Clim. Past Discuss.,
https://doi.org/10.5194/cp-2020-102-AC2, 2020

Climate of the Past Discussions

Interactive comment on "Climate-driven desertification triggered the end of the Ancient Silk Road" *by* Guanghui Dong et al.

Guanghui Dong et al.

wanglb@gzhu.edu.cn

Received and published: 19 November 2020

Reviewer #2: 1. In this paper, the authors tried to figure out the fundamental cause of the demise of the Ancient Silk Road trade was climate-triggered desertification. It is not easy to prove it. It seems that there is still room for improvement in this paper. I recommended that this paper can be accepted after a moderate revision. Some comments are as follow: 1) In this paper, two desertification events were founded during 800-600 BC and about 1450 AD, corresponding to sand layers in the XSW profile. But it is not clear that how far can desertification extend when the extreme drought events has been happened. It is more perfect if the author provided more profiles in this area to compare with XSW profile. Response: Thanks for the reviewer's constructive suggestion. It is not easy to determine the exact extent of the desertification area. Previous results sug-

Printer-friendly version

Discussion paper

gested that large-scale desertification affected ∼1,700 km2 during the Ming and Qing dynasty in the Shule River Basin which contains the Dunhuang-Guazhou area (Cheng, 2007). In addition, Dunhuang city and Guazhou city are all located in the central part of the eastern Gobi Desert. When the desertification event occurred at the XSW site (located in the middle of the Dunhuang and Guazhou oases, ∼60 km on both sides), we assume that the desertification would affect these areas and cause the degradation of the oases. Li (2003) pointed out that during 15th and 16th centuries, drought events and locust plagues occurred frequently in the Hexi area. We agree that results from "more profiles in the area as comparison with XSW profile" would be more convincing, and we thank you for this kind suggestion. However, although we searched many sites for more sections and evidence during our field investigation, the only profile we found was the at the XSW site. Also, we are fortunate that the only age of ∼1450 AD (0-10 cm) in the Ming dynasty was from wood and is therefore likely to be reliable. Importantly, the arid event is also recorded in the sediments of Sugan Lake (Qiang et al., 2005) and Tian' E lake (Zhang et al., 2018); these lakes were dried up during the modern interval of arid climate (Wünnemann et al., 2010). Reference: Cheng, H.Y.: Human impact on environment in historical time, a quantificational case in Hexi Corridor, NW China. China Population, Resources and Environment, 2011, 22(3): 360-363. Li, B.C.: Study on Desertification of Hexi Corridor in historical period, China. Beijing: Science Press (in Chinese), 2003. Wünnemann,B. Demske D , Tarasov, P., et al. Hydrological evolution during the last 15 kyr in the Tso Kar lake basin (Ladakh, India), derived from geomorphological, sedimentological and palynological records[J]. Quaternary Science Reviews, 2010, 29(9-10):1138-1155. Qiang, M.R., Chen, F.H., Zhang, J.W., Gao, S.Y., and Zhou, A.F.: Climatic changes documented by stable isotopes of sedimentary carbonate in Lake Sugan, northeastern Tibetan Plateau of China, since 2 ka BP. Chinese Sci. Bull., 50, 1930-1939, 2005. Zhang, J., Huang, X., Wang, Z., Yan, T., and Zhang, E.: A late-Holocene pollen record from the western Qilian Mountains and its implications for climate change and human activity along the Silk Road, Northwestern China. Holocene, 28, 1141-1150, 2018.

2. In XSW profile, the upper sand layer is only 10 cm thick. Only one OSL sample was determined (see Figure 3). How did the author get the top age (1350 a) of this sand layer? Response: Thanks for the reviewer's constructive comments. The 10cm-thick sand layer has one radiocarbon age (1440-1460 AD). And the wood sample that we applied on dating was collected from the depth of 10cm from the top of sampled profile. We didn't date the samples on top but instead using linear fitting method of two radiocarbon age in combination with comparing with tree ring records (Fig. 2f and 2g) to achieve the top age. It's not enough rigorous to give the top age without exact dates indeed. We accept the reviewer's advice and make relative modifications through the content. Please see Line 463 and Line 469.

3. There are some inconsistencies in this manuscript. For instance, tree-ring based precipitation record and stream flow record showed that the drought events happened during 1460 to 1510, recovered after 1510 (Figure 2 f and g). The authors should provide more evidences to explain it. Response: Thanks for the reviewer's constructive suggestion. We agree that the influence of the arid event of ∼1450 AD on the streamflow of the Qilian Mountains gradually decreased after the 1510s. However, oasis formation and development are long-term processes (Stamp, 1961; Zhang and Hu, 2002; Li et al., 2016). For example, the decline of Loulan city was irreversible because of regional climate conditions and possible human impact (Mischke et al., 2017). First, the oasis ecological response would not be to disappear immediately (Fan, 1993). Also, after 1-3 year's destruction, an oasis takes at least 15-20 years to recover (Zhang and Hu, 2002), and therefore a degraded oasis is not as easily reversible as streamflow. The ancient Silk Road was interrupted by the deteriorating ecological environment along the routeway. The obvious decline in tribute exchange (Fig. b and Fig. c) indicates that the prosperity of the Silk Road declined rapidly in the Ming dynasty. We accept the reviewer's advice and have modified the text accordingly Please see Lines 452-462. References: Fan, Z.L., A study on the formation and evolution of Oases in Tarim Basin, Acta Geographica Sinica, 1993, 48:421-427. Li, X., Yang, K., Zhou, Y., Progress in the study of oasis-desert interactions. Agricultural

and Forest Meteorology, 2016, 230-231:1-7. Mischke, S., Liu, C., Zhang, J., Zhang, C., Zhang, H., Jiao, P., Plessen, B. The world's earliest Aral-Sea type disaster: the decline of the Loulan Kingdom in the Tarim Basin. Sci. Rep. 2017, 7, 43102. Stamp, L.D., 1961. A history of land use in arid regions. Literary Licensing, LLC. Zhang, Q., Hu, Y.Q., The geographical features and climatic effects of oasis. Advance in Earth Sciences, 2002,17(4).

Please also note the supplement to this comment:
https://cp.copernicus.org/preprints/cp-2020-102/cp-2020-102-AC2-supplement.pdf

---

Interactive comment on Clim. Past Discuss., https://doi.org/10.5194/cp-2020-102, 2020.