Reconstructing aggradation and incision of the Lancang River (Upper Mekong) at Yunlong reach, southeast Tibet

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In active orogen area, the transient landscape with upstream-migrating knickpoints substitutes temporal evolution with spatial distribution, and thus offers an unique chance to understand the interaction of tectonics, surface processes, and climate change on various time and space scales. Correspondingly, river longitudinal profile, geomorphic surfaces, and sedimentary sequences generally act as the key archives of the knickpoint passage and regional landscape evolution. The gently-sloping southeast Tibet is in transient state, with abundant high-elevation but low-relief surfaces perched between deep gorges (up to 2-3 km in depth) incised by the Salween, Mekong, and Yangtze rivers. In this study, we carry out geomorphic analysis for the Lancang River at Yunlong reach, and focus on field investigation, Unmanned Aerial Vehicle (UAV) photogrammetric technique, and K-feldspar post IR-IRSL (pIR-IRSL) dating for fluvial terraces preserved on western bank of the Lancang River at Songdeng.

Our work reveals that the Yunlong reach is located at a steeper segment of the Lancang River, although it is below the main knickzone to the south of Weixi; most tributaries at this reach are in transient state with an adjusting and steeper reach, and has transmitted upstream some distance on western bank. Reconstruction of some tributary profiles with relict segment yield >1300 m incision on west bank, and 500-700 m incision on east bank. This elevation difference of reconstructed tributaries' outlets may result from two separate phases of external perturbation, or local tectonic modification. Five levels of fluvial terraces T5 to T1 are preserved on western bank at Songdeng, with the bedrock strath of T5 to T2 at ~320-340 m, ~200-230 m, ~130-160 m, ~80-60 m high above the Lancang River. Terrace deposits transported by both the western-bank Songdeng tributary river and the Lancang main trunk are investigated to collect suitable fine-grained sediments for K-feldspar post IR-IRSL dating, and initial measurements yield age estimates at 530-240 ka. Correspondingly, fluvial incision rates since the Middle Pleistocene can vary from 0.6 mm/yr to 0.25 mm/yr with time, which may relate to one passage of the knickpoint along the Lancang main trunk. Reconstruction of the Songdeng River profile characterized with a slope-break knickpoint reveals ~1300 m incision at the confluence with the Lancang River. Assuming a constant and averaged incision value of 0.4 mm/yr since the knickpoint arrived the Songdeng confluence, the response time is estimated to be >3 Myr, which is consistent with the initiation of rapid cooling around 3 Ma by west-bank bedrock low-T thermal modeling published. Further work
such as numerical modeling is needed to shed insight into the role of tectonics, surface processes, and climate change in shaping the landscape of southeast Tibet in late Cenozoic time.