Environmental evolution of Xingkai Lake since 200 Ka by OSL dating of sand hills

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Session 2: climate change

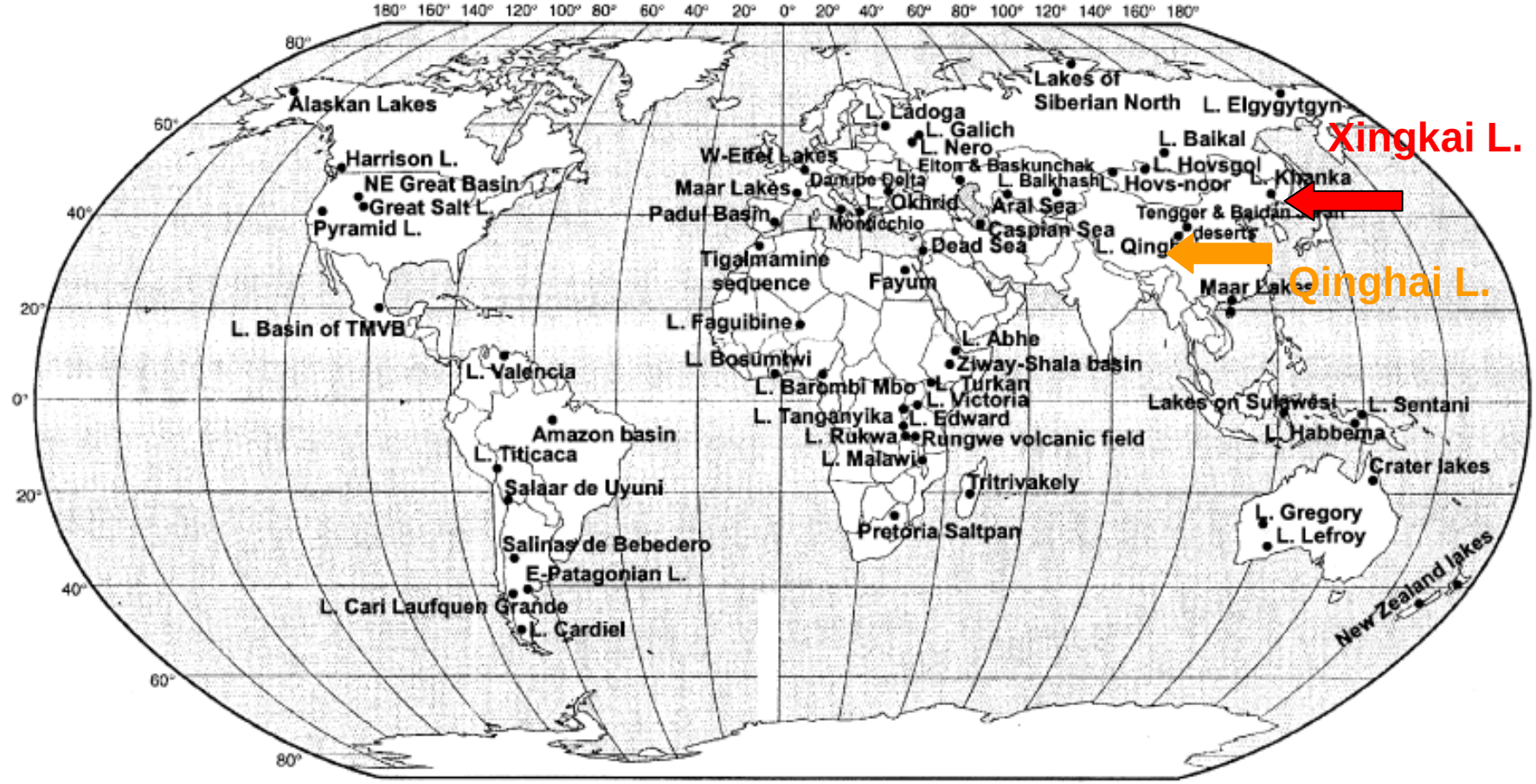
Paleoclimate ⟹ climate change in the past

Lake sediments as the record ⟹

Information about climate change

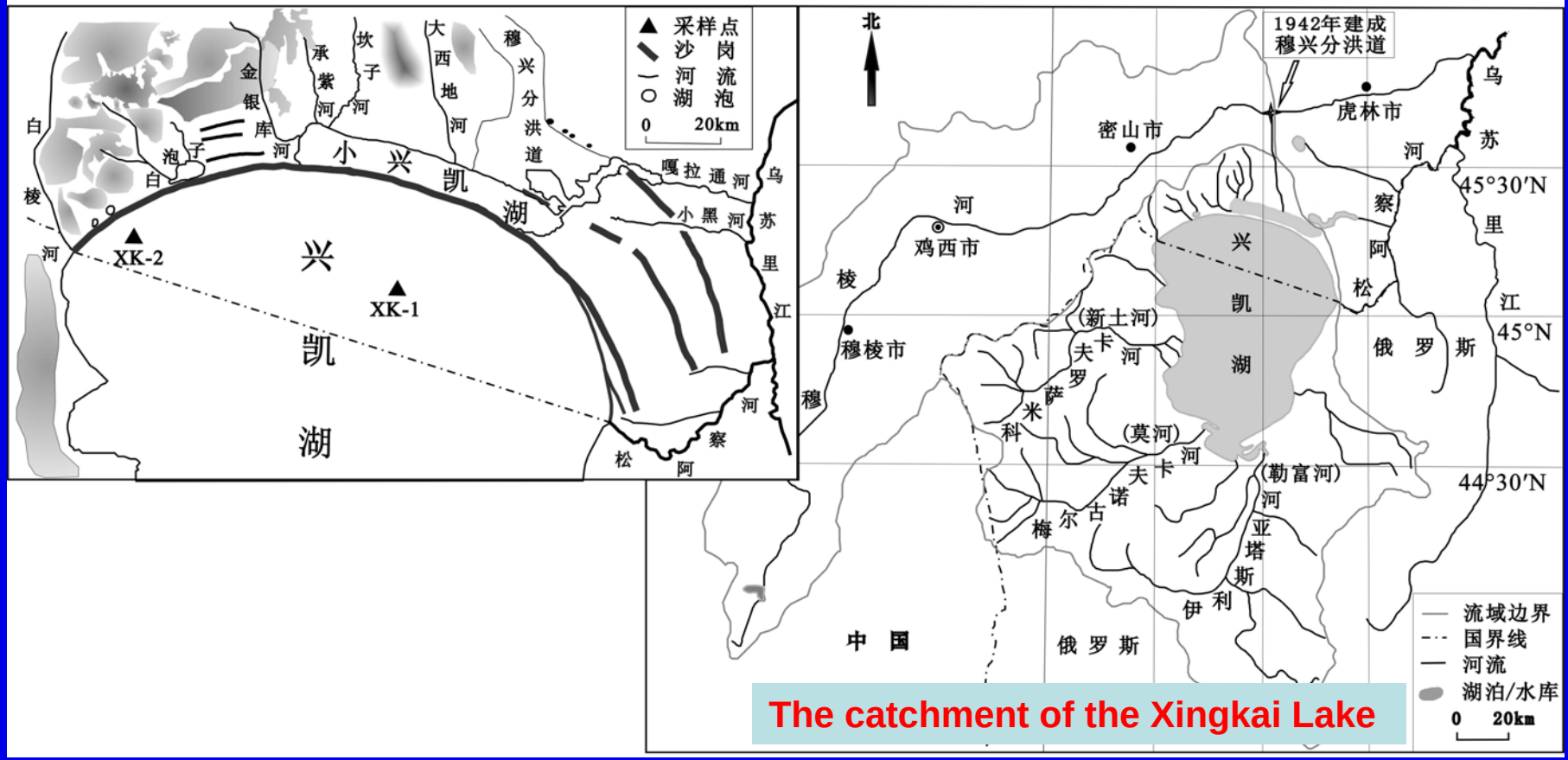
Lake-level change ⟹ precipitation, temperature

- In the global lake drilling project of the PEP (pole-equator-pole) belt, there are two Chinese lakes which have been concerned



Distribution of the lakes in the project of PAGES （Williams et al., 2001）

The Xingkai Lake Located on the boundary of China and Russia, It is the largest freshwater lake in NE Asia. The length from north to south is 91km, with the area of 4,380 km^2. But three forth, the south part, belong to the Russia. The average depth of the lake water is just 4m, and the deepest part is 12m.



The catchment of the Xingkai Lake

Situated at high latitude, climate in the lake catchment is controlled by both north pole and east Asia monsoon. In winter season, it's dry and cold due to the regime of the Mongolia High press; however in summer season, the climate is rainy and warm due to the warm-and-moisture east Asia monsoon. Therefore this area is very sensitive to climate change.

Our research work was divided into two steps:

1、We investigate the sand hills in the north of the lake to obtain the information about evolution of the lake, such as transgression and depression of the lake.

2、We drill sediment cores in the centre of the lake using platform. After that we will set up the time sequence by dating the cores and analyse multiple proxies, such as the pollen, grain size, TOC and isotopes.

1、Investigation of the sand hills

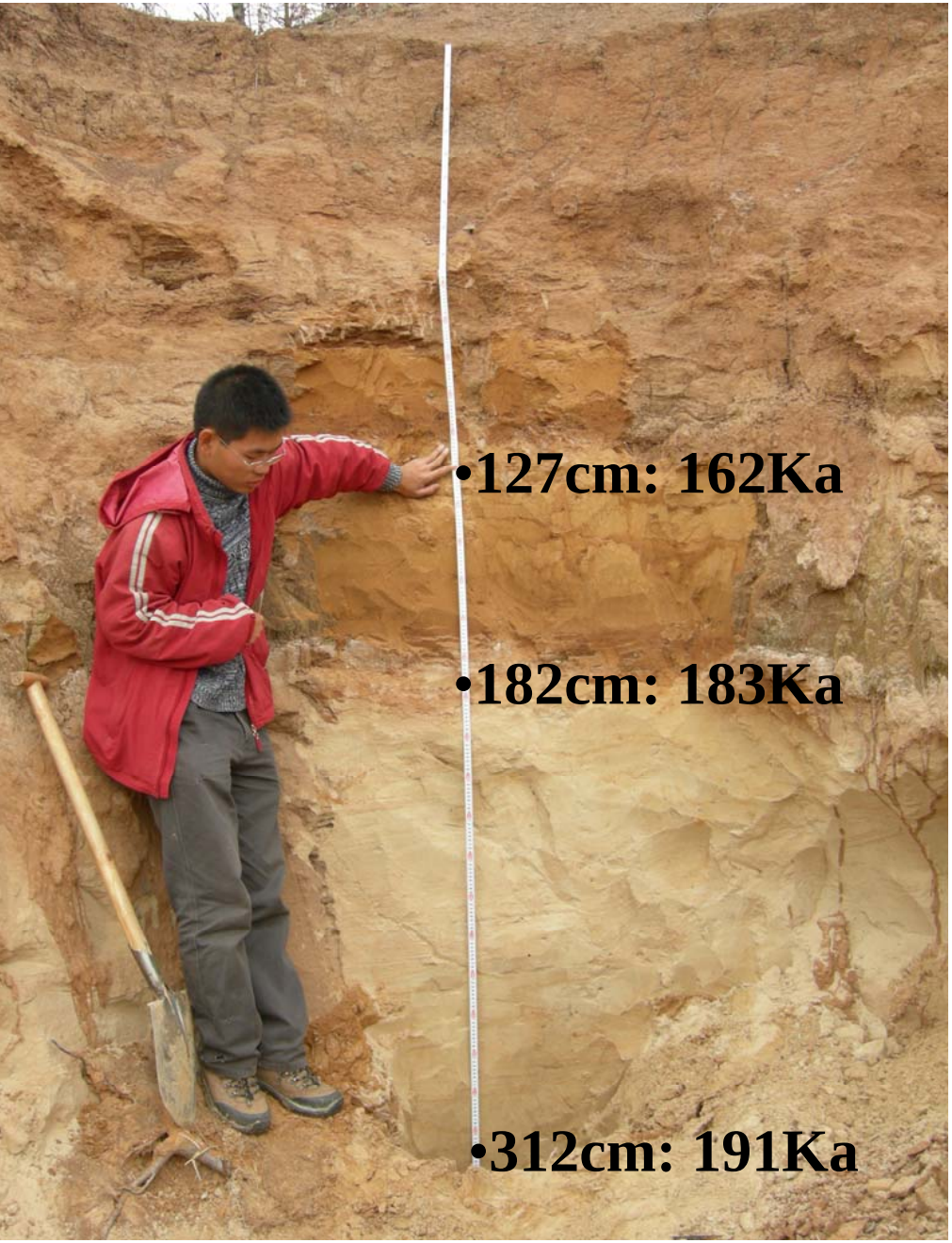
Sampling sites for OSL dating in the 4 terrace

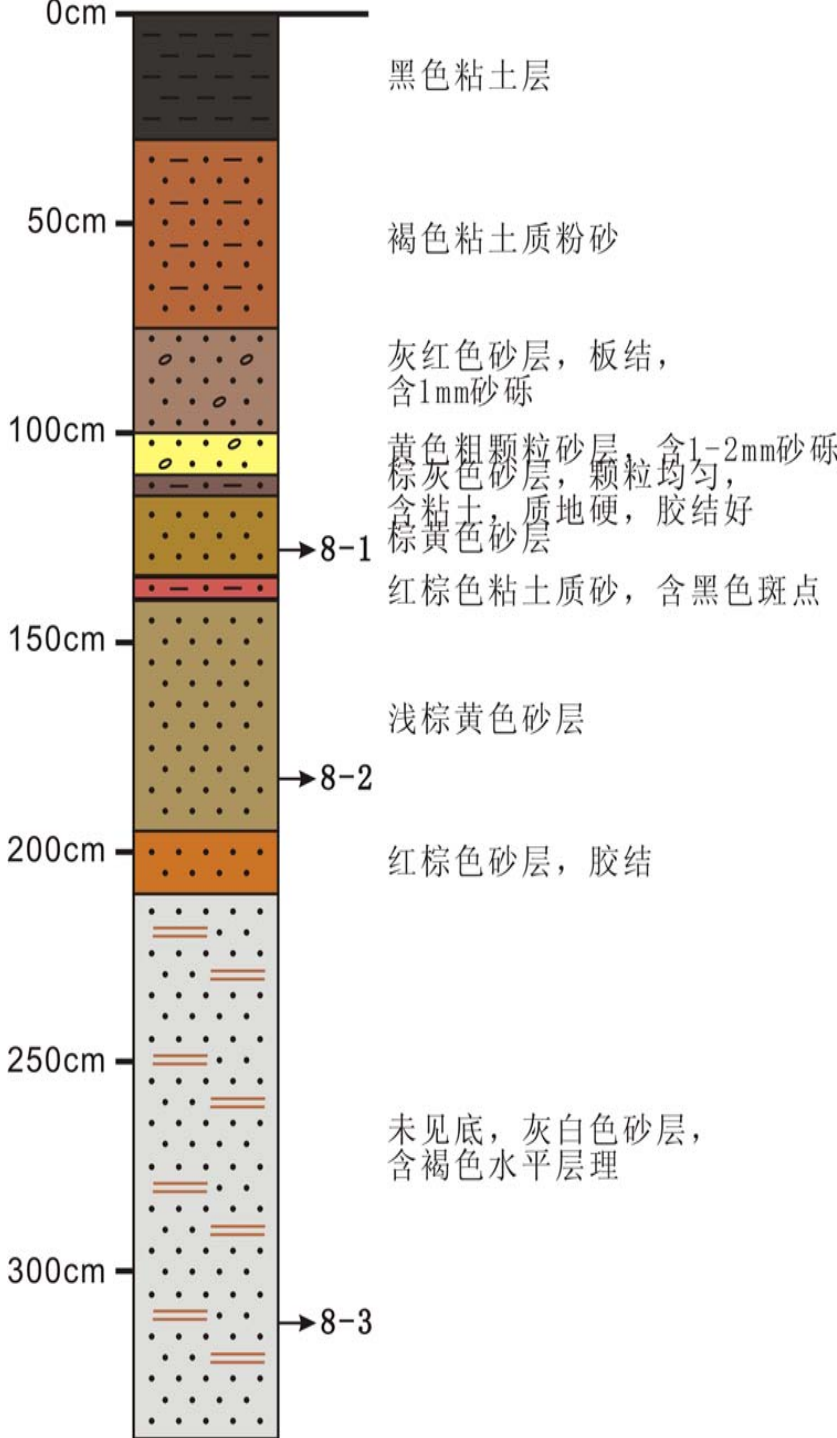
名称　荒岗（剖面8）

地点　造纸厂往东南深坑

Location:　N45° 15′ 11.4″
E132° 59′ 36.7″

length: 340cm


•127cm: 162Ka
•182cm: 183Ka
•312cm: 191Ka


0cm
黑色粘土层
50cm
褐色粘土质粉砂
灰红色砂层，板结，
含1mm砂砾
100cm
黄色粗颗粒砂层，含1-2mm砂砾
棕灰色砂层，颗粒均匀，
含粘土，质地硬，胶结好
棕黄色砂层
8-1
红棕色粘土质砂，含黑色斑点
150cm
浅棕黄色砂层
8-2
200cm
红棕色砂层，胶结
250cm
未见底，灰白色砂层，
含褐色水平层理
300cm
8-3

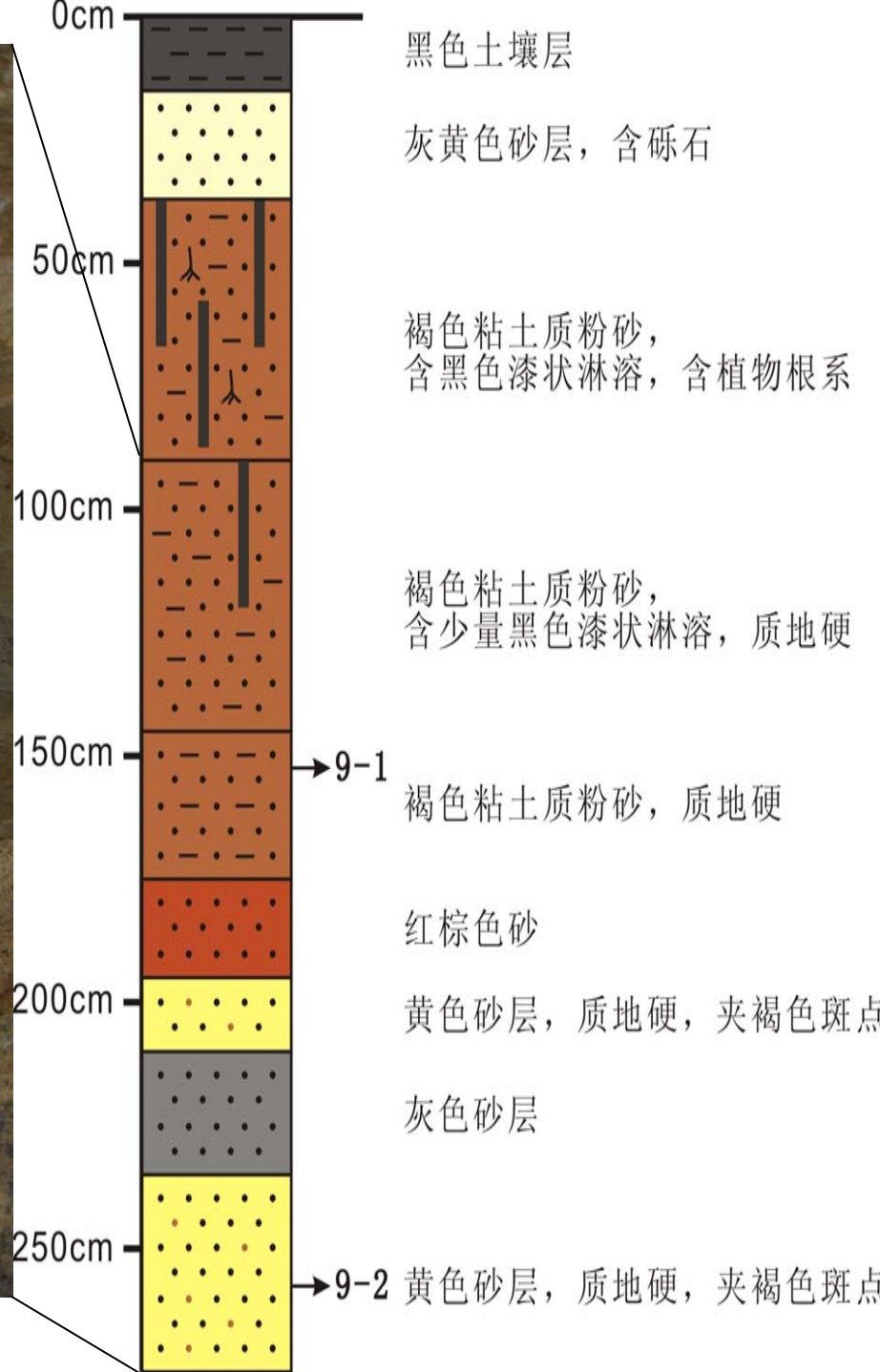
名称　二道岗（剖面9）

地点　兴凯湖5队与6队之间

Location: N45° 13′ 37.7″
E132° 55′ 20.1″

Length: 275cm


• 152cm: 128Ka
• 257cm: 135Ka


0cm
黑色土壤层
灰黄色砂层，含砾石
50cm
褐色粘土质粉砂，
含黑色漆状淋溶，含植物根系
100cm
褐色粘土质粉砂，
含少量黑色漆状淋溶，质地硬
150cm
9-1
褐色粘土质粉砂，质地硬
红棕色砂
200cm
黄色砂层，质地硬，夹褐色斑点
灰色砂层
250cm
9-2
黄色砂层，质地硬，夹褐色斑点

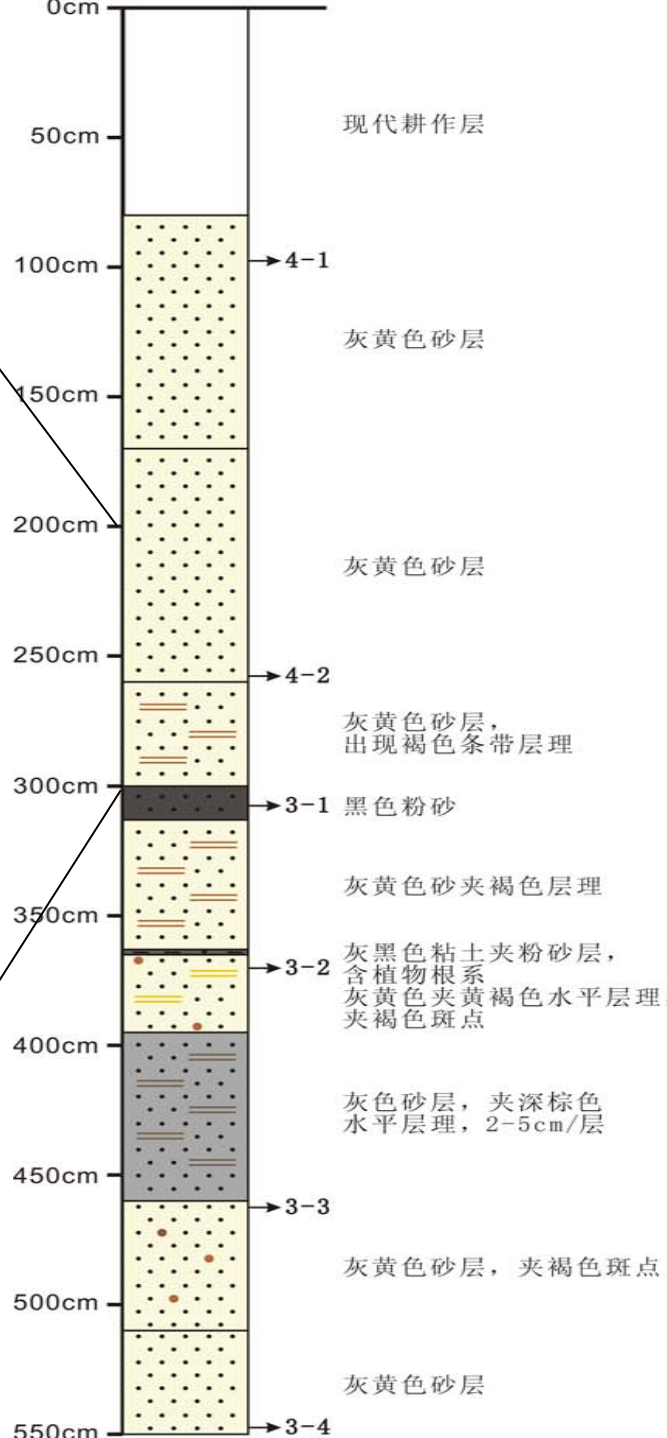
名称　太阳岗（剖面3）

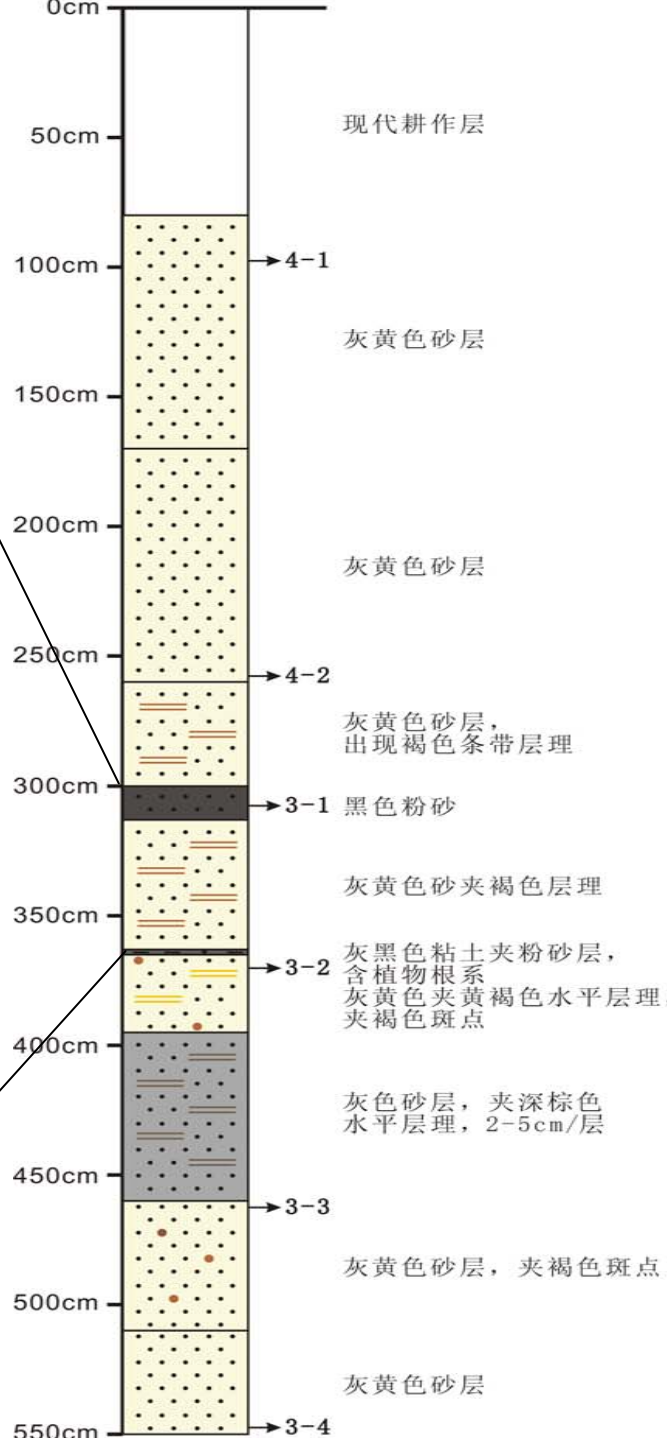
地点　养鹿场往西

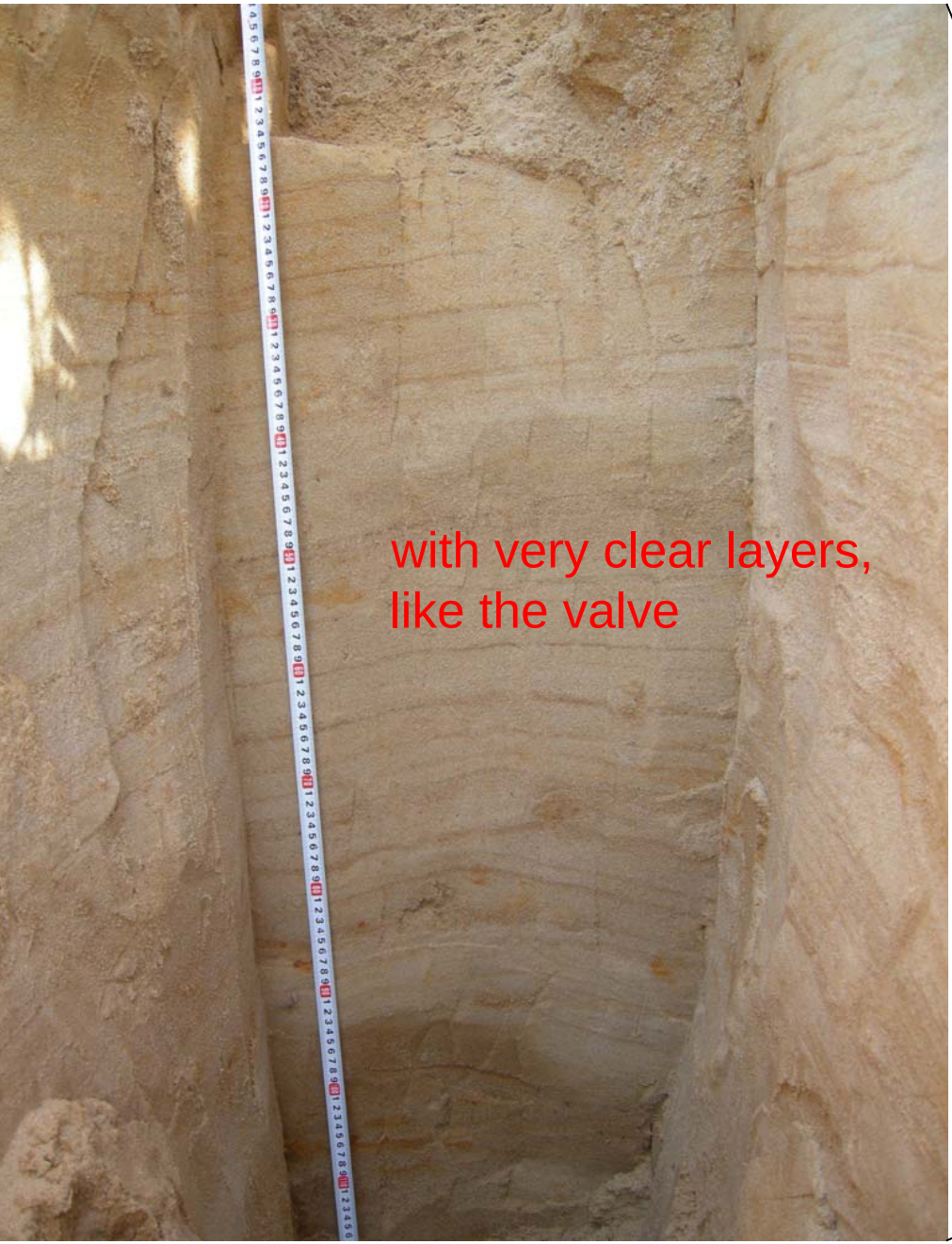
Location:　N45° 14′ 17.6″
E132° 45′ 33.1″

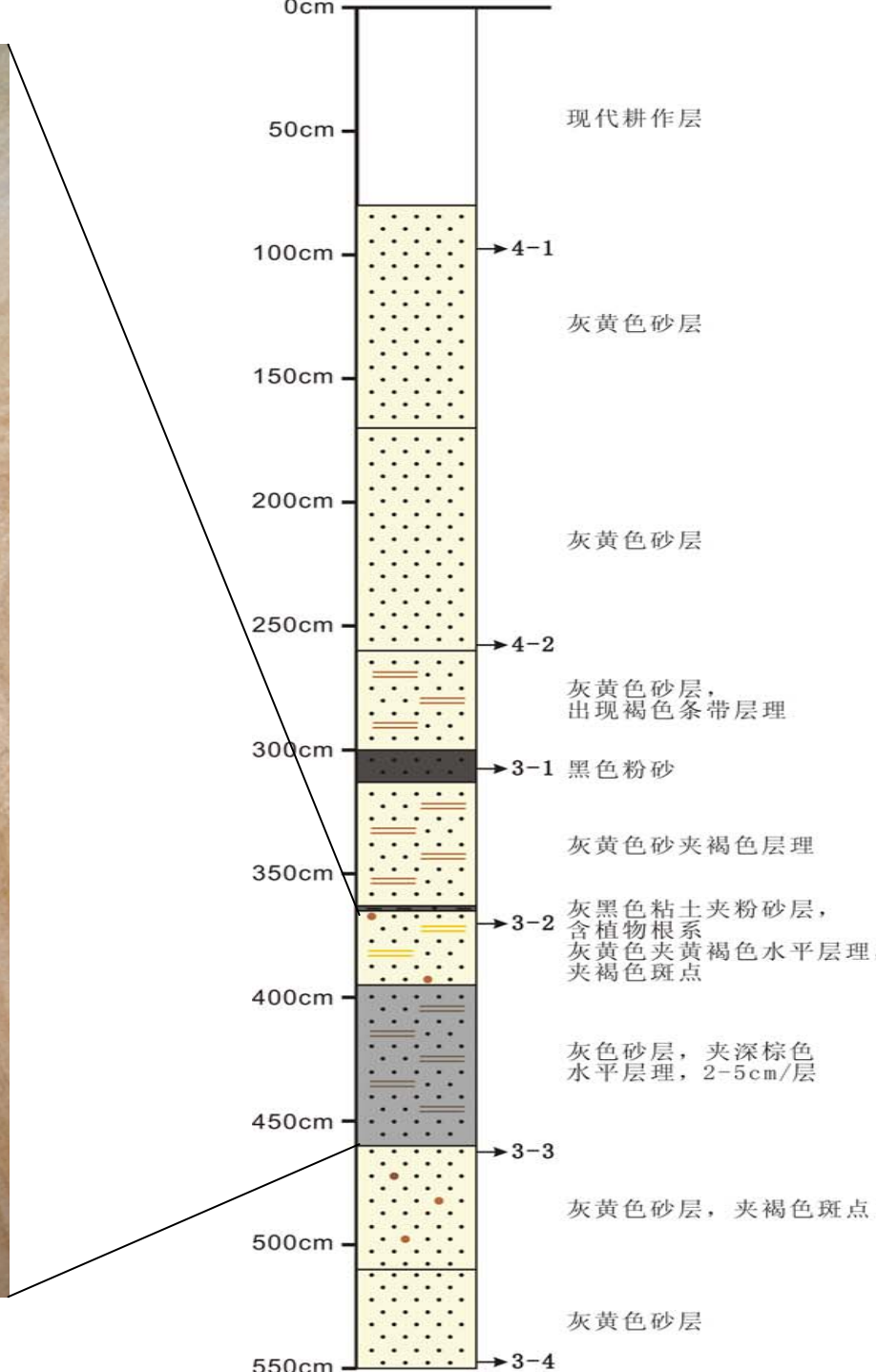
Length:　550cm

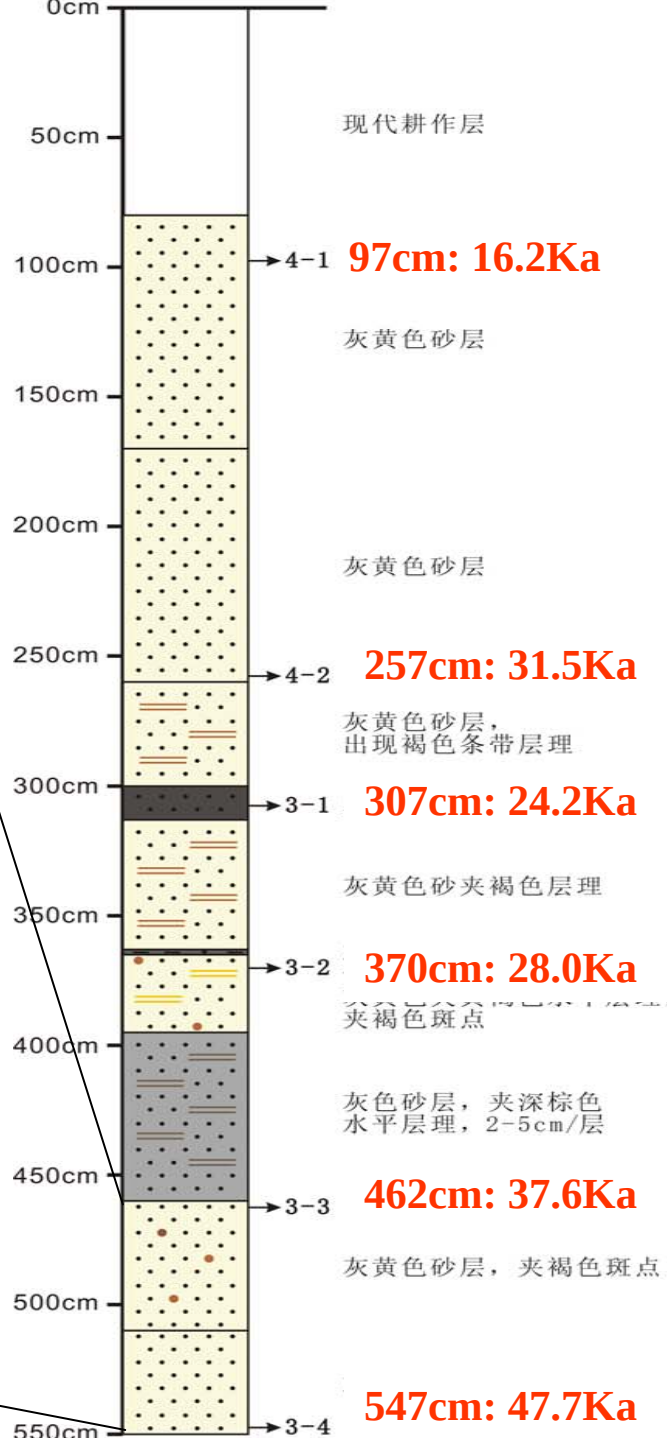
0cm
50cm 现代耕作层
100cm → 4-1 灰黄色砂层
150cm
200cm 灰黄色砂层
250cm → 4-2
灰黄色砂层，出现褐色条带层理
300cm → 3-1 黑色粉砂
灰黄色砂夹褐色层理
350cm
灰黑色粘土夹粉砂层，含植物根系
→ 3-2 灰黄色夹黄褐色水平层理
夹褐色斑点
400cm
灰色砂层，夹深棕色水平层理，2-5cm/层
450cm → 3-3
灰黄色砂层，夹褐色斑点
500cm
灰黄色砂层
550cm → 3-4


0cm
50cm
100cm
150cm
200cm
250cm
300cm
350cm
400cm
450cm
500cm
550cm
现代耕作层
4-1
灰黄色砂层
灰黄色砂层
4-2
灰黄色砂层，
出现褐色条带层理
3-1
黑色粉砂
灰黄色砂夹褐色层理
3-2
灰黑色粘土夹粉砂层，
含植物根系
灰黄色夹黄褐色水平层理
夹褐色斑点
灰色砂层，夹深棕色
水平层理，2-5cm/层
3-3
灰黄色砂层，夹褐色斑点
灰黄色砂层
3-4


0cm
50cm
100cm
150cm
200cm
250cm
300cm
350cm
400cm
450cm
500cm
550cm
现代耕作层
4-1
灰黄色砂层
灰黄色砂层
4-2
灰黄色砂层，
出现褐色条带层理
3-1
黑色粉砂
灰黄色砂夹褐色层理
3-2
灰黑色粘土夹粉砂层，
含植物根系
灰黄色夹黄褐色水平层理
夹褐色斑点
灰色砂层，夹深棕色
水平层理，2-5cm/层
3-3
灰黄色砂层，夹褐色斑点
灰黄色砂层
3-4


with very clear layers,
like the valve


0cm
50cm
100cm
150cm
200cm
250cm
300cm
350cm
400cm
450cm
500cm
550cm
现代耕作层
4-1
灰黄色砂层
灰黄色砂层
4-2
灰黄色砂层，
出现褐色条带层理
3-1
黑色粉砂
灰黄色砂夹褐色层理
3-2
灰黑色粘土夹粉砂层，
含植物根系
灰黄色夹黄褐色水平层理
夹褐色斑点
灰色砂层，夹深棕色
水平层理，2-5cm/层
3-3
灰黄色砂层，夹褐色斑点
灰黄色砂层
3-4


0cm
50cm
现代耕作层
100cm
4-1
97cm: 16.2Ka
灰黄色砂层
150cm
200cm
灰黄色砂层
250cm
4-2
257cm: 31.5Ka
灰黄色砂层，
出现褐色条带层理
300cm
3-1
307cm: 24.2Ka
灰黄色砂夹褐色层理
350cm
3-2
370cm: 28.0Ka
夹褐色斑点
400cm
灰色砂层，夹深棕色
水平层理，2-5cm/层
450cm
3-3
462cm: 37.6Ka
灰黄色砂层，夹褐色斑点
500cm
550cm
3-4
547cm: 47.7Ka

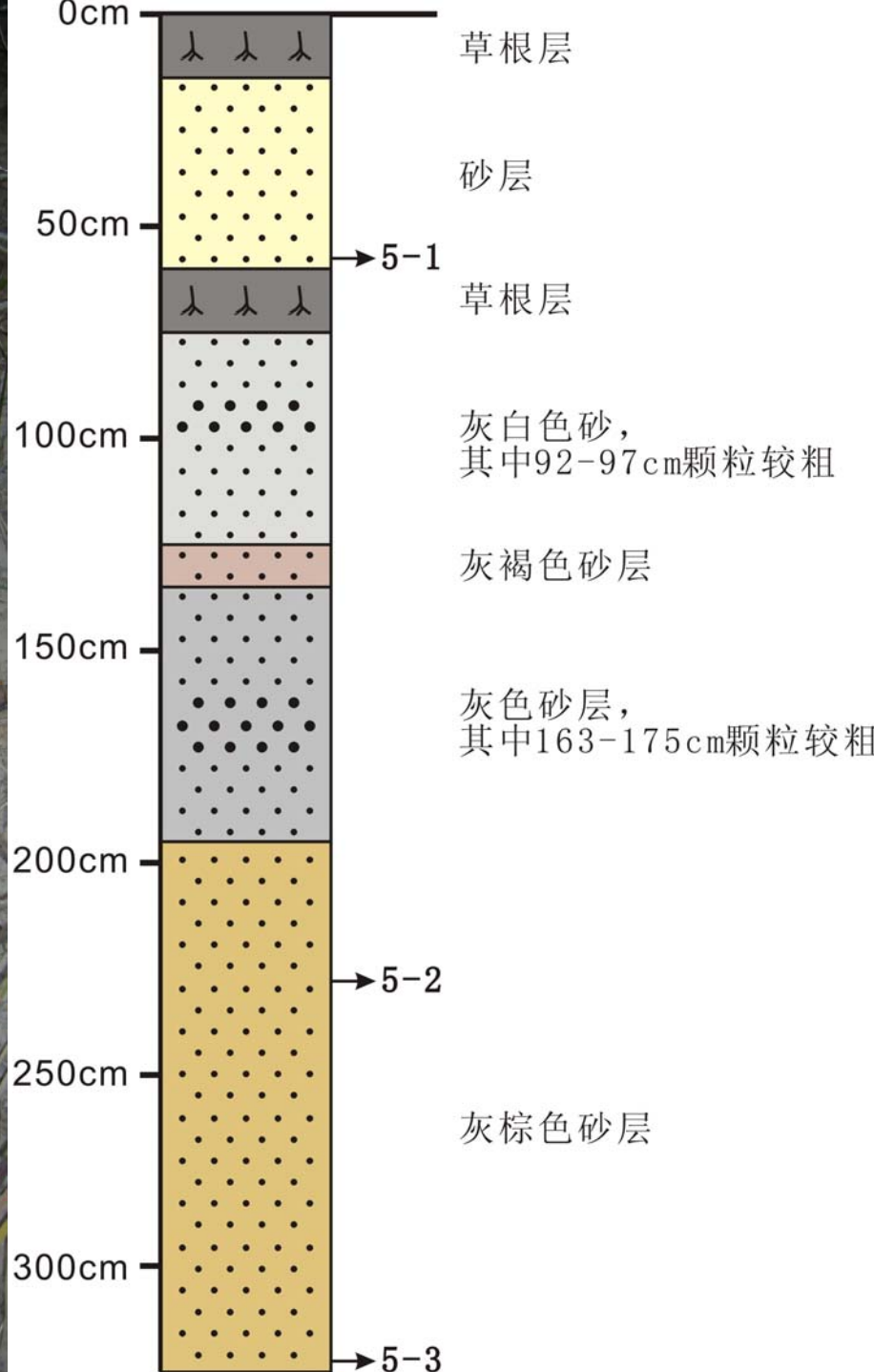
名称　大湖岗（剖面5）

地点　去场部的分岔路口

Location: N45° 15' 25.73"
E132° 43' 27.47"

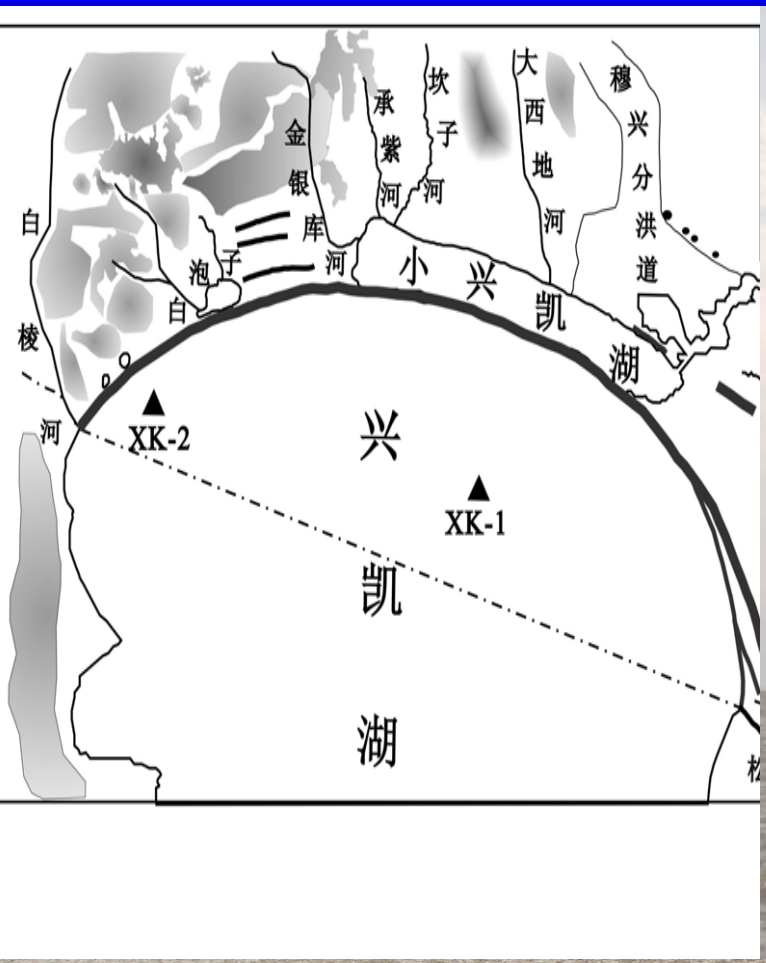
Length: 230cm


• 57cm: 0.7 Ka
• 227cm: 1.6 Ka
• 317cm: 2.0 Ka

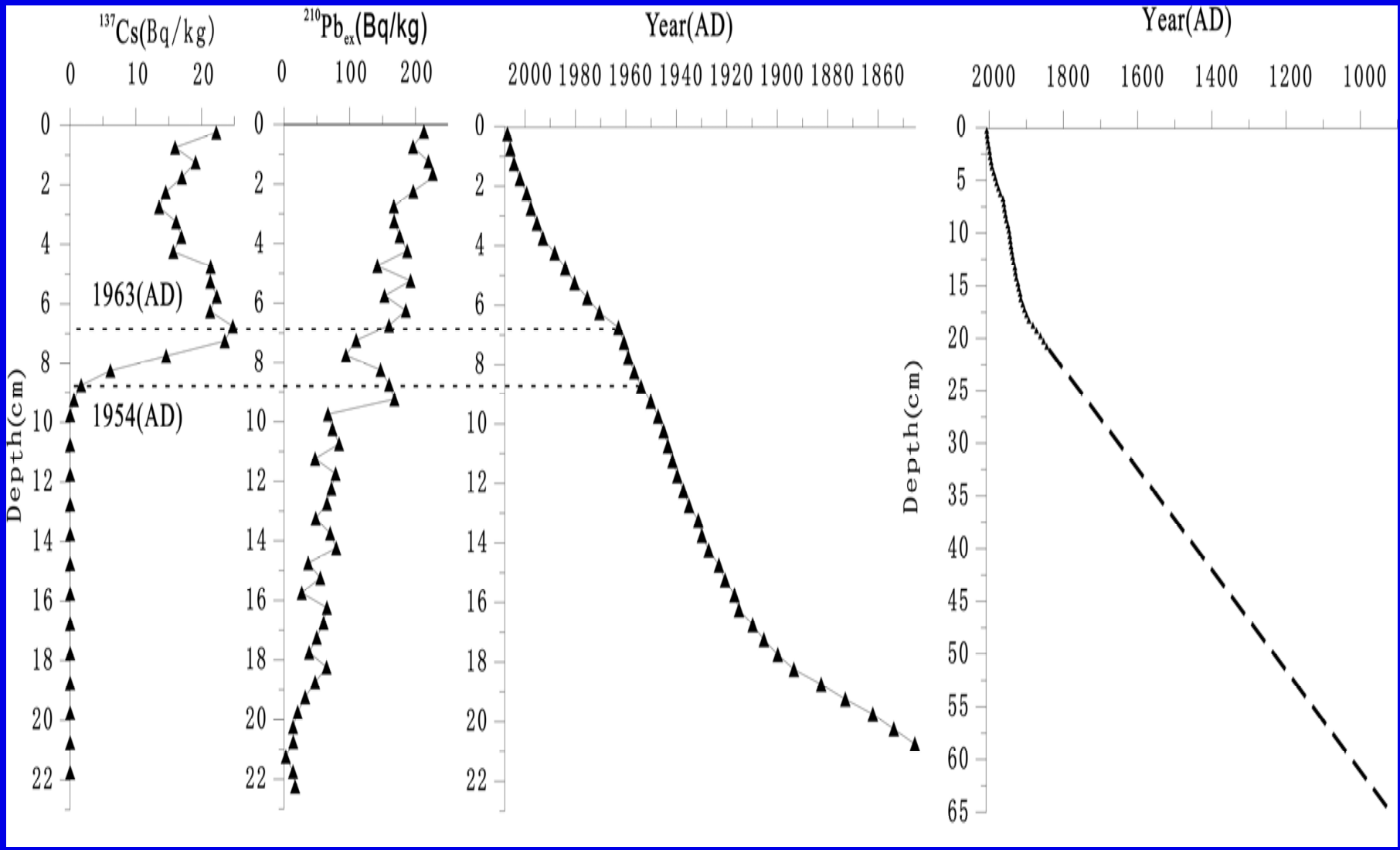

0cm
草根层
砂层
50cm
5-1
草根层
灰白色砂，
其中92-97cm颗粒较粗
100cm
灰褐色砂层
150cm
灰色砂层，
其中163-175cm颗粒较粗
200cm
5-2
250cm
灰棕色砂层
300cm
5-3


大湖岗（剖面1）
0.7 — 2.0 Ka
大湖岗（剖面5）
47 — 16 Ka
太阳岗（剖面3、4）
大湖岗（剖面2）
135 — 191 Ka
荒岗（剖面6、7）
荒岗（剖面8）
二道岗（剖面9）
128 — 135 Ka
Indicated that the lake water retreated since about 200Ka

2、Study of Lake sediment cores

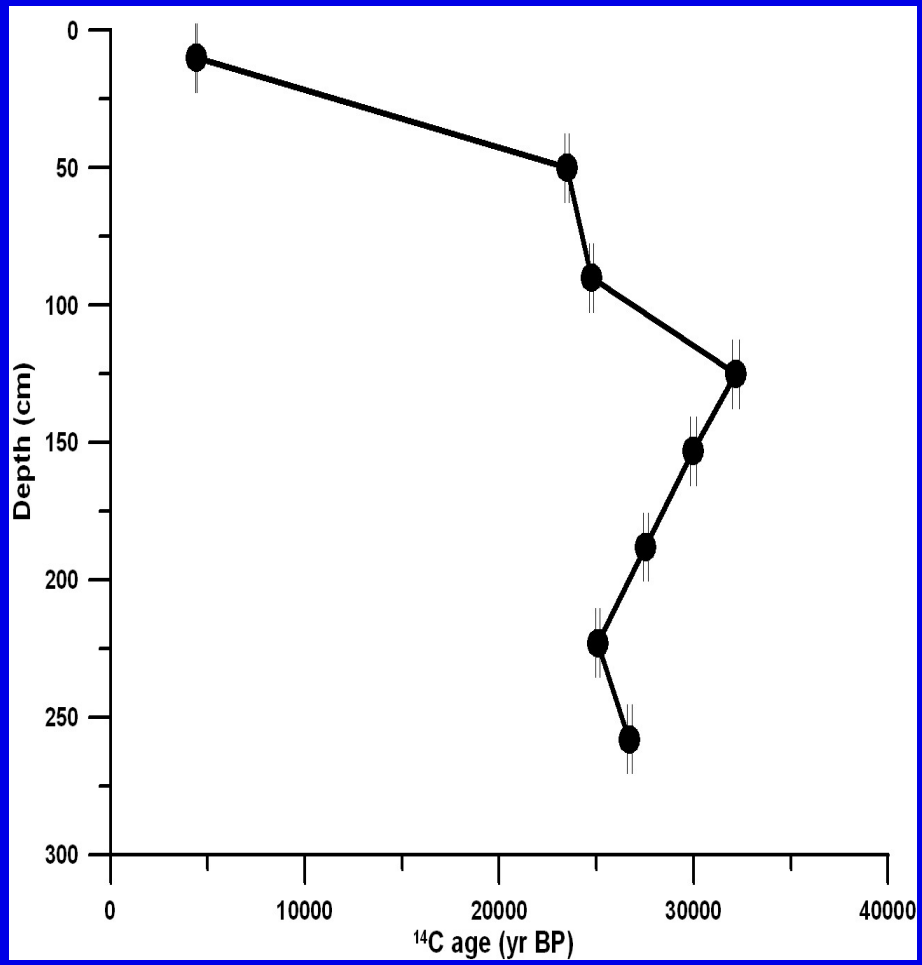


Dating by ^{137}Cs, ^{210}Pb



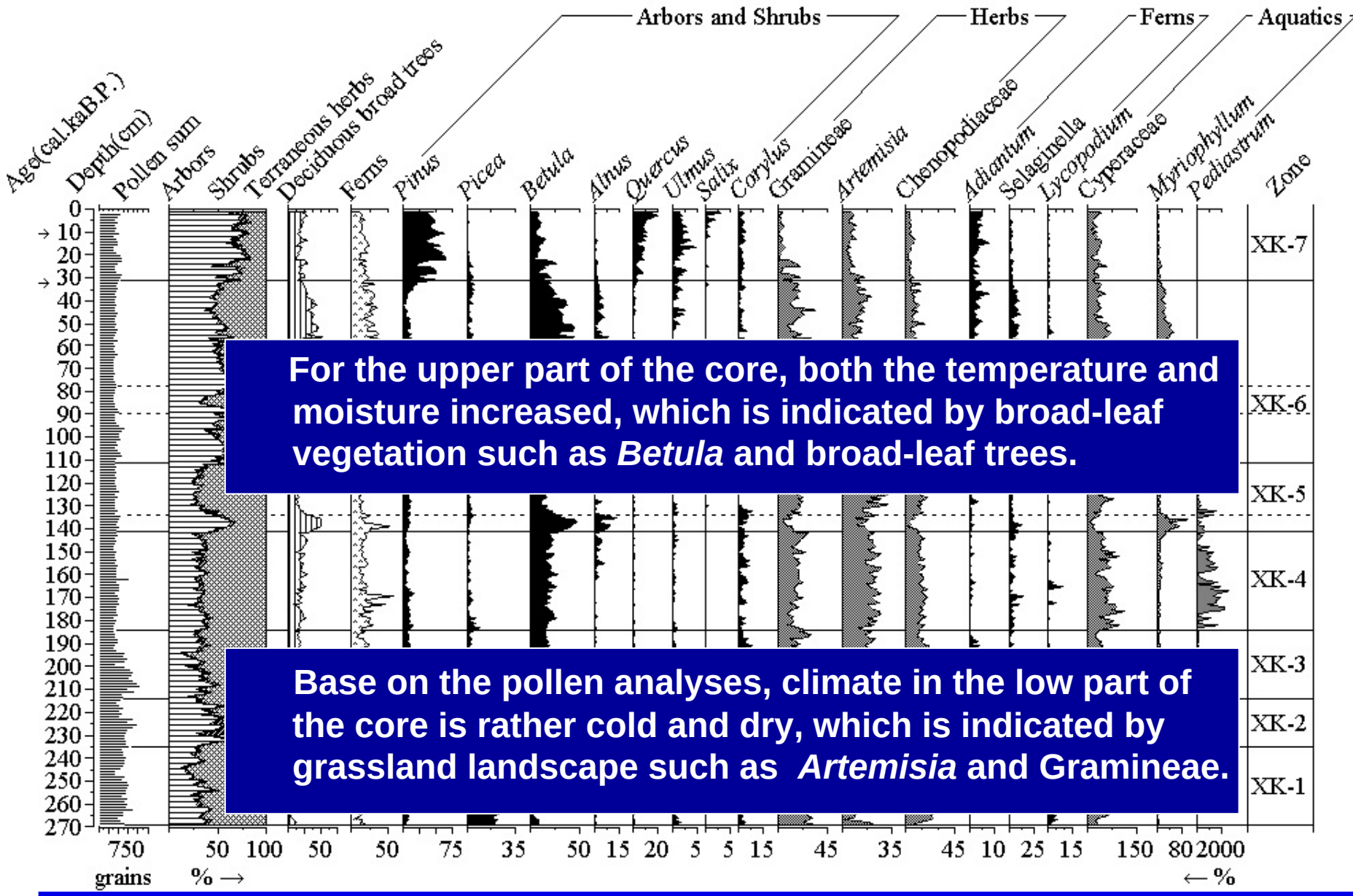
- Sedimentation rate is 1.4 mm/a

Dating the core by AMS ^{14}C



We sent 8 samples to Tokyo University, Japan for the AMS dating. Unfortunately, because of the low TOC content (less than 1% for the samples) , The time sequence of the sediment core is confused.

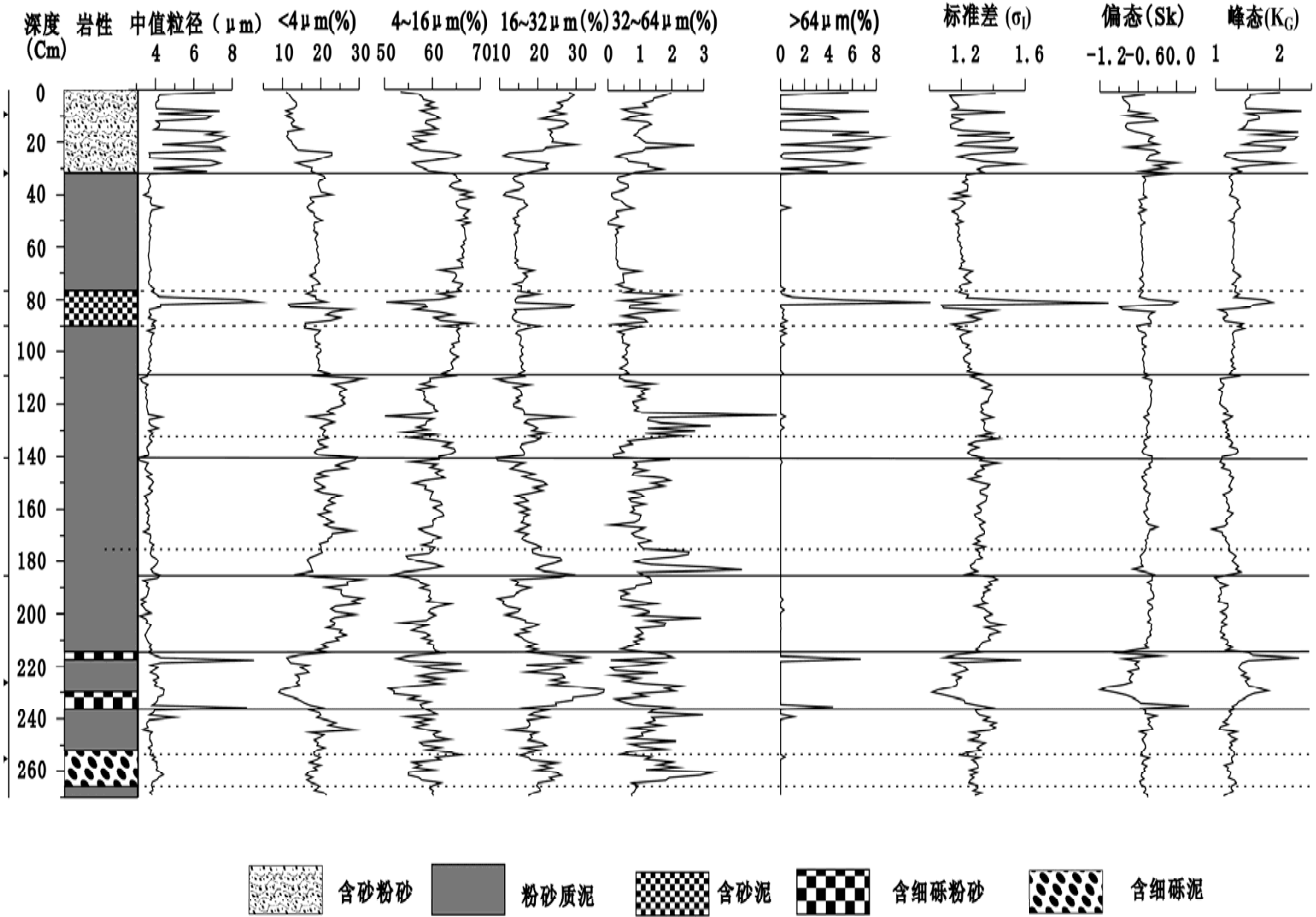
Pollen analysis of the core



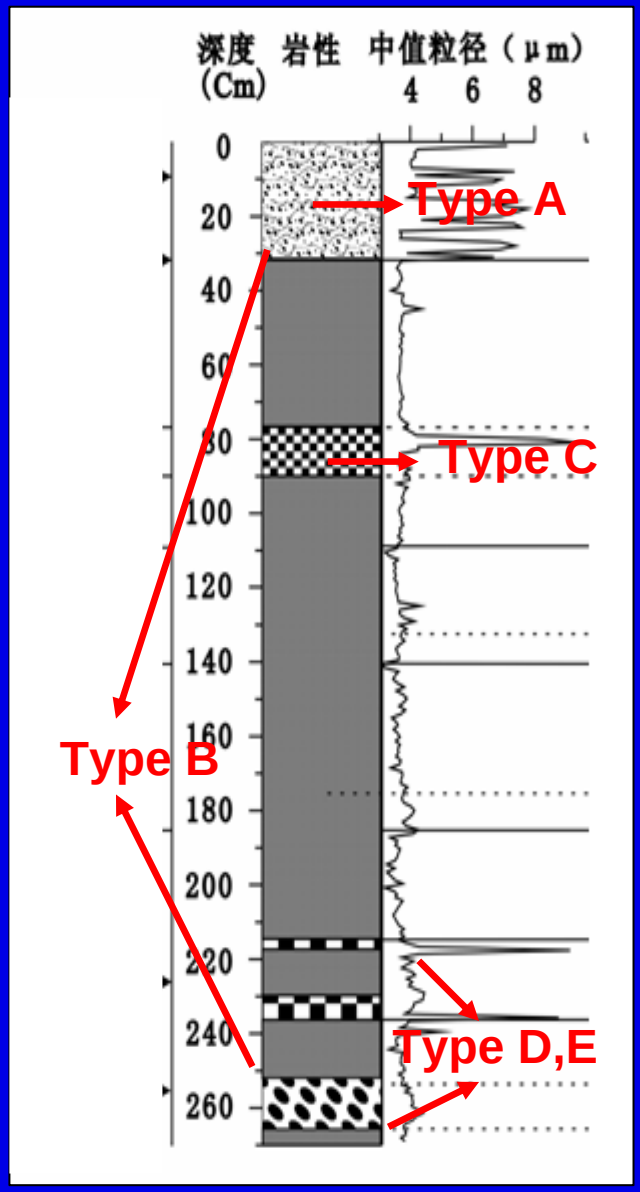
For the upper part of the core, both the temperature and moisture increased, which is indicated by broad-leaf vegetation such as *Betula* and broad-leaf trees.

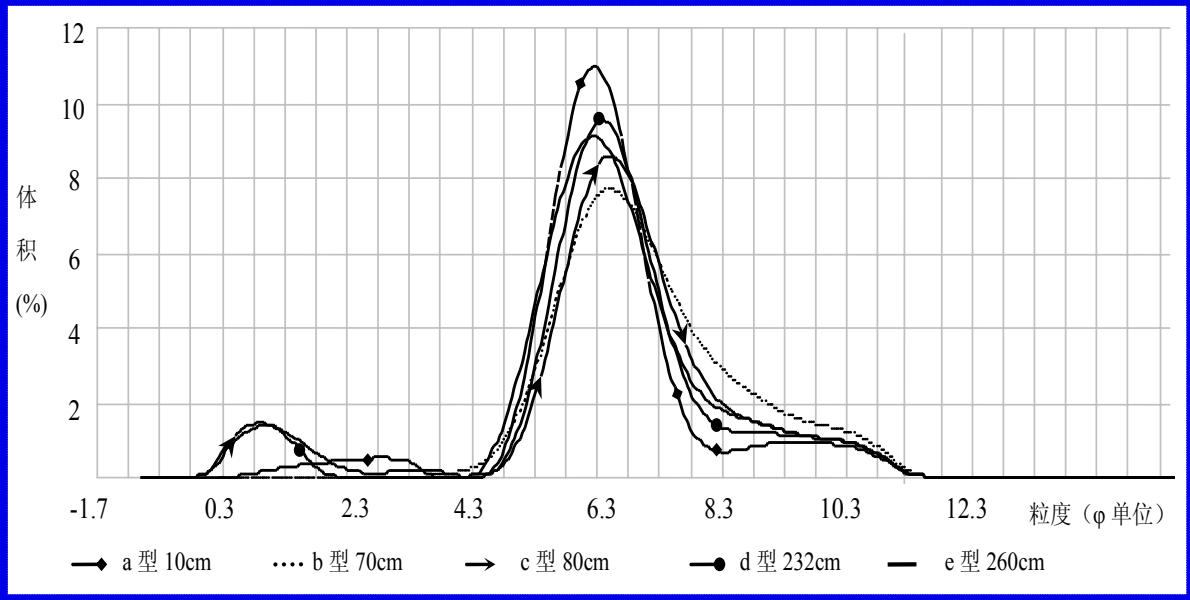
Base on the pollen analyses, climate in the low part of the core is rather cold and dry, which is indicated by grassland landscape such as *Artemisia* and Gramineae.

Particle size of the sediment core



Relationship between particle size and sediment environment

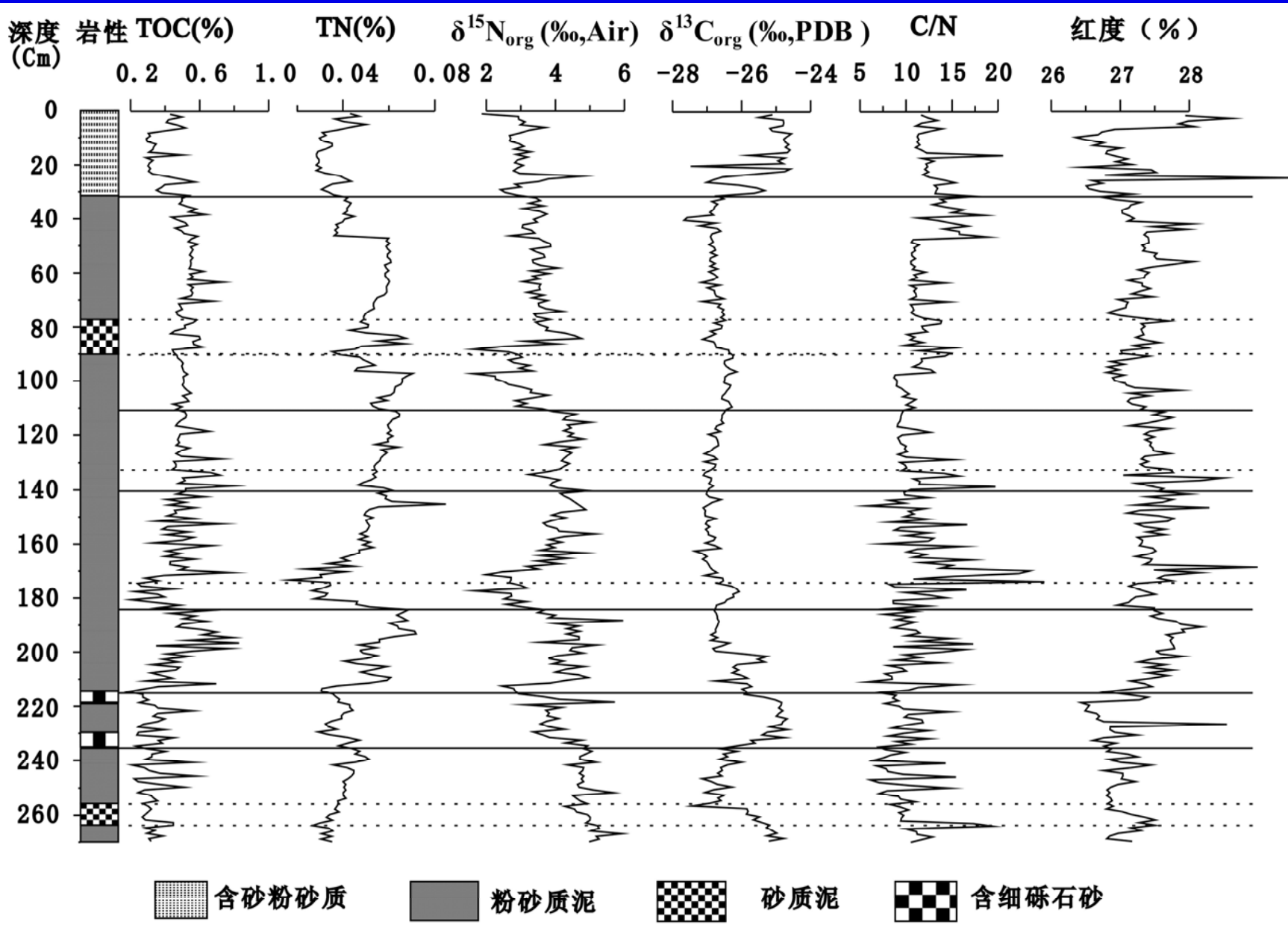




Based on distribution of the particle size, we set up the relationship between particle size and the sediment environment.

For the top part, particle size belong to type A which indicate low lake level and increased hydrology. Most part of the sediment core belong to type B which represent the shallow lake. In the middle of the core the type C indicate shallow but strong hydrology. In the bottom of the core the type D and E refer very strong hydrology.

Other environmental proxies of the core



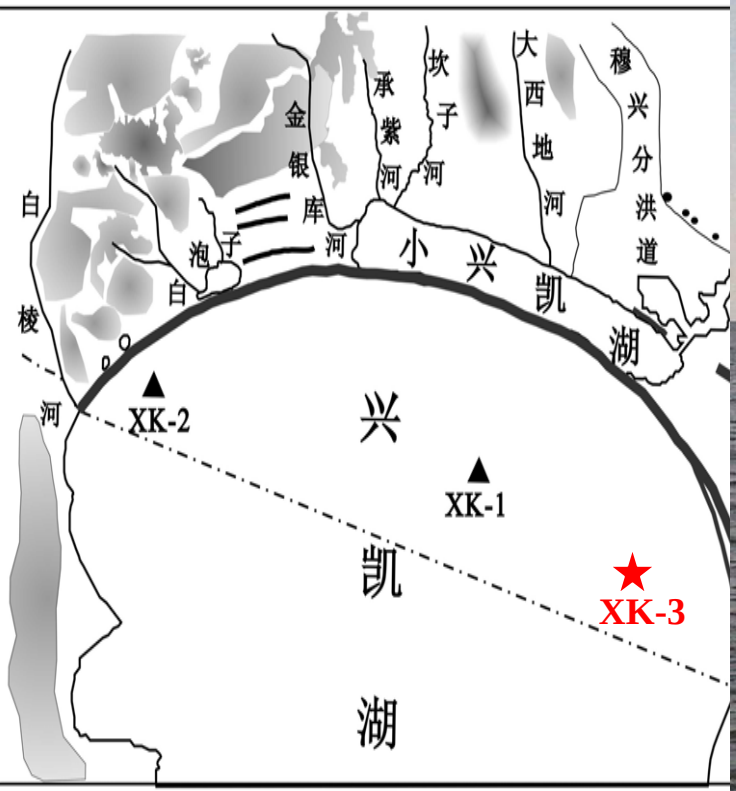
Conclution

1/ Lacustrine transgression was preserved by sand hills and the lake water retreated from north to south since about 200 Ka.

2/ Based on analysis of multi-proxy of the core

- climate in lake catchment was cold and dry in the early time, then both the temperature and moisture increased.
- the lake level fluctuated several times and the hydrodynamics was very strong.
- Without time sequence for the core, it is difficult for us to discuss evolution of the environment

Next work



Last year we obtained a cooperate research project with our Japanese colleagues and Korea colleagues. We selected our research site in the Xingkai Lake (another site is Jingpo Lake). In August 16, we drilled in the site of XK-3 and obtained the sediment cores which reach to 3.5m. We plan to dating the core again and measure some environmental proxy for these cores.

Our colleagues (Prof. Kashiwaya, Prof. Hasebe and the student) joined this field work

So, after this workshop some Japanese colleagues will come to Nanjing Institute to cut the sediment core.


Thank You !