Fire episodes response to the droughts and El Niño events in the past 1700 years: phytolith and multiproxy records from the tropical sediments in southwest China

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Résumé

Tropical monsoon rainforest in southwest China (21-22○ N, 101-102○ E) is sensitive to the evolution of Indian Summer Monsoon from the past to present. Drought and fire episodes related to the monsoon evolution played a great role on the vegetation structure and rainforest ecosystem function. The aims of this research are to reconstruct the local palaeovegetation, palaeoclimate, and fire history of Xishuangbanna, and to understand the extent to which the rainforest was sensitive to climate change using phytolith, TOC, magnetic parameters, grain size and charcoal records from a fluvial sediment profile in the tropical Xishuangban rainforest area. Grass phytolith indices have been successfully used to reconstruct humidity and aridity in marine sediments, wetlands, grasslands and rainforest area. The total of 33 phytolith morphotypes are described in detail. The major plant groups documented are the Poaceae, Cyperaceae, Compositae, ferns, gymnosperms, and broad-leaved trees. Poaceae phytoliths include short cells, long cells, bulliform cells, and hair cells (grass-type). Short cells can be classified as Pooideae (rondel and trapeziform), Panicoideae (bilobate, cross, and polylobate), Chloridoideae (square saddle), Bambusoideae (oblong concave saddle), and Arundinoideae (trapeziform saddle or plateaued saddle) based on their micro-morphological characteristics and typical descriptions. Depth distribution pattern of climate indices (temperature and aridity indices) indicate that the study area has witnessed 4 phases of climate changes as following: (1) 1700-1100 cal BP, alternation of warm-dry and/or cool-wet and cool-dry, temperature declining in response to the Bond 1 Event and weakening Indian Summer Monsoon; (2) 1100-700 cal BP (Medieval Warm Period), alternation of hot-humid and hot-arid, temperature rising in response to the enhanced solar variability and strong Indian Summer Monsoon; (3) 700-250 cal BP (Little Ice Age), mostly cold-wet inter-bedded with warm-dry, declining temperature in response to the low solar variability and weak Indian Summer Monsoon; (4) 250 cal BP-present, mostly warm-dry inter-bedded with cold-wet, rising temperature in response to the increasing solar variability and strong Indian Summer Monsoon. Fire indicators such as micro/macro-charcoals, burnt phytoliths, and highly-weathered phytoliths are exploited to reconstruct the fire episodes that occurred in the past 1700 years. The study area has experienced 2 phases of fire history as following: (1) 1700-700 cal BP, small scope of fires in response to the rising droughts marked by high frequency and low amplitude oscillation linked to the rising El Niño events; (2) 700 cal BP-present, large scope of fires in response to the droughts marked by low frequency and high amplitude

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oscillation related to the declining El Niño events. The fire occurrence in the tropical rain forest of Xishuangbanna is predominantly under the control of natural climate variability and El Niño events. Nearly every fire episode is coupled with a climatic event and triggered vegetation composition changes marked by pronounced expansion of grasses. These results are significant to understand the interactions between climate change and tropical rainforest. Our study provides some innovative evidence for the history and impact of Indian Summer Monsoon on southwest China.

Mots-Clés: Tropical rainforest, Indian Summer Monsoon