Clim. Past Discuss.,
doi:10.5194/cp-2017-50-AC3, 2017

Climate of the Past
Discussions

Interactive comment on "Environmental dynamics since the last glacial in arid Central Asia: evidence from grain size distribution and magnetic properties of loess from the Ili Valley, western China" *by* Yue Li et al.

Yue Li et al.

liyueqg0816@163.com

Received and published: 12 May 2017

CS: Dear authors, I agree with most of your replies and thank you for the modifications. I just want to react with 2 comments: 1. To the origin of the very fine silt-clay component: Chemical weathering is indeed a good candidate as measured by Konert and Vandenberghe 1997, and well illustrated by the experiments of Sun YB et al 2006. Transport as aggregates of fines by monsoonal dust storms (Qiang et al 2010) is contradicted by their very widespread and general occurrence (Vandenberhe 2013). Adherence of fines to larger grains has been contradicted by several authors. 2. Prove-

nance of EM 1-2: I agree with your explanation. I understand now that you also agree with a northern wind, however not crossing the high mountains to the north but carrying dust only at low elevation over short distance. In my opinion, the carrying agent may still be the northern monsoonal wind, although restricted to the Ili basin.

AR:

1. The complexity of finer component is reflected in not only its origin but also uncertainty of instrument measurement (Ujvari et al., 2016;Mason et al., 2011). Chemical weathering can efficiently decrease gain size of loess (or paleosol) through the transformation of feldspar minerals into clay minerals linked closely to the process of pedogenesis. Sun et al. (2011) regarded this component formed by pedogenesis "ultrafine component". However, we have investigated clay mineralogy of NLK loess section, and results showed that the major clay mineral components in the NLK section were illite, chlorite, kaolinite and smectite, and that those clay minerals mainly had detrital origin, and rather than are in-situ weathered products. Moreover, variations in illite contents along the NLK section may be controlled by wind intensity, because weaker wind intensity would transport more fine fractions, which was supported by the wind tunnel experiment (Wang et al., 2017). Therefore, we think the degree of influence of chemical weathering on the loess grain size depends on the differences of environment conditions from site to site. Qiang et al. (2010) suggested that formation of aggregation increased particle mass, which enabled fine grains to be deposited even under stronger winds by dry deposition, however, the aggregates had larger pores and relevant lower density than individual minerals grain of the same size. Therefore the aggregates still can be influenced by the effects of sorting by aeolian processes. However, by observing the dust deposition collected in dust storm, Lin et al. (2016) thought that particles less than 20 μm could settle down during floating dust weather when the wind velocity decreased and even stopped. Therefore, it seemed to be difficult to distinguish that the aggregates were formed after deposition or they were transported by winds directly. Observations of modern dust under the scanning electron showed the phenomena of

aggregation and/or fine particles adhering to larger ones (Pye, 1987, 1995;Derbyshire et al., 1998;Falkovich et al., 2001;Qiang et al., 2010), whereas the micrographs of fresh samples from the southern margin of Tarim Basin under SEM showed little aggregation, or adhering of fine particles to the coarse particles (Lin et al., 2016). Maybe more convincing evidence will come from a lot of studies of modern storm processes.

2. For provenance of EM1 and EM2, it seems we cannot exclude the influence of monsoonal wind as a carrying agent from northeast. Gurbantunggut Desert in the Junggar Basin is a large source area of aeolian dust. However, "the upper limit of the loess distribution of 2400 m above sea level (asl) is much lower than the average elevation of about 4000 m of the northern Tianshan Mts. downwind" (Sun, 2002). And the Junggar Basin is not a frequent dust storm outbreak region (cf. Fig. 7 in Sun (2002)). Moreover, airmass backward trajectory was performed for April of this year using the HYSPLIT model (https://ready.arl.noaa.gov/HYSPLIT.php). Although the backward trajectory results may contain some uncertainties due to the uncertainty in meteorological data, Fig. 1 showed that an atmospheric circulation was formed in the Junggar Basin, and the northern Tianshan Mts. could serve as the southern boundary of this circulation. Therefore, we prefer to consider the surface-level air from west as the main transport agent of NLK loess, and maybe there is a tiny amount of dust as a background sedimentation reaching the Ili Basin crossing the high mountains, but their grain size are very fine.

References

Derbyshire, E., Meng, X. M., and Kemp, R. A.: Provenance, transport and characteristics of modern aeolian dust in western Gansu Province, China, and interpretation of the Quaternary loess record, J Arid Environ, 39, 497-516, DOI 10.1006/jare.1997.0369, 1998.

Falkovich, A. H., Ganor, E., Levin, Z., Formenti, P., and Rudich, Y.: Chemical and mineralogical analysis of individual mineral dust particles, J Geophys Res-Atmos, 106,

18029-18036, Doi 10.1029/2000jd900430, 2001.

Lin, Y. C., Mu, G. J., Xu, L. S., and Zhao, X.: The origin of bimodal grain-size distribution for aeolian deposits, Aeolian Res, 20, 80-88, 10.1016/j.aeolia.2015.12.001, 2016.

Mason, J. A., Greene, R. S., and Joeckel, R. M.: Laser diffraction analysis of the disintegration of aeolian sedimentary aggregates in water, Catena, 87, 107-118, 2011.

Pye, K.: Aeolian Dust and Dust Deposits, in, Academic Press, London, 29-62, 1987.

Pye, K.: The nature, origin and accumulation of loess, Quaternary Sci Rev, 14, 653-667, Doi 10.1016/0277-3791(95)00047-X, 1995.

Qiang, M., Lang, L., and Wang, Z.: Do fine-grained components of loess indicate westerlies: Insights from observations of dust storm deposits at Lenghu (Qaidam Basin, China), J Arid Environ, 74, 1232-1239, 10.1016/j.jaridenv.2010.06.002, 2010.

Sun, D., Su, R., Li, Z., and Lu, H.: The ultrafine component in Chinese loess and its variation over the past 7.6 Ma: implications for the history of pedogenesis, Sedimentology, 58, 916-935, 2011.

Sun, J. M.: Provenance of loess material and formation of loess deposits on the Chinese Loess Plateau, Earth Planet Sc Lett, 203, 845-859, Pii S0012-821x(02)00921-4 Doi 10.1016/S0012-821x(02)00921-4, 2002.

Ujvari, G., Kok, J. F., Varga, G., and Kovacs, J.: The physics of wind-blown loess: Implications for grain size proxy interpretations in Quaternary paleoclimate studies, Earth-Sci Rev, 154, 247-278, 10.1016/j.earscirev.2016.01.006, 2016.

Wang, X., Lang, L., Hua, T., Zhang, C., and Li, H.: The effects of sorting by aeolian processes on the geochemical characteristics of surface materials: a wind tunnel experiment, Frontiers of Earth Science, 1-9, 2017.

Interactive comment on Clim. Past Discuss., doi:10.5194/cp-2017-50, 2017.

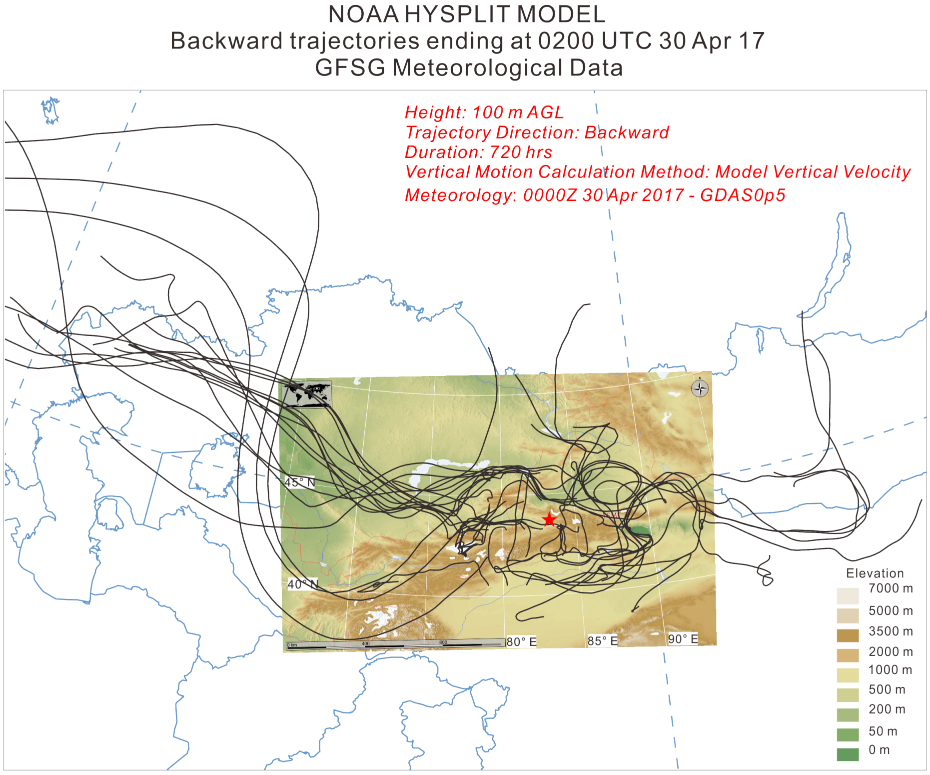

Fig. 1. Backward trajectory results for Tianshan area during April in 2017, showing the potential dust transport paths