Slab rollback and magmatic flare-up: Constraints from Late Cretaceous plutonic rocks in the Gangdese zone, southern Tibet

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Continental arc magmatism has highly episodic features, and igneous rocks produced during magmatic flare-ups often exhibit enriched geochemical compositions. However, the mechanism of episodic arc magmatism and its relationship to the growth and reworking of continental crust remains enigmatic. We present a combined study of geochronology and geochemistry for Late Cretaceous plutonic rocks from the Gangdese batholith in southern Tibet. The results show the regular spatiotemporal migration of magmatism along and perpendicular to the strike, and the systematic spatiotemporal evolution of rock compositions, suggesting that the Late Cretaceous magmatic flare-up at 90 ± 15 Ma is most likely triggered by rollback of the subducting Neo-Tethyan oceanic slab. The magmatic flare-up consists of three scenes: (1) the prelude at 105-95 Ma, the onset of slab rollback, leading to limited melting of the metasomatized mantle wedge for moderate mafic magmatism; (2) the climax at 95-85 Ma, intensive slab rollback, triggering extensive melting of the mantle wedge for voluminous mafic magmatism. The most enriched metasomatites at the base of the mantle wedge would partially melt at first, followed by shallower less enriched ones; (3) the epilogue (85-75 Ma), flattening of the subducting slab, leading to the shut-down of mafic magmatism, crustal thickening and crustal melting. Both growth and reworking of continental crust take place during magmatic flare-up with crustal reworking shortly after crustal growth. Combined with magmatism in the rear-arc/back-arc regions, several phases of magmatic flare-up with regular spatiotemporal migration can be recognized in the Lhasa Belt, which can be ascribed to episodic slab rollback and flattening. Therefore, the slab rollback would induce upwelling of the asthenospheric mantle and heating of the overlying fertile and enriched metasomatites in the mantle wedge for intensive magmatism. As such, the episodic slab rollback would result in episodic magmatic flare up.