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Research Advances

The First Discovered Last Glacial Maximum (LGM) Event in the Middle and Lower Region of the Yongding River Basin, Southern Beijing Plain

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Objective

LGM is a critical climate period in the late Quaternary and is the most recent extreme cold event. Clark et al. (2009) used 4271 ^{14}C records and 475 cosmogenic nuclide datings to define LGM be in 26.5–19.0 kaBP. LGM age often changes with time in different regions (Mix et al., 2001; Zhang Zhigang et al., 2015). However, LGM has not been described to date in the Beijing region. During our field work in 2015–2017, LGM event stratigraphy was discovered from sevral boreholes in the middle and lower region of Yongding river basin, Southern Beijing plain.

This is the first discovered LGM event in the Beijing region and it is very important to explore the evolution and distribution of the strata and paleoclimate of LGM.

Methods

During the field work, we measured and described the strata in detail, collected the samples such as organic sediment and shell,and recorded the distribution of different samples. We analyzed the deep and space distribution and the characteristics of LGM valley.

Results

(1) Discovered hard clay layer

Hard clay was discovered firstly in our study area, which was widely distributed with a layer of bronzes, brown, reddish-brown. As a discontinuity buried below the Holocene strata, its thickness varies from dozens of centimeters to 3.6 m. According to analysis of the data ^{14}C (first reported), it was mainly formed in (23190±10)–(12380±40) BP (Appendix 1), which has proved the hard clay was formed the last glacial maximum. There are some characteristics such as adhesion, leaching, deposition, oxidation and reduction, and lack of bedding structure. So it was exposed to surface and consolidated equivalent. The upper layer began to appear fluvial sand and organic sediments and the upward color turned to be dark. It was a sign of warming and increasing precipitation after the ice age.

(2) Pollen concentration's abnormality

In the PGZ01 hole, the hard clay layer (19.1 m) was conducted sporopollen analysis. The records show that the absolute concentration of the wood and algae is very low in the sporopollen, and the the sporopollen assemblage is monotonous with no algal spores. The sporopollen assemblages are different from those above 7.9–13.4 m and below 28.5–41.7 m. It is further confirmed that LGM is a period of geological changes and environmental deterioration, resulting in undeveloped vegetation.

(3) Discovered incide valley

In the LGM lowest sea level, the base level of erosion of river was decreased. While the water quantity is small, river dynamic process is strong, leading to stream trenching and headward erosion in the middle and lower region of Yongding river basin. As in the AC01 borehole, it reveals the channel was cut down according to the ^{14}C age (Appendix 1). The existence of paleo-incised valley was seen. Because of the long exposure to the earth surface, the widely distributed hard clay layer (Fig. 1) is formed between the interfluve.

Conclusion

Up to data, The LGM has been firstly discovered from the middle and lower region of Yongding river basin, southern Beijing plain. The LGM strata are preserved and the characters are self-evident. It can open another window for us to explore the paleoclimate and even the evolution of terrestrial ecosystems.

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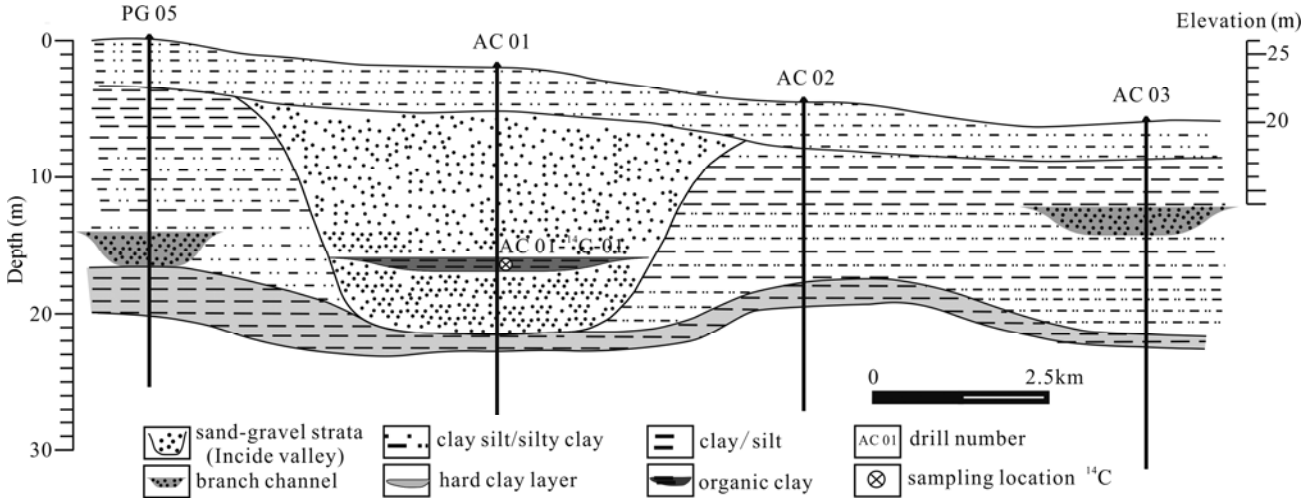

Fig. 1. The geological section of ancient stream channel.

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Appendix 1 List of AMS ^{14}C results

Sample number	Depth (m)	Material	Conventional Radiocarbon Age (aBP)	Borehole location
AC27-^{14}C -07	12.25	Organic sediment	12380±40 BP	39°31'19.62", 116°45'34.33"
L05-^{14}C -01	3.45	Organic sediment	14620±40 BP	39°37'27.88",116° 2'56.95"
P01-^{14}C-10	17.80	Organic sediment	16570±50 BP	39°30'55.22",116°20'9.22"
AC27-14C-06	14.6	Organic sediment	18870±60 BP	39°31'19.62", 116°45'34.33"
AC01-^{14}C-01	14.70	Organic sediment	19530±60 BP	39°39'33.70",116°30'36.71"
AC27-^{14}C -03	14.80	Organic sediment	20890±80 BP	39°31'19.62", 116°45'34.33"
L07-14C-02	4.80	Organic sediment	21760±70 BP	39°38'58.88",116° 7'24.94"
AC05-^{14}C -01	8.90	Organic sediment	21860±80 BP	39°39'42.46",116°42'16.79"
AC6-^{14}C -01	7.30	Organic sediment	22420±90 BP	39°39'40.18",116°43'42.74"
L05-^{14}C -02	7.00	Organic sediment	23040±90 BP	39°37'27.88",116° 2'56.95"
P05-14C-05	31.45	Organic sediment	23190±100 BP	39°34'47.04",116°20'50.30"