Age-fluctuation and regional-variation of Os-Nd-Sr multi isotopic system in loess-paleosol sequences in China

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The Re-Os isotopic data were obtained for loess-paleosols from the Zeketai and Kuerdenengbulake sequences in the Yili Basin, NW China and compared with Sm-Nd and Rb-Sr isotopic data for the samples from the same sequences reported previously.

In the Malan Loess section, deposited during Late Pleistocene times, depth profiles of 187Os/188Os ratios (0.904 – 1.449) are complementary to those of Os abundances (28 – 61 pg/g). The fluctuation patterns of Re-Os isotopic compositions are similar to those of grain-size characters and display the successive excursions, which is more significant than those of the grain-size variations. The timing of the cumulating peaks display a striking resemblance to the timing of the Heinrich events in North Atlantic Ocean. The Re-Os isotopic system of the Malan Loess section, therefore, record fluctuations in the vigor of the regional paleo-winds at the Yili Basin and may link to the North Atlantic oceanic conditions.

By contrast, for the Middle Pleistocene Lishi Loess section, Os abundance fluctuations (25 – 50 pg/g) are accompanied by little variation in 187Os/188Os ratio (mainly 1.206 – 1.400), and were more likely caused by Os enrichment in pedogenically formed magnetic minerals during paleosol development in wet periods. The change of fluctuation mode at [Malan]/[Lishi] Loess transition of Re-Os isotopic composition suggests the paleo-climate change at [Late]/[Middle] Pleistocene transition, as previously indicated by the traditional indices such as magnetic susceptibility (Ye, 2001).

The 87Sr/86Sr and 143Nd/144Nd ratios range from 0.7116 to 0.7167 and from 0.51220 to 0.51224, respectively (Ye, 2001). The 87Sr/86Sr ratios in the Lishi Loess section are clearly increased in paleosol layers as same as magnetic susceptibility, suggesting that the increase in the 87Sr/86Sr ratios were caused by pedogenesis, whereas the 87Sr/86Sr ratios in the Malan Loess section show little variation because of weak development of paleosols. The deviations of the 143Nd/144Nd ratios are within the experimental errors throughout the Malan and Lishi Loess sections. Therefore, Re-Os isotopic system could be a powerful tool to decode the paleo-environmental records in loess-paleosol sequences.

In addition, Os-Nd-Sr multi isotopic data for the Yili loess-paleosols are compared with Loess Plateau loess-paleosol data (Re = 94 – 617 pg/g; Os = 22 – 40 pg/g; 187Os/188Os = 0.875 – 1.209; 143Nd/144Nd = 0.51202 – 0.51215; 87Sr/86Sr = 0.7144 – 0.7184) reported previously (Peucker-Ehrenbrink and Jahn, 2001; Jahn et al., 2001). The Re-Os and Sm-Nd isotopic data of these loess-paleosols possess a regional variation, suggesting that these isotopic systems could be useful for tracing long-range transported aeolian dust. The Re-Os isotopic characters for Chinese loess and desert sands are different from the Sm-Nd isotopic characters. Therefore, Os-Nd multi isotopic system could give more valuable information on a transport process of aeolian sediments.