



China basin saline aquifer study

---- aquifer characteristics in Bohai Bay Basin
(Jizhong, Huanghua and Jiyang depressions)

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- 1. What to learn from European projects**
- 2. Current situation of aquifer study in China**
- 3. Saline aquifer in Bohai Bay Basin**
- 4. Discussion**

1. What to learn from European projects



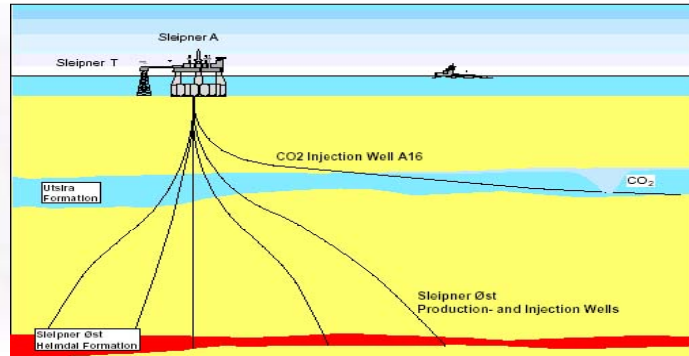
CO2STORE

Mid-Norway Sleipner Valleys
Kalundborg Schwarze Pumpe

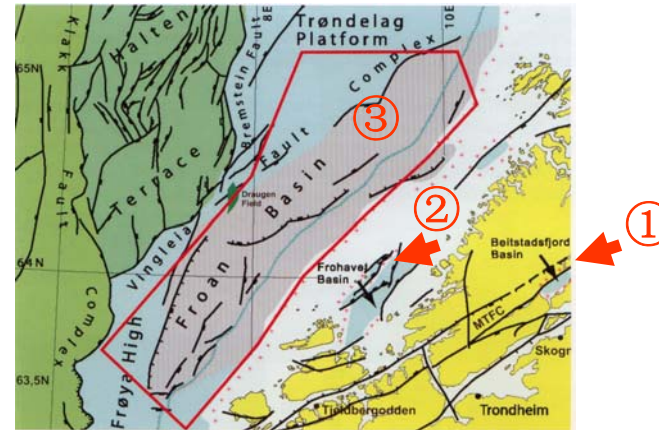
From “Best practice for the storage of CO2 in saline aquifers”, BGS 2008



SLEIPNER CO₂-STORAGE IN THE UTSIRA FORMATION



Sleipner– Utsira 200–250m, sandstone



**Kalundborg --Large anticline,
160 km², Gassum Fm Triassic
sandstone,
-1500m。**

Mid-Norway

- ① Beitstadsfjord basin,
- ② Frohavet basin
- ③ Froan Basin



**Schwarze Pumpe power plant
Schweinrich structure,
elongated anticline, 100 km²,
Triassic and Jurassic, -1500m.**



**Valleys (IGCC)
Offshore Beneath the Irish Sea,
St George's Channel Basin,
sandy aquifer of Cenozoic age**

Sedimentary basin

Anticline structure

Reservoir formation (sandstone)

2.Current situation of aquifer study in China

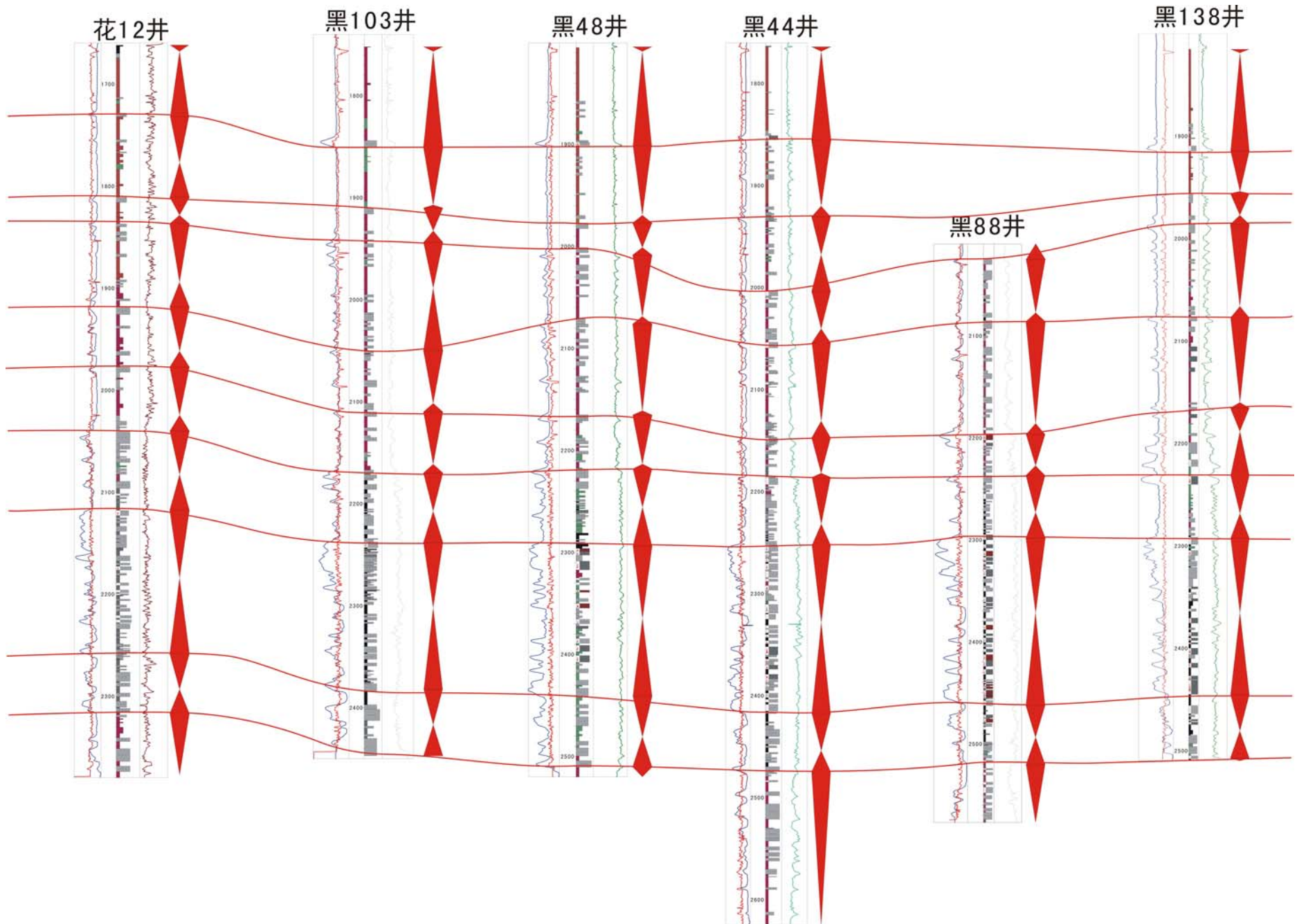
**(2.1) Making thorough investigation and
study for fresh water reservoir.**

For drinking, irrigation...

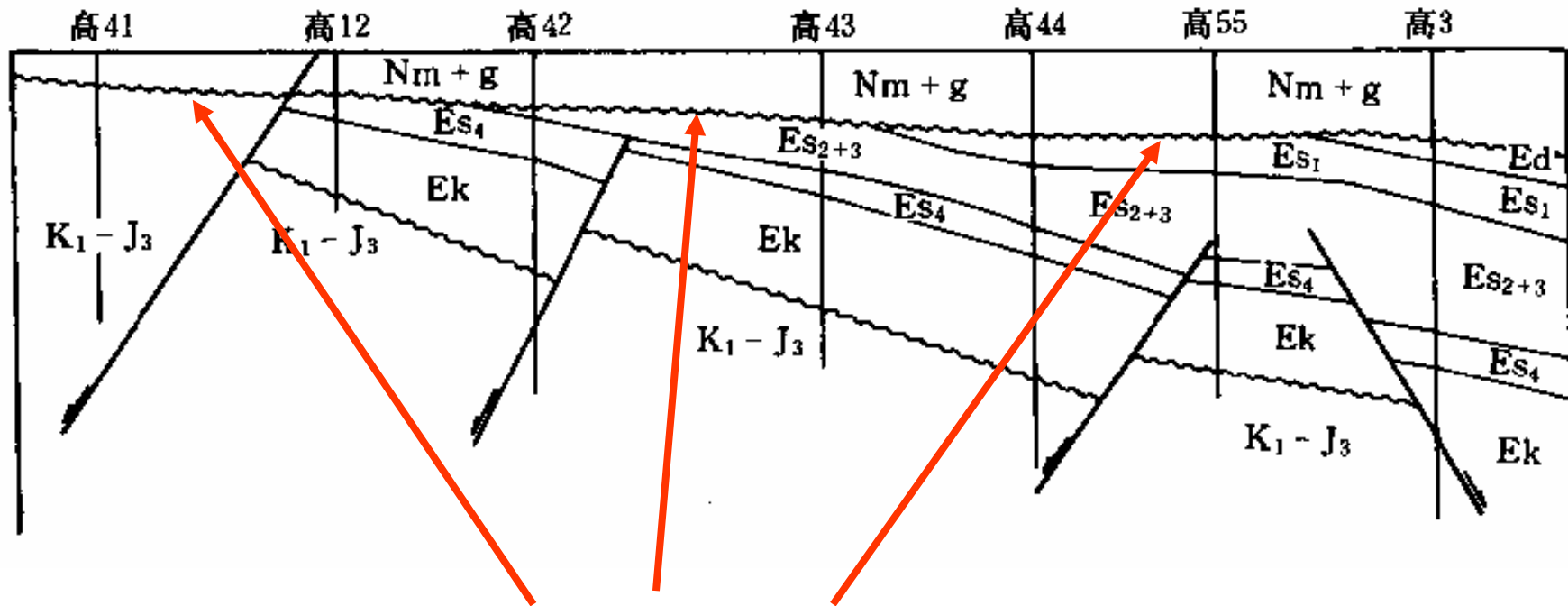
(2.2) Lack of deep aquifer information

- CO₂ geo-storage is a new task.
- For deep saline aquifers, the knowledge and data are generally much less numerous than those in depleted oil or gas fields.
- Petroleum company owns the data mainly.

Connecting-well profiles



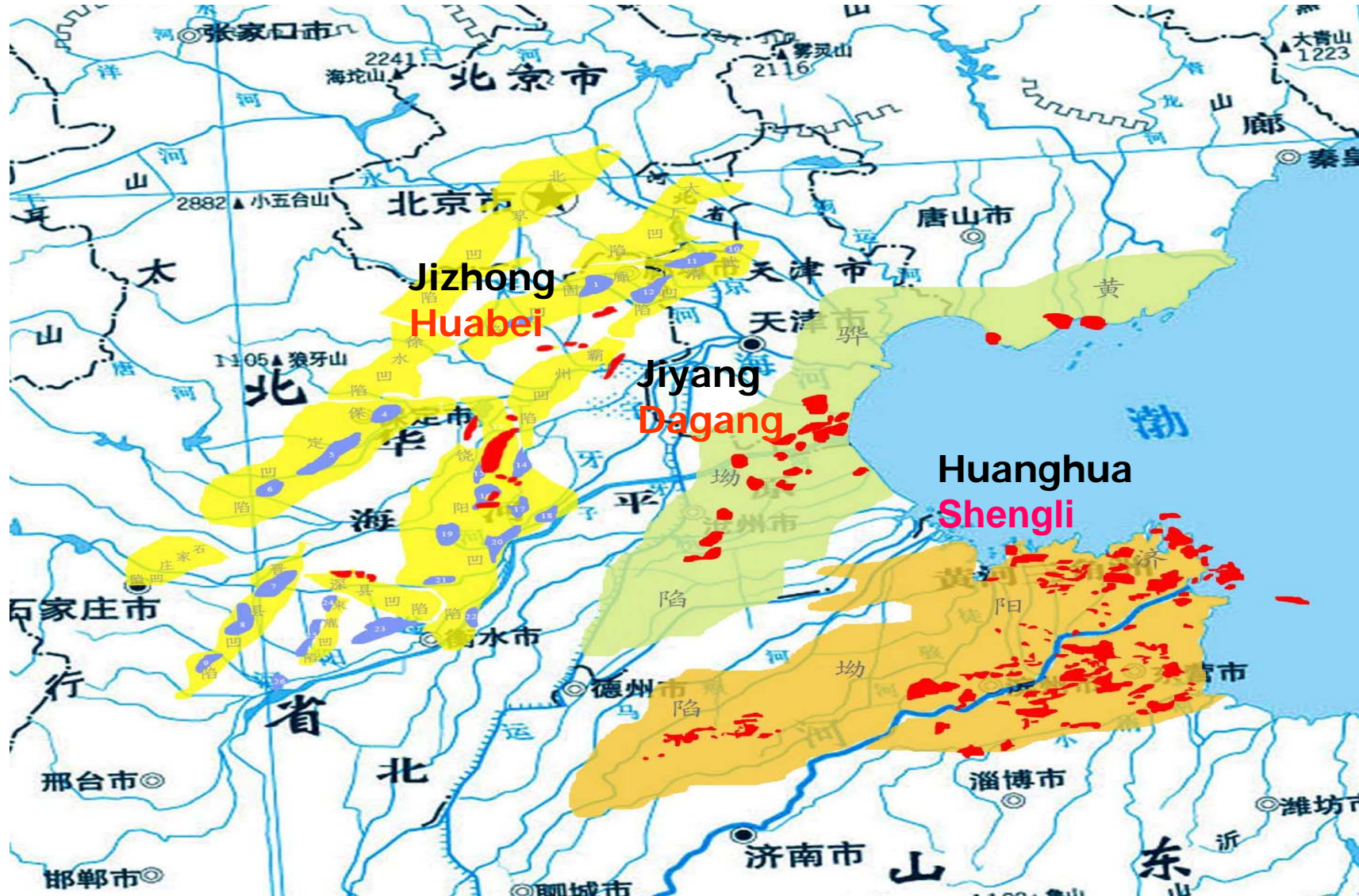
3. Saline aquifer in Bohai Bay Basin



unconformity interface

Nm-g are discordanted contact with underlying fm

Deposition trend of Guantao— Minghuazhen Fm from west to East



Mudstone: Lacustrine ---- Flood plain

3 different hydrological systems:

(3.1) Buried hill hydrological characteristics

limestone 800 ~ 6000m,

up to 7500 m in the central part.

From mid-upper Proterozoic to lower

Palaeozoic

Carbonate rocks of buried hill in the basin are widely exposed in Yanshan (north) and Taihang Mountains(west).

Elevation differences between carbonate rock and inner carbonate aquifer **up to 10,000m.**

Along the downdip direction of aqueous rocks, atmospheric water migrate to internal part of the depression, and finally form a unified water dynamic system. (open system)

(3.2) Lower Tertiary hydrological characteristics

The **bottom** is **Kongdian** group (Eocene)

The **middle** is **Shahejie** group (Oligocene)

Both have strong closed hydrological conditions.

Aquiferous rock -- sandstone, sandy gravel and pebble layer.

Depth-- from over 3500m (Kongdian) to 2500-3500m (Shahejie)

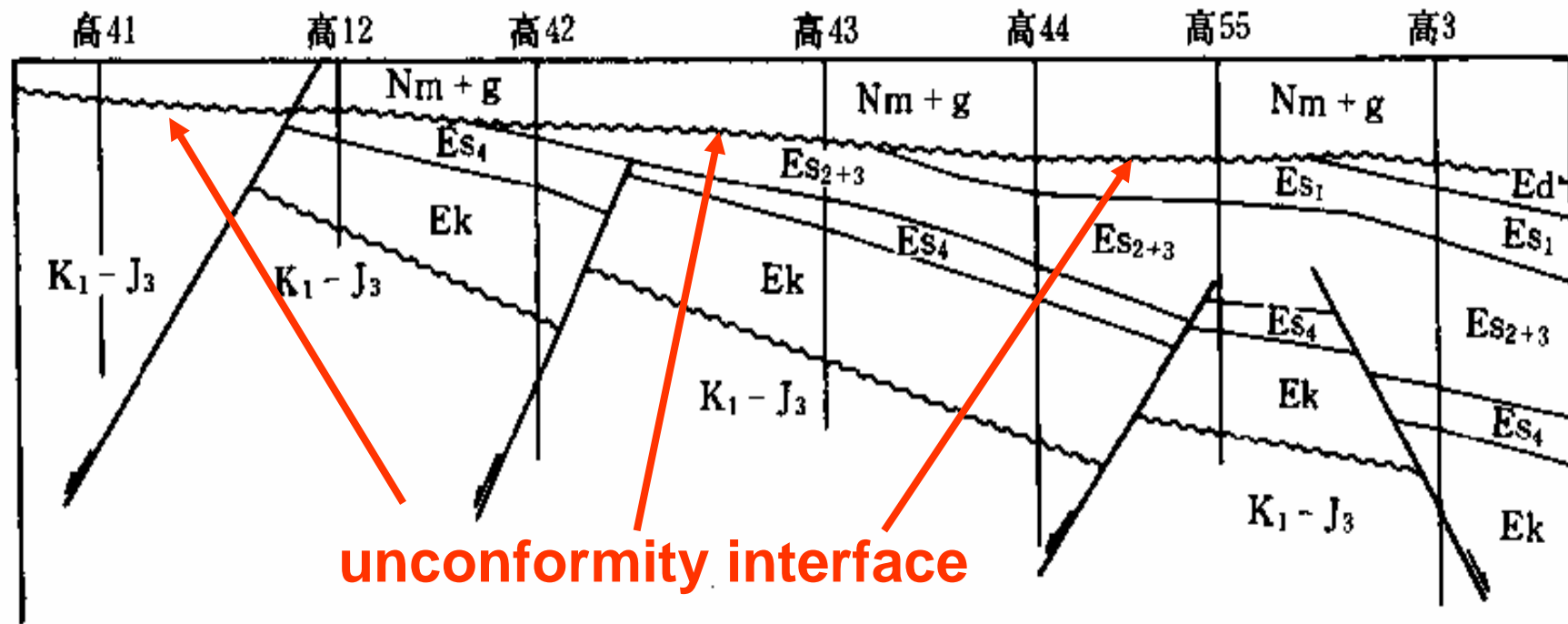
Upper is **Dongying** group (Oligocene)

Mainly rivers, marshes facies.

500-1100 m sandstone widely developed.

(3.3) The upper Tertiary hydrological characteristics

It is fluvial facies sediments, which is thin in the South (1700-1800 meters) and thick in the north (2200-2500 meters). Covered on top of all the old strata, the upper Tertiary make the Jizhong depression a unified deposition Depression except the thin uplift.



The **top is Minghuazhen** Group (Pliocene)

The **bottom is Guantao** group (Miocene)

① **Guantao group**

red sandstones and mudstones formed at the beginning of late Tertiary.

typical fluvial sediments at the bottom is unconformity contacted with the Tertiary regionally.

Have good regional stability and continuity. Bottom depth is 1100-3000 m, Water-bearing property in the lower section is the best.

Ground water type is

Cl • HCO₃--Na or **HCO₃• Cl—Na**,

salinity 1000-3600 mg / L,

Na / Cl ratio is 1.3 -- 2.5.

As the depth increased, the water salinity and degenerative levels show increasing trend.

② Minghuazhen Group

Sandy mudstone: fine grain at bottom, coarse on top.

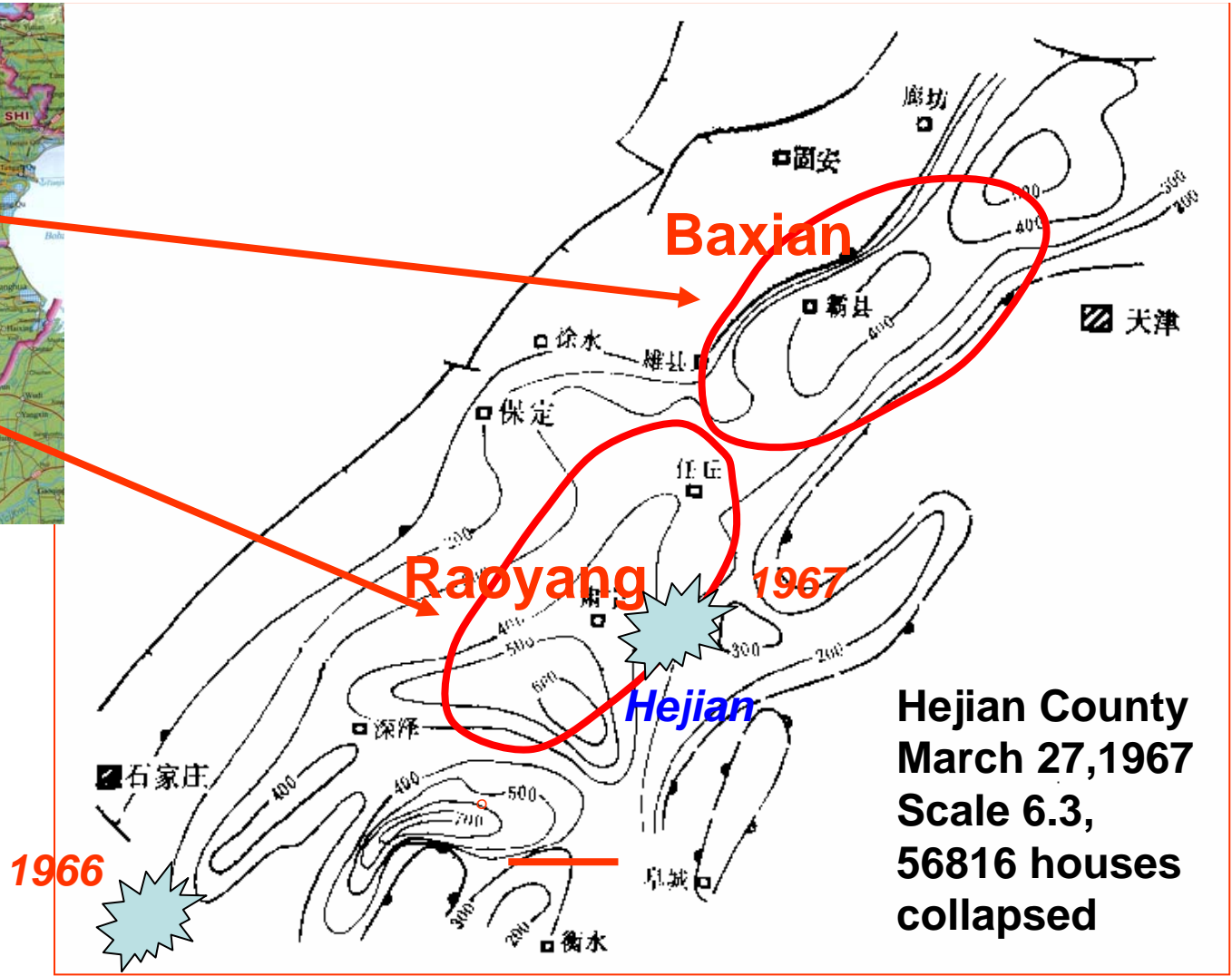
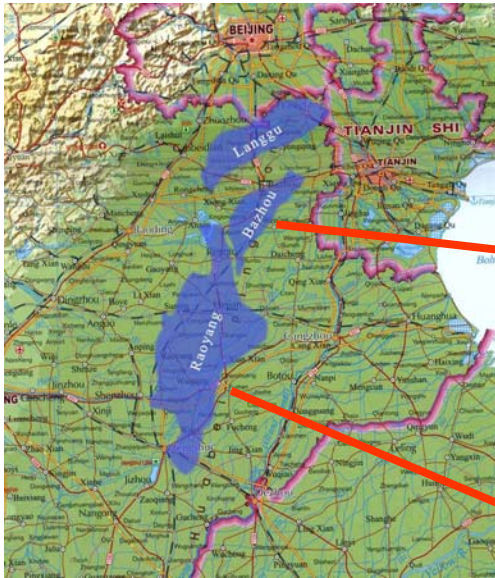
Aquifer rocks are spread in the whole depression .

The top burial depth is 200-400 m and bottom burial depth is 1,200-1,600 m.

Thick layer of mudstone developed in Minghuazhen group. Its closure function makes it a good sealing to trap CO₂ in Guantao formation.

(3.4) Reason to select Guantao Fm

- ① alluvial plain, stable horizon**
- ② depth 1000~2000m,**
- ③ location far from sediment source
(Yanshan and Taihang Mountain)**
- ④ Oil-bearing reservoir, Stratigraphic trapping,**
- ⑤ Good caprock -- Minghuazhen Fm**

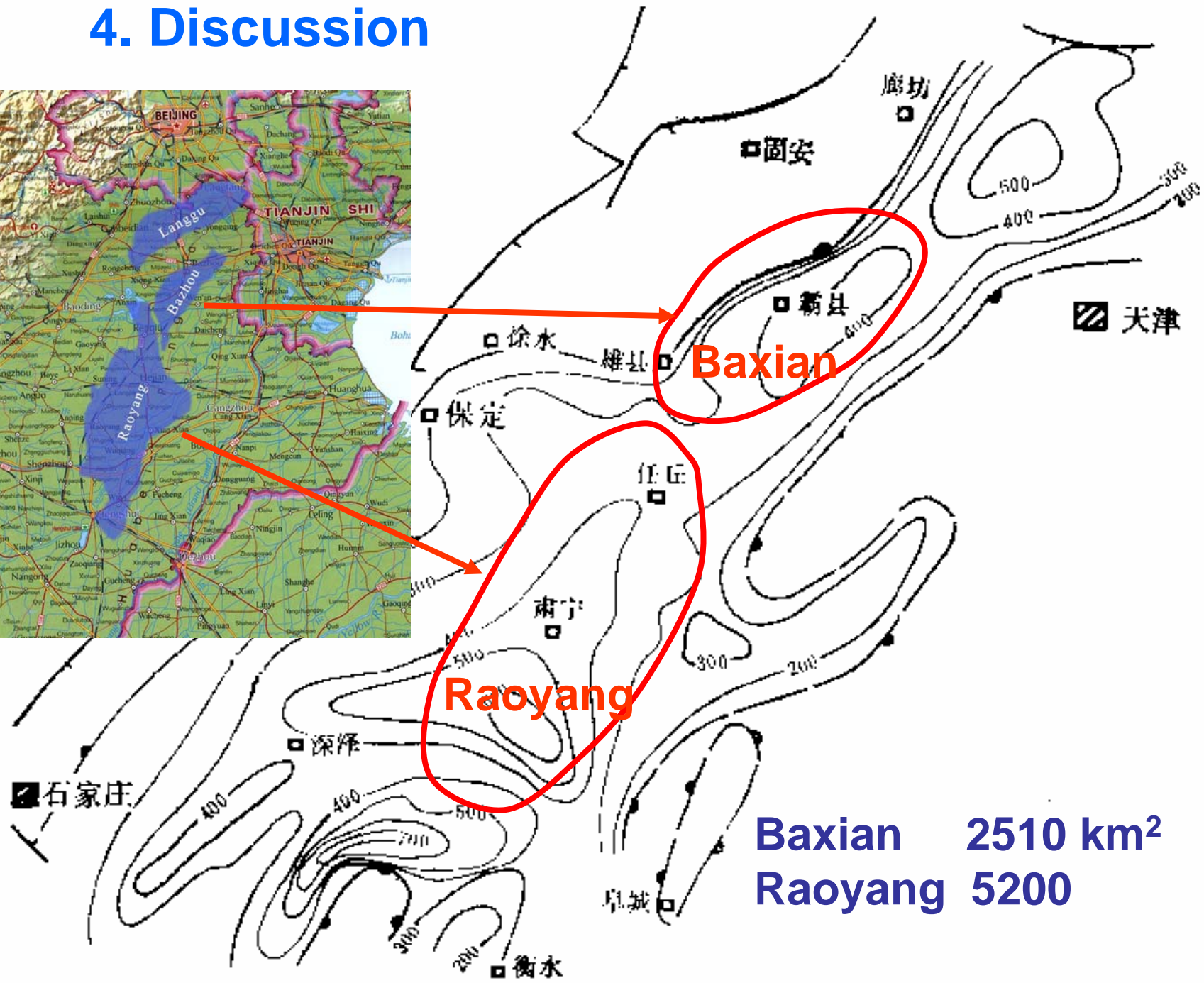
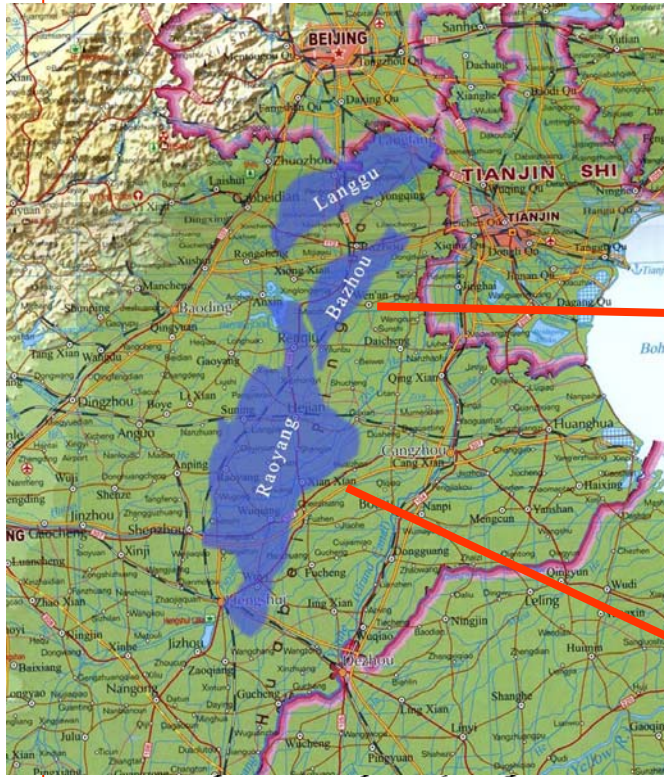


Hejian County
March 27, 1967
Scale 6.3,
56816 houses
collapsed

Xingtai City,
March 3~29, 1966
Scale 6~7 Max. 7.2
(March, 22)
8182 died,
51395 injured
more than 4 Million
houses collapsed

(3.5) Disadvantageous factor is earthquake

4. Discussion

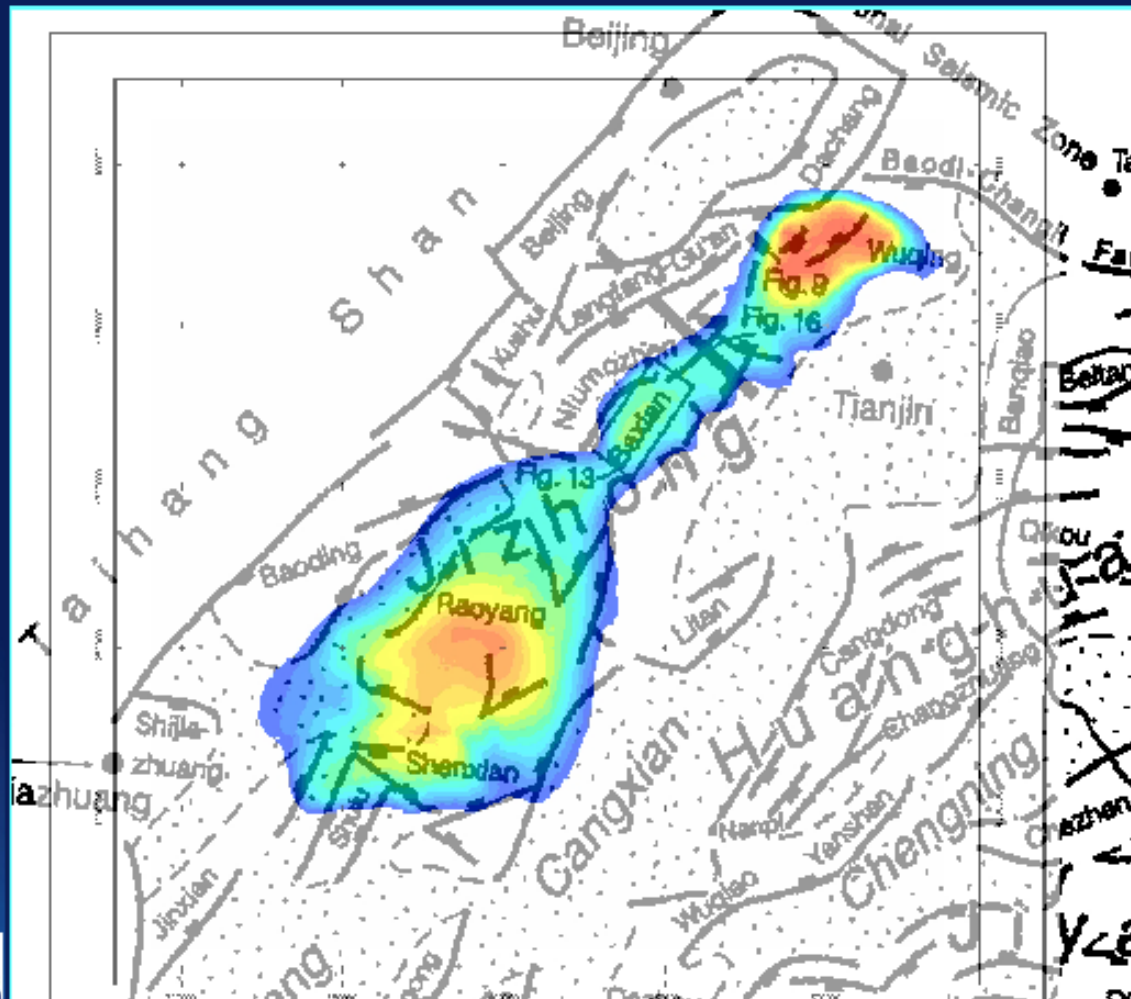


Baxian 2510 km²
Raoyang 5200

Site selection criteria

- (1) Storage optimization:
capacity, injectivity
- (2) Risk minimization
- (3) Respect of regulation and environmental
constraints
- (4) Consideration of social and economic
aspects

Depth constraints: top Guantao >850m – Structural map (GIS)



NZEC-Coach- GeoCapacity workshop, February 11st – 12th, 2009 – Nottingham

**Depth constraints: top Guantao >850m
Structural map (GIS)**

**Total estimated CO2 storage capacity
in deep saline aquifers (open / single
Horizon) 747 (Mt)**

**in deep saline aquifers (closed / Guantao)
371 (Mt)**

Many thanks!