Provenance changes of eolian dust in the Chinese Loess Plateau since 7 Ma and its implication for desert development in East Asia

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It is suggested that the uplift of Himalaya-Tibetan Plateau enhanced interior aridity in East Asia and resulted in development of middle latitude gobi and sandy deserts and accumulation of the eolian sediments in the Chinese Loess Plateau. Therefore, estimation of the provenance for eolian sediments in the Chinese Loess Plateau is critical to reconstruct the environmental changes in East Asia and their relation to the Himalaya-Tibetan Plateau uplift.

We recently developed a new provenance tracing method by using a combination of Electron Spin Resonance (ESR) signal intensity and Crystallinity Index (CI) of quartz, and demonstrated that fine fraction of the surface sediments from nine major deserts in East Asia could be distinguished one another on the ESR signal intensity versus CI diagram. Here, we measured ESR signal intensity and CI of quartz in fine fractions of samples covering the last 7 Ma obtained from Lingtai section in the central Chinese Loess Plateau, and compared the results with those of the surface samples from nine major deserts in East Asia.

The results suggest that the provenance of fine fraction of the eolian sediment in Lingtai section changed at 4.3, 2.1, 1.4, 1.1, 0.8 and 0.4 Ma. During 7 to 4.3 Ma, the dust might have been supplied from Precambrian to Paleozoic metamorphic and granitic rocks and granite exposed in the present central to eastern part of the Tian Shan Mountains. The contribution from the Taklimakan desert appeared at 4.3 Ma, increased drastically at 1.1 Ma, and persisted till 0.8 Ma, whereas the main source of detrital material to the Taklimakan desert changed from eastern part of the Kunlun and the Altyn Mountains to western part of the Kunlun and the Tian Shan Mountains. During 0.8 to 0.4 Ma, contribution from the Badain Juran desert gradually increased. Finally, contribution from the Tengger desert appeared from 0.4 to 0 Ma. Together with tectonic evidences from literatures, the provenance changes from 4.3 to 0.8 Ma seem to reflect uplift of the Tian Shan and the Kunlun Mountains and consequent formation of the Taklimakan desert, whereas the change at 0.4 Ma may reflect uplift of the Qilian Mountains although formation of mountain glaciers could be an alternative possibility. These provenance changes will provide important constraints not only on the development of arid areas and evolution of monsoon but also on the uplift and erosion of mountains in East Asia.