Tectonophysics

T71A MC: Hall D Sunday 0830h
Tectonics of the India-Eurasia Collision Zone I Posters

Presiding: **P Kapp**, University of California, Los Angeles

T71A-01 0830h POSTER

Post-mid-Cretaceous Shortening Along the Banggong-Nujiang Suture and in West-Central Qiangtang, Tibet

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The mechanisms of Tibetan plateau formation remain uncertain, largely due to the lack of field studies in central and northern Tibet. To begin characterizing Cenozoic deformation in this region, we conducted 1:100,000-scale mapping at five localities, spaced over a distance of 900 km along the Late Jurassic-Early Cretaceous Banggong-Nujiang suture (BNS), and along a 170-km-long N-S transect from the BNS near Gaize to Gangma Co in west-central Qiangtang. Mapping near Shiquanhe in far western Tibet revealed a S-directed thrust system which imbricates Mesozoic strata, ophiolitic fragments and igneous rocks and places Permian and Cretaceous strata over folded Tertiary conglomerates. Flat-lying volcanics lie unconformably on top of the conglomerates and have been dated to be 18-20 Ma (Arnaud and Vidal, 1990) to the east, providing a minimum age for the timing of deformation. A preliminary cross-section constrains a minimum of 47% of post-mid-Cretaceous shortening across 45 km of the thrust belt. East of Shiquanhe, between Gaize and Siling Co, we mapped a laterally continuous (~580 km), dominantly N-dipping thrust system. This thrust system juxtaposes Jurassic mélange, volcanics, and turbidites in the hangingwall against deformed terrestrial sediments and volcanics in the footwall. The basins are >1 km thick, and near Gaize, consist of ~50% felsic-intermediate volcanic tuffs, flows, and breccias. Their southernmost margin is bounded by a N-directed thrust with Aptian limestone in the hanging wall, and constrains the basins to be post-mid-Cretaceous in age. In the central Qiangtang, north of Gaize, we mapped three S-directed thrusts (spaced ~35 km apart) which place Permian carbonate or blueschist-bearing mélange in the hanging wall over Tertiary redbeds and volcanics in the footwall. Deformed Tertiary strata underlie all the major, flat-lying E-W trending Quaternary-Tertiary basins we observed, but are generally only exposed directly beneath thrusts or in the footwalls of Late Cenozoic normal faults. We propose that Cenozoic deformation has significantly modified the BNS and shortened western Qiangtang. This deformation may represent distributed upper-crustal shortening of northern Tibet, and/or surficial deformation related to formation of the Qiangtang anticlinorium during (1) underthrusting of Lhasa beneath Qiangtang along a mid-crustal ramp, or (2) lithosphere-scale buckling.

T71A-02 0830h POSTER

Early Miocene Anatexis Identified in the Western Syntaxis, Pakistan Himalaya

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New U-Th-Pb data from the Southern Chhichi granite, a large leucogranite in southern Nanga Parbat in the western Himalaya of Pakistan, reveal that crustal melting occurred at 24-16 Ma. This indicates that the main belt(s) of Miocene granite that are documented for the main Himalaya continues all the way to the syntaxis. Previous work has identified only extremely young plutonism: 10 Ma in the north to ~1 Ma in the south. The newly discovered and dated pluton is a largely undeformed, fine-grained leucogranite of several 10s sq km; it intrudes strained marbles and metapelites of the Indian cover sequence adjacent to the Rupal shear, a major Nanga Parbat uplift-related shear zone. Th-Pb ion microprobe results of monazites from the Chhichi granite yield ages between 22 and 16 Ma, with the majority of analyses lying at 19-18 Ma. U-Pb IM zircon analyses yield ages which fall along a chord with a concordant lower intercept age of 24 ±1 Ma. The zircons also contain an ~1860 Ma inherited component showing that the protolith was probably the underlying Proterozoic Indian basement, which is exposed to the north. The older Miocene ages are consistent with typical High Himalayan melting (24-20 Ma); however the younger ages may reflect a component of younger plutonism similar to the North Himalayan granite belt (17-10 Ma; Harrison et al., 1997). This could suggest that the active western syntaxis represents the terminus of both granite belts with a protracted history. Also dated was a small, little-deformed structurally discordant granite dike within the outer Rupal shear. It yielded monazite ages between 22-9 Ma, indicating an Early Miocene source rock, possibly similar to the exposed Chhichi granite. The extent of this granite dike is unknown, and we think it possible that displacement has not occurred concurrently across the entire Rupal shear, but has migrated into the massif as deformation progressed. This is consistent with a general inboard younging of plutonism that we have previously reported for the massif. We infer that most of the displacement along the outer portion of the Rupal shear ceased by 9 Ma, consistent with our crystallization ages and nearby biotite cooling ages.

T71A-03 0830h POSTER

Along - Strike Variations in Strain Accommodation in the Northern At Bashi Basin, Kyrgyz Tien Shan, Central Asia: An Example of Strain Partitioning Within an Intracontinental Thrust Belt

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The Kyrgyz Tien Shan of central Asia, one of the most spectacular examples of active deformation within a continental interior, are the northernmost expression of the India - Eurasia continental collision. As much as 40by deformation within the Tien Shan. Long-term rates of intracontinental shortening in the Kyrgyz Tien Shan are poorly characterized; slip rates along Neogene faults are not well understood. The northern At Bashi basin, within the central Kyrgyz Tien Shan, exemplifies along - strike variations in strain accommodation. The northern basin edge is bounded by a south - vergent thrust fault that places Paleozoic rock over Paleogene and Neogene sediments. Two cross-strike, structural profiles approximately 15 km apart show variations in strain accommodation within the basin. Shortening along the eastern profile is primarily accommodated by aseismic folding, while strain is taken up by faulting along the western profile. The eastern profile is dominated by the moderately (40 degrees) north - dipping Paleozoic - Neogene thrust fault, and two fault-related anticlines. The most prominent of these two folds is a north - vergent fault propagation fold. Here, the south dipping backlimb panel can be traced westward into the western cross-strike profile. The second anticline is south - vergent and is thrust over the fault propagation fold, placing late Paleogene and early Neogene sediments over middle Neogene sediments. The western profile is dominated by a steep (80 dipping) south - vergent thrust fault that places Paleozoic rock over Neogene sediments, and a north - vergent thrust fault that places lower Neogene sediments over middle Neogene sediments. The north - vergent fault dips approximately 40 to the south, and places a prominent south dipping panel over a north dipping panel. Ongoing palinspastic restorations of Neogene sediments will provide more realistic estimates of Neogene shortening in the central Kyrgyz Tien Shan.

T71A-04 0830h POSTER

Late Neogene Extension in the Shuang Hu Graben, Central Tibet

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Over the past two decades it has been widely recognized that the tectonic and topographic evolution of the Tibetan Plateau are of fundamental importance for both, tectonic models of collision-related deformation as well as global climate models. However, our understanding of the evolution of the plateau is limited, as the presently available data are largely based on studies in the southernmost part of the plateau, whereas little is known about its central and northern parts. The work presented here comprises preliminary results of field work in central Tibet, which was carried out during the summer of 1998 as part of the project INDEPTH III.

Near the town of Shuang Hu in central Tibet (ca. 33°20'N, 88°40'W), NE-SW trending active normal faults define a ca. 50 km long and 10 km wide asymmetric graben with the master fault at the western margin. Preliminary kinematic analyses of fault slip data from Quaternary normal faults along the western graben margin indicate that extension of the NE-trending Shuang Hu graben is left-laterally oblique. Information on the timing and rates of this extension is recorded by 5 well-preserved alluvial terrace surfaces which are offset by 2 m to >300 m along major graben-bounding normal faults. Ongoing work to be presented at the meeting includes (1) detailed kinematic analysis of fault slip data from Quaternary normal faults, (2) cosmogenic isotope dating of the 5 displaced terrace surfaces, and (3) U-Th dating of pedogenic carbonate crusts on clasts contained in the terrace materials.

T71A-05 0830h POSTER

Structual Evolution of the Majba Dome, Southern Tibet

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The Majba Dome (MD), southern Tibet, is one of a series of gneiss domes located south of the Indus-Tsangpo suture zone and north of the high Himalaya. The origin of the domal form has been attributed to diapirism, formation of a duplex at depth, or metamorphic core complex-type extension. However, with the exception of the Kangmar Dome (KD), little is known about these domes. Our new detailed field mapping, structural studies, and preliminary U/Pb geochronology of the MD shed light on its structural evolution, timing of deformation, and mechanism of formation. The dome is cored by a migmatitic K-feldspar augen biotite orthogneiss which is mantled by high grade metapelites and granitic orthogneisses. Grade of metamorphism, defined by concentric sill-in, ky-in, st-in, gnt-in, and chltd-in isograds, decreases upsection. Peak metamorphism and isograd development occurred post D1 and pre- to syn-D2. Metamorphism dies out at the highest structural levels where unmetamorphosed clastic rocks are exposed. The older deformational event, D1, exposed at structural levels above the gnt-in isograd, resulted in WNW-ESE-trending, open to tight to isoclinal folds of S0 with an associated moderately NE-dipping axial planar foliation, S1. The second event, D2, exposed at structural levels below the gnt-in isograd, resulted in a high strain mylonitic foliation, S2, which is parallel to unit contacts, and an associated ~NS-trending stretching and mineral alignment lineation. The foliation and lineation largely obliterate D1 deformational fabrics. The S2 foliation is domed across the area: it dips to the SSW on the southern flank of the dome and to the NW on the northern flank. D2 mesoscopic kinematic indicators record top-to-the-south shear on the south dipping flank and both top-to-the-north and top-to-the-south shear on the north dipping flank of the MD; the orthogneiss core exhibits predominantly symmetric fabrics. Brittle deformational structures are scarce throughout the dome. A pegmatite dike swarm, exposed at the deepest structural levels, was emplaced syn- to post-D2 deformation. In addition, two undeformed 2-mica granites cut across mineral-in isograds, unit contacts, and the D2 structural fabrics indicating they were emplaced post D2; andalusite in the contact metamorphic aureole implies emplacement at shallow depths. Preliminary U/Pb geochronology on zircons show that the orthogneisses of the MD are in part Proterozoic and represent basement similar to that seen in KD. U/Pb geochronology on monazites indicate that one of the post-tectonic granites is 14.5±0.1 Ma. These preliminary data indicate that D2 deformational fabrics and domal form developed prior to the middle Miocene. The striking similarity between the structural geology and metamorphic history of the MD and the KD suggest that they formed as a result of the same process: stretching over a duplex which developed at depth above a north-dipping crustal ramp along the Main Himalayan Thrust. This is our preferred interpretation, however because of the presence of migmatitic rocks and syn- to post-tectonic pegmatites within the MD we can not yet rule out a diapiric origin.

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