GEOCHEMICAL RECORDS OF PALAEOCLIMATIC CHANGES IN WEINAN SECTION SINCE THE LAST INTERGLACIAL

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ABSTRACT: Weinan section consists of Holocene soil S0, last glacial loess L1, and last interglacial soil S1, furtherly L1 can be subdivided into three layers of loess (L1-1, L1-3, and L1-5), and two layers of weakly developed soil (L1-2 and L1-4). Based on studying the content variations of carbonate, free Fe₂O₃, and the total organic content in Weinan section, the environmental evolution of this region has been discussed over the last glacial-interglacial cycle. Our results indicate that the chemical parameters can be used as climatic proxy data, and the variations of these indexes reflect the cyclic nature of the Quaternary climatic change. In addition, the climatic records of Weinan section can also be correlated with that of the marine oxygen isotope records, so the environmental evolution of the Loess Plateau is also consistent with the global climatic changes. The unexpected finding is that the climatic curve of L1-5, which can be correlated with stage 4 of marine oxygen isotope records, consists of three troughs and two sandwiched peaks, and may suggest the existence of the second-order warm-cold oscillations of this period.

KEY WORDS: geochemistry, palaeoclimatology, loess, Weinan section

Chinese loess is characterized by the great thickness and good continuity. It records Quaternary climatic oscillations (Liu, 1985). In recent years, scientists have tried to use physical or chemical parameters to reconstruct the past climatic changes. For instance, the particle size is used as proxy indicator for the winter monsoon intensity (Liu, 1993), stable oxygen isotopic record of carbonate nodules is used to reflect the temperature variations of soil formation (Han, 1995), and magnetic susceptibility and carbonate content are used as proxy parameters for summer monsoon intensity (An, 1991). Although the detail mechanism of these climatic proxy data have not been well understood, the previous studies suggest that they should partly reflect the climatic changes.

The purpose of this paper is to use the variations of carbonate content, TOC (total organic content), and free Fe₂O₃ content in Weinan section to reconstruct the past climatic changes
since the last interglacial.

I. MATERIAL AND METHODS

Chinese loess deposits in the arid and semi-arid region of an E–W trending belt between 33°–47°N and 107°–75°E (Liu, 1985). The central part of this region is the well known Loess Plateau, with a thickness ranging from about 100 to more than 200 m. The studied Weinan section (34°4′ N, 109°0′ E) is just located in the southern part of the Loess Plateau (Fig. 1).

Fig. 1 Location of the Loess Plateau

Weinan section lies in the East Asia southeast monsoonal zone, with the semi-humid climate condition. The annual mean precipitation is about 600 mm and mainly occurs in the summer season. The annual mean temperature is 12°C, warm in summer and cold in winter. Thus, the climate of Weinan is characterized by the warm-humid summer and cold-dry winter season.

The complete loess-paleosol succession of Weinan section is underlain by well weathered red silt-clay sediment, named the Red Clay Formation. The contact between the Red Clay and loess was palaeomagnetically dated about 2.5 Ma. So, the loess-paleosol series of Weinan section covers an age of 2.5 Ma. But in this paper we mainly study the upper part of this section, i.e. the sediments deposited during the last climatic cycle.

Thickness of the eolian sediments deposited during the last climatic cycle is 14 m, this part of sediment consists of three separated units, which are the Holocene loam soil (S0), last glacial loess (L1), and the interglacial palaeosol (S1). Among them, L1 can be further divided into three clearly separated loess beds (L1-1, L1-3, and L1-5), and two interbedded weakly developed soils (L1-2, L1-4); S1 can also be separated as three layers of palaeosol (S1-