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Evaluation of the desertification in Tarim Basin based on provenance study of size-separated fluvial sediment since 8Ma

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Tarim Basin is located to the north of Tibetan Plateau. Tarim Basin is characiterized by very dry climate and the Taklimakan desert is developed in the central part of Tarim Basin. In previous studies, the desertification of Tarim basin was considered as having been triggered by the uplift of Tibetan Plateau (e.g. Zheng et al., 2000, DH Sun et al., 2011). However, the timing of desertification has been dated only roughly by eolian sediments, and there is a possibility that Tarim Basin was arid but eolian sediments are not generated.

In this study, we tried to evaluate the timing of aridification based on the dust contribution to the fine fraction in the fluvial sequence which is evaluated by examining provenance of size-separated samples. We conducted the provenance study of quartz, which is common mineral in sediments resistant to weathering.

For the provenance study of quartz, we used Electron Spin Resonance (ESR) signal intensity of quartz and crystallinity index (CI) of quartz. ESR signal intensity of quartz reflects the age of mother rock (Toyoda and Naruse, 2002), whereas CI of quartz reflects physical condition of its formation such as temperature and rate of crystallization (Murata and Norman, 1976). In her study of modern river sediments in the Tarim basin, Isozaki (2009 MS) suggested that quartz in coarse fraction (>63um) of river sediments reflects bedrock geology of the catchment area based on ESR signal intensity and CI of quartz. On the other hand, fine fraction (<16um) of river sediments may reflects geology of the river catchment area and eolian dust.

We applied this method for the fluvial sequence. Firstly, we revealed the size-separated provenance change of fluvial sediments. Secondly, we found the provenance separation of size-separated fluvial sediments, and we evaluated the contribution of eolian dust in the fine fraction of the fluvial sequence.

We conducgted field survey at the Yecheng section in the southwestern Tarim Basin. Fluvial to alluvial deposits with occasional intercalations of eolian sediments deposited between 7.6Ma to 1.8 Ma are continuously exposed along the Yecheng section (Zheng et al., 2010; Tada et al., 2010). We selected 27 river sediments (9 sandstones and 18 conglomerate matrix) in 0-16um and 63-500um, and measured ESR signal intensity and CI of quartz.

From the result of analyses, we found the provenance separation of size-separated fluvial sediments (difference in provenance between fine and coarse fractions) at 6.6Ma, 6.0Ma, and after 4.5Ma. Assuming the provenance separation was caused exclusively by eolian contribution, Tarim Basin was arid after at least 6.6Ma.

By comparing with the provenance changes at the Yecheng section in coarse fraction (63-500um)(presented in H-CG33), the ages of uplift activity in the leading edge of Kunlun mountains are approximately the same as the timing of eolian dust contribution increase and desert formation in the Tarim Basin. So, there is possibility that the uplift activity in the leading edge of Kunlun mountains contributed dust production and sand desert formation in the Tarim Basin after 8Ma.

Keywords: Tarim Basin, Desertification, Taklimakan Desert, Provenance study, Eolian dust, Uplift