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Contributions of different components to magnetic susceptibility of Ili Loess, central Asia

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Magnetic enhancement mechanisms of loess on the Chinese Loess Plateau (CLP) have been well studied. It has been widely accepted that ultrafine magnetic grains produced during pedogenesis (ZHOU et al., 1990) are responsible for the enhancement of magnetic susceptibility (MS) from the CLP. And MS has been extensively used as a proxy of East Asian summer monsoons intensity on the CLP (AN et al., 1991). In contrast, loess magnetic enhancement mechanisms from outside the CLP in China have not been fully understood. Recent rock magnetism on the loess in the Ili basin, Central Asia have revealed the magnetic properties of Ili loess (e.g. magnetic mineral composition, concentration and granularity) are different with those of loess in the CLP (SONG et al., 2010). The enhancement mechanism and paleoclimatic significance of Ili loess MS are still unclear by now (SONG et al., 2008 & 2010). Here, we report the contributions of different components such as organic matter, carbonate, soluble salt on MS of the Ili loess, central Asia.

Total 12 loess samples were collected from ZSP section (80.25° E, 42.69° N) near the boundary of China and Kazakhstan and TLD section (43.15° N, 83.1° E) in the Ili basin, Xinjiang, China. Every sample was subdivided into five equal portions. We kept one without any pretreatment, and other 4 subsamples were pretreated by distilled water for diluting soluble salt, by 10 % perhydrol (H_2O_2) for dissolving organic matter, by 10 % acetic acid (AA) for removing secondary carbonate, by 10 % hydrochloric acid (HCl) for removing both carbonate and possible iron silicate, respectively. Magnetic susceptibility of all subsamples were measured with a Bartington MS2B meter at frequencies of 470 Hz and 4700 Hz in the state key laboratory of Loess and Quaternary Geology, Institute of Earth Environment, Chinese Academy of Sciences.

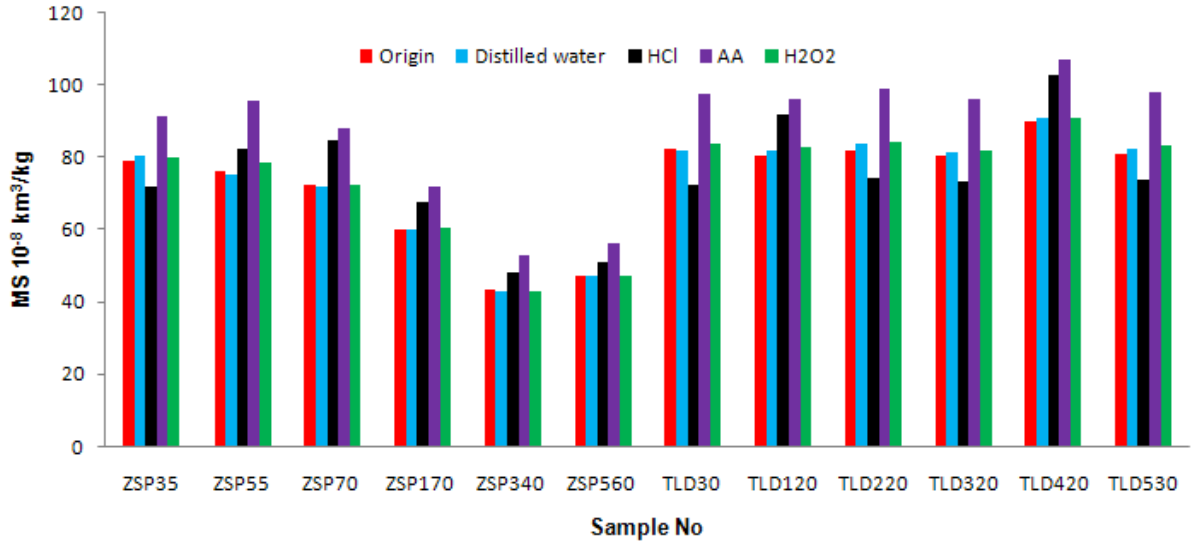

Fig. 1: Low-field magnetic susceptibility (MS) changes of the Ili loess samples pretreated by different methods.

The results of comparative analyses are showed in Figure 1 and Figure 2. Compared with the original samples, both low-field mass MS (Fig. 1) and frequency dependent susceptibility (χ_{fd}) (Fig. 2) of subsamples pretreated by the AA increase obviously, which indicates that the weak acid AA can leach the carbonate components in the Ili loess, but has little effect on silicates or iron oxides. In other words, the carbonate minerals can dilute the concentration of magnetic minerals, which causes the

lower MS. Changes of MS and χ_{fd} pretreated by HCl are complicated. MS of near half subsamples increase, but most of χ_{fd} decrease after they are pretreated by HCl. These facts indicate strong acid HCl not only can remove carbonate, but also can react with Fe ion of ferrous silicate minerals. The MS and χ_{fd} values may be related with the balance between the degree of carbonate diluting and Fe Ion reaction with HCl. χ_{fd} is usually used as a tool to estimate the content of superparamagnetic particles (SP) .The decrease of χ_{fd}, may be caused by the dissolving of SP under strong acid solution. The MS of subsamples pretreated by distilled water and H_2O_2 have little changes (< 4 %) (Fig. 1), which implies that both soluble salt and organic matter have little effect on MS, most of χ_{fd} values of distilled water and H_2O_2 subsamples decreased obviously, which suggests that soluble salt and organic matter have contribution to SP of loess in some extent. However, further mineralogy and rock magnetism works are necessary to test the above conclusion.

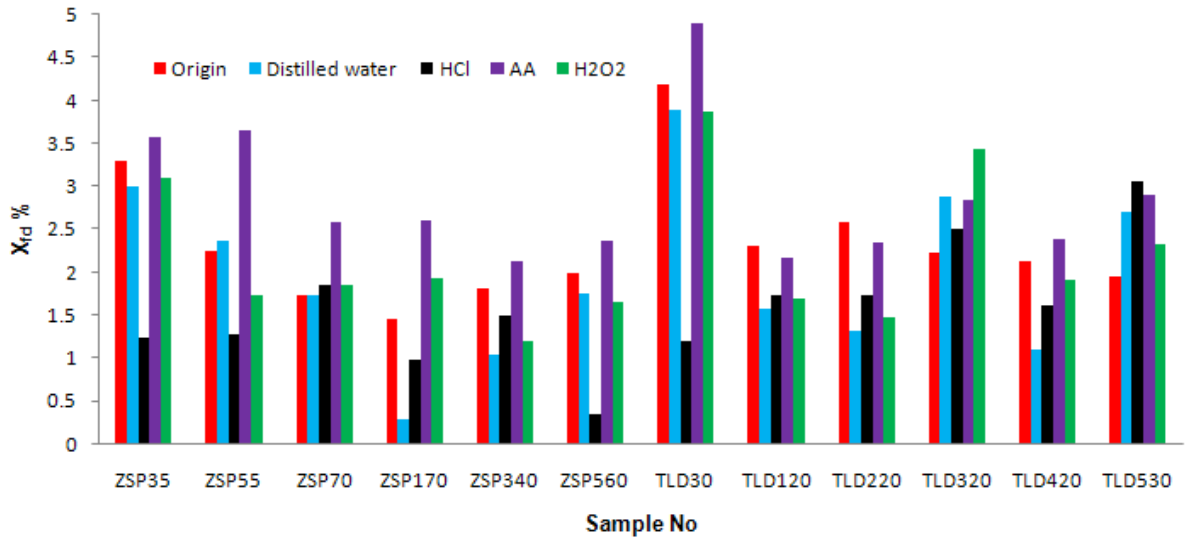

Fig. 2: Frequency-dependent susceptibility (χ_{fd}) changes of the Ili loess samples pretreated by different methods.

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