Rise and Fall of Arid Area Life
- A case study of Xiaohe Tomb site (1,600-1,000 BC), Xinjiang-

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IDP International Conference
Archaeology of the Southern Taklamakan
8-10 November 2012
The area was formed because of climate?
Subtropical high pressure
Damp air from the sea does not reach inland
>> The area is prone to be dry

But only that is the cause of desertification?

What about human activities?

Need a research with a view of long time span!
>> Research of the Xiaohe Tomb Site (1,600-1,000BC), Xinjiang
Background of the Xiaohe Tomb Site research
Xiaohe Tomb Site (1,600〜1,000BC)

2,500 m² Cemetery site

East Taklamakan desert
Ex-Tarim River coast
Long. 88°40′E  Lat. 40°20′N
Altitude 827m
130 km in west from Loulan
First discovery of the Xiaohe Tomb Site (1934)

- Legend of ‘The hill with 1,000 coffins’
- Discovered by Sven Hedin’s servant Ördek, called "Ördek's necropolis"
- Research by Swedish archaeologist Bergman
- Found 120 coffins
Second discovery (2000) and the archaeological research (2002-2005)

First systematic archaeological research by the Xinjiang Uygur Autonomous Region Bureau of Cultural Heritage

164 mummies
350 coffins
1,000 artefacts
Etc...

“Xiaohe Beauty”
350 wooden (Populus euphratica Olivier) coffin

At least 3 trees are needed for making 1 coffin nearby?

The coffin takes the shape of a boat

not a kind of idea that arid region people have

Rich cattle skulls & skins

3 skins to wrap 1 coffin / killed at the premise

able to support cattle grazing?

Wheat grains in grass basket in each coffin

Produced wheat?

It was not a barren land like today?
Collaborative research of the Xinjiang Uygur Autonomous Region Bureau of Cultural Heritage and Research Institute for Humanity & Nature, Kyoto (2006-2011)

Xinjiang first interdisciplinary research on an archaeological site

Genetics, botany, histology, zoology...
Environmental transformation from early 20th century to today in Xiaohe and Loulan area

Photographs and other data of Sven Hedin
>> Digital Archive (For public use)
Concluding symposium of the collaborative research (November 2010)

Isotope Analyses
Palynology
Literature History
Genetics
AMS Dating
Archaeo-metallurgy
General Survey

Contents of the collaborative research
General survey of the Xiaohe Tomb Site area

- Slag (iron casting)
- Shells
- Salt (Na, Ca, Mg...)
- Cemetery
- Slag

Xiaohe site: 40° 21’ 11”N, 88° 40’ 21”E

3000m
ANIMALS

Archaeological data
Birds (species unknown)

Wild cats (*Feris lynx*)

Literature
Tigers (*Panthera tigris var. tigris*)

Reasonably rich forest?
Wheat Production?

Contents of the collaborative research
DNA analyses of excavated wheat grains

Ancient seeds

1  2  3  4  5

Living wheat (common/bread wheat)
DNA analyses of excavated wheat grains

- **Einkorn**
  - Genotype: **AA**
- **Emmer**
  - Genotype: **AABB**
- **Durum**
  - Genotype: **AABB**
- **T. compactum**
  - Genotype: **AABBD**
- **Common wheat**
  - Genotype: **AABBDD**

Productive but require much water
Experiments of wheat production

![Graph showing grain yield comparison for different wheat varieties.](image)

- **Grain yield (g m⁻²)**

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<tr>
<th>Variety</th>
<th>Triticum</th>
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The range of size and weight of wheat grains

Layer 1

M11
M13
M20
M25
M27
M29
M32
M33
M34
BM13
BM17
BM23

3225 BP
3240
3375
3545

Coffin

Standard Deviation

0 1.0 cm
0 10 mg

4 5 6 mm

10 20 30 mg
Xiaohe people *cultivated common wheat*, probably because of its high productivity.

Common wheat *require much water*, and if plenty of water is supplied, the production can be quite high.

*Intensification* of the production, probably increasing water supply with *irrigation*, was promoted.

Wheat production was increased well up to the middle of the Xiaohe period- but later *failure* became often.

*Soil salinisation by irrigation? Lost land productivity?*
Environmental shifts?

Contents of the collaborative research
Pollen sampling from the mud-coating of coffins

Yr.
3200 b.p.
3400 b.p.
3600 b.p.

Sparganium sp. (wet habitat plant)
Chenopodiaceae (aridity- & saline-enduring plant)

Proportion (%)
20
40

Pollen analyses of the Xiaohe period
Environmental Shifts through the Xiaohe period

• In the **beginning** of the Xiaohe period (3,600bp = 1,600 BC), the area had **rich water**
• Towards the **latter half of the period** (3,400-3,200bp = 1,400-1,200BC), the area became **drier**, and soil **salinisation** happened
• Pollen analyses of the nearby area where **not much human inhabitation** has happened (Ruoqian), such a **drastic change was not recognised**
• The land degradation in the Xiaohe area was caused by human activities?
Soil sequence?

Contents of the collaborative research
Layer 1

- 0 cm
- 10 cm
- 20 cm
- 30% Clay

- 2
- 3
- 4
- 5
- 6

- 1300 yBP
- 2540 yBP
- 3370 yBP
- 3500 yBP
- 4430 yBP
- 5140 yBP
- ca. 6000

Diameter of sand grains (μm)

Loulan Kingdom

Xiaohe period
Layer 1

Clay

0 10 20 30%

yBP.

1300 Layer 1

2

2540

3

3370

4

3500

5

4430

6

Clay

Saline-soil problem

Shells

Marco Polo trip report

Xuanzang trip report (to India)

Extinction from record

Capital relocation

Saline-soil problem?

Iron making

Agro-pastoralism

Wheat production

Indian people, tef (African millet)

Saline-resistant plants increased

Shells

Wheat, millet, pastoralism (cattle, sheep, goat), birds, forest

Shells

humid stage

dry stage

Loulan Kingdom

Xiaohe period
The story of Xiaohe wheat production

• Taking advantage of rich water in the initial stage of the Xiaohe period, water-requiring common wheat was chosen to cultivate for the high productivity.

• The start of the drier period then, keeping up the production became difficult, and people tried to solve the problem by intensifying the production, possibly with irrigation (of river water).

• At first it worked, but after a while wheat production became quite unstable, because of soil salinisation caused by irrigation.

• Eventually the land lost productivity... **Wrong**
Was it all finished in the ‘past’?

After the Xiaohe period...
Loulan Kingdom (200-100BC around)

One of prospering Western Region 36 Country

But disappeared in the Western Region upheavals
On the way to India to learn Buddhist scriptures, Xuanzang was welcome by the Gaochang King, of which kingdom (north edge of the Takramakan desert) was prospering having 50,000 population and 4,000 monks.

On the way back from India, Xuanzang saw the Gaochang Kingdom had disappeared being concurred by the Tang Empire.
More water than today in the Taklamakan area

But soil salinisation is also recognised

>> ‘Xiaohe pattern’ is still repeated?
In the arid area, human living can be more vulnerable than in other areas— a ‘wrong choice’ like the Xiaohe case can easily lead fatal results.

In prehistoric and historical time, people solved the problem by moving out, but today, we try to solve it without moving, using modern technology.

>> even more pressure on the land, and more rapid
Thank you!! 謝謝！

Xiaohe Tomb site & me
October 2007