Crustal-Lithospheric structure, geological evolution and continental extrusion of Tibet

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Crustal shortening and thickening of the Tibetan Plateau to ~70-85 km occurred both before and after the India-Asia collision. Abundant evidence exists for a Permian HP eclogite-blueschist belt along the southern Lhasa Block and a Triassic-Early Jurassic Indosinian orogenic event that thickened the crust enough to form sillimanite-cordierite grade metamorphic rocks, prior to the Indian plate collision in the Early Eocene (ca 50 Ma). Sillimanite grade migmatites record U-Pb monazite ages spanning 71-50 Ma metamorphic rocks in the Bayi region of SE Tibet concomitant with intrusion of abundant I-type granite-granodiorite intrusions, and kyanite grade gneissesand migmatites record a crustal thickening event spanning the period 44-33 Ma (Palin et al. 2013). In the Eastern part of Tibet (Danba dome) all metamorphic ages are Jurassic and unrelated to the India-Asia collision (Weller et al. 2014). The Gongga Shan granite is a composite intrusion including both I- and S-type granites of both Indosinian (Late Triassic – Early Jurassic) and extremely young (Late Miocene- Early Pliocene) ages as shown by U-Pb zircon and allanite dating. Mapping and age dating of the Gongga Shan granites has major implications for the evolution of the Xianshui-he fault, the most actively slipping strike-slip fault in Tibet.

Potassic-ultrapotassic shoshonitic and adakitic lavas erupted across the Qiangtang (~50-29 Ma) and Lhasa blocks (~30-10 Ma) indicate a hot mantle , thick crust and eclogitic root during that period. The progressive northward underthrusting of cold, Indian mantle lithosphere since collision shut off the source in the Lhasa block at ~10 Ma. Late Miocene-Pleistocene shoshonitic volcanics in North Tibet require hot mantle. We review the major tectonic processes proposed for Tibet including ‘rigid-block’, continuum and crustal flow models as well as the geological history of the major strike-slip faults (Searle et al., 2011). We examine controversies concerning the cumulative geological offsets and the discrepancies between geological, Quaternary and geodetic slip rates. Low present-day slip rates measured from GPS and InSAR along the Karakoram and Altyn Tagh faults in addition to slow long-term geological rates can only account for limited eastward extrusion of Tibet since Mid-Miocene time. We conclude that despite being prominent geomorphic features, sometimes with wide mylonite zones, the faults cut earlier formed metamorphic and igneous rocks and show limited offsets. Concentrated strain at the surface is dissipated deeper into wide ductile shear zones characterized by spectacular deformation fabrics, yet modest displacements.

References

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