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# Provenance of eolian dust and reconstruction of millennial-scale atmospheric circulation changes in East Asia during the last glacial to the Holocene

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It is well established that mineral dusts exert significant influence on global climate. It is also well recognized that deserts in Eastern to Central Asia, especially Taklimakan and Gobi Deserts are the major source of dusts in the northern hemisphere. Taklimakan Desert is especially important because it is the only desert that is capable of lifting up dusts to higher altitude in excess of 5,000 m where the dusts are entrained in the westerly jet and dispersed all over the northern hemisphere. Taklimakan Desert is unique and important in this regard. On the other hand, Gobi Desert is also unique because it is located where Siberian High develops. Consequently, winter monsoon wind carries dusts from Gobi Desert.

Dusts in sediments have information on the location and extent of the dust source (desert) area(s) as well as the route and intensity of transport wind. To extract such information, it is necessary to clarify its provenance. We collected surface samples from East Asian deserts, extracted <16 micron fraction, and analyzed them for their ESR signal intensity of E1' center of quartz and crystalinity of quartz to characterize their provenance. ESR signal intensity approximately reflects age of the source rock while crystalinity reflects type of the source rock. The result revealed that <16micron fractions of Taklimakan samples are characterized by low ESR signal intensities while those of Gobi samples by high ESR signal intensities.

We further examined how homogeneous the dusts emitted from the Taklimakan Desert (strictly speaking the Tarim Basin) are, how they are formed, and what their ultimate sources are using river sediment samples discharged into the basin and compared their characters with those of dry lake samples in the northeastern part of the basin and mountain loess samples in the southwestern margin of the basin. The results revealed recycling process of <16 micron detrital particles within the basin that resulted in dusts with relatively constant ESR signal intensity and crystalinity values, which are dominantly derived from Late Cenozoic granitic rocks in western Kunlun Mountains due to rapid uplift and erosion with smaller contributions from other parts of the surrounding mountains. Dusts emitted from Gobi Desert are also relatively homogeneous and considered as being derived from Precambrian sedimentary rocks.

From above results, it becomes evident that dusts from Taklimakan and Gobi Deserts can be used as tracers of westerly jet and winter monsoon wind, respectively, and that dusts from the two sources are distinguishable based on ESR signal intensity (and crystallinity) of quartz. We applied this idea to the hemi-pelagic sediments of the Japan Sea. We analyzed ESR signal intensity of quartz in the 4-16 micron fraction of the detrital component in the Japan Sea sediments. During the last glacial period, dusts from the Taklimakan Desert becomes dominant during the D-O interstadials while dusts from the Gobi Desert became dominant during the D-O stadials, suggesting northward shift of the westerly jet axis during the D-O interstadials and southward shift during the D-O stadials. Since the D-O interstadials coincide with stronger East Asian summer monsoon [EASM] precipitation in South China, the result suggests that northern shift of westerly jet axis coincided with stronger EASM precipitation in south China.

During the Holocene, on the other hand, dusts from the Taklimakan Desert became dominant during North Atlantic IRD events which correspond to stadials, while dusts from the Gobi Desert became dominant during interstadials. This relationship is opposite to what we observed during the last glacial period. As to the relationship with EASM,

northward shift of westerly jet axis corresponds to dry events in south China and southward shift of westerly jet axis corresponds to wet events in south China, again the relationship is opposite to what we observed during the last glacial period.

It is possible that the former opposite phase relationship between N-S oscillations in westerly jet axis over East Asia and cold-warm oscillations in North Atlantic between the last glacial and the Holocene is related to the change in westerly jet meandering mode. On the other hand, we consider that the latter opposite relationship between N-S oscillations in westerly jet axis over East Asia and wet-dry events in south China does not necessarily mean the change in the phase relationship between the two. Rather, we consider it to be a matter of the definition of EASM intensity. We claim that precipitation in south China is not a good proxy for the EASM intensity in glacial-interglacial timescale. Better indicator will be a penetration degree of the EASM front into the East Asia, which is closely related to the position of westerly jet axis during spring to summer.

We also plan to introduce our project on eolian dust provenance study in East Asia and a new technique to specify dust provenance of single grain quartz as small as 5 micron in diameter.