A world map is visible in the background, rendered in a lighter shade of blue than the main background. The map shows the continents and oceans, with a focus on the Yellow River Delta region in East Asia.

Introduction to the Yellow River Delta: origin, evolution, challenge and endeavor

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CGS

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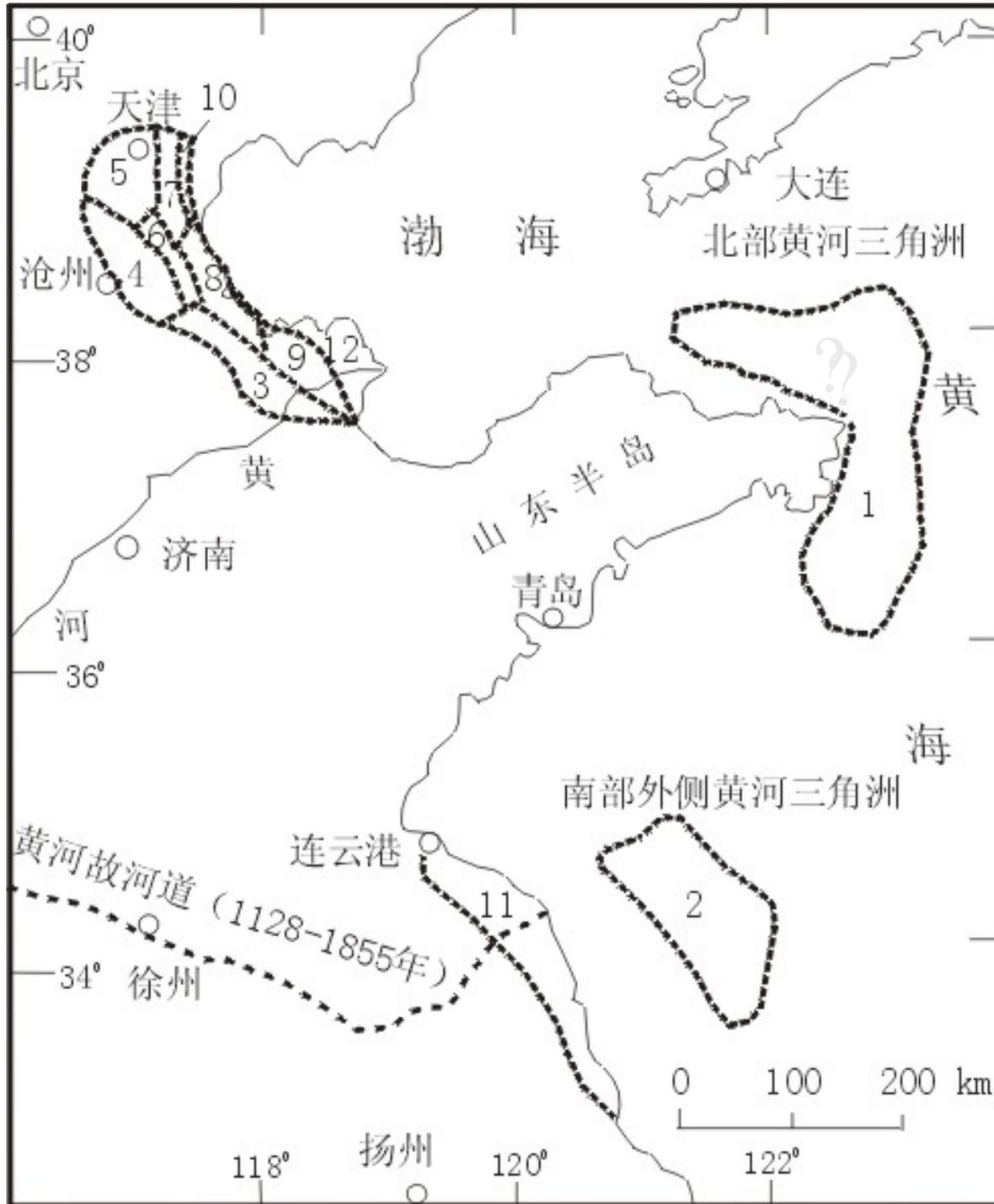
Location & characteristic of Yellow River Delta

- Newly created wetland
- Second largest oil field
- National natural reserve
- Agriculture base
- Dynamic estuary



Origin

Yellow River delta since the end of Late Pleistocene (Xue, 2001)



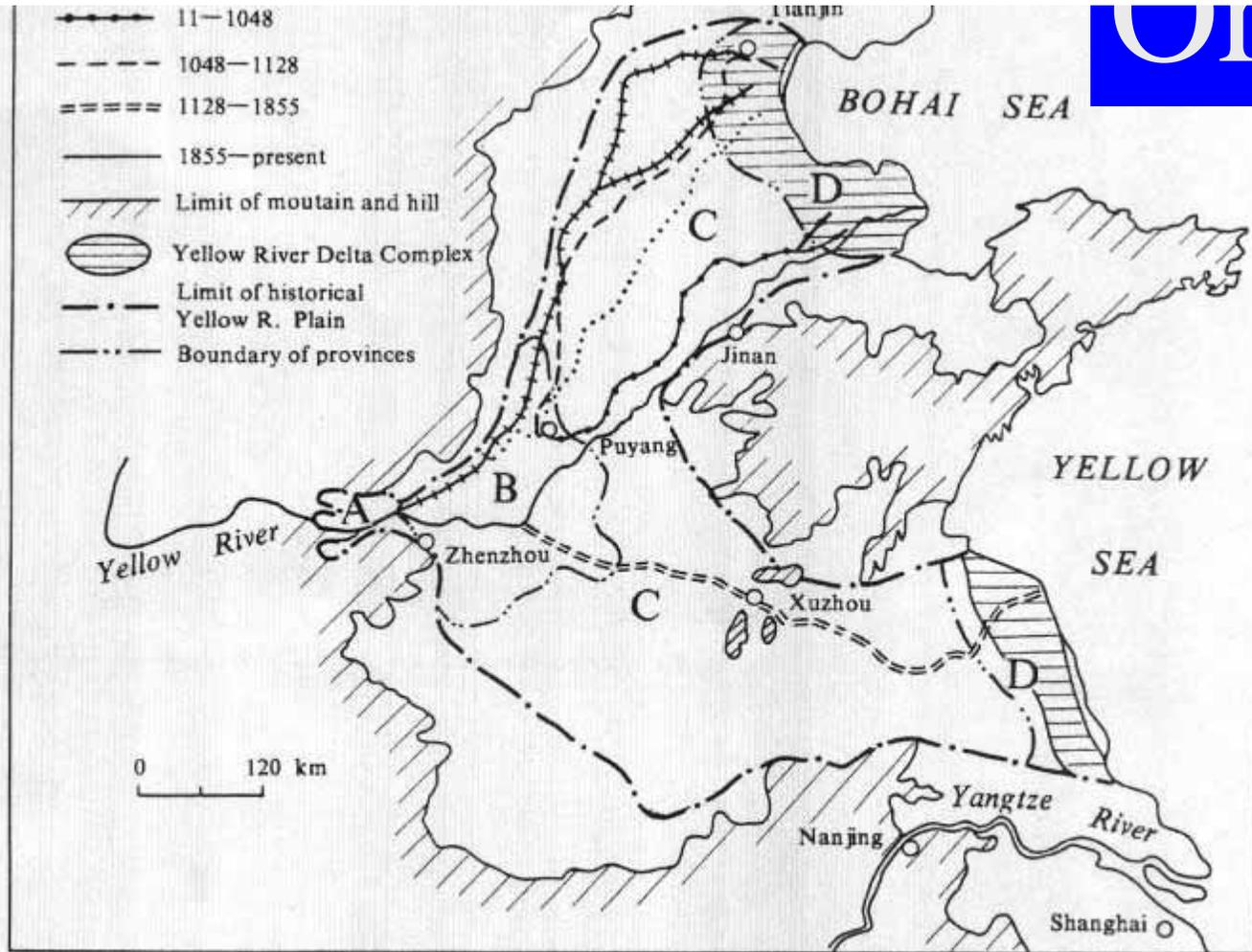


Fig. 1. Simplified map showing shifts in the lower Yellow River (simplified after Zhou Yilin et al., 1982) and geomorphological and sedimentary provinces of the floodplain of the lower Yellow River. (A) Alluvial fan; (B) western plain; (C) middle plain; and (D) eastern plain (coastal deltas).

Shifting of Yellow River lower channel(Xue,2001)

Origin

Delta superlobes of the Yellow River (Xue, 1993)

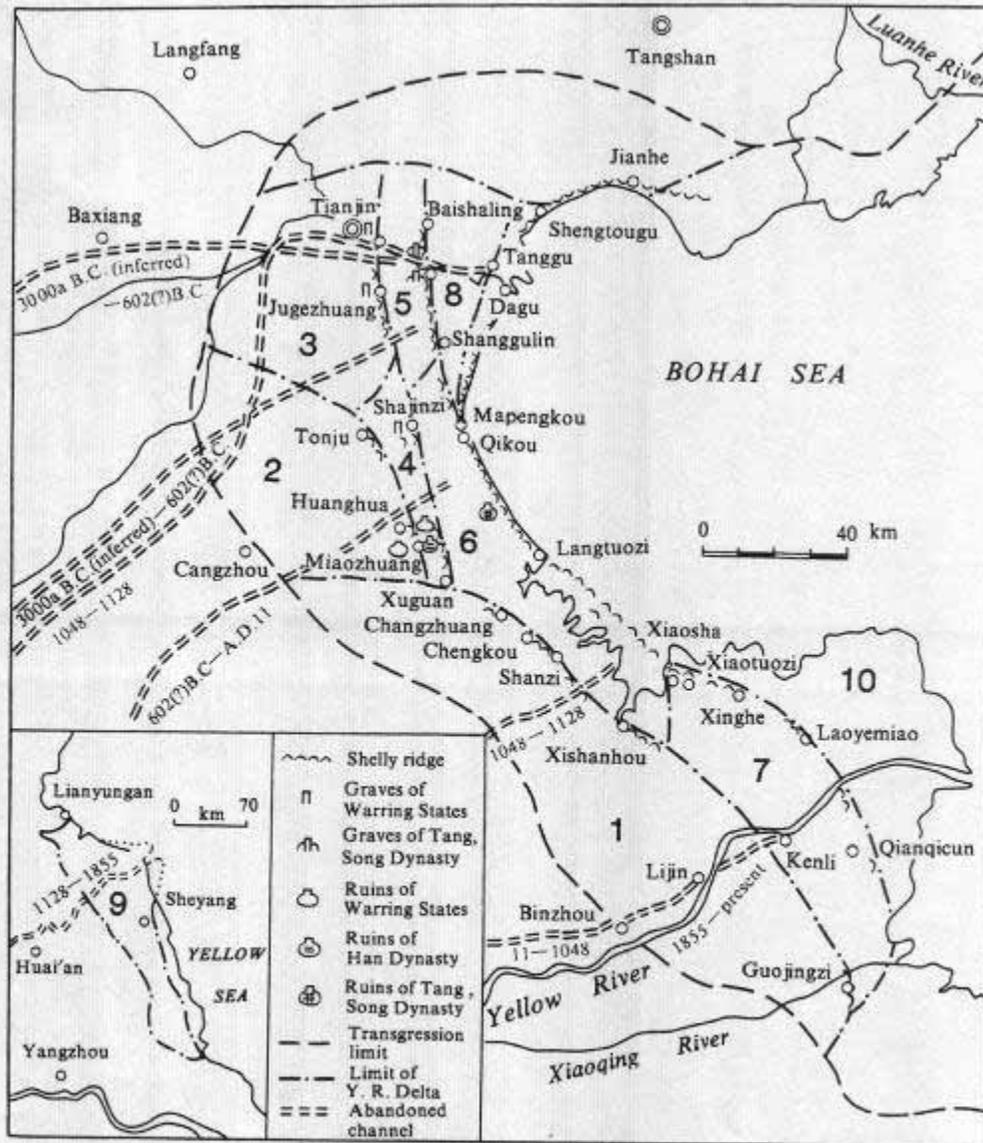


Fig. 2. Yellow River delta complex and shelly ridges in the western coastal lowlands of the Bohai Sea. The complex is composed of the following delta superlobes: (1) Lijin superlobe, inferred age 6000–5000 years B.P.; (2) Huanghua superlobe, inferred age 5000–4500 years B.P.; (3) Jugezhuang superlobe, inferred age 4500–3400 years B.P.; (4) Shajinzi superlobe, inferred age 3400–3000 years B.P.; (5) Nigu superlobe, 3000 (inferred)–602(?) years B.C.; (6) Qikou superlobe, 602(?) B.C.–A.D. 11; (7) Kenli superlobe, A.D. 11–1048; (8) Tangu superlobe, A.D. 1048–1128; (9) North Jiangsu superlobe, A.D. 1128–1855; and (10) modern superlobe, A.D. 1855–present. Ages in legend are: Warring States, 475 B.C.–221 B.C.; Han Dynasty, 206 B.C.–A.D. 220; Tang Dynasty, A.D. 618–907; Song Dynasty, A.D. 960–1279 (modified after Xue and Cheng, 1989).

Origin

Composition
of the
Yellow
River delta
(Xue, 1993)

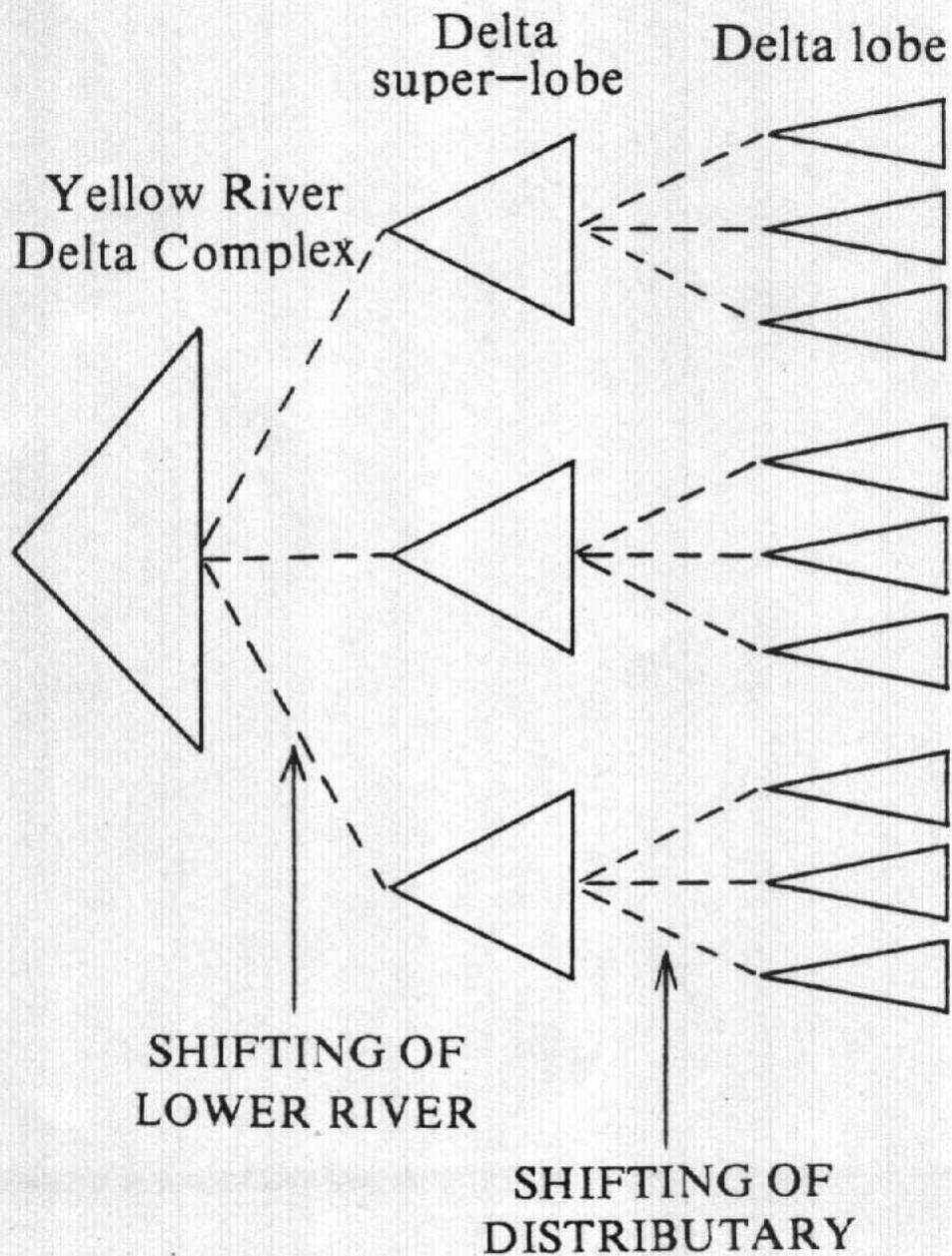
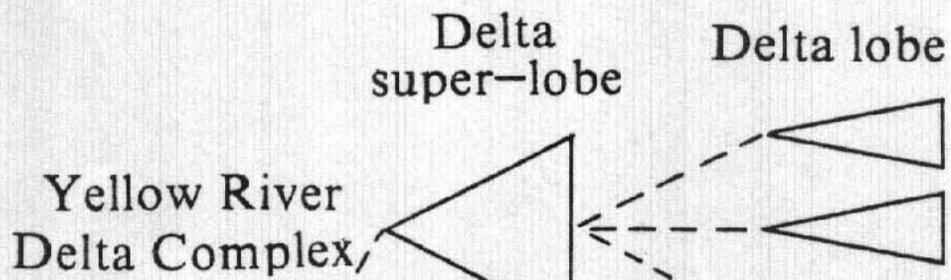
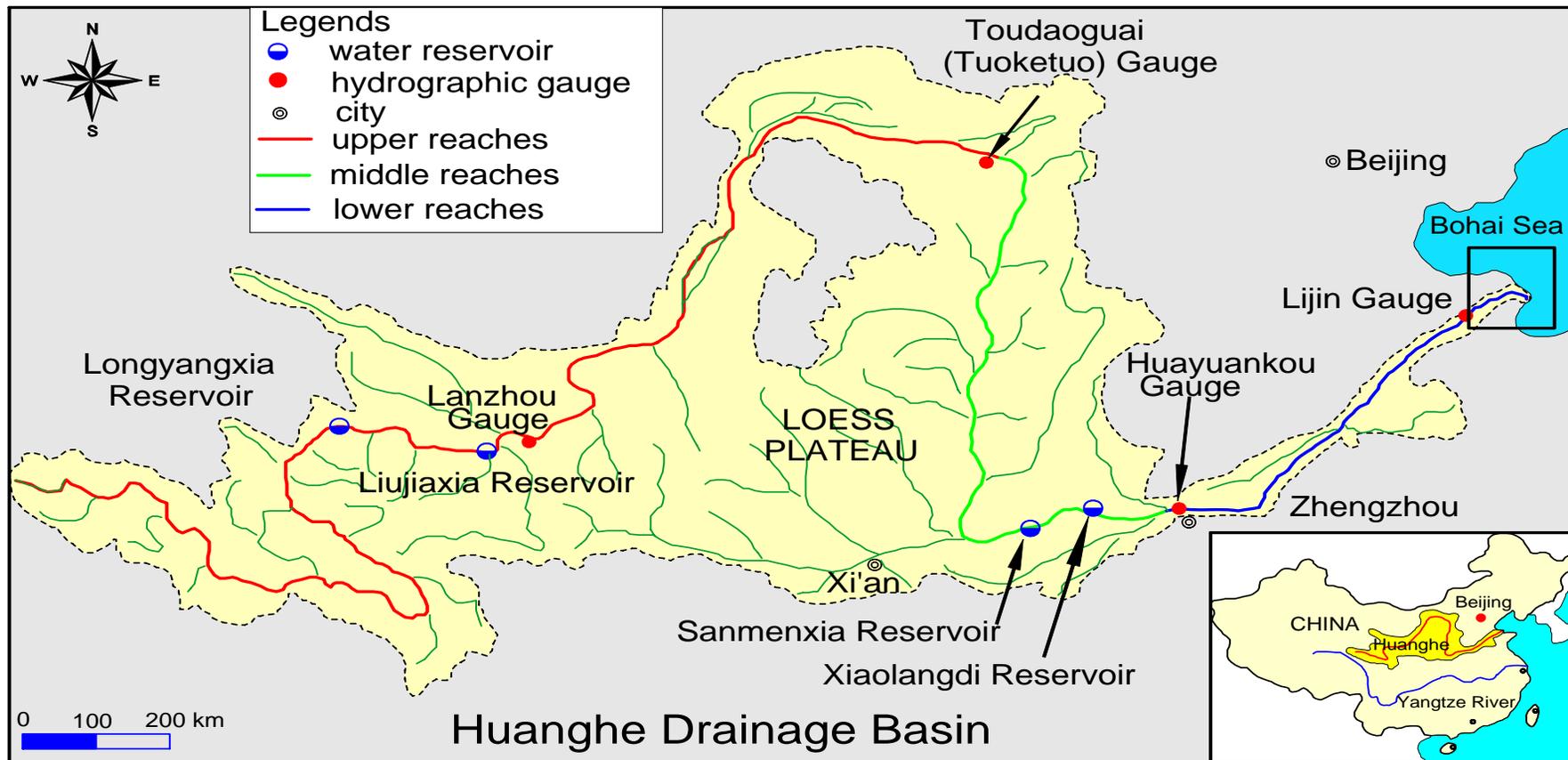


Fig. 3. Schematic diagram of the composition of the Yellow River delta complex.



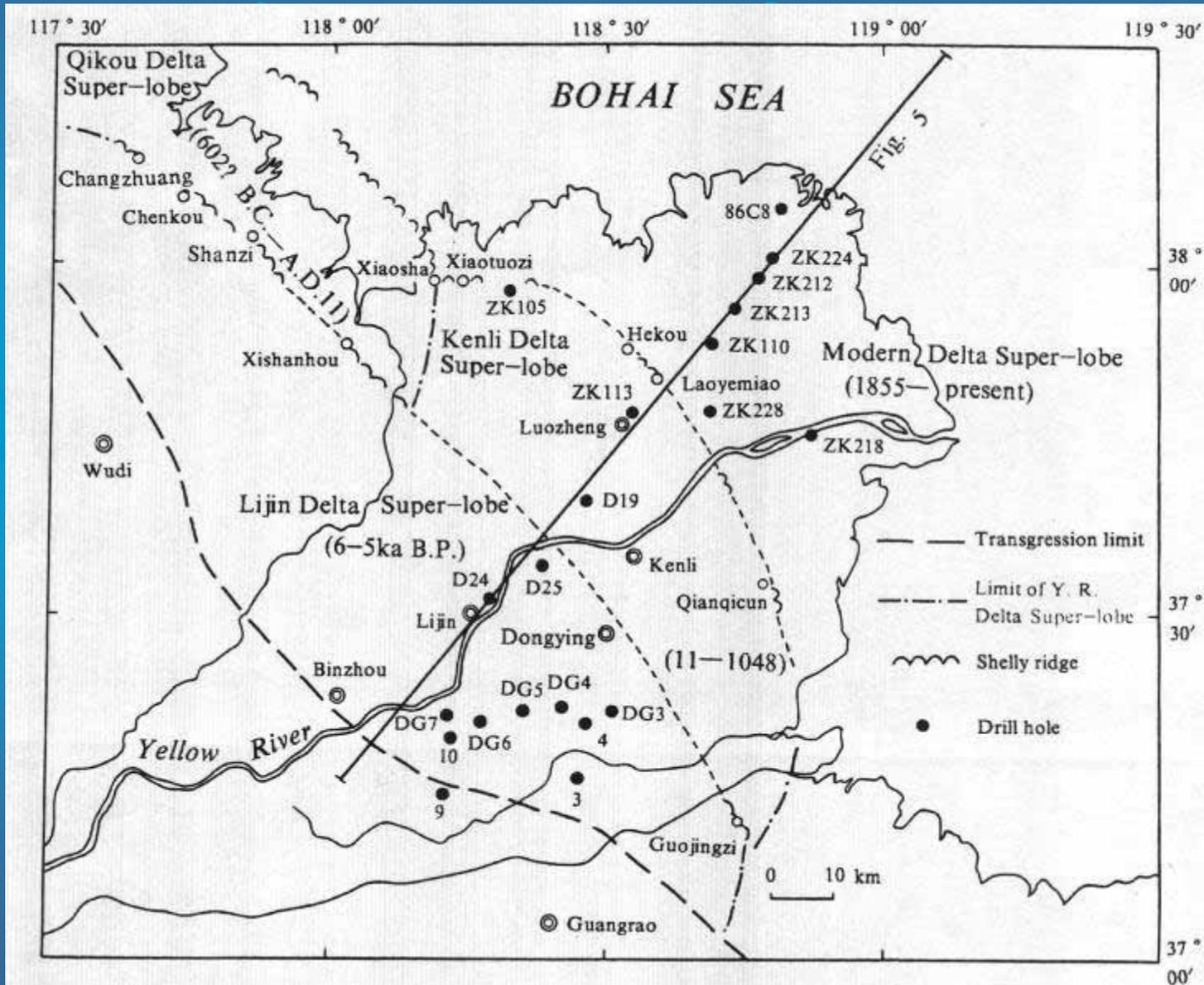
Origin



DISTRIBUTION

Fig. 3. Schematic diagram of the composition of the Yellow River delta complex.

Origin



Some superlobes and drilling hole

Origin

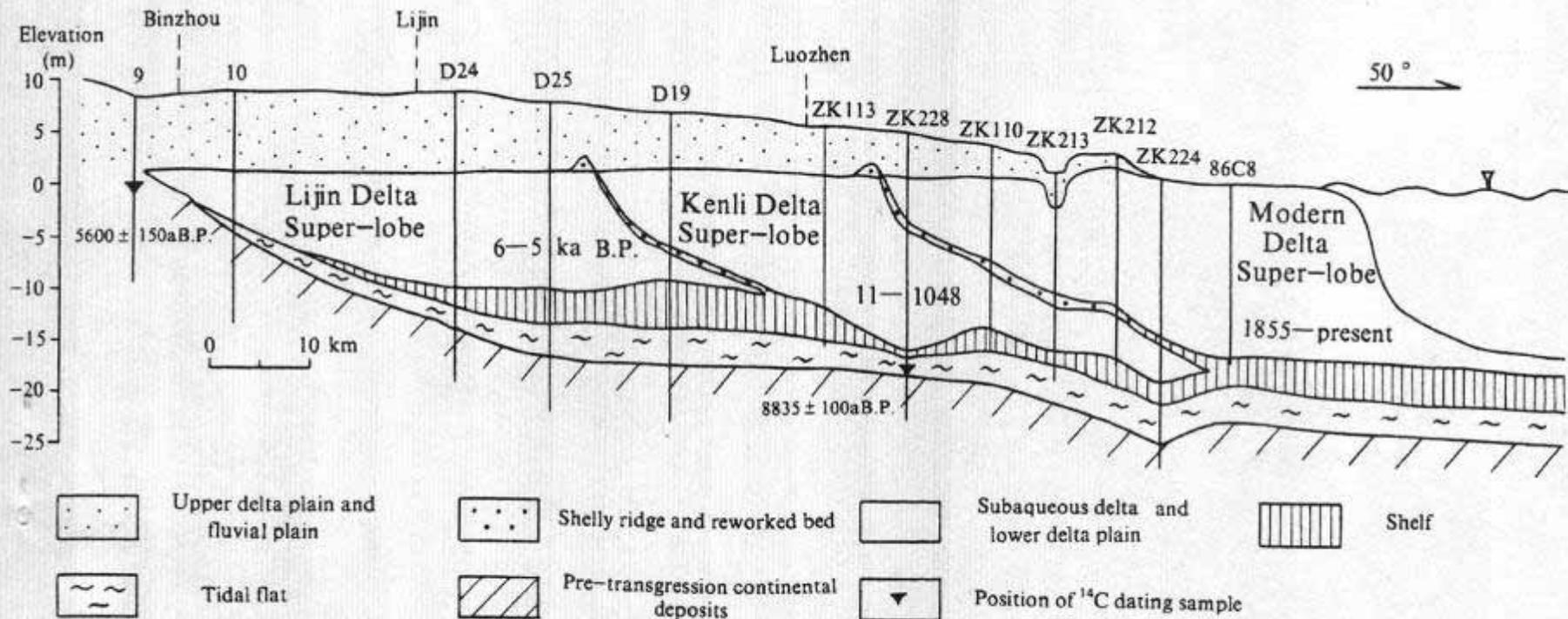
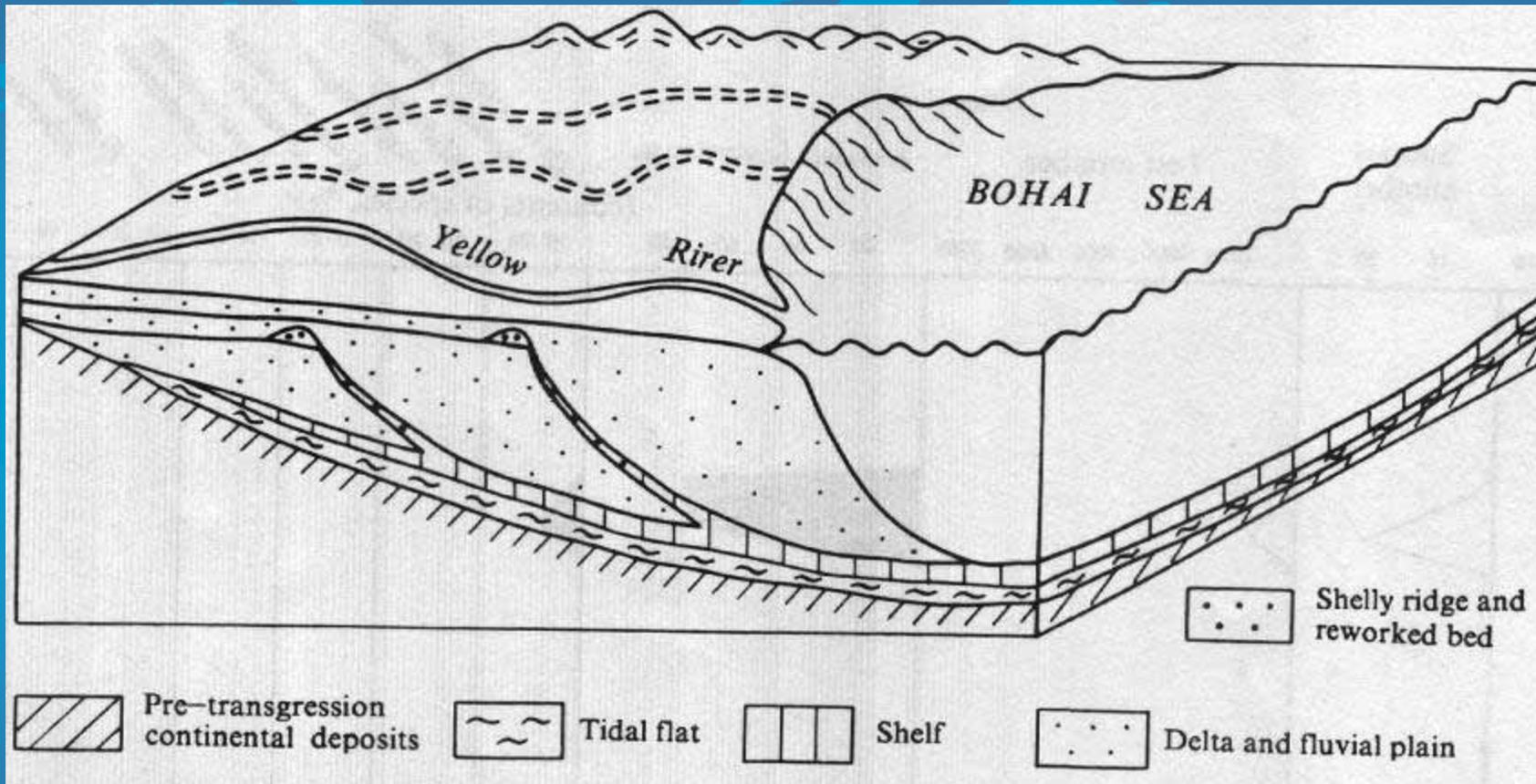


Fig. 5. Cross-section through three imbricated delta superlobes of the Yellow River delta complex: Lijin delta superlobe, Kenli delta superlobe and the modern delta superlobe. For location of this section, see Fig. 4.

Cross section showing imbricating between delta superlobes.
(Xue, 1993)

Origin

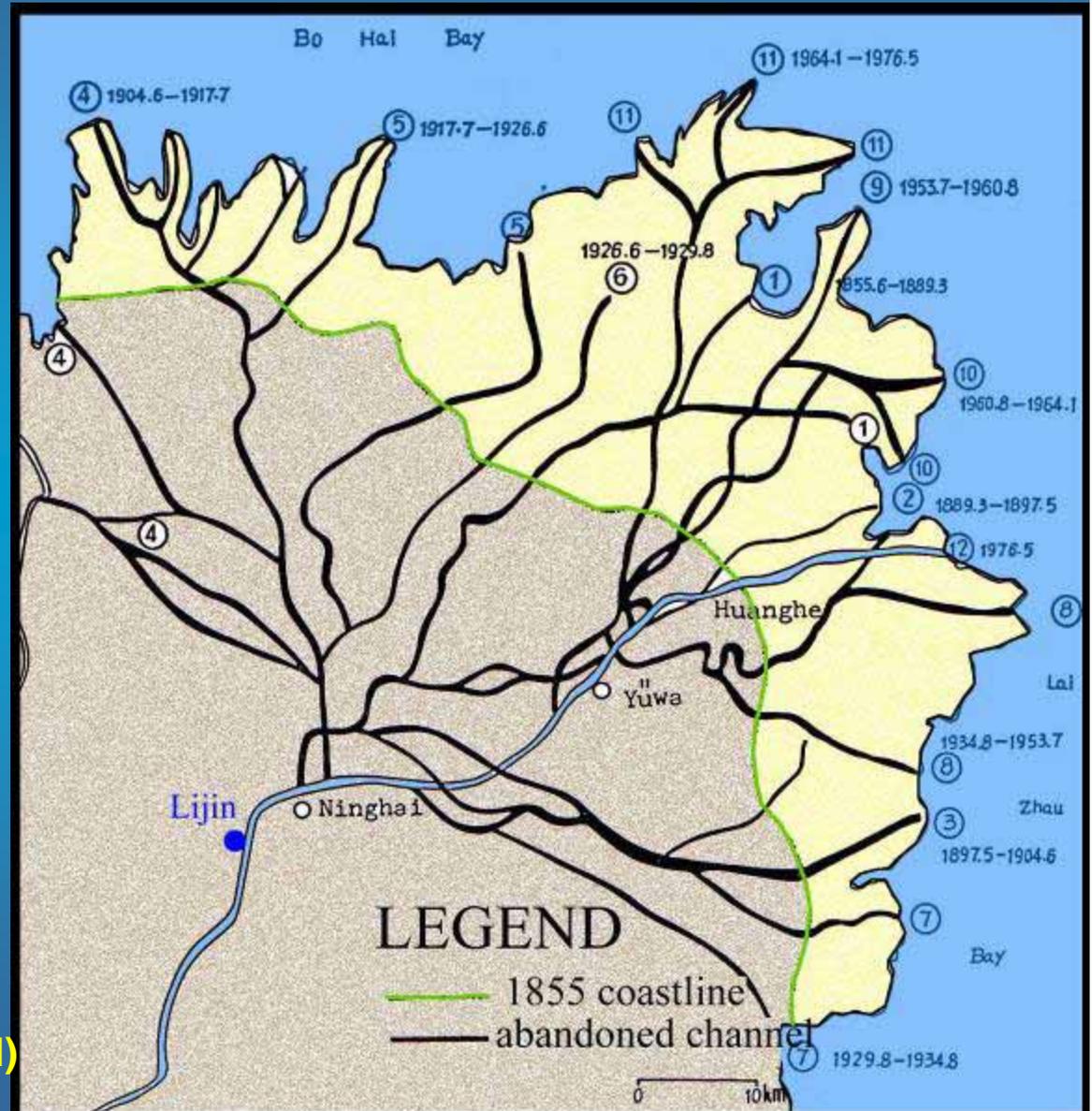


A block diagram showing relationship of Holocene sedimentary environments. (Xue et al,1993)

Evolution

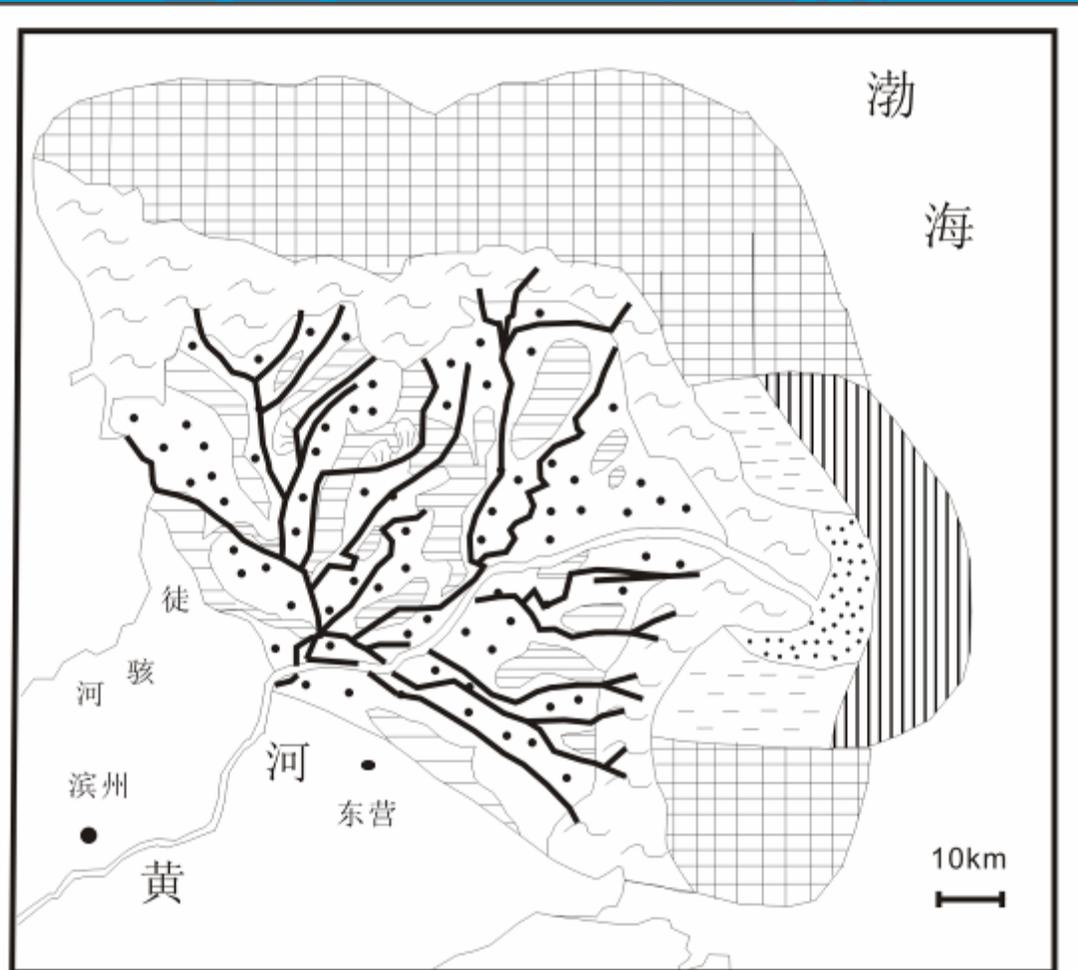
Abandoned channels on the modern Yellow River Delta (1855-present)

1. 1855-1889 (natural flood)
2. 1889-1897 (ice flood)
3. 1897-1904 (natural flood)
4. 1904-1917 (natural flood)
5. 1917-1926 (natural flood)
6. 1926-1929 (natural flood)
7. 1929-1934 (artificial channel)
8. 1934-1953 (artificial channel)
9. 1953-1960 (artificial channel)
10. 1960-1964 (artificial channel)
11. 1964-1976 (ice flood artificial channel)
12. 1976- present (artificial channel)



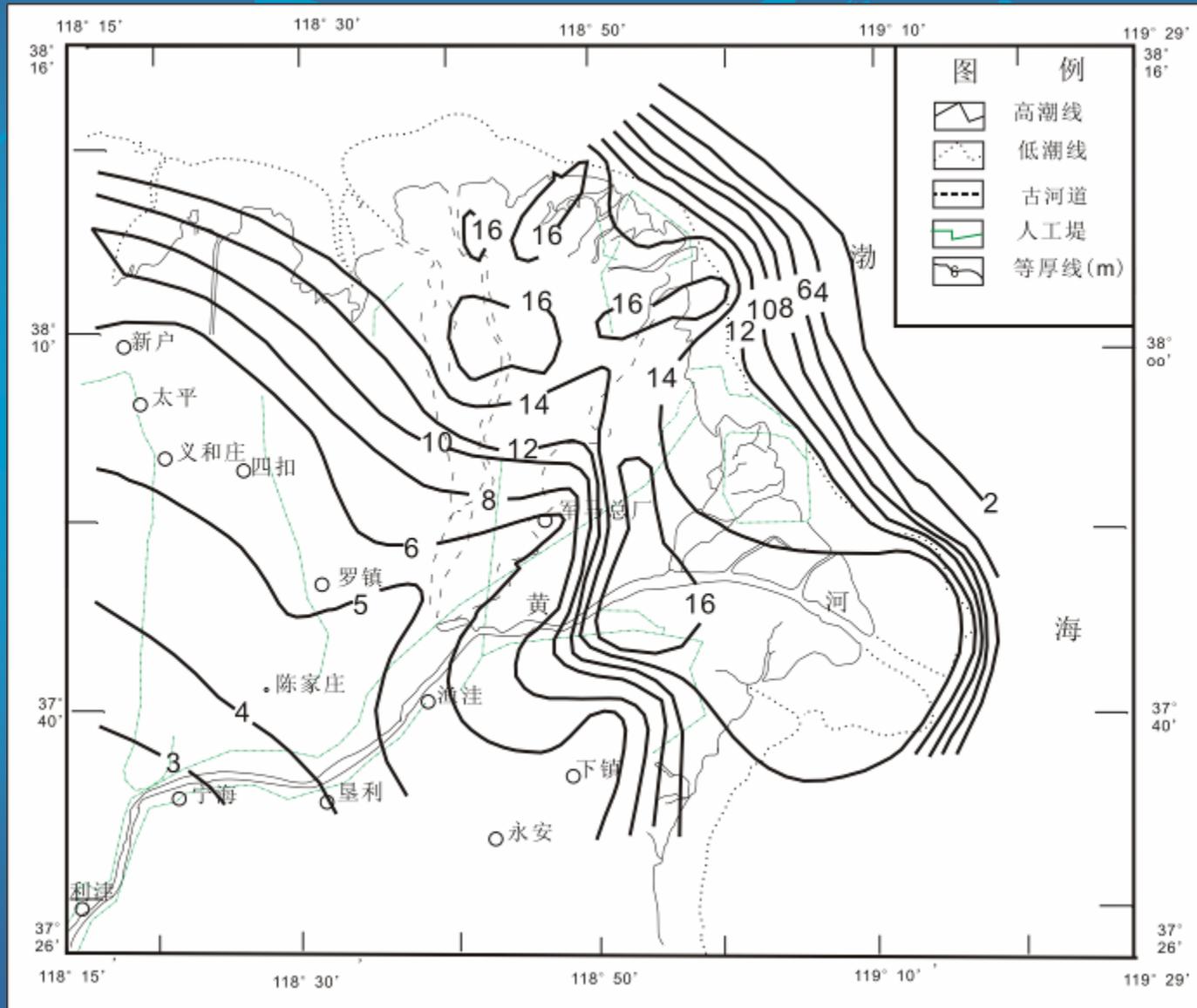
Evolution

River shifts and depositional pattern



- 1 Distributary channel
- 2 Crevassed fan
- 3 Flood plain
- 4 Distributary & crevassed fan
- 5 Low delta plain
- 6 Delta front
- 7 Distributary bay
- 8 Prodelta
- 9 Subaqueous delta of abandoned lobes

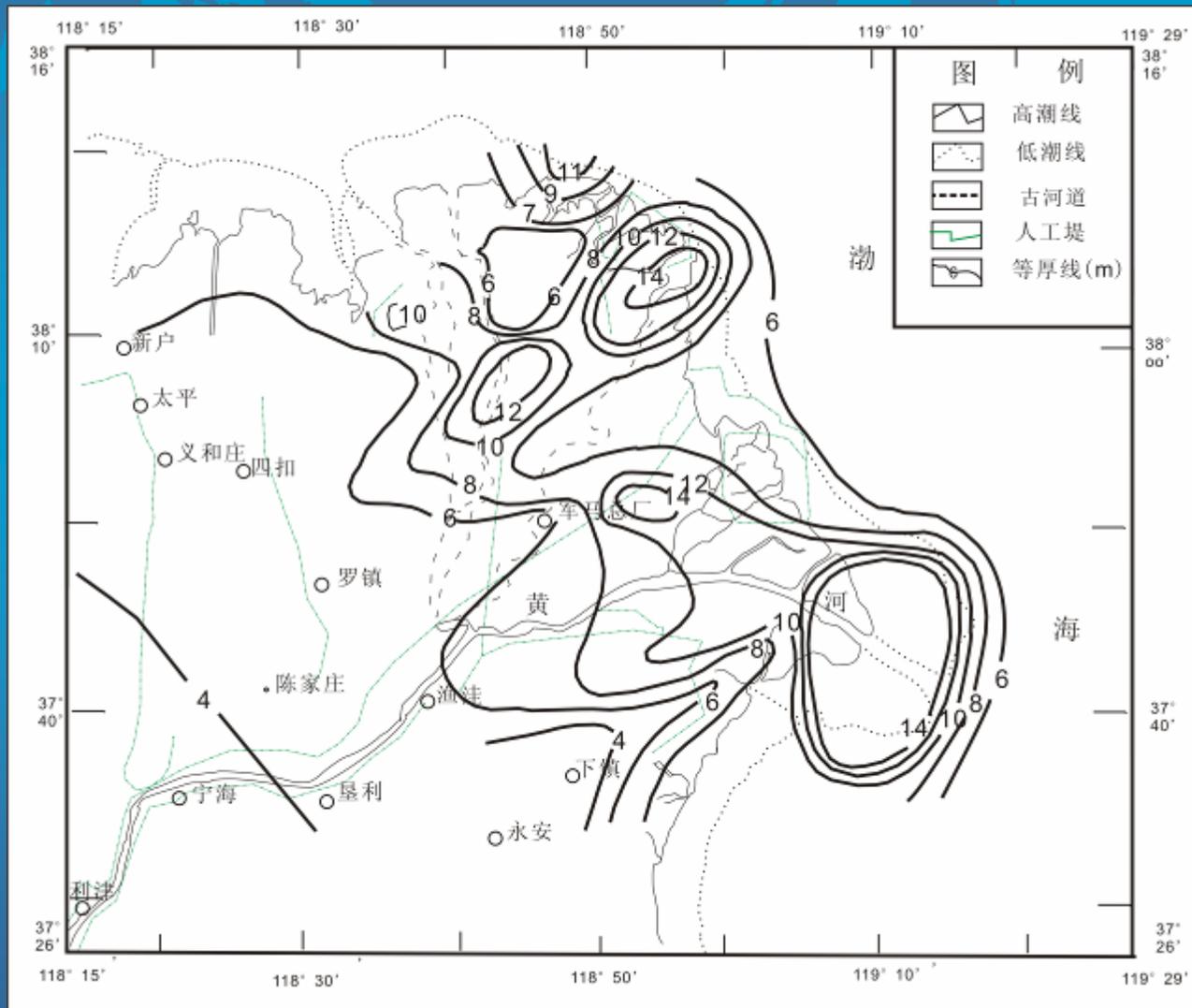
Evolution



Deposition
thickness of the
modern YRD



Evolution



Silt thickness
of the
modern
YRD

Evolution

- The Diaokou delta lobe was formed before 1976 . After 1976, the end river channel shifted to Qingshuigou course.



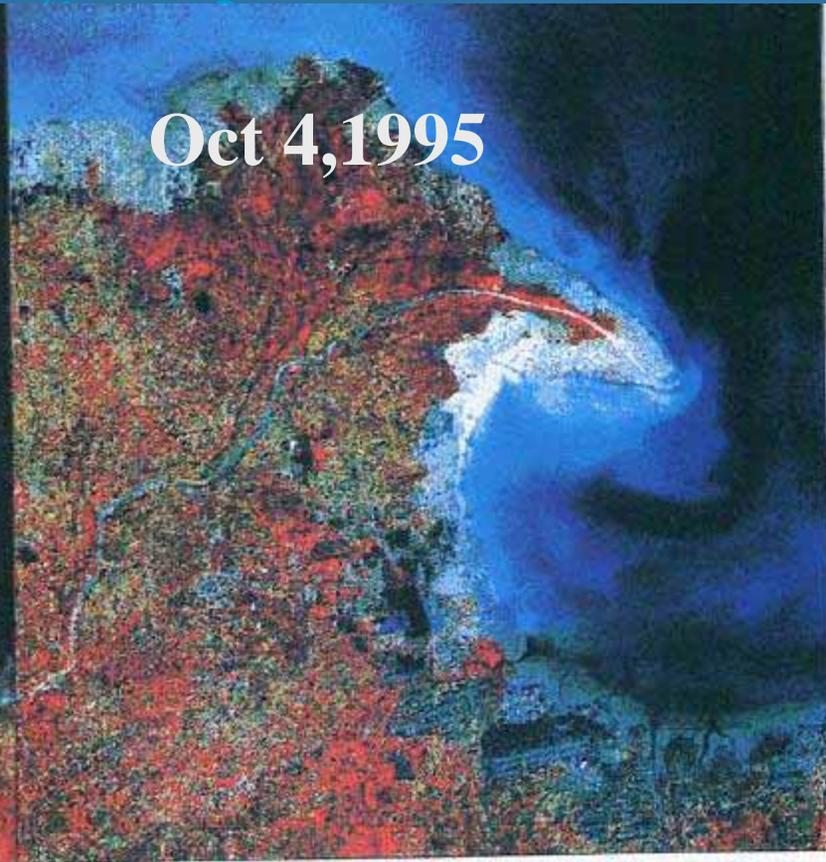
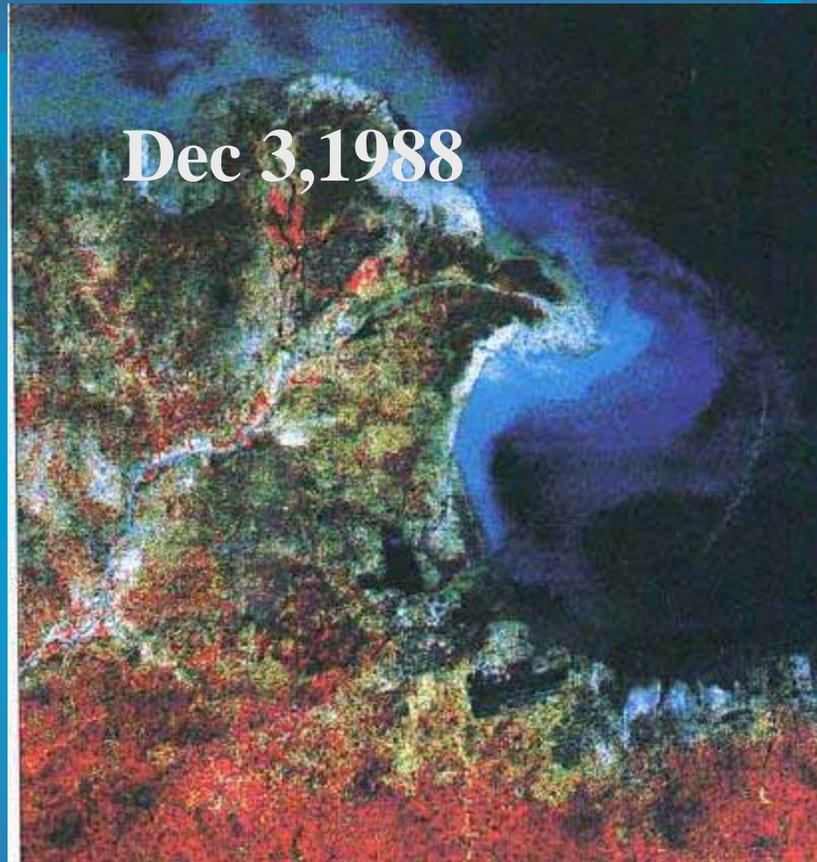
(From Yang Zuosheng)

Evolution



Shift of the apex
of the channels
of the modern
YR delta in
1934 limited the
space of the
delta evolution
greatly

Evolution



Constraint shift of the river course happened in 1976 to create a new land in the area of a nearshore oil field and to build a port in the eroding northeast delta.

Evolution

The delta shifting direction was changed once more by human activities.

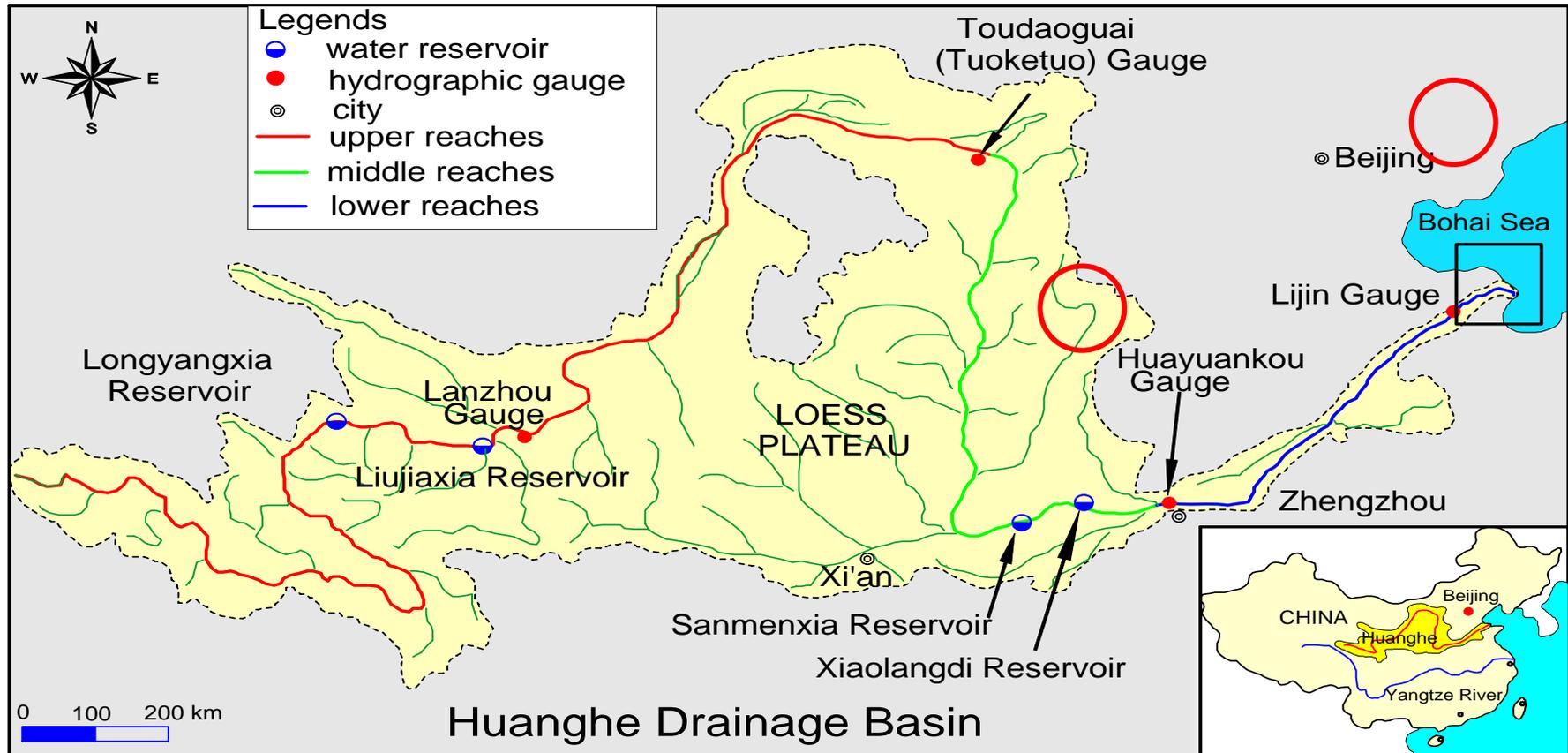


May 31, 1996



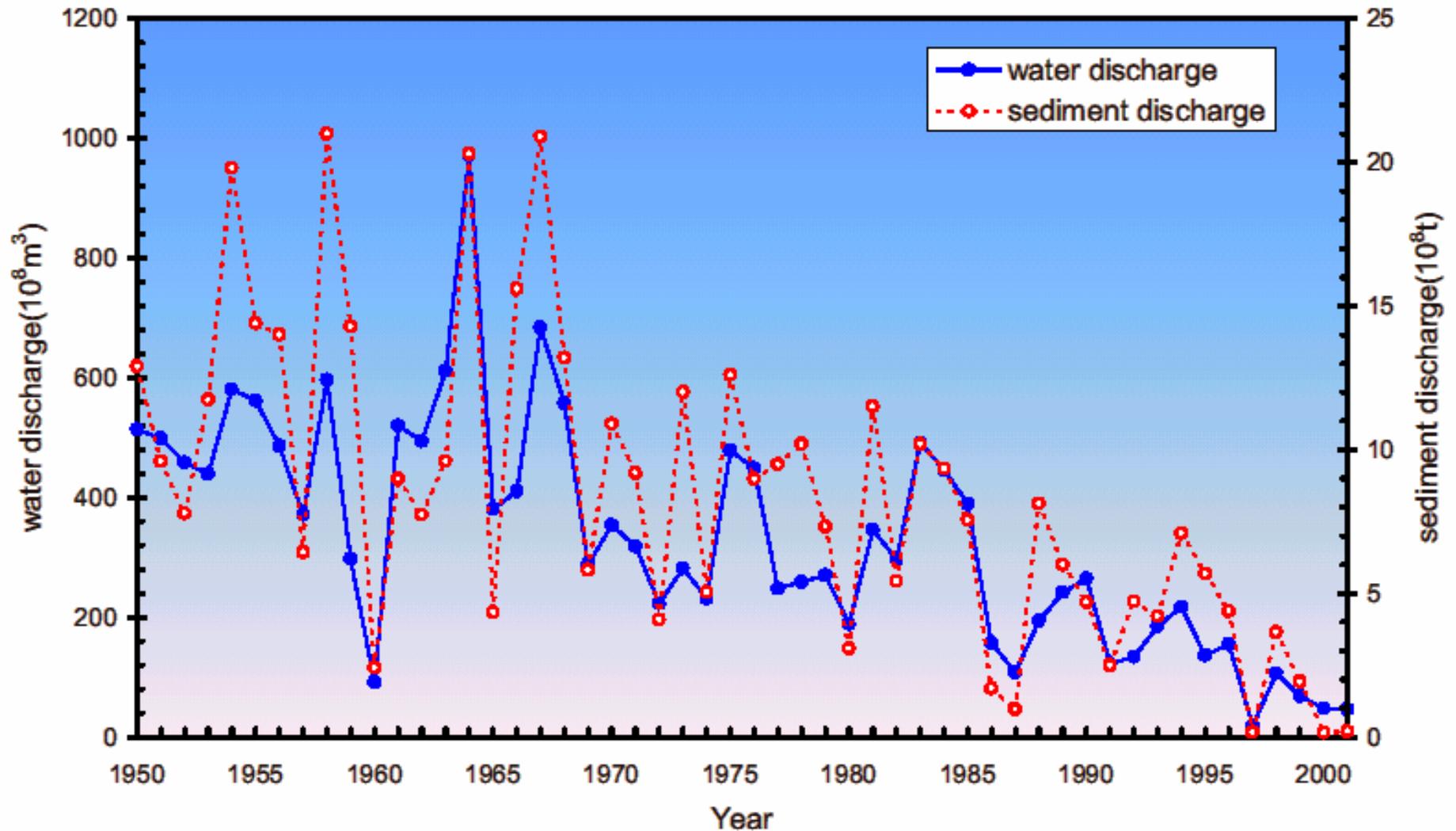
Sep 20, 1996

Evolution



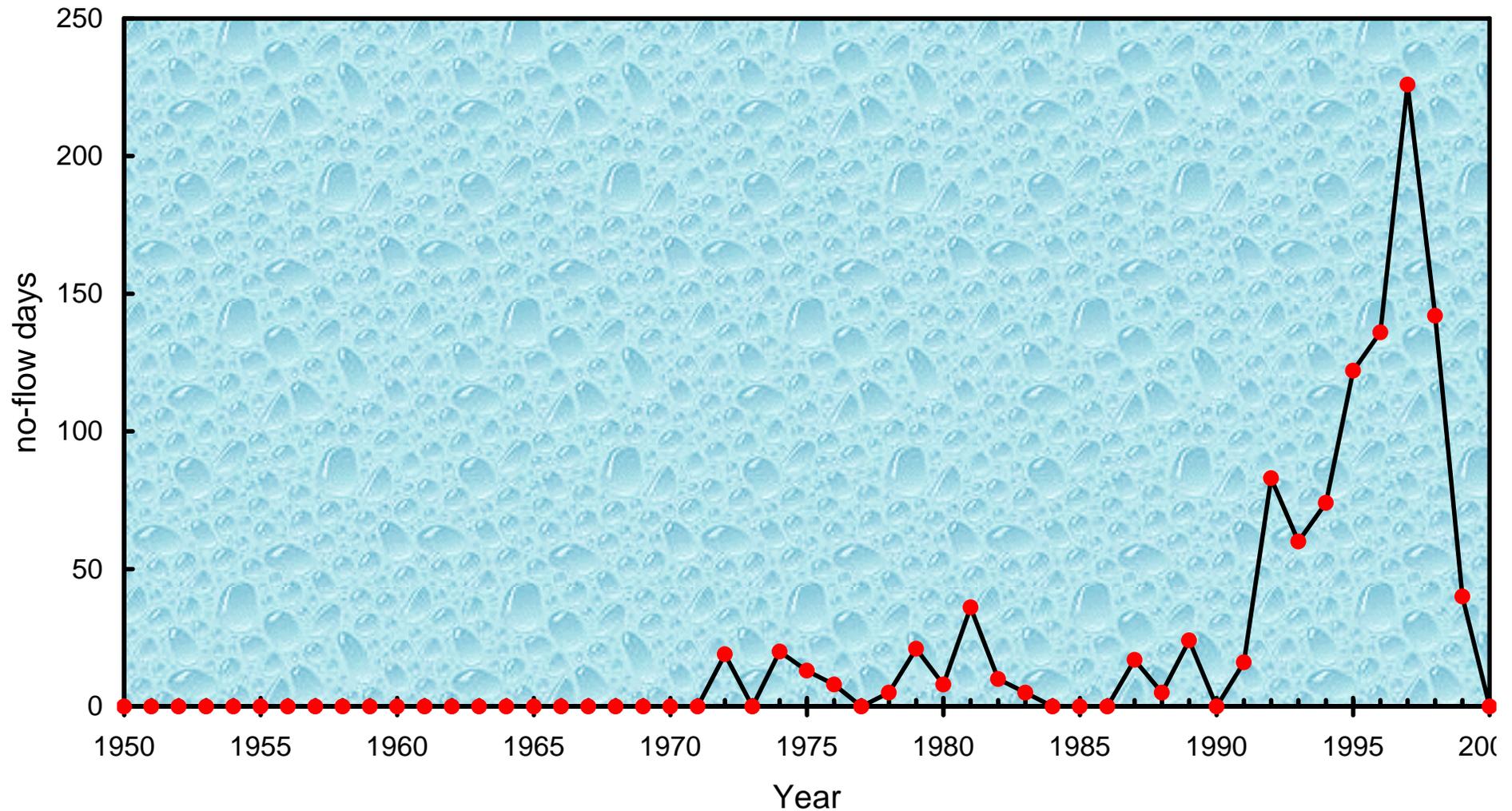
9.7bt of sediment will be stored in reservoirs during 30 years(from YRCC), so the sediments discharge to the delta was getting decreasing over time.

Evolution



Water and Sediment discharge during 1950 - 2001

Evolution



No-flow days during 1950-2000

Evolution

Sharp descending in water and sediment discharge over three stages

	Water discharge		Sediment discharge	
	Average(10^8 m ³)	Ratio(%)	Average(10^8 t)	Ratio(%)
1950-1968	501.5	100	12.37	100
1969-1985	327.0	65.2	8.40	67.9
1986-2001	137.7	27.4	3.51	28.4

From YRCC

Evolution

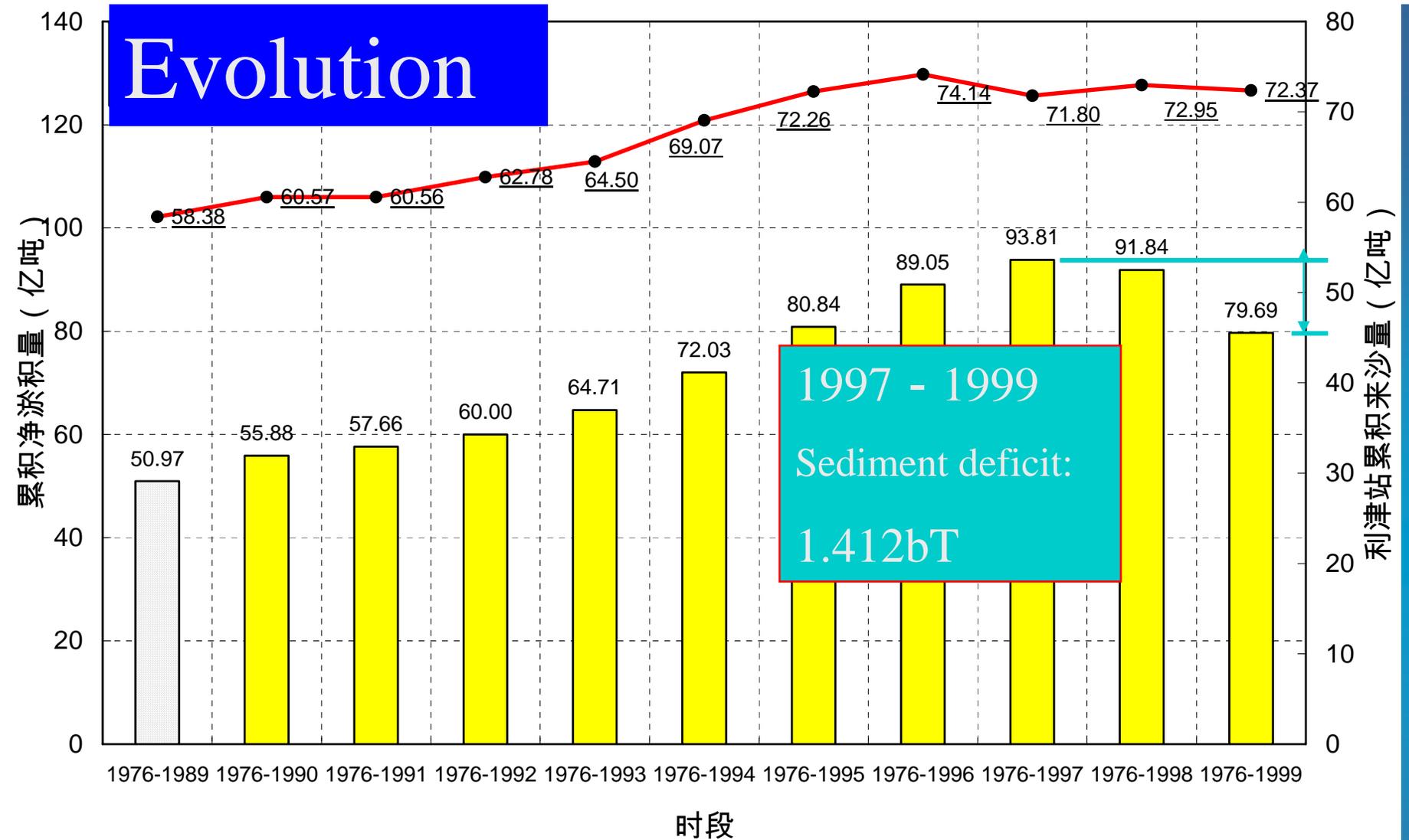
Water and sediment discharge and the days without current

Year	W.discharge(10^8 m^3)	S.discharge(10^8 t)	Days without current
1976	449.1	8.98	8
1977	248	9.49	5
1978	259	10.2	21
1979	270	7.33	8
1980	189	3.08	36
1981	346	11.5	10
1982	297	5.42	5
1983	491	10.2	
1984	447	9.34	
1985	389	7.56	
1986	157	1.69	
1987	108	0.96	17
1988	196	8.49	5

Evolution

Water and sediment discharge and the days without current(YRCC)

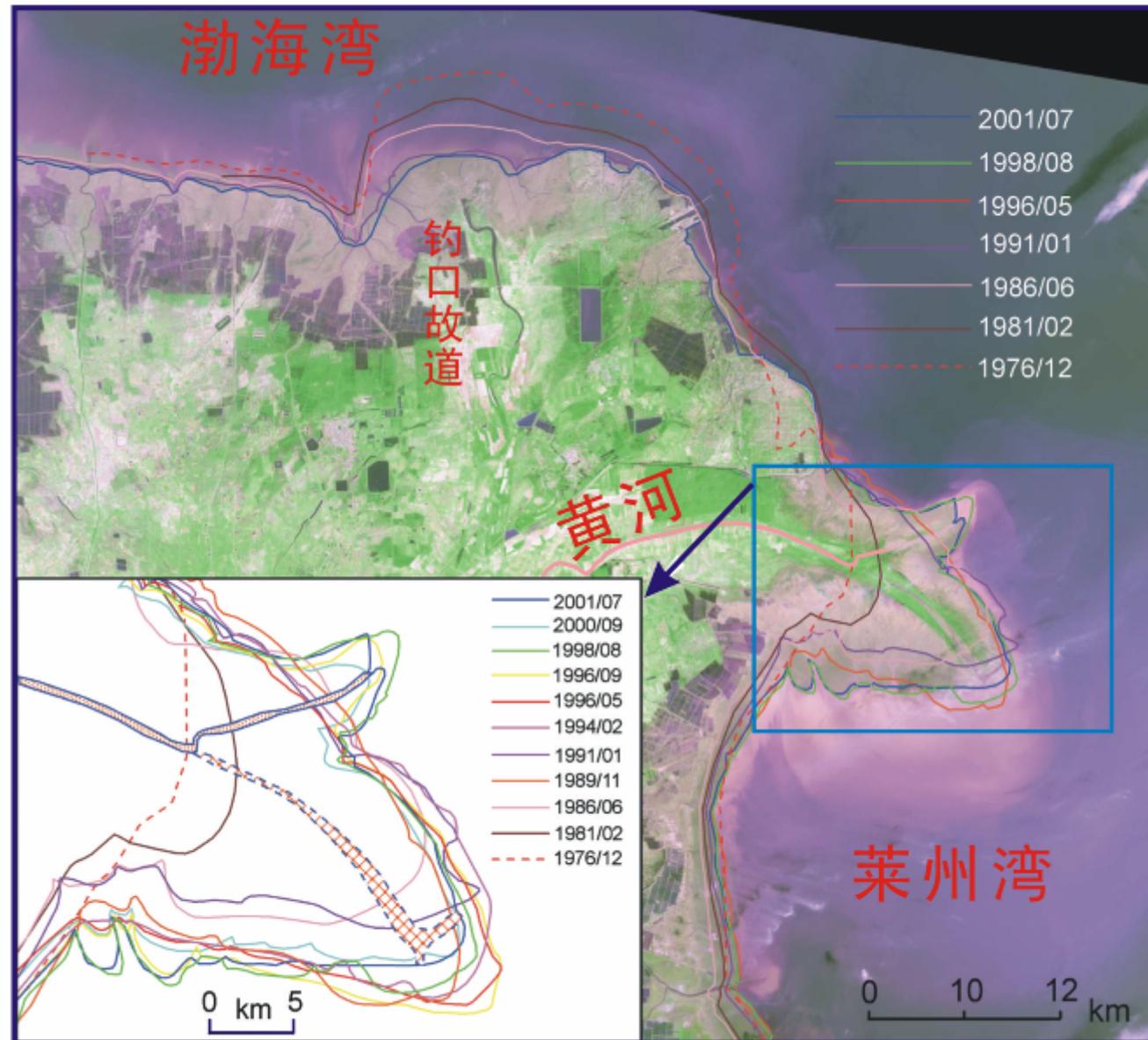
Year	W.dischage	S.dischage	Days without current
1989	242	5.99	24
1990	264.25	4.69	
1991	122.54	2.49	16
1992	133.74	4.72	83
1993	184.97	4.21	60
1994	216.97	7.08	74
1995	136.7	5.69	122
1996	155.17	4.38	136
1997	19.2	0.356	226
1998	101.1	3.66	142
1999	66	1.85	42
2000	49.11	0.241	0



The red line shows the sediments accumulation value over the time at Lijin station;

The yellow columns show net deposit value within 15m depth

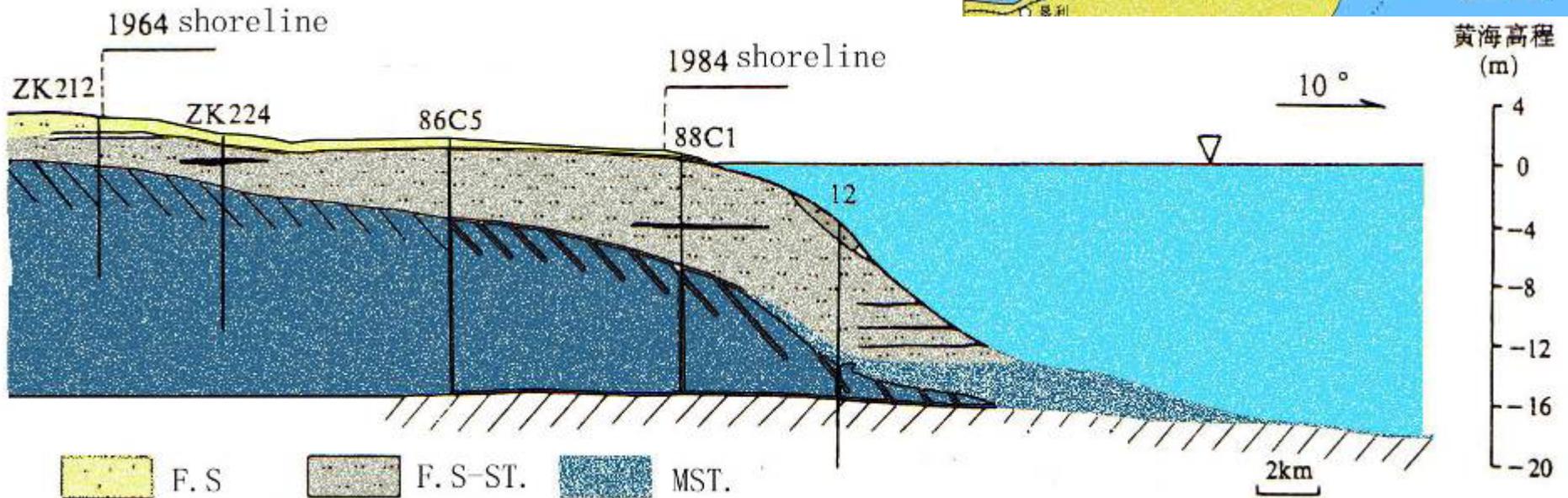
Challenge



Comparison
of coast line
in different
periods

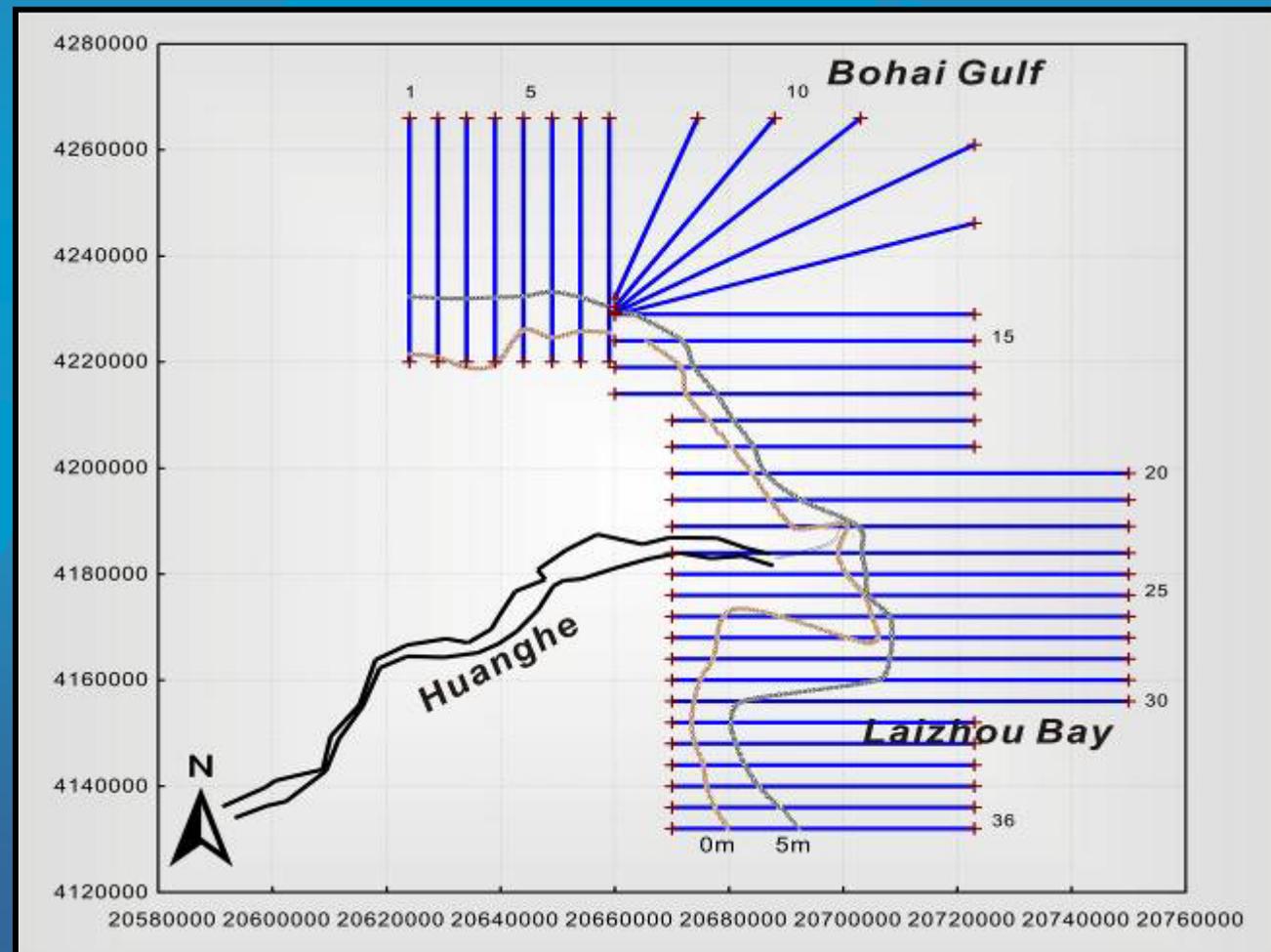
Challenge

1. 3230 km² of new land formed from 1855 to present
2. Shoreline progress with a speed of 150m/a
3. About 100 km² land was submerged by erosion (li, 2003)



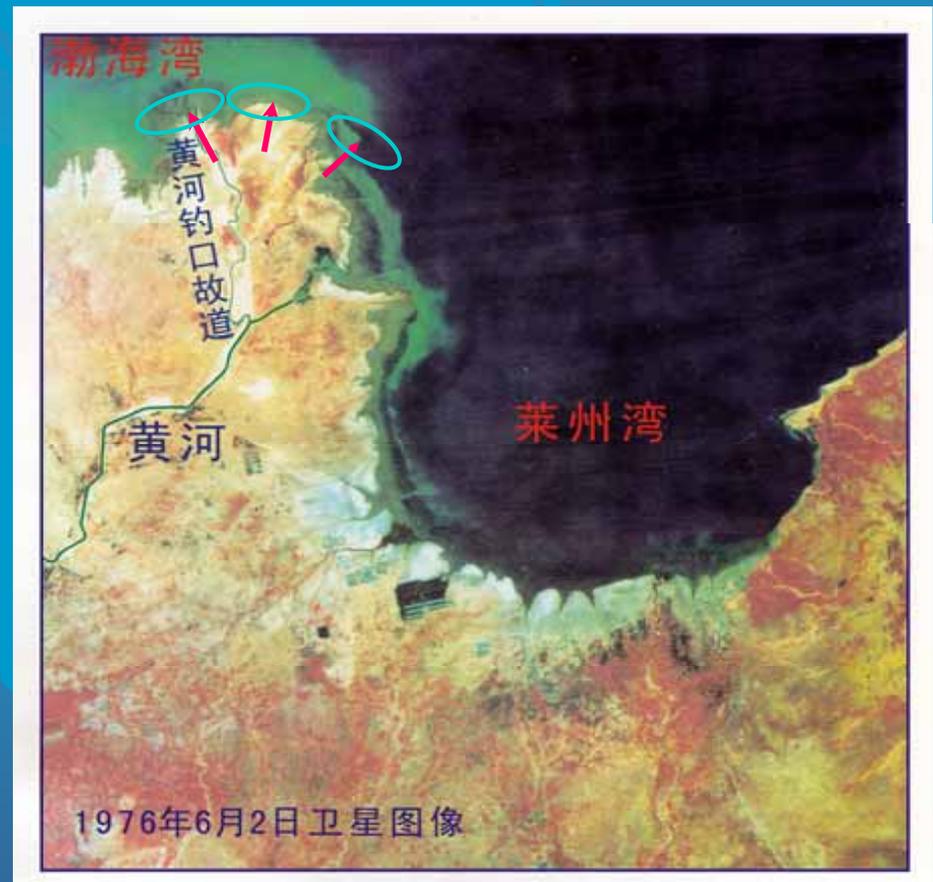
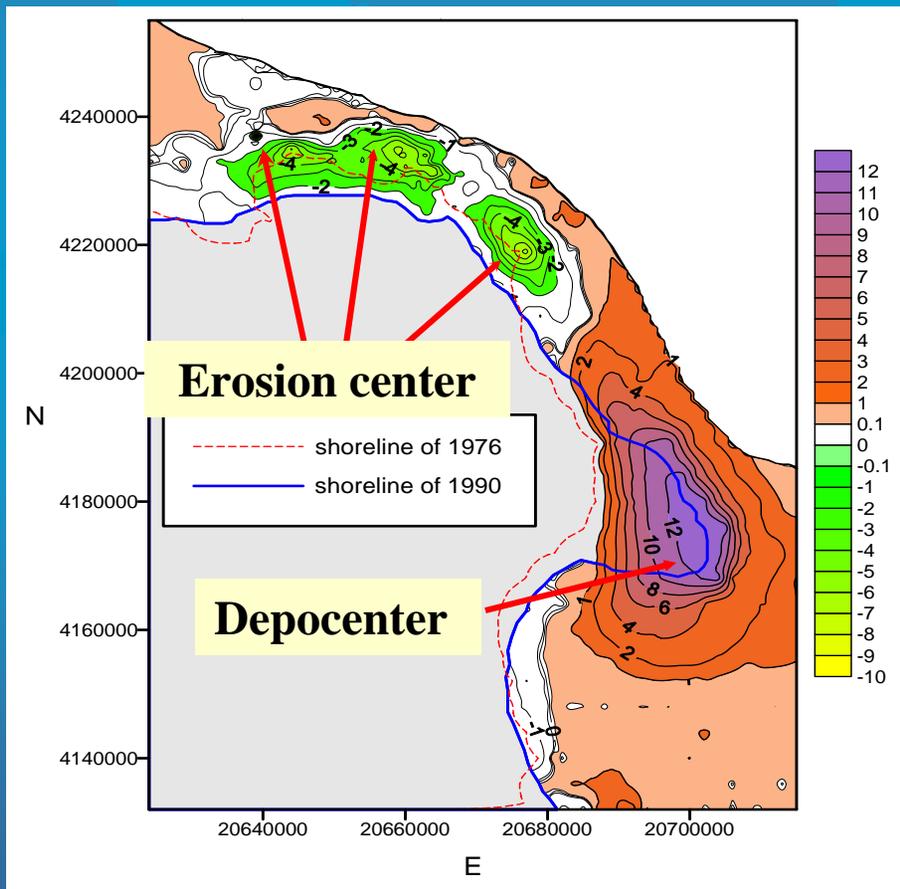
Challenge

- The erosion-accumulation of the subaqueous delta was estimated based on the bathymetric measurements of 36 survey lines along the delta coast. (From Yang Zuosheng)



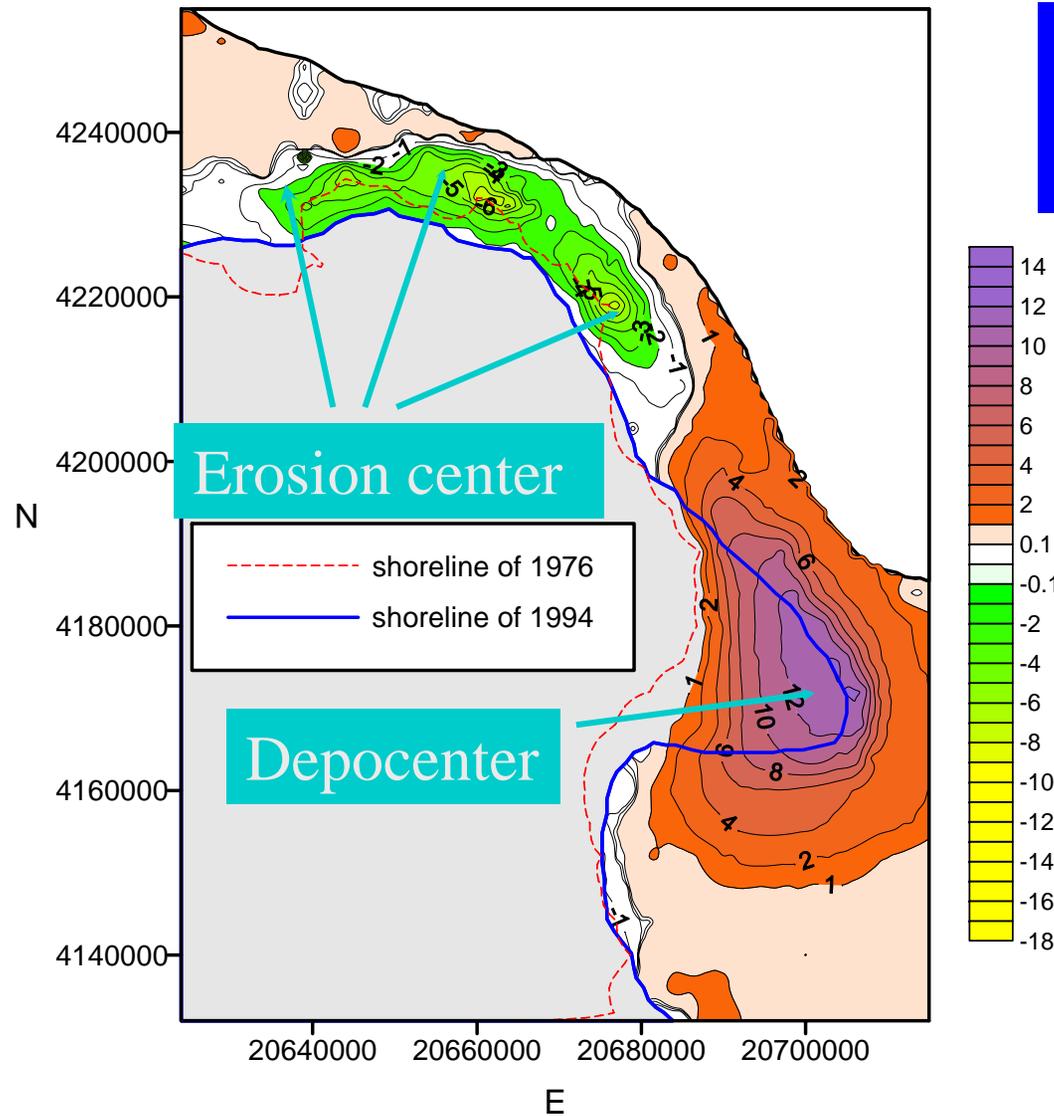
❖ Erosion –accumulation of the delta area within the water depth of 15m from 1976-1999: 3 erosion centers in the north of the previous river mouth, 1 accumulation center in the present subaqueous area.

❖ Erosion-accumulation amount : pure erosion of the delta happened in 1997.



(From Yang Zuosheng)

Challenge



1976-1994

(From Yang Zuosheng)

Challenge



12/01/1976



05/10/1977



02/06/1981



10/05/1984



06/05/1986



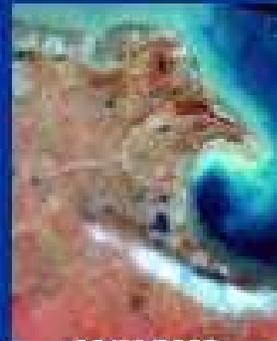
05/07/1987



02/13/1989



01/26/1991



10/30/1993



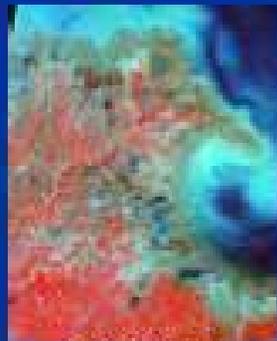
10/04/1995



05/31/1996



09/20/1996



05/05/1998



06/25/1999



05/02/2000

Challenge

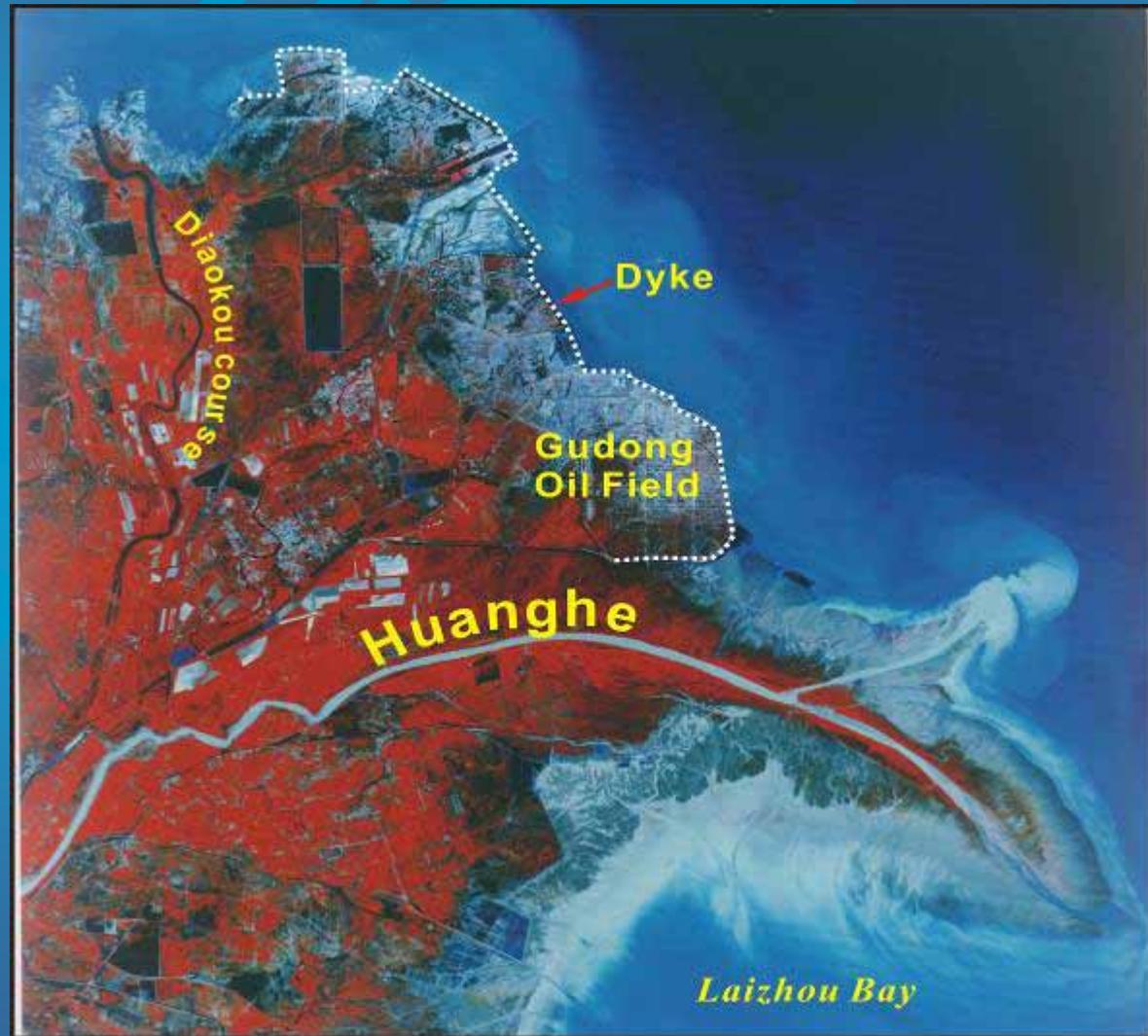
The planned river courses are to east and to north. No any plan to southeastern way.

It may be correct for control the courses and the further industry development. But for the wetland maintenance and delta growth, southeastern way is a good choice.



Challenge

- The scouring of the delta slope beneath the coastal dikes will continue and develop as the time passes by.
- The shallow trenches/ridges could be formed as long as more than hundred km long around the delta

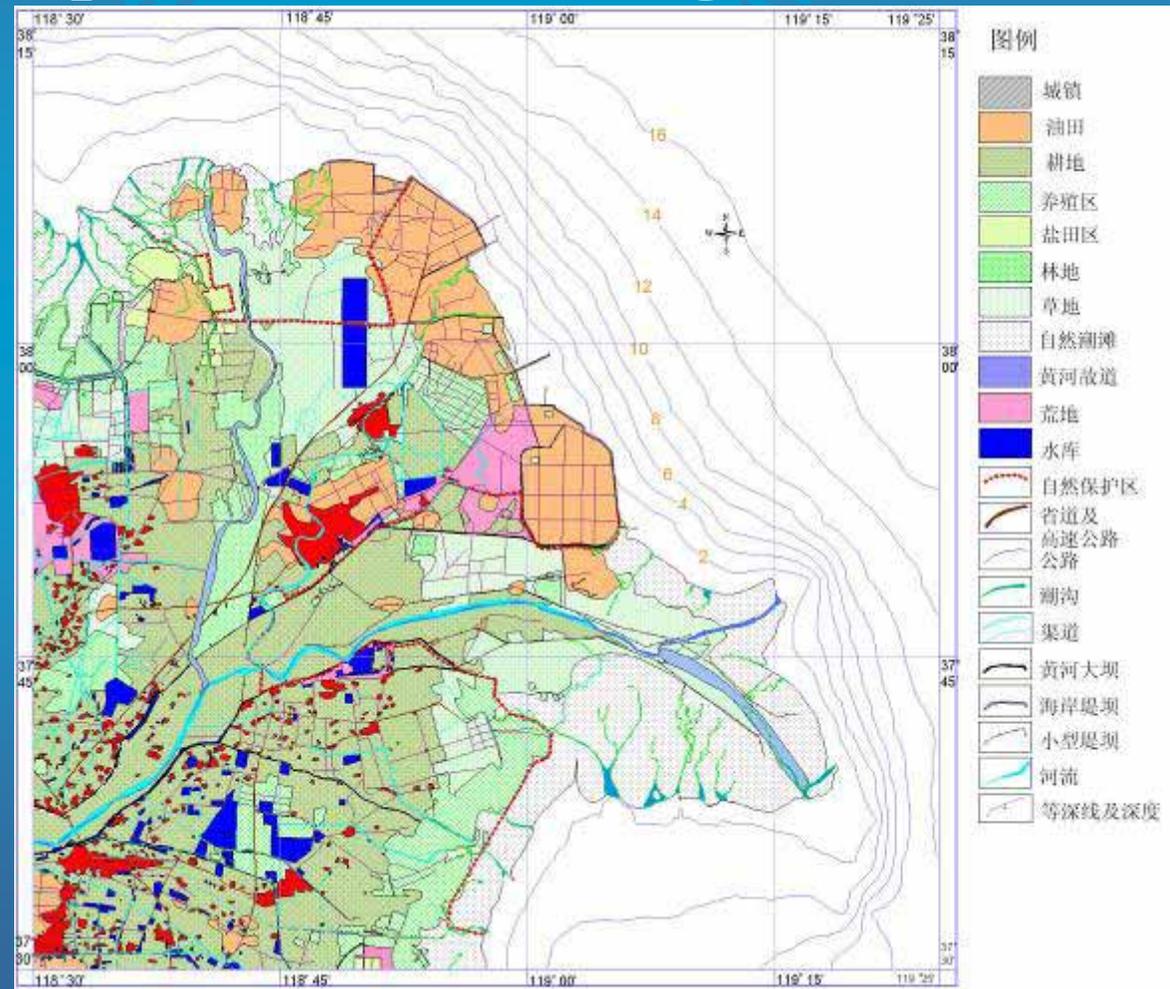


(From Yang Zuosheng)

Challenge

As consequence of the lack water discharge from YR, the wetlands here experienced severe degradation

From 1984 to 2000, 8000ha of reed were reduced, 33% was changed to farmland, 27% to Chinese Tamarisk, and 26% to Lalang grass. About 4000ha of fresh water area was lost(Liu, 2001)



Challenge

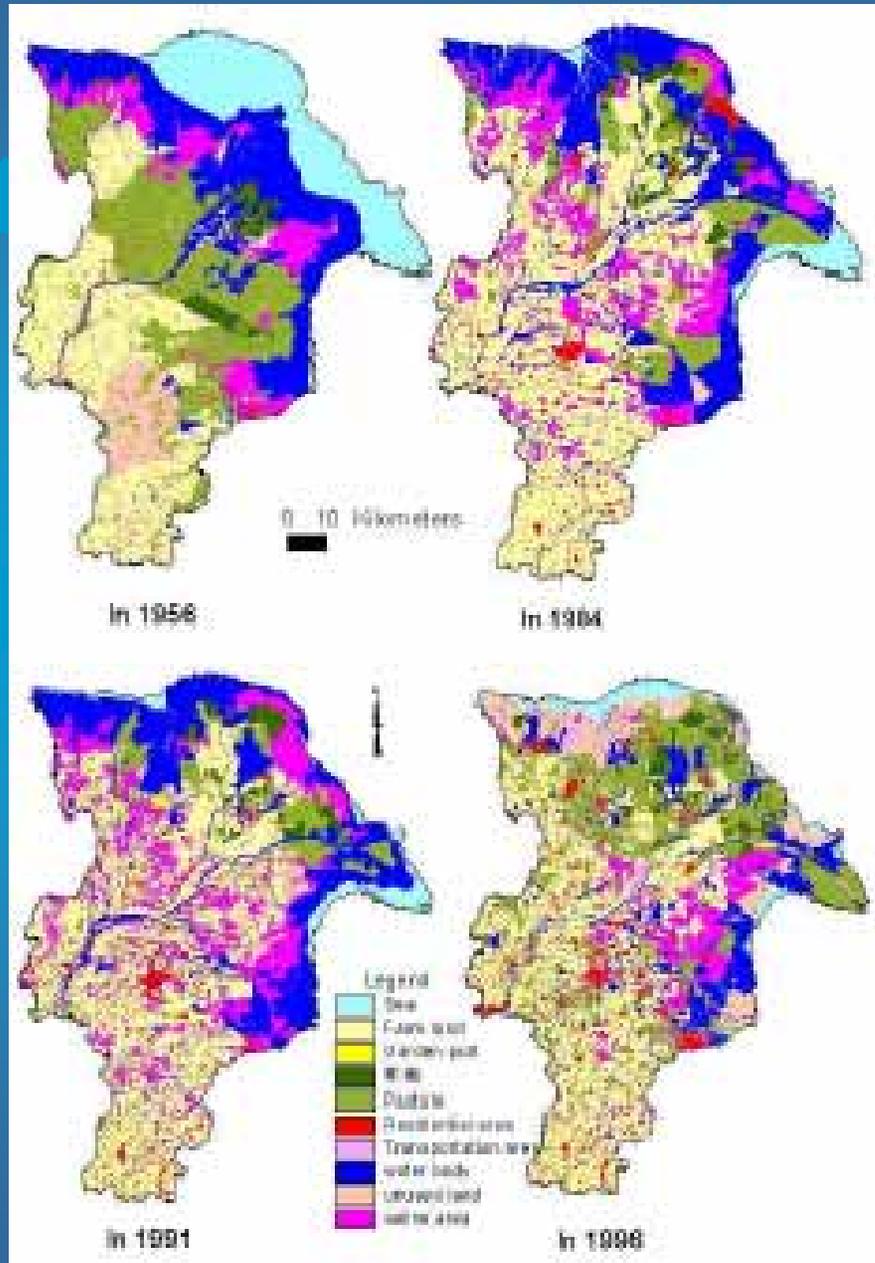
Landuse changes in last 40years

-1956, digital topographic maps

-1984, remote sensing

-1991, 1:50,000 land survey

-1996, remote sensing



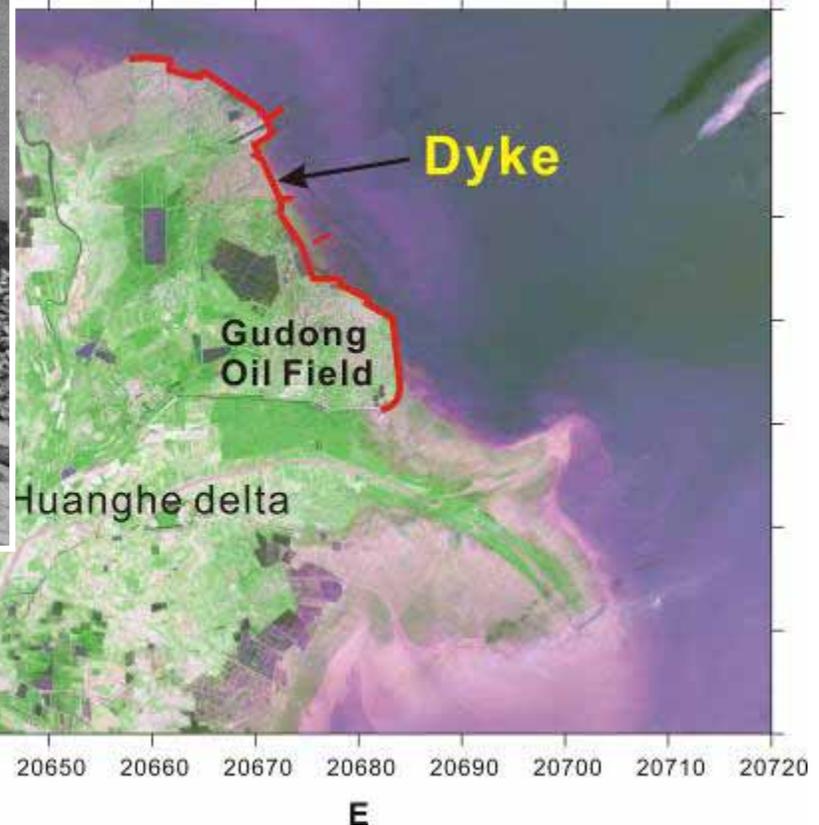
Challenge



- *The sediments or fresh waters loss represents more than just the loss of land. It represents the loss of what sustains much of the regional habitat, economy, culture, and national image.*

Endeavor

- Coastal dikes of about 130 km were built since 1986 to protect the coast from erosion.



(From Yang Zuosheng)

Endeavor

Impact of coastal dike constructions on the delta morphology

The coast dykes were built in 1986-1987 to protect the oil fields .New dikes were built in 2002-2004 in the southeast coast to protect the Dongying city. The natural balance shoreline of coast erosion-accumulation is replaced by the fixed coastline - dikes.

Endeavor

water and sediments adjustment-why

- As one of the most important places for migrant birds in northeast Asia as well as the Asia-Pacific rim, the Delta has been put on both world and Chinese bio-diversity and wetland protection lists.
- However, a shortage of water has caused the frequent drying-up of the lower reaches of the YR in recent years and posed a grave threat to the ecosystem at the estuary of the river.
- In the face of water deficiency, the Yellow River conservancy committee has carried water and sediments adjustment since 2002.

Endeavor

Water and sand adjustment project(2002-2006)

Year	Whole year Flux (bm ³)	Water and sediment adjustment	
		Duration (days)	Flux (bm ³)
2002	4.189	25	2.434
2003	19.27	28	4.346
2004	19.88	35	4.574
2005	20.68	45	4.204
2006	19.17	21	4.904

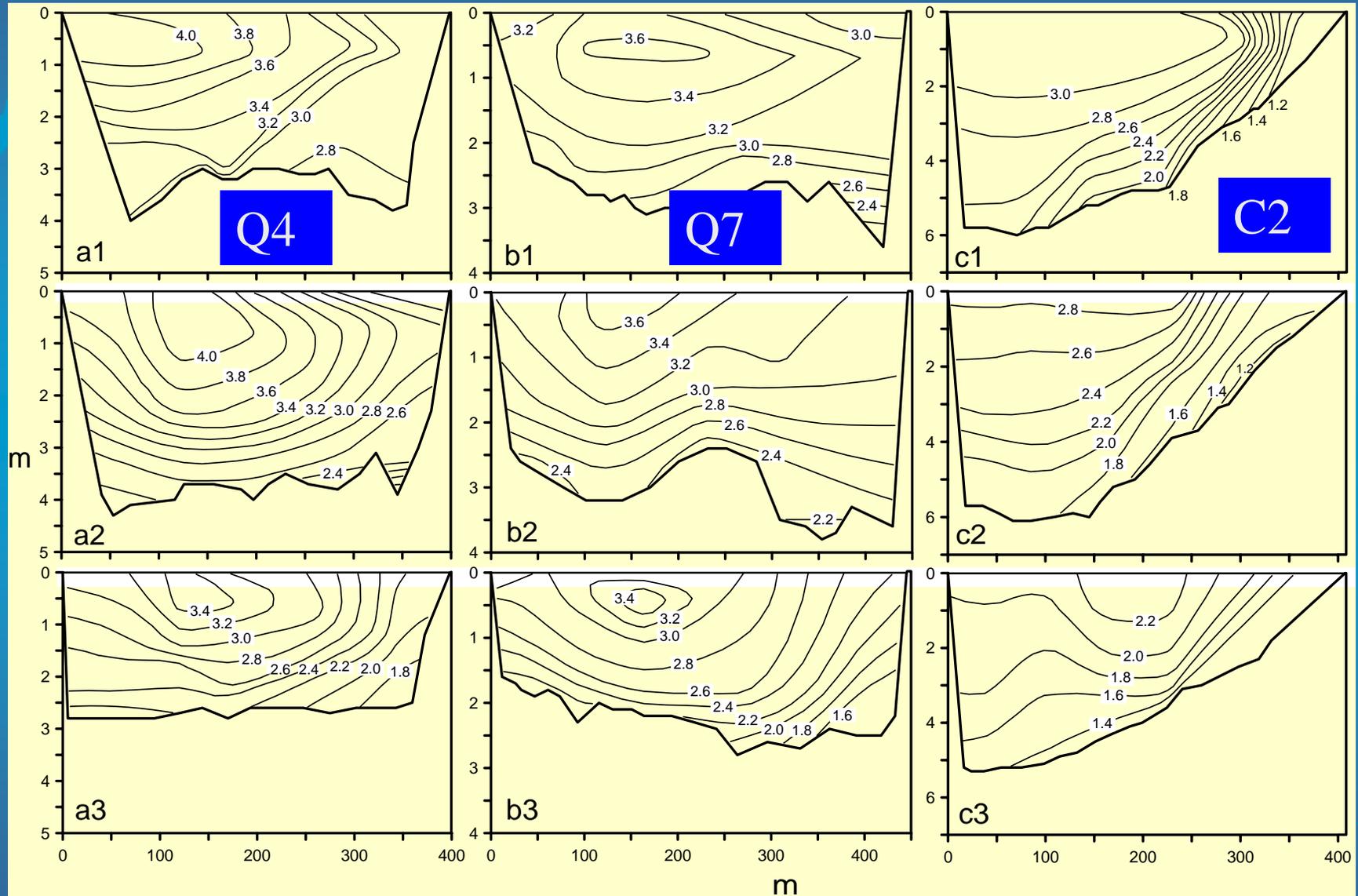
(From YRCC)

Endeavor

Water and sand adjustment project

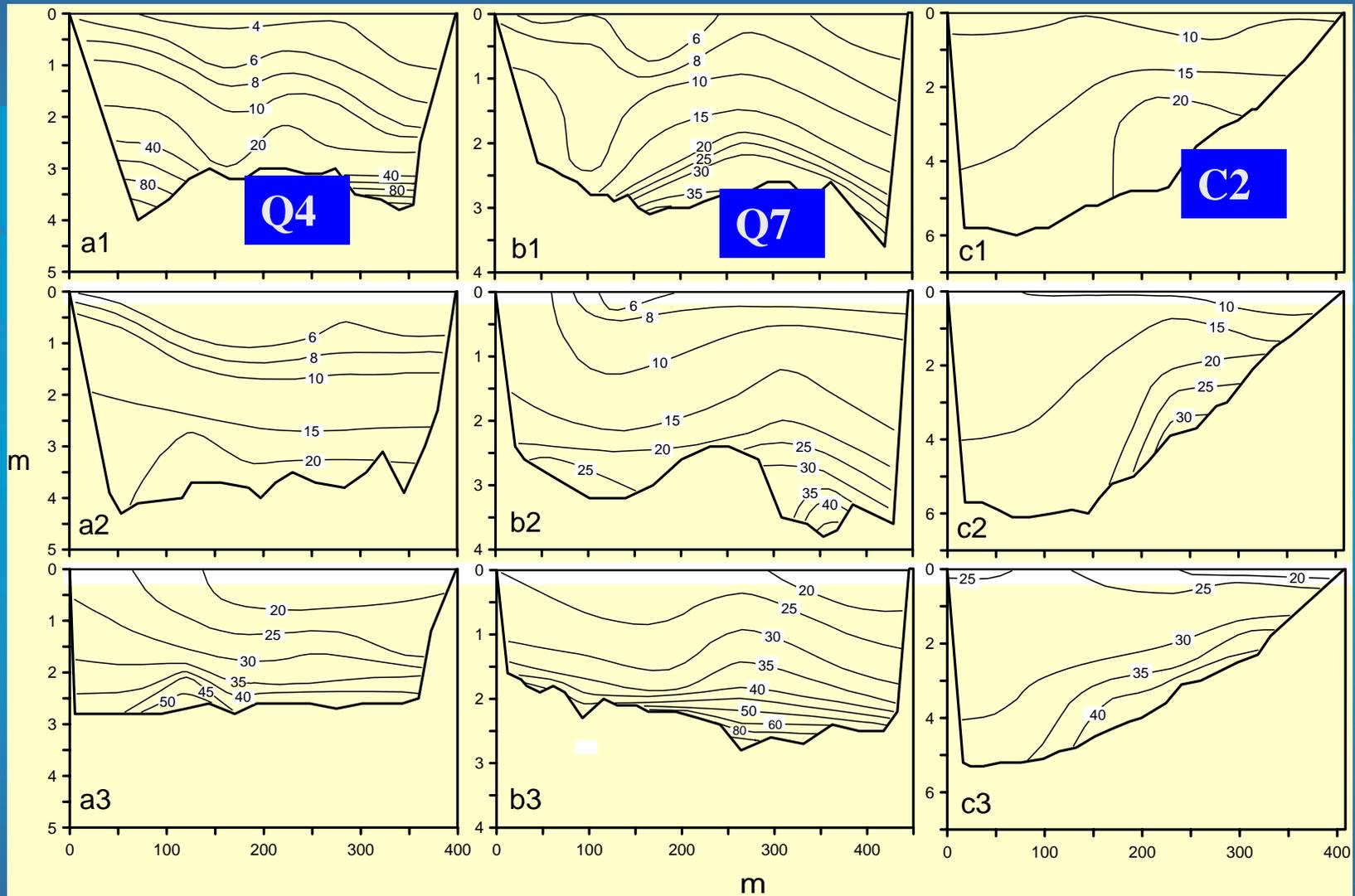


Endeavor



The flow velocity of the river at 3 cross section(m/s)

Endeavor



Sand contents of the River at 3 cross section(kg/m³)

Endeavor

80 million m³ water and 20 mT sediments from the Yellow River has been stored in the wetland area **when the sand-discharging project was undertaken.**

Summary

- Origin
- In 1855, the Yellow River was broken at the Tong Wa Xiang, Henan province. The flood water of the Yellow River captured the course of the Daqing River to the Bohai Sea, where it created a new delta rapidly.

Summary

- Evolution
- major shifts in the course of the Yellow River have contributed significantly to the evolution of the YRD. Natural processes alone, however, are not responsible for all of this .
- Human activities such as construction of reservoirs in the drainage basin have reduced sediment supply for the healthy growth of habitat in the YRD. Draining and filling the sea for agriculture activities and oil exploitation have also been largely responsible for shaping the Delta.

Summary

- **The Erosion(1997-2002)**

- ❖ The northern part of the delta had been constantly eroding since 1976. The accumulation had happened in the new delta-lobe area since 1976, but had turned to erosion since 1997. The whole delta had changed from the constructive phase to a destructive one as its water and sediment discharge to the sea decreased sharply during 1997-2002.

- ❖ **The shape**

- The morphology of the delta will remain asymmetric, The shallow trenches/ridges on the subaqueous delta slope will develop.

Summary

The dyke

The coast dykes were built in 1986-1987 to protect the oil fields .More dikes were built in 2002-2004 in the southeast coast to protect the Dongying city. The natural balance Shoreline of coast erosion-accumulation is replaced by the fixed coastline fixed--dikes.

Summary

the River

- The Yellow River Delta had been shrinking by an average of 7.6 square kilometers a year during 1996-2002, according to the Shandong Provincial Bureau of Geology and Mineral Resources.
- The river channel silting is not serious as the sediment discharge keeps continuously low.
- Stabilization of the river course on the delta meets to the demand of local economic development and oil exploitation on the delta,.
- Small change of the river outlet could be happen.

Summary

water and sediment adjustment project

80 million m³ water from the Yellow River has been stored in the wetland area when the water and sediment adjustment project was undertaken. Inflow of freshwater has eased the decline of wetland and extension of salinity and improved soil quality and water bodies in the wetland.

At present, the Yellow River Delta Conservation Area has become a rare bird aggregating spot along eastern coast in China and bird species has increased from 187 to 283. Rare bird species, such as red-crowned crane, white-neck grey crane, white marabou have inhabited in the Delta.



Thank you