

Interactive comment on “Late Cenozoic continuous aridification in the western Qaidam Basin: evidence from sporopollen records” by Y. F. Miao et al.

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Editor Climate of the Past

Dear Editor

With interest I have read the manuscript by Miao et al: Late Cenozoic continuous aridification in the western Qaidam Basin: evidence from sporopollen records. The Qaidam basin is a high-elevation, hyperarid basin in western China that makes part of the north-east side of Tibetan plateau. The basin is surrounded on all sides by mountains and it

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is a prolific producer of gas and minerals. Understanding the evolution of the Tibetan plateau is critical for its implications on global climate and the tectonics of a large part of Asia. Miao studied the palynological context of three cores, almost 4.5 km long, that cover a span of the last 18 Million years. These cores offer a unique opportunity to understand the evolution of the plateau and its results are of global interest. Miao separate the pollen record into three main categories (xerophytic, conifers and thermophilic), and based on the patterns of abundance infer that the thermophilic taxa were abundant during the MMCO, and decrease after 14 ma. At 3.6 Ma, thermophilic decrease even more and xerophytic increases rapidly, that correlates with the onset of the northern hemisphere glaciation. Since 18 Ma, the aridification has increased as a result of global cooling, and also the uplift of the Tibetan plateau contributed to the aridification of the region.

However, there are major problems with this manuscript that need to be addressed before it can be published. I list them below.

1. The paper lacks proper statistical analysis. All interpretations are based upon visual inspection of the pollen abundance curves without statistical support. In order to support the interpretations the following analysis need to be done 1A. A multivariate analysis (e.g. A non parametric multidimensional scaling) of both samples and species. Confidence intervals can be done using a randomization approach (e.g. bootstrapping). What would be the analysis for? first, to test if the five distinctive floras that are interpreted in the text, have statistical support. Is that is the case, the analysis would show well defined clusters of samples in agreement with Miao's interpretation. Second, to test if the a-priori defined pollen assemblages (xerophytic, conifers and thermophilic) are supported for the data. If that is the case, the analysis should show all species clustered in agreement with the proposed assemblages. I would suggest consulting the following publications Kovach, W. L. 1989. Comparisons of multivariate analytical techniques for use in Pre-Quaternary plant paleoecology. Review of Palaeobotany and Palynology 60:255-282. Clarke, K. R. 1993. Non-parametric multivariate analyses of

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changes in community structure. Australian Journal of Ecology 18:117-143. Kendel, N. C. & L. Orlocci. 1986. Applying metric and nonmetric multidimensional scaling to ecological studies: some new results. Ecology 67:919-928. Shi, G. R. 1993. Multivariate data analysis in palaeoecology and palaeobiogeography - a review. Palaeogeography, Palaeoclimatology, Palaeoecology 105:199-234. Manly, B. F. J. 1994. Multivariate Statistical Methods, A primer. second edition. Chapman and Hall, London. Jacoby, W. and Armstrong, D.A. 2012 Bootstrap confidence regions for multidimensional scaling solutions. R package 1B. A first-differencing correlation of temperature vs thermophilic taxa, and of elevation of tibetan plateau and xerophytic taxa. The paper indicates that floras are changing following the global temperature. Paper also suggests that the elevation of the plateau is correlated to increase in abundance of xerophytic taxa. Both of these major statement need statistical support. I would advise to read the following paper Alroy, J., P. L. Koch, & J. C. Zachos. 2000. Global climate change and North American mammalian evolution. Pages 259-288 in D. H. Erwin & S. L. Wing, editors. Deep Time: Paleobiology's Perspective. The Paleontological Society, Lawrence..

1C. A Detrended Correspondence Analysis (DCA) could be very useful, as it could identify clearly changes in vegetation along a gradient. See Kovach, W. L. 1989. Comparisons of multivariate analytical techniques for use in Pre-Quaternary plant paleoecology. Review of Palaeobotany and Palynology 60:255-282. Clarke, K. R. 1993. Non-parametric multivariate analyses of changes in community structure. Australian Journal of Ecology 18:117-143.

2. Authors need to keep in mind that the large differences in sampling density among the three cores can affect results. In the youngest core, it is possible than the great variability in abundances could be the product of a higher sampling density compared to the mid and lower cores. To test that, a randomization (bootstrapping) needs to be performed in the upper core, to simulate the sampling density of the lower cores. I suggest consulting: Gilinsky, N. L. 1991. Bootstrapping and the fossil record. Pages 185-206 in N. L. Gilinsky & P. W. Signor, editors. Analytical paleobiology. Paleontolog-

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ical Society, Pittsburgh.

3. As a result of lack of proper statistical analysis, the manuscript is too story-telling and ideas get all mixed up. What is the main driver of the vegetation changed observed? Global temperature? the elevation of the Tibetan plateau? the intensification of the monsoon? local tectonics producing a rain shadow in the basin? Each of these questions could be tested with the pollen record presented here.

4. the raw counting data must be provided.

This manuscript has a great potential but still requires a substantial amount of analysis. I hope to see it published soon.

Best,

Carlos Jaramillo

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