The Impact of Mesozoic Tectonism on Eastern Tibet Plateau Crustal Infrastructure: Implications for Plateau Evolution

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Often the impact of pre-Himalayan tectonic episodes is left largely unaddressed in plateau evolutionary models, which are primarily based on Cenozoic geological records. A legacy of Mesozoic collisional tectonics may be that no one mechanistic model is appropriate to explain wholesale elevation development of this region. Thus, constraining the architecture of pre-Himalayan Asian lithosphere is an integral element for an accurate model of Tibet plateau rise (Yin and Harrison, 2000; Kapp and others, 2003). The idea that the Qiangtang and Lhasa blocks formed an elevated proto-Tibet plateau, perhaps up to 3–4 km by Early Cretaceous time, prior to collision of India with Asia, has long been proposed (e.g., England and Searle, 1986; Murphy and others, 1997). High elevation (>2-3 km) may have persisted in the Qiangtang and Lhasa blocks since prior to the Late Eocene (Garzione and others, 2000; Spicer and others, 2003; Graham and others, 2005; Rowley and Currie, 2006; DeCelles and others, 2007). This elevation increase was likely caused by a series of Mesozoic collisional events that preceded Himalayan orogenesis and increased the thickness of the Asian lithosphere (e.g., Kapp and others, 2005, 2007). Models predicated upon geological evidence from western and central regions of Tibet support crustal thickening, and by association surface rise, during Early Cretaceous time. However, Reid and others (2005) concluded based on thermochronologic data that eastern Tibet experienced rapid uplift and denudation as early as Late Triassic, with <2 km of denudation across the high elevation, low relief areas of the Yidun arc since the India-Asia collision.

Analysis of well-preserved Mesozoic sediments in the Changdu basin (a.k.a., Qamdo or Markham basin) of eastern Tibet and adjacent fold belts offers geologic records with which to assess pre-Cenozoic plateau development. The Changdu basin is a 12,000 km^2, NW-SE elongate basin containing ~7000 m of well-exposed Upper Triassic-Lower Cretaceous basin-fill that rests on top of Precambrian and Paleozoic basement rocks of the Qiangtang block (Wang and others, 2008). Sedimentary evidence from the Changdu basin suggests subaerial terrestrial environments dominated since Early Jurassic time. The fossiliferous Tethyan marine carbonate Bolila Fm. is overlain by the Upper Triassic Bagong Group, a thick package of coal-bearing deposits representing the last marine-influenced deposition on the Qiangtang block. Overlying these marine-influenced deposits is the ≤5,000 m of interbedded siliciclastic fluvial, lacustrine and paleosol-bearing strata of the Lower-Upper Jurassic Chaya Group and Lower Cretaceous Xiangdui Fm. Thus, marine environments vacated the Qiangtang block ~75 Ma earlier than the Lhasa block.

The Changdu basin is bracketed by two suture zones: (1) the Jinshajiang suture to the NE, along which the Yidun arc collided with the Qiangtang block in latest Triassic time (Reid and others, 2005), and (2) the Bangong-Nujiang suture to the SW that formed due to collision between the Lhasa and Qiangtang blocks prior to Late Jurassic time (Kapp and others, 2003, 2005). The Jinshajiang suture may have marked the northern limit of the Tibetan plateau by 50 Ma (Roger and others, 2008; Tapponnier and others, 2001), but given the Mesozoic history of collisional tectonism along these sutures, perhaps surface elevation increase occurred even earlier. Determining provenance links between the rocks of the fold belts and Changdu basin deposits will permit deciphering Mesozoic structural evolution and crustal thickening from later overprinting coaxial Cenozoic deformation (e.g., Studnicki-Gizbert and others, 2008).

Preliminary detrital zircon U-Pb ages of the Upper Triassic Jiapeila mélange exposed along the western margin of the Jinshanjiang suture zone is compared with that of basal Chandu basin deposits (Fig. 1). Jiapeila zircon ages are more compatible with zircon ages reported from the Qiangtang block (Pullen and others, 2008), indicating a southerly affinity. However, the zircon age signature of the Upper Triassic Adula Fm. of the Bagong Group differs significantly from the adjacent Jiapeila mélange, suggesting Jiapeila melange rocks were not sources of sediment to the Changdu basin during Late Triassic time. Instead, the Bagong Group shares ages known from the SE Songpan-Ganzi complex, which was sourced primarily by rocks of South China block-affinity, with minor input from the Yidun arc. Also, Changdu basin sandstone exhibits temporal compositional changes. Jiapeila mélange bears abundant poly- and monocrystalline quartz along with abundant sedimentary, low-grade metamorphic and volcanic lithic fragments. However, samples of Upper Triassic Bagong Group and Jurassic Chaya Group sandstone are primarily composed of monocrystalline quartz, implying a recycled orogen source, further rebutting any link between Jiapeila Fm. or its source as a contributor of sediment to basal Changdu basin siliciclastic deposits. In contrast, Lower Cretaceous Xiangdui Fm. sandstone contains abundant poly- and monocrystalline quartz along with abundant sedimentary, low-grade metamorphic and volcanic lithic fragments, potentially indicating a late-phase association with the Jiapeila Fm.

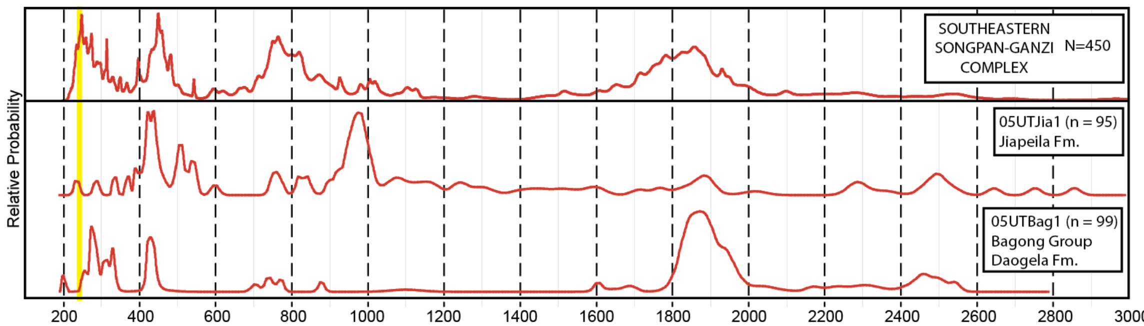

Figure 1. Detrital zircon ages from the Triassic Jiapeila Fm. and basal Changdu basin Bagong Group compared with detrital zircon ages of the SE Songpan Ganzi Complex. Yellow bar represents age of Yidun arc zircon ages.

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Cite as: Weislogel, A.L. and Robinson, D.M., 2010, The Impact of Mesozoic Tectonism on Eastern Tibet Plateau Crustal Infrastructure: Implications for Plateau Evolution, *in* Leech, M.L., and others, eds., Proceedings for the 25th Himalaya-Karakoram-Tibet Workshop: U.S. Geological Survey, Open-File Report 2010-1099, 2 p. [http://pubs.usgs.gov/of/2010/1099/weislogel/].