Despite over 30 years of intensive geological and geophysical investigations of the Tibetan Plateau, popular models for its origin and evolution still range from a pure shear history (e.g., England and McKenzie, 1982) to those involving pre-collisional topography and extrusion of crustal blocks (Tapponnier et al., 1982). That these various models imply vastly different crustal thickness histories underscores our lack of understanding of the time-varying thickening of southern Tibet prior to and post collision. Model cross sections of Lhasa block evolution (Chung et al., 2005; Kapp et al., 2007) propose that crustal thicknesses as great as ~70 km at the southern edge of the magmatic belt immediately prior to Indo-Asian collision. Using Nd isotopic variations across the Lhasa block (see DePaolo et al., this volume), we have obtained a model ca. 55 Ma Lhasa Block crustal thickness estimate. Specifically, Nd isotopic data from early Cenozoic granitoids along a N-S traverse near Lhasa show a clear gradient in $\varepsilon_{Nd}$, with mantle-like values adjacent to the suture decreasing to strongly negative $\varepsilon_{Nd}$ (ca. -12) in the northern Lhasa block. This gradient is interpreted (see DePaolo et al., this volume) in part to reflect increasing crustal assimilation due to progressively thickened crust continentward (i.e., high lower crustal temperatures enhances crustal assimilation). A calibrated thermal model suggests crustal thicknesses ranging from ca. 15 km adjacent the suture to $\geq$50 km in the northern portion of the Gangdese Batholith. However, seismic imaging of the Tibetan crust and upper mantle along a N-S transect just west of our Nd traverse (Nableck et al., 2009) is interpreted to show ~85 km thick crust, including ~35 km of Indian crust. If this section is representative of the crustal structure beneath our transect, then the lack of significant postcollisional upper crustal deformation in the Lhasa Block (implied by the Maqu unconformity) and ~10 km of denudation adjacent the suture zone (e.g., Copeland et al., 1987) requires that ca. 50 km of crustal thickening have occurred since ~55 Ma (including the ~10 km lost via denudation) via accretion – most likely the result of underplating of Indian crust. If we are correct, this observation represents the first quantitative constraint on the Cenozoic crustal thickness history of southern Tibet. To confirm our finding, we have conducted a detailed N-S geotraverse across southern Tibet in the vicinity of 92°E. In addition to using Nd isotopic data from K-T granitoids as described above, we are testing our hypothesis using zircon U-Pb dating, thermometry ($T_{\text{xlln}}$), O isotope and trace element signatures in order to refine quantification of the relative mix of juvenile magma vs. crustal assimilant. Over 90 whole rock samples of granitoids ranging from 28 to 230 Ma have been collected. Zircon separates have been extracted from all samples and the majority analyzed for $d^{18}O$, $T_{\text{xlln}}$, U-Pb age, and trace elements. Results show the high degree of variability expected from digestion of ancient crust by juvenile magmas and interaction with connate and meteoric fluids (+4‰ $\leq d^{18}O_{\text{SMOW}} \leq +12$‰, 575°C $\leq T_{\text{sat}} \leq$815°C) permitting detailed assimilation modelling. We are investigating the use of the Energy-Constrained Recharge, Assimilation and Fractional Crystallization (EC-RAFC) model (Spera and Bohrson, 2001) to extract estimates of each of the RAFC parameters in order to better constrain ambient crustal temperature at the assimilation level. Exhumation rates obtained from continuous thermochronology applied to pre-collisional plutons are being used to assess the
quantity and timing of removal of material from the Lhasa
Block surface and record time-varying paleo-geothermal
gradients. Thus, projecting back from the present
reference, we can in principle use these multiple data sets
to determine crustal thickness, exhumation, and
petrogenesis through time and possibly assess potential
feedbacks between tectonics and topography.

Key words: Lhasa block, crustal thickness, Gangdese
Batholith, zircon

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