Evolution of the paleolandscape(s) of Yunnan, China: implications from Be-10 erosion rates and river channel morphology

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Abstract

In Yunnan and Sichuan Provinces, the identification of an ancient, low-relief landscape has provided an important datum for measuring surface uplift and inferring geodynamic process. It has been argued that a regionally significant landscape surface was formed by river planation and deposition at low elevation. Thereafter, this surface was progressively uplifted and incised as the Tibetan Plateau grew during Neogene time. However, recent geomorphic analysis and stable isotope paleoaltimetry have indicated a more complex history of surface uplift. We present new Be-10 drainage-average erosion rates and normalized river steepness (Ks) calculations from both on and off the mapped remnants of the paleolandscape in order to understand its evolution. We sampled river sands for Be-10 from 16 tributaries of the Red, Mekong and Yantze Rivers in clusters that span Yunnan and western-most Sichuan between 22.5° N and 28.5° N. Each cluster typically includes samples from 2 small (~25 km2) tributaries and 1 larger (~1000 km2) tributary that encompass both smaller ones. We also calculated Ks values for these tributaries and others in the region, covering ~140,000 km2 in total. At the provincial scale, Be-10 erosion rates appear uniform, with an average value of 104 mm/kyr and a standard deviation of 36 mm/yr. There is no trend with latitude. At a finer scale, within each sample cluster, erosion rates are typically lower on the paleolandscape than off (mean rate on: 83 ± 12 mm/kyr (1 s.d.); mean rate off: 138 ± 19 mm/kyr (1 s.d.)). Ks values are also consistently lower on the mapped paleolandscape than off (mean on: 81 ± 26 (1 s.d.); mean off: 174 ± 98 (1 s.d.)). Unlike erosion rates, Ks values increase northward, with a pronounced jump near the Yalong-Yulong fault. Our results support the mapped paleolandscape as locally important. However, the erosion rates on the paleolandscape are likely too fast to preserve such a landscape over tens of millions of years. (Low-temperature thermochronology could confirm this.) We tentatively suggest that

the fragments of “paleolandscape”, south of the Yalong-Yulong Fault, are independent features, constantly being created by river capture and destroyed by erosion.

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