Past 900 ka climate variability at the SE Tibetan Plateau – a lacustrine record

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The south-eastern Tibetan Plateau (TP) is a key location for studying the interference of the East-Asian summer monsoon (EASM) and the Indian summer monsoon (ISM). To investigate the monsoon variability during the past about one million years we analysed a 168 m deep drill core from the centre of the Heqing paleo-lake. The sequence comprises a continuous succession of fine-grained almost uniform lacustrine sediments. From previous magnetostratigraphy results and radiocarbon dating, and comparison with a nearby core [1], we derived a revised age span from 900 ka to 30 ka.

In our further study we analysed a high-resolution data set of various magnetic, geochemical and palynological proxies using time series analysis and multivariate statistics. The detection of orbital variations (especially the 100 ka cycle) in different proxy records provides evidence for a strong relation to global climate variability during the observed period. FCM cluster analysis involving carbonate content (CC), *Tsuga* (hemlock spruce), magnetic susceptibility, and ARM/SIRM (a grain-size sensitive magnetic ratio) reveals four climatic phases, which are further characterized by a humidity index (HI) derived from convolution of CC, ARM/SIRM and S-ratio (a magnetic parameter sensitive to weathering of magnetite to hematite). The environmental significance of the magnetic parameters in terms of discriminating humid and drier climate conditions is supported by a catchment study.

The climate evolution can be summarized as follows: Predominantly humid climate with few drier episodes lasted until ~670 ka (Phase I). After a strong increase of humidity between ~670-630 ka higher-amplitude humidity fluctuations, clearly following orbital cycles, appeared and prevailed until ~380 ka (Phase II). Between ~380 ka and ~320 ka climate variability reduced gradually and low cluster probabilities dominate, both indicating a climate transition. The HI values after ~320 ka suggest drier conditions with weak variability and much lower orbital signals than during Phase II. This Phase III continued until ~80 ka, after which much wetter conditions reappeared (Phase IV).

The main features of the HI variation are in fairly good agreement with the ISM index record of An et al. [1], but the onset of a humid phase at ~80 ka, i.e. during the last glacial period and much earlier than the 'Greatest Lake Period' on the TP [2], and in particular the persistent drier phase with low orbital control between ~320-80 ka are new observations. We interpret the detected climate variability to a changing importance of the EPSM and the ISM. It has been reported that the ISM strengthens during a global warming scenario [3], while the EASM only responds with a spatial shift [4]. As an inter-hemispheric phenomenom the ISM is more sensitive to orbital insulation changes than the EASM that is restricted to northern hemisphere atmospheric circulations. Therefore, drier conditions and less orbital control during Phase III can be explained by a weaker ISM leading to a less humid climate due to the reduction of moisture inflow to the south-eastern TP region. It remains an open question which factor caused the long-lasting situation of a weak ISM for nearly 300 ka during Phase III.

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