^{8}m^3**



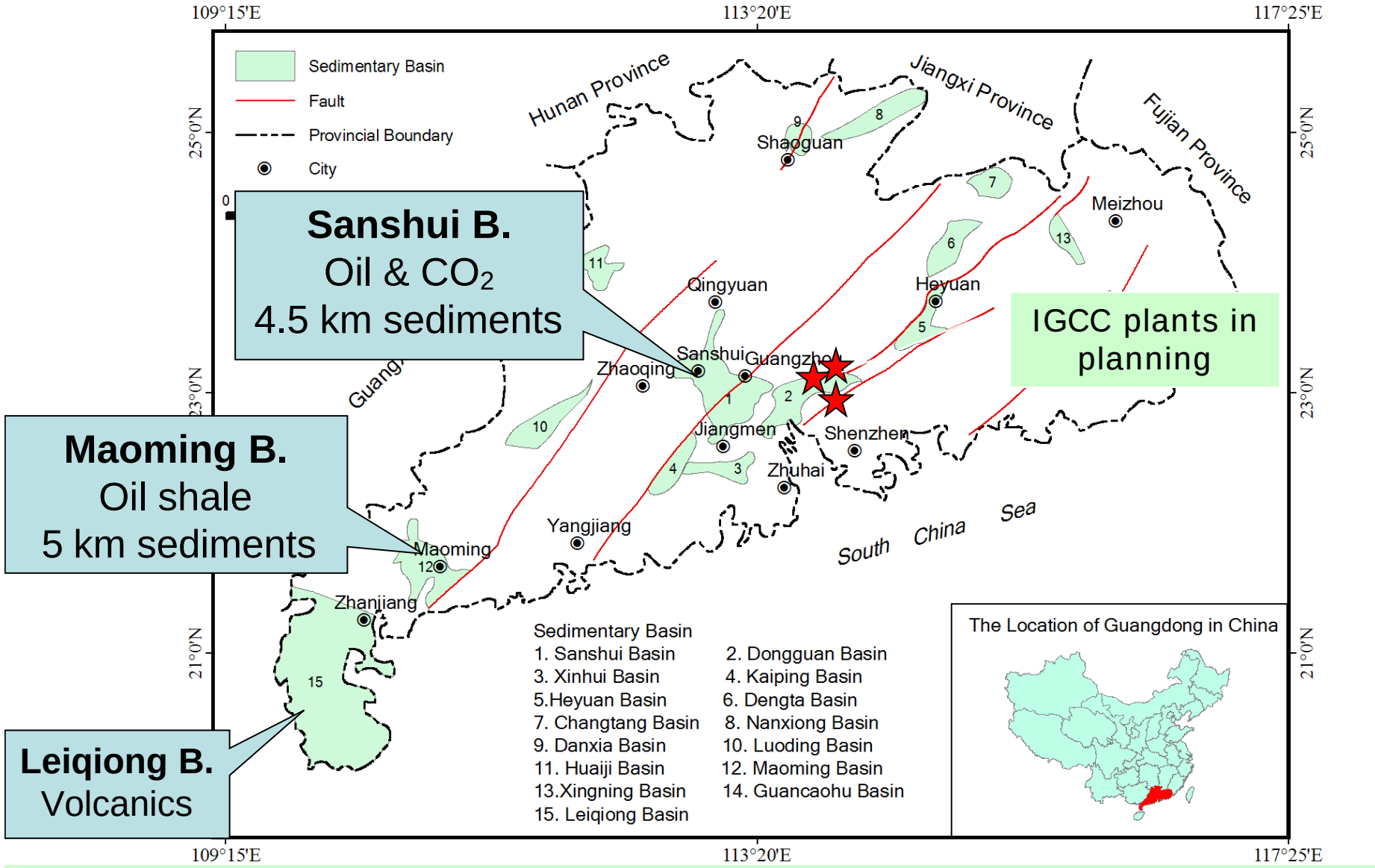
中国近海历年探明天然气地质储量统计图

2010, oil equivalent production(油当量产量**)5158*10^{4}t**

The importance of offshore CO_2 storage for China



- SE China is a fold belt with only small continental basins with limited CO2 storage capacity.
- However offshore basins are large and of high prospectivity for CO2 storage
- This basins match nicely the large emission sources along the coastal SE China.
- Offshore storage is perhaps the only hope for CCS in SE China!

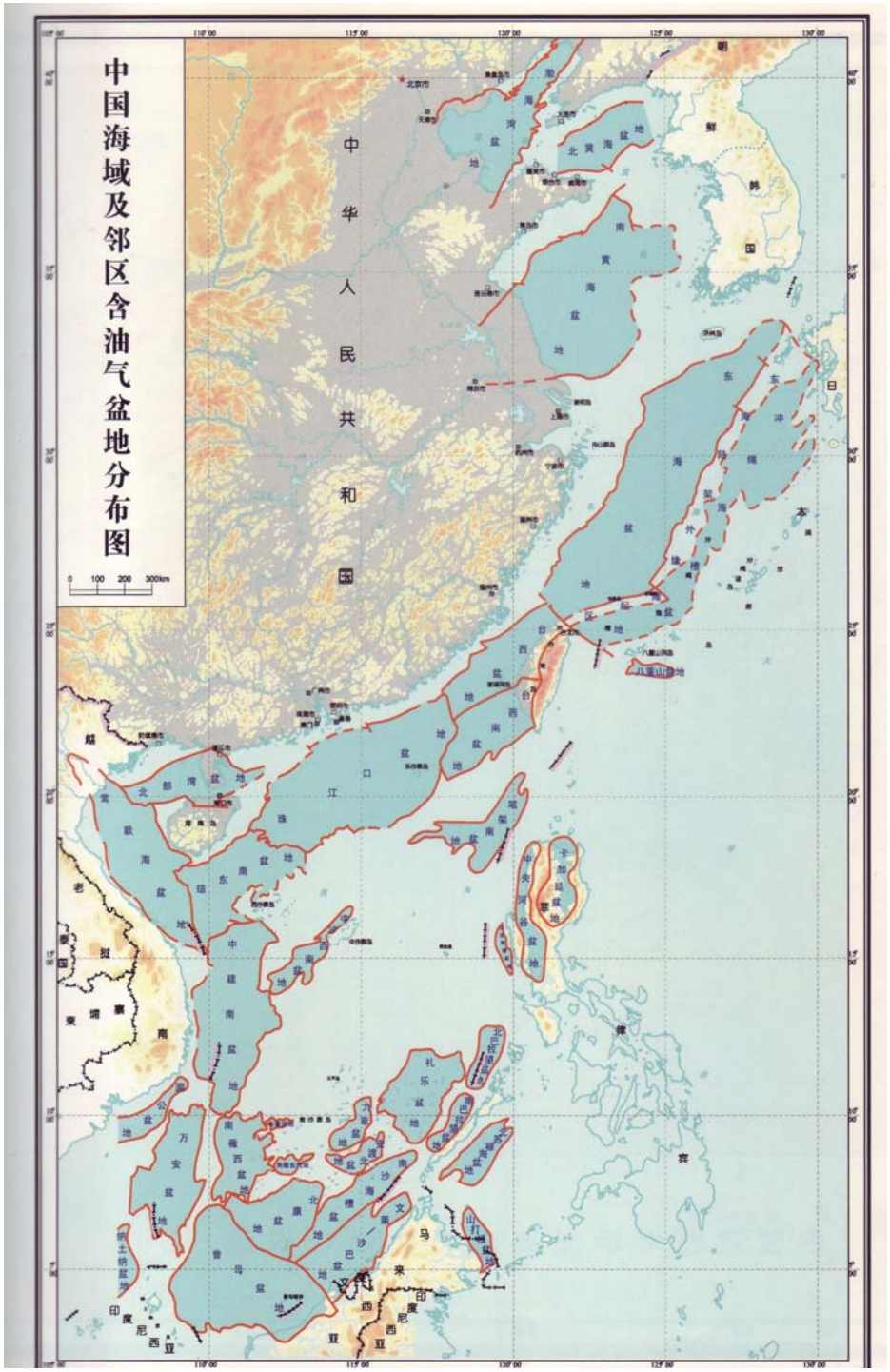


Basins inland Guangdong are small & with low storage capacity

Offshore CO_2 storage is crucial for southern China !

- Depleted oil/gas fields are Early opportunities: By utilizing existing data, platform and other facilities, the cost of offshore CO_2 injection may be greatly reduced.
- Early planning is the key !

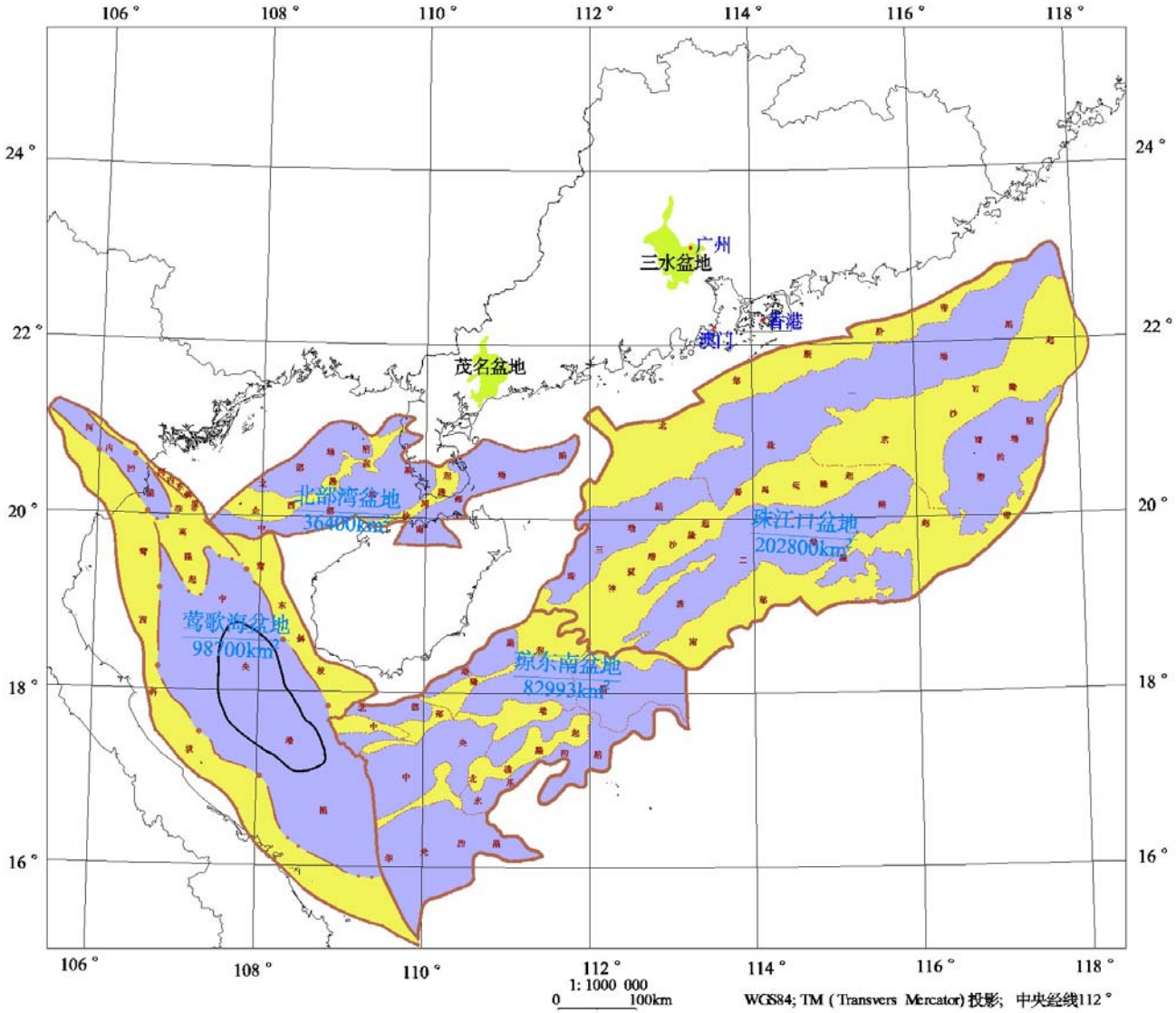
CO2 storage potential and early opportunities in Chinese offshore basins



CO2 storage potential

Based on published data, geological conditions and paramners for CO2 storage are anaylized.
National Scale assessment on CO2 storage capacity in offshore basins of China,
The estimated effective storage capacity of 17 offshore basins is 1928Gt, which capacity of South China Sea Basins is 1179Gt, account 60%

CO2 storage potential of Northern South China Sea Basins

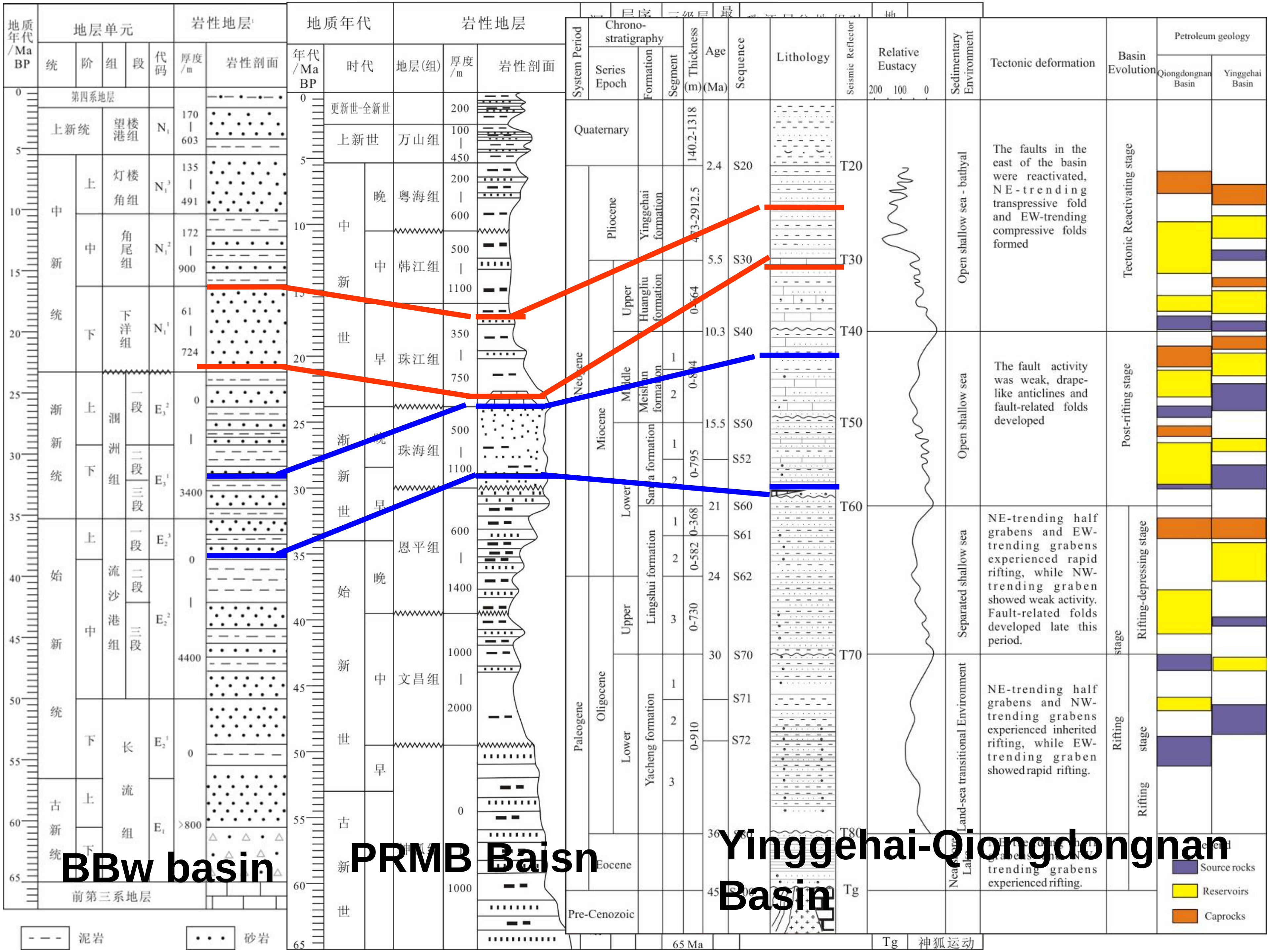


PRMB baisn: 陆缘裂陷盆地**Passive Continental Margin Depressed *Basin***

BBW Basin: intracontinental rift *basin*陆内裂谷盆地

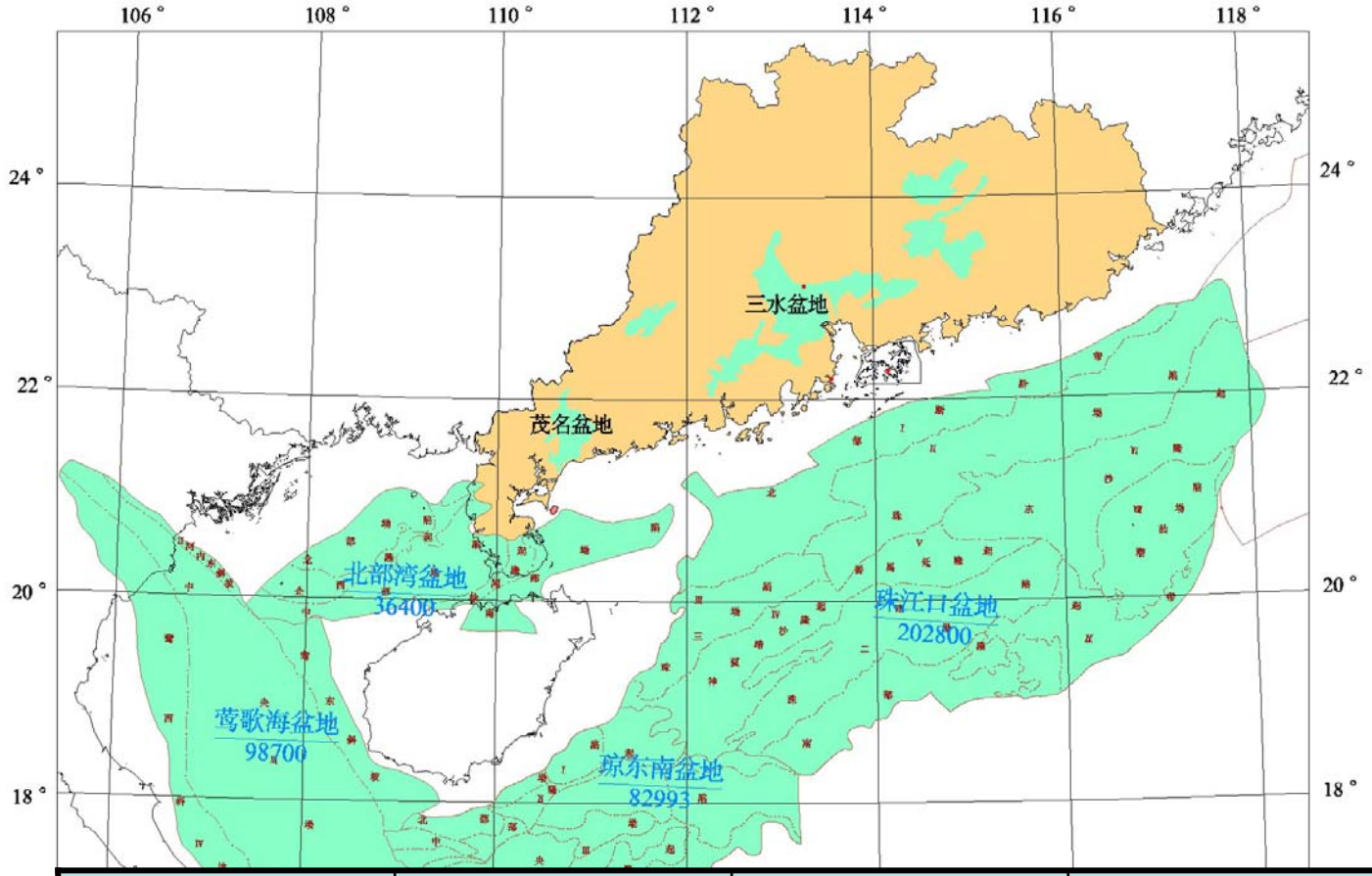
QDN Basin: Passive Continental Margin Depressed *Basin*

YGH Baisn: strike-slip rifting *basin*走滑拉张盆地



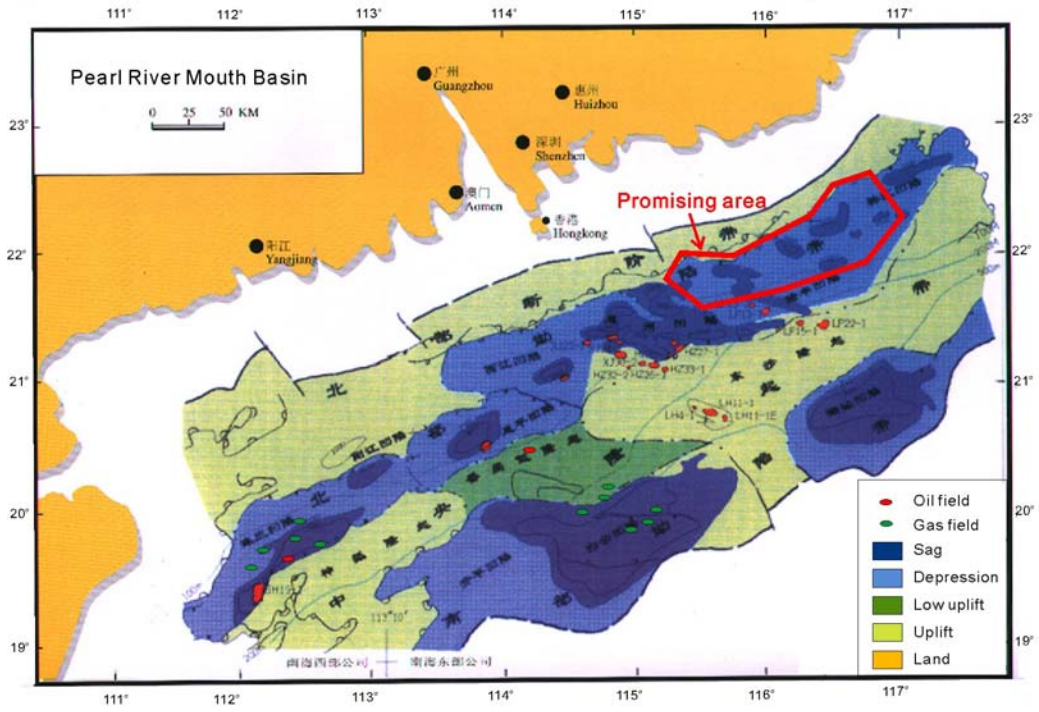
BBw basin
PRMB Baisn
Yinggehai-Qiongdongnan Basin
地质年代/Ma BP
地层单元
岩性地层
岩性剖面
年代/Ma BP
时代
地层(组)
厚度/m
System Period
Chrono-stratigraphy
Series Epoch
Formation
Segment
Thickness (m)
Age (Ma)
Sequence
Lithology
Seismic Reflector
Relative Eustacy
Sedimentary Environment
Tectonic deformation
Basin Evolution
Petroleum geology
Qiongdongnan Basin
Yinggehai Basin
Source rocks
Reservoirs
Caprocks
泥岩
砂岩

CO2 storage potential of Northern South China Sea Basins



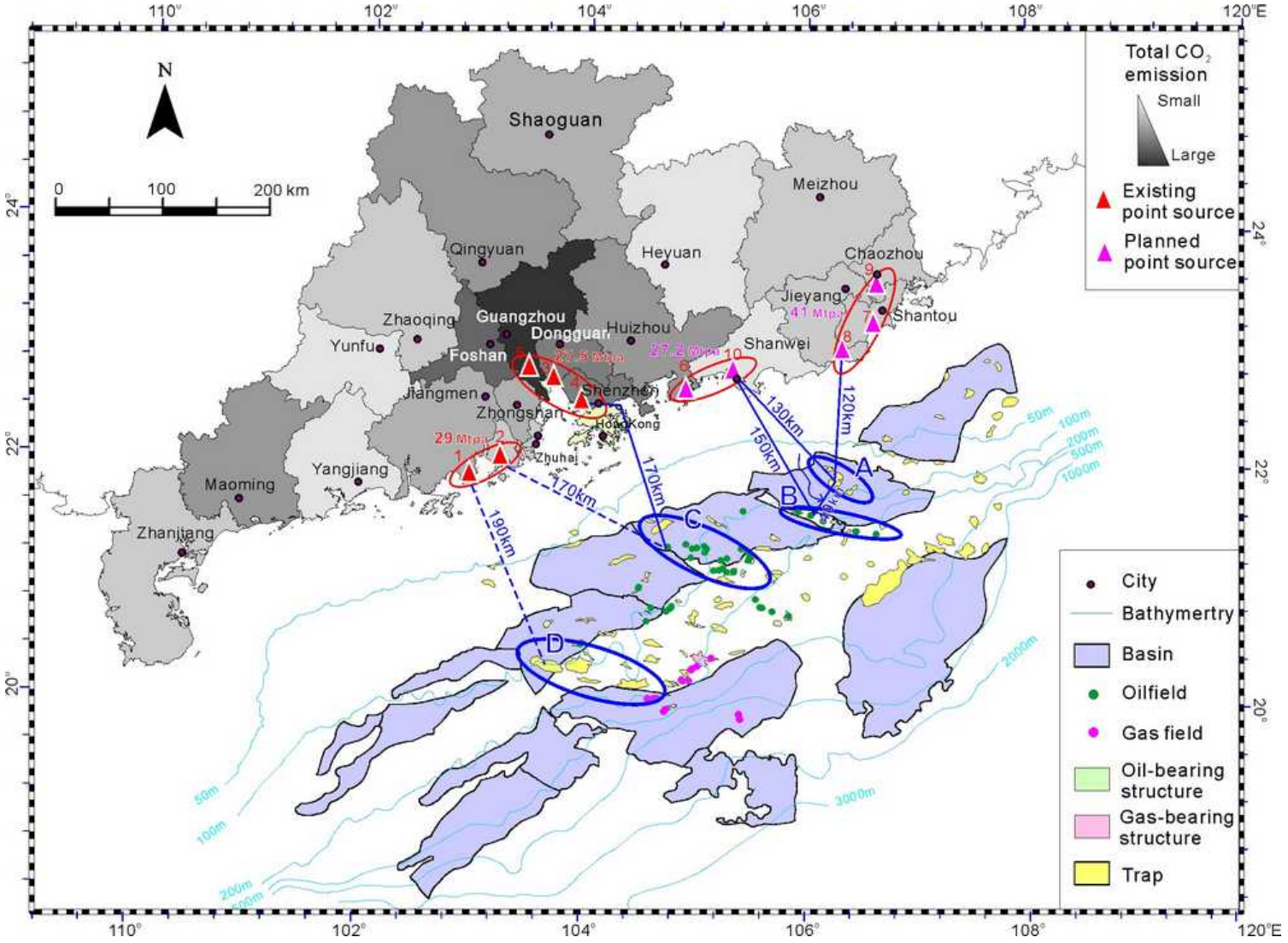
basin	PRMB	BBW	QDN	YGH
Capacity **× 10^8t**	3080	526	379	**1487.4**

The Pearl River Mouth Basin

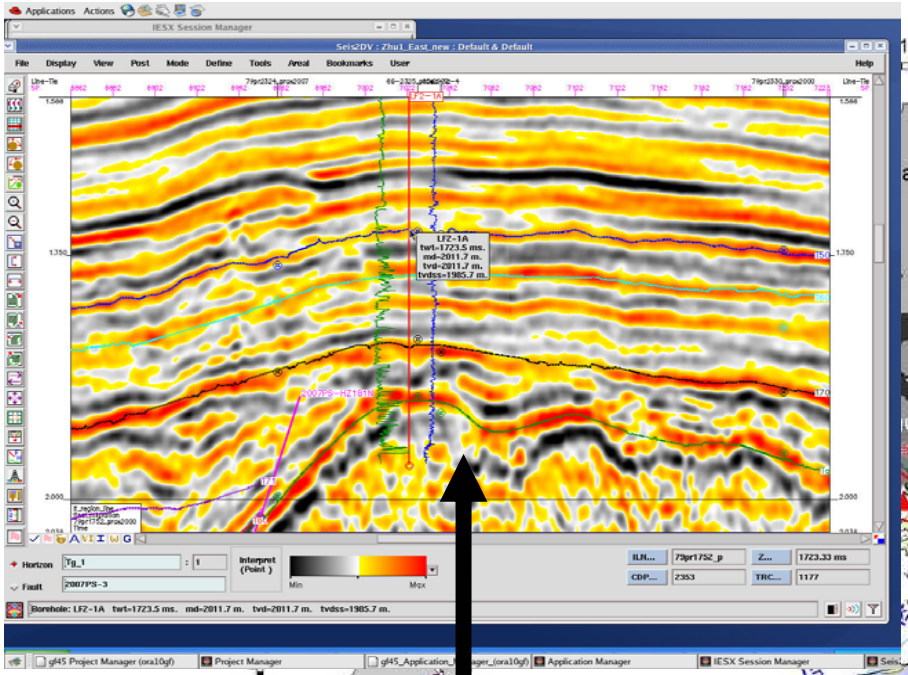


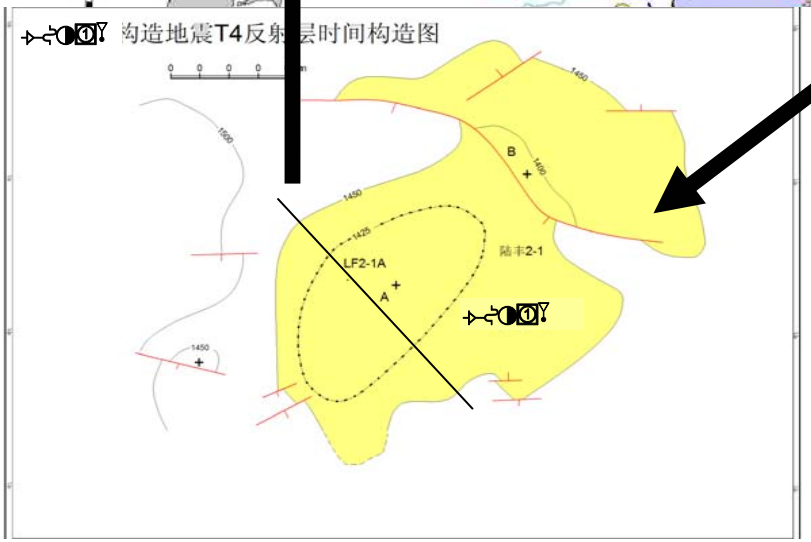
- ~200,000 km^2
- Maximum sediment thickness >14 km
- The largest basin in northern South China Sea
- Rich oil/gas reserves
- Proximal to industrialized coastal Guangdong

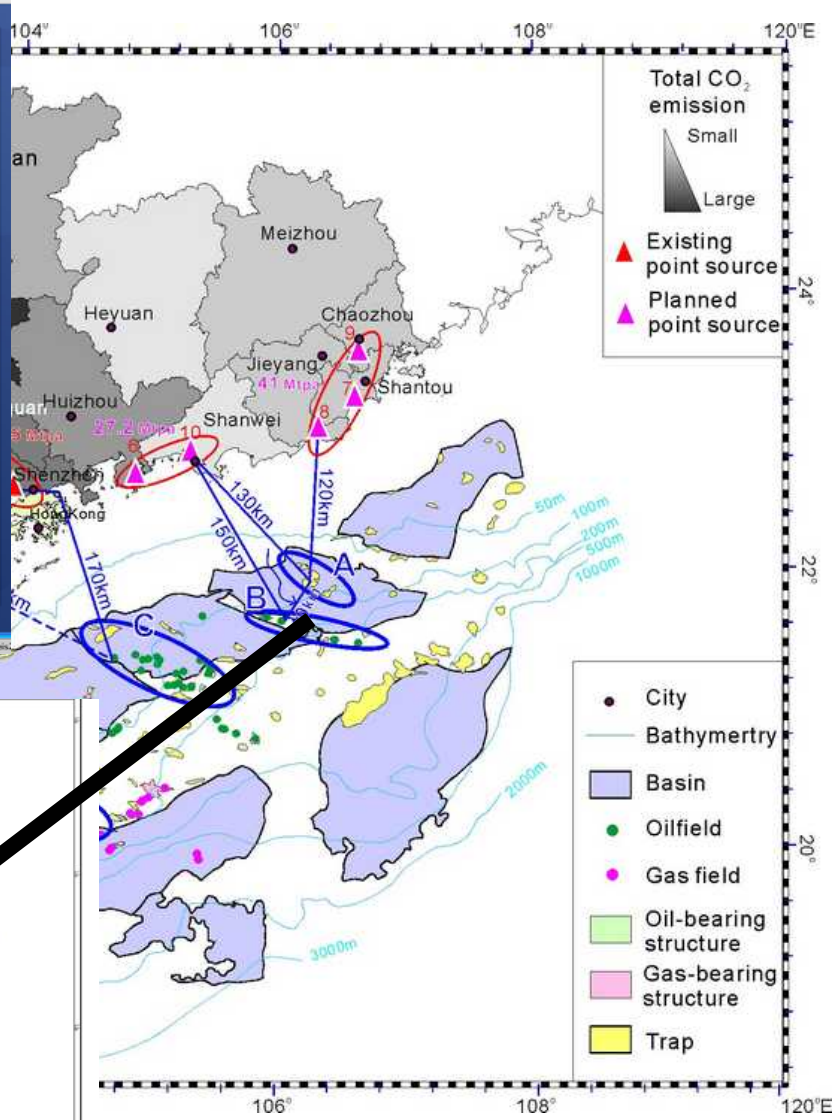
Source-Sink Matching



Case study




构造地震T4反射层时间构造图
LF2-1A
陆丰2-1
A
B


Total CO_2 emission
Small
Large
Existing point source
Planned point source
City
Bathymertry
Basin
Oilfield
Gas field
Oil-bearing structure
Gas-bearing structure
Trap
Meizhou
Heyuan
Chaozhou
Jieyang
Shantou
Huizhou
Shanwei
Shenzhen
Hong Kong
130km
120km
150km
170km
A
B
C
104°
106°
108°
120°E
24°
22°
20°

Thank you for your attention

Questions