Late Eocene crustal thickening followed by Early-Late Oligocene Extension along the India-Asia suture zone: Evidence for cyclicity in the Himalayan orogen

Ran Zhang[1], Michael A. Murphy[1], Thomas J. Lapen[1], Veronica Sanchez[1], Matthew Heizler[2]

[1]Department of Earth and Atmospheric Sciences, University of Houston, Houston, TX 77204, U.S.A., mmurphy@mail.uh.edu
[2]New Mexico Geochronology Research Laboratory, New Mexico Institute of Mining and Technology, Socorro, NM 87801, U.S.A.

The timing of geologic events along the India-Asia suture zone remains poorly understood because exposures of structurally deep rocks are rare due to low amounts of denudation across much of the Himalayan orogen. In this study, we present geologic mapping across the India-Asia suture zone in southwestern Tibet of two structurally deep domes that are cored by mylonitic orthogneisses. This field study is complemented by U-Pb zircon geochronology from the orthogneisses as well as mylonitic leucocratic granite sills that intrude it. Our results indicate that the protolith of these orthogneisses are Gangdese arc rocks and that they experienced Late Eocene prograde metamorphism that we attribute to crustal thickening (Figure 1). Leucocratic granite sills have undergone top-to-southeast extension related to slip along a brittle-ductile shear zone referred to as the Ayi shan detachment. U-Pb zircon ages from synextensional granite bodies bracket the timing of extension between Early and Late Oligocene (Figure 1). A widespread siliciclastic unit, which is correlated to the Kailas Formation, lies in depositional contact across the Ayi shan detachment. A $^{40}Ar/^{39}Ar$ muscovite age from a rhyolitic dike cutting the Kailas Formation is 18.10 ± 0.05 Ma, thereby placing an upper age limit on slip along the Ayi shan detachment. The Kailas Formation is cut by the north-directed Great Counter thrust which defines the surface trace of the India-Asia suture zone. The Great Counter thrust, in turn is cut by the Karakoram fault which facilitates transtensional deformation. A $^{40}Ar/^{39}Ar$ muscovite age of 10.17 ± 0.04 Ma of a granite along its southside (footwall) is consistent with previously published thermochronologic data which suggest transtensional deformation along the Karakoram fault in southwest Tibet was active in the Late Miocene.

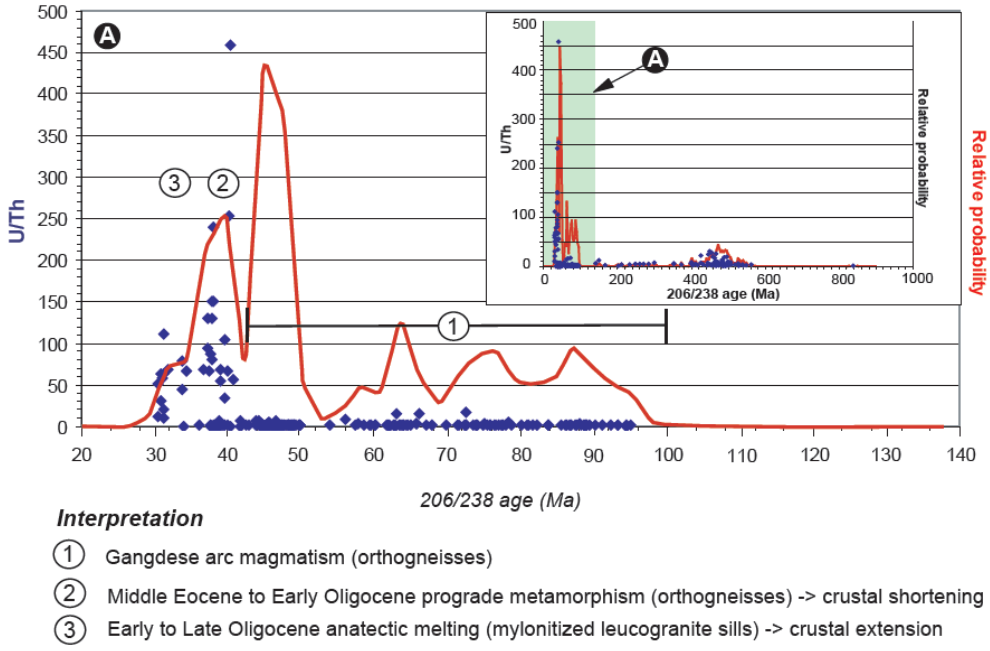

Figure 1. Plot of $^{206}Pb/^{238}U$ zircon ages versus U/Th values and their relative probability.

These results indicate two cycles of shortening and extension archived in the rocks along the India-Asia suture zone in southwest Tibet (Figure 2). The first cycle of shortening and extension, from Late Eocene to Late Oligocene, is recorded in Gangdese arc rocks. Previous results show that deformation of Gangdese arc rocks did not commence until the Late Oligocene, some 25 Ma after the initial collision between India and Asia. Structural interpretations of suture zone rocks that have undergone these two cycles of shortening and extension predict a complex structural configuration at depth, characterized by northward translation of the upper-crustal suture zone with respect to its position in the middle and lower crust.

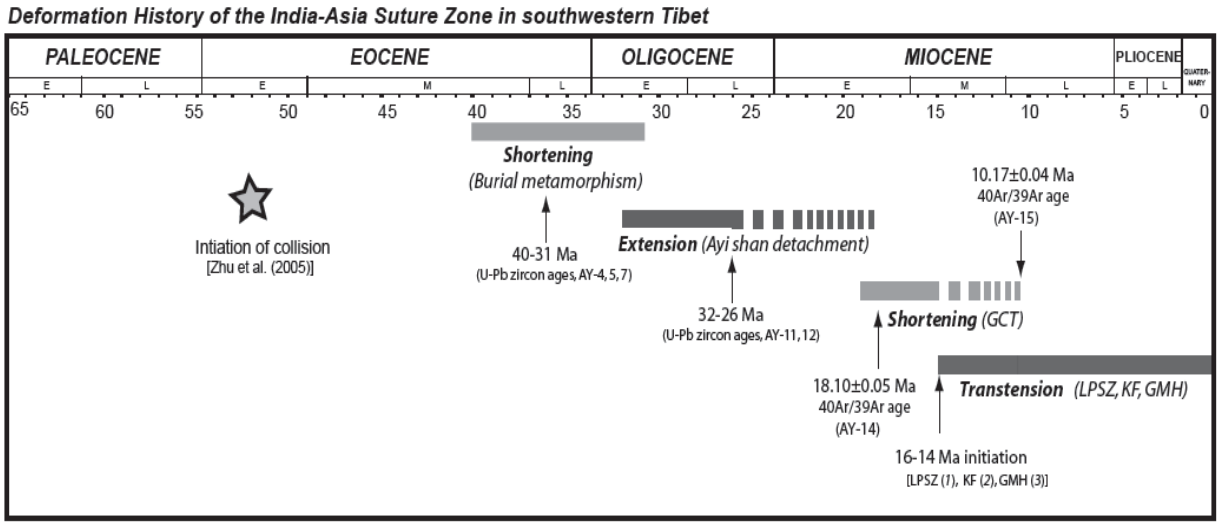

Figure 2. Table showing the history of geologic events along the IYS in southwest Tibet based on our geologic mapping and geochronologic studies of rocks exposed in the Ayi shan. Abbreviations: GCT-Great Counter thrust, LPSZ – Leo Pargil shear zone, GMH – Gurla Mandhata-Humla fault, KF – Karakoram fault. (1) Theide and others (2006, (2) Arnaud (1992), (3) Murphy and Copeland (2005).

References

Arnaud, N.O., 1992, Apports de la thermochronologie 40Ar/39Ar sur feldspath potassique a la connaisance de la tectoniique Cenozoique d'Asia: Ph.D. Dissertation: Universite Blaise Pascal; France, 160 p.

Murphy, M. A. and Copeland, P., 2005, Transtensional deformation in the central Himalaya and its role in accommodating growth of the Himalayan orogen, Tectonics, 24, doi: 10.1029/2004TC001659.

Thiede, R., and others, 2006, Dome formation and extension in the Tethyan Himalaya, Leo Pargil, northwest India, Geol. Soc. Am. Bull., 118, 635-650.

Cite as: Zhang, R., Murphy, M.A., Lapen, T.J., Sanchez, V. and Heizler, M., 2010, Late Eocene crustal thickening followed by Early-Late Oligocene Extension along the India-Asia suture zone: Evidence for cyclicity in the Himalayan orogen, *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/zhangmurphy/].