Diachronous Tibetan Plateau landscape evolution derived from lava field geomorphology

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Evolution of the Tibetan Plateau is important for understanding continental tectonics because of its exceptional elevation (~5 km above sea level) and crustal thickness (~70 km). Patterns of long-term landscape evolution can constrain tectonic processes, but have been hard to quantify, in contrast to established datasets for strain, exhumation and paleo-elevation. This study analyses the relief of the bases and tops of 17 Cenozoic lava fields on the central and northern Tibetan Plateau. Analyzed fields have typical lateral dimensions of 10s of km, and so have an appropriate scale for interpreting tectonic geomorphology. Fourteen of the fields have not been deformed since eruption. One field is cut by normal faults; two others are gently folded with limb dips <6°. Relief of the bases and tops of the fields is comparable to modern, internally-drained, parts of the plateau, and distinctly lower than externally-drained regions. The lavas preserve a record of underlying low relief bedrock landscapes at the time they were erupted, which have undergone little change since. There is an overlap in each area between younger published low-temperature thermochronology ages and the oldest eruption in each area, here interpreted as the transition between the end of significant (>3 km) exhumation and plateau landscape development. This diachronous process took place between ~32.5°-36.5° N between ~40 and ~10 Ma, advancing northwards at a long-term rate of ~15 km/Myr. Results are consistent with incremental northwards growth of the plateau, rather than a stepwise evolution or synchronous uplift.