

Origin of the Red Earthy Deposit (RED) at the Northeastern Tibetan Plateau (China) and its implication to regional desiccation since the middle Miocene

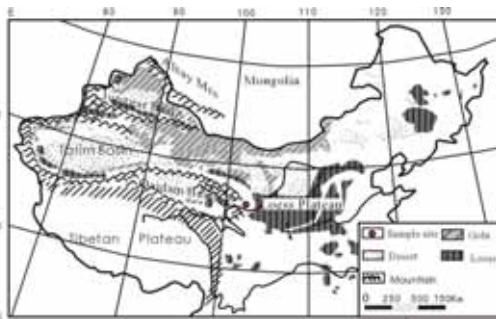
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In this work, the Red Earthy Deposit (RED) at Xining, the Northeastern Tibetan Plateau (China), was investigated on soil micro-structure, grain size, major- and trace- chemistry elements, and magneto-stratigraphy. These evidences indicate a wind-blown origin of the RED.

The magnetostratigraphy investigation shows that the RED begin to deposit about 11.4 Ma BP. Miocene aeolian sequence at Qin'an, northwest of China was reported (Guo et al, 2002), but its' distribution is still unknown. Our result indicates that the Miocene aeolian deposits had extended to northeastern Tibetan Plateau at least since the middle Miocene. Existence of the RED proves aridity of interior of the Tibetan Plateau and the Asia began at least since the middle Miocene time. Change of the proxy index such as grain size indicates two important desiccation process took place at 9.61-9.91 Ma BP and 7-8 Ma BP, respectively.

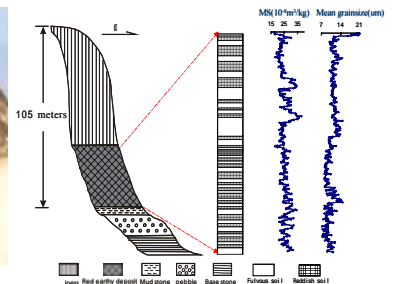
Trend of the proxy index sharply is varied from high-frequency and high-amplitude pattern to low-frequency and low-amplitude pattern at around 10.4 Ma BP, which may indicate there was a geological events with change of climatic pattern at that time. Other records have showed intensity of Indian monsoon has an increase, and $\delta^{18}O$ of foraminiferal oxygen isotope has an increase as well, and sea level have a sharp decline at around 10Ma BP. Thus, this event occurred in the Northeastern Tibetan Plateau at 10.4Ma BP may be a reflection of a global event.



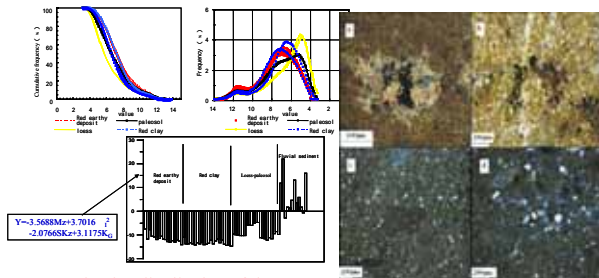
Location of the study area



Stratigraphy of the RED (up and right)



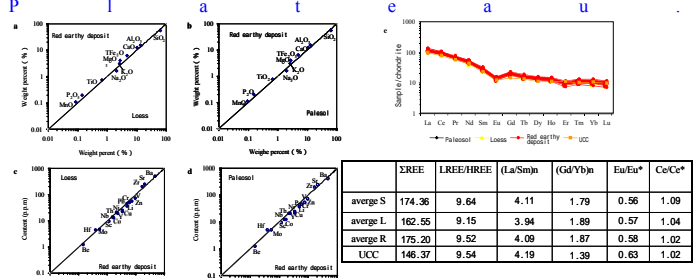
The Red Earthy Deposit (RED) at Xining, on one of river terraces, consists 25 visually definable fulvous weakly-developed soils interbedded with reddish strongly-developed soils, which have similar structure with the typical Red Clay in Chinese Loess Plateau.



Grain-size distribution of the RED

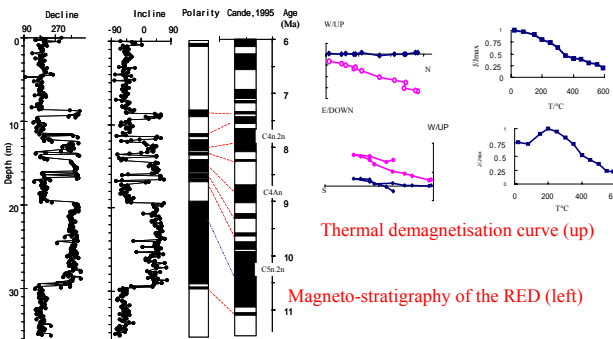
Micro-structure of the RED

Particles of the RED are very fine with sand fraction being negligible. All the mineral grains are antiangular-angular and generally finer than $63 \mu\text{m}$. Grain size distribution and micro-structure are very similar to typical aeolian sediment.



Geochemistry characters of the RED

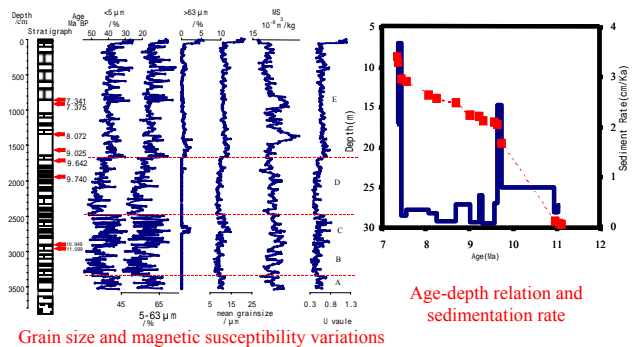
There is a good agreement of both major and trace chemistry element compositions between loess-soil units and the RED. The REE distribution of them are similar in shape with enriched LREE and fairly flat HREE profiles, and clear negative Eu anomaly, identical to those of upper continental crust.



Thermal demagnetisation curve (up)

Magnetostratigraphy of the RED (left)

Magnetostratigraphy analysis show the Red Earthy deposit was formed since around 11.4Ma BP. Above analysis of the soil micro-structure, grain size distribution, major- and trace- geochemistry elements indicates wind-blown origin of the Red Earthy Deposit. The exist of the RED demonstrates the interior Asia and the Tibetan Plateau should have been arid since at least the middle Miocene.



Grain size and magnetic susceptibility variations

Compared with the Quaternary loess, grain-size of the RED is finer with lower variation amplitude and the accumulation rate is lower. But proxy index indicate two important shift taking place at 10Ma and 7-8Ma. Change of the proxy index are from high frequency and high amplitude to low frequency and low amplitude.

ACKNOWLEDGEMENTS

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