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Climate of the Past Discussions

Interactive comment on "Three exceptionally strong East-Asian summer monsoon events during glacial conditions in the past 470 kyr" *by* D.-D. Rousseau et al.

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Rousseau et al. have presented convincing evidence about three exceptional glacial intervals with abundant cold-aridiphilous and warm-moist & oriental species of land-snails in the Chinese Luochuan loess sequence. These levels correspond to the loess units L2, L4 and L5, correlative with marine isotope stages (MIS) 6, 10 and 12, respectively. The authors interpret the exceptionally abundant snails in these loess levels as evidence of strong summer monsoon. Because similar features were also observed in the Xifeng loess section (Wu et al., 2007), these data would suggest a new aspect of the Asian monsoon climate, with likely large regional significance. The data are highly

interesting/important and the paper merits publication after minor revision.

It sounds reasonable to interpret the abundance of warm-moist species as an indication of summer monsoon or to assign it as a summer monsoon index (SMI) because moisture in the Loess Plateau was mainly brought by the summer monsoon. However, it would deserve more thought to describe the abundance of cold-aridiphilous species as an winter monsoon index (WMI) in the context of this paper as the growth of any snail species would require a suitable level of humidity, and a temperature high enough for snail growth. Under really cold/dry conditions with extremely strong winter monsoon, the abundance of both kinds of species (cold-aridiphilous or warm-moist) would be largely reduced. From this sense, the presence of abundant cold-aridiphilous species in those loess layers rightly indicates more suitable conditions for snail growth (not too cold with a relative humidity), probably during relatively cold season (mid-Spring?), rather than a strengthened winter monsoon. Consequently, the abundant cold-aridiphilous species in L2, L4 and L5 loess layers would more likely reflect warmer/more moist spring seasons than for the other glacial periods. The exceptional abundances of both kinds of species would suggest a strengthened influence of the summer monsoon as indicated by the authors, but also a weakened influence of the winter monsoon.

The intervals with abundant warm moist & oriental species were compared with the Lake Baikal record. The last record suggests mild conditions for MIS-12, but it is not evident for MIS-6 and 10. A comparison of the malacology data with some palynology timeseries from northern China (if available) would be of particular value. Also, recently published grain-size data from another loess section (Guo et al., 2008 CPD, 4:1061–1088) showed intervals with quite weak winter monsoon during MIS-6 and 12. These appear to be consistent with the booming of land-snails during yearly cold seasons.

The paper used very long paragraphs to discuss the possible causes of these anomalous glacial intervals. Invoked factors include high- and low-latitude insolation changes,

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sea surface temperature, ENSO, ice-sheets and tectonic uplift etc, but none of these factors could explain all the three intervals. These discussions made the last part of the paper rather complicated. Some discussions are highly interesting, such as those about the S-N thermal insolation gradients, but others may deserve more thought. For example, it sounds hard to link the possible tectonic changes with these climate events because tectonic effects on climate are usually stepwise at this scale. It sounds somewhat odd that tectonic uplift played a role for MIS-12 and MIS-6, but not for the glacial and interglacial periods between them.

Most of these discussions focused on the possible causes of the summer monsoon. The readers would benefit more if some discussions on the hiemal aspects of climate, as well as the possible causes could be added. Clearly, the extremely abundant cold-aridiphilous species also imply some kinds of anomaly beyond the summer season that would not be explainable only by strengthened summer monsoon. The hiemal half-year (including early-mid Spring) was likely warmer/more moist than for the other glacial times. This might also be an important cause of the strong summer monsoon, because warmer winter and spring would reduced snow cover, a factor particularly favorable to stronger summer monsoon winds (Goes et al., 2005, Science, 308, 545-547).

In Fig. 4, it would be nicer to add 2 curves showing the percentages of the cold-aridiphilous/warm moist & oriental species versus the total individuals. The horizontal scales of the 3 right panels are hard to read. More distance between the panels would be finer.

Interactive comment on Clim. Past Discuss., 4, 1289, 2008.