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Research Advances

The Dry-Cold Climate of the Qijia Archeological Civilization in Chankou of the Loess Plateau along the Silk Road Since the Neolithic Period

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Objective

Large numbers of archeological relics from the Neolithic period are widely distributed in all tributaries of the Yellow River. The early humans tended to reside along the river valleys, and developed small but characteristically decentralized ancient valley culture. It is universally acknowledged that the agriculture exchange between China and western countries and the moderate climate pushed the Neolithic culture prosperity (Chen et al., 2015; Liu Lian et al., 2016; An Chengbang et al., 2017). In this study, we used environmental proxies and age data from the terrace archeological relics sediment section, which are found at the first time in Chankou, a part of the Guanchuan River, the tributary of Yellow River in Gansu to reconstruct the palaeoenvironmental change since the last degalcial period, Qijia culture formed under the dry and cold climatic background and with a relative independence.

Methods

Sediment grain size, carbonate-content, TOC-content, element, Fe^{2+} ion concentration, carbon and oxygen isotope of carbonates, organic isotope and *n*-alkane biomarkers were analyzed from the sediment section at a depth of 747 cm taken from the first terrace of Chankou, the Guanchuan River tributary of Yellow River in Gansu. Five AMS ^{14}C data were determined in the BETA and Lanzhou University radioactive labs and an age model since ~13500 cal. a BP is built after the calendar year calibration (Appendix 1).

Results

According to the reconstructed paleoenvironment (Fig. 1.), it was cold and dry indicated by the low river-level sand and gravel sediment before ~13500 cal. a BP. From 13500 to 12800 cal. a BP, two peat layers embedding one silt layer with abundant ostracod shells of *Ilyocypris* sp. and *Tonnacypris tonnensis* indicate a cold/wet-cold/dry-cold/wet climate cycle, which may fall to the Bölling-Older Dryas-Allerod interstadial in the last glacial. From 12800 to 11300 cal. a BP, a cold and dry climate condition was featured by the grass savanna. From 11300 to 5200 cal. a BP, it was a semi-dry forest-grassland environment under high effective humidity, and two arid events occurred during 8300–8100 cal. a BP and 7350–6950 cal. a BP. From 5200 to 3700 cal. a BP, it was a cold and dry climate condition, and one thick green and grey silty mud layer containing a large number of pottery relics belonging to the period of Late Majiayao to Qijia culture, were discovered. The pottery relics are green and sandy ceramics, which sintered at low temperature and decorated with rope imprints. The pottery manufacture technique represented two methods: the first type of pottery was primarily pinched by fingers and the second type was advanced in a more sophisticated way on potter's wheels with rope ornaments on the outer and inner walls. The archeological relic illustrates that human being migrated to the alluvial flat near by the river when the stream shrank under the cold and dry climate condition. From 3700 to 2000 cal. a BP, loess sediment indicates an arid climate characteristic with the grass savanna, although the precipitation and temperature recovered by a small degree. From about 2000 cal. a BP to present, human activity has been strengthened in this area.

Conclusion

The Majiayao-Qijia culture during 5200–3700 cal. a BP in Chankou belongs to a branch of aboriginal culture with the closure of primitive civilization. Certainly, the

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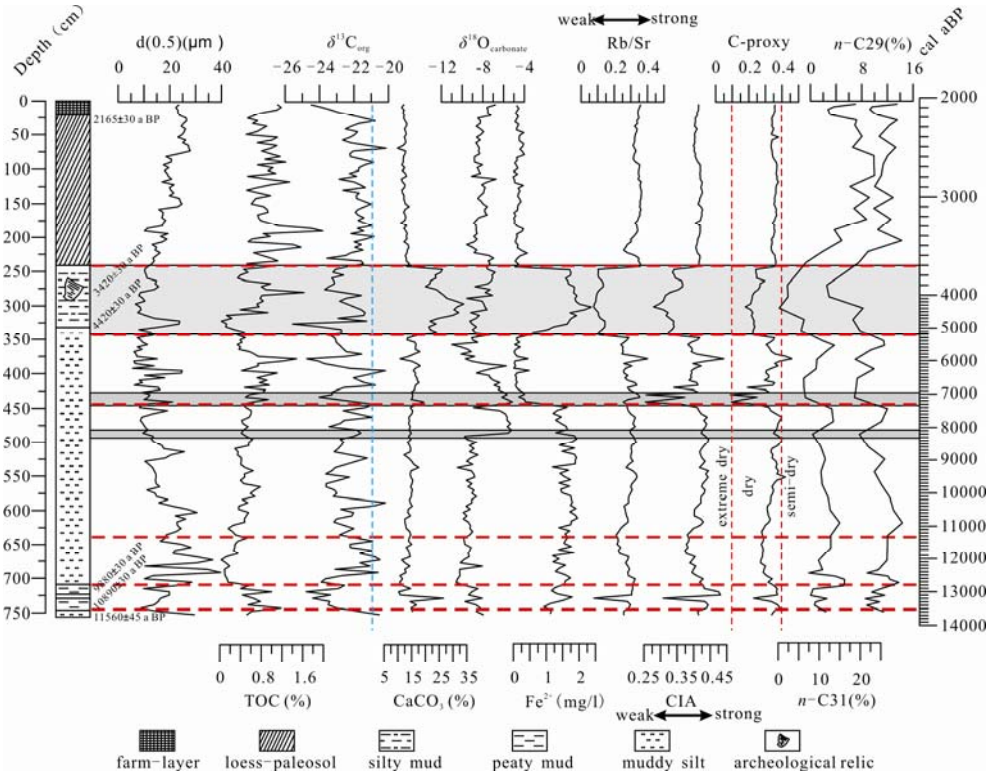

Fig. 1. Paleoenvironmental change since last deglacial and archeological relic layer in the first terrace of Chankou, the tributary of Yellow River.

undeveloped method of production was also influenced by the advanced manufacturing technique from the mainstream culture at that time. It shows that paleocultures in the Silk Road were exchanged to some degree. Relic places in the river valley where the palaeo-culture located along the tributaries of Yellow River had a direct connection with the paleoclimate. Cold/wet and warm/wet climate with high effective humidity were favorable for the forest-grassland development and human activity during the last deglacial to the middle of Holocene (about 13500–5200 cal. a BP). The climate was cold and dry during the Majiayao-Qijia culture periods (5200–3700 cal. a BP), and the river runoff decreased in the upstream of loess plateau. It was an arid period from 3700 to 2000 cal. a BP with low effective humidity and grassland vegetation dominated, when human activity was weakened in the Chankou area.

Acknowledgments

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Appendix 1 Radiocarbon dating results for the Chankou section determined in the BETA (USA) and Lanzhou University AMS Lab (China)

Lab ID	Sample ID	Depth (cm)	Material	$\delta^{13}C_{org}$ (‰)	$F^{14}C^{*}$	^{14}C a BP	Cal. a BP (min.)	Cal. a BP (max.)
LZU16336	LJG2016-8	30–32	TOC	-	0.7636±0.0027	2165±30	2247	2300
BETA-422874	LJG206-69	274–276	TOC	−22.7	-	3420±30	3590	3720
LZU16337	LJG2016-84	338–340	TOC	-	0.5767±0.0018	4420±30	4959	5047
LZU16339	LJG2016-172	710–712	TOC	-	0.2923±0.0011	9880±30	11236	11287
BETA-422875	LJG2016-174	720–722	TOC	−24.7	-	10890±30	12720	12780
LZU16340	LJG2016-178	740–742	TOC	-	0.2372±0.0013	11560±45	13328	13436

Note: *Fraction modern *sensu* Reimer et al. (2004).