Provenance changes of eolian dust in Chinese Loess Plateau since 2.6 Ma and their links to the mountain uplift in East Asia

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Eolian dust deposited in the Chinese Loess Plateau [CLP] is considered as having been derived from the arid and semi-arid areas of the western to central China and Mongolia-western Siberia by prevailing winds. It has been suggested that the uplift of Himalaya-Tibetan Plateau enhanced interior aridity in East Asia that resulted in development of these deserts and deposition of the eolian sediments in CLP (Tada, 2005 : Zheng, 2004). Numerical climate model experiments, which examined impact of stepwise increases of mountain elevation on Asian monsoon evolution, support the argument that the stages in evolution of Asian monsoons are linked to phases of Himalaya-Tibetan plateau uplift (An et al, 2001).

It is generally believed that both the extent of the desert area that becomes the source of eolian dust and the wind that transports the dust influence accumulation of eolian sediments at CLP. Therefore, the estimation of eolian dust provenance is crucial to understand the climate changes in tectonic timescale. However, the method to examine eolian dust provenance is not well established. In addition, it is not well understood when these deserts were formed, which desert supplied eolian dust to CLP, and how tectonic events influence formations of these deserts and routes of prevailing winds.

We analyze fine (0-30 micron) fractions of 35 loess and 33 paleosol sample obtained from loess-paleosol sequence at Lingtai section of the central CLP since 2.6 Ma, using Electron Spin Resonance [ESR] signal intensity of quartz, which reflects its formation age (Toyoda, 1992), and crystallinity index [CI] of quartz, which reflects its formation temperature and crystallization speed (Murata and Norman, 1976). With these two parameters, we identified the provenance of quartz in fine fractions of loess and paleosol samples by comparing with present desert deposits in East Asia (Sun et al., 2007 submitted). The results suggest that the provenance changes in fine fraction occurred at 2.2, 1.1, and 0.3Ma. During 2.6-2.2Ma, the fine fraction was derived from Badain Juran desert in northwest China with gradual increase in the contribution from Mongolia Gobi desert. During 2.2-1.1Ma, the contribution from Mongolia Gobi desert became significant with strongest contribution from Mongolia Gobi desert at 1.6Ma. Then, during 1.1-0.3Ma, contribution from Taklimakan desert increased in addition to Mongolia Gobi desert and Badain Juran desert and/or Tengger desert in northwest China with strongest contribution from Taklimakan at 0.8Ma. Contribution from Badain Juran and/or Tengger desert gradually increases again from 0.8 to 0.3Ma. Finally, the fine fraction was derived mainly from Tengger desert during 0.3-0Ma. These provenance changes may reflect the uplift of the Tianshan, Kunlun, Qilian, Altai and Gobi Altai Mountains, which are considered as the source of the desert sand mention above. Conversely, the provenance changes may reflect changes in transport wind system between the winter monsoon and westerly jet. Our results will provide important clues to resolve the process of mountain uplift in East Asia and evolution of Asian wind systems.