Tectonophysics

Indo-Asian Tectonics (T11A)

Room 307/309 Mon AM
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T11A-01 0900H

Geology of the Ulugh Muztagh area, northern Tibet: evidence for Miocene-Pliocene crustal thickening in the northern Tibetan Plateau.

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The Ulugh Muztagh area, a remote area in central northern Tibet, contains an east-west trending belt of ophiolitic melange with large blocks of limestone that marks a probable late Triassic or slightly younger suture between two continental blocks. Rocks south of the suture consist of a thick sequence of upper Triassic quartz-rich sandstones with coal beds in its upper part. Intruded into the sandstone is a suite of tourmaline-bearing two-mica leucogranites and associated hypabyssal dikes. The intrusive rocks are metaluminous, alkalic (potassic) leucogranites and adamellites, and the hypabyssal dikes are peraluminous alkalic (sodic) leucotonolites. These rocks represent partial melts from older continental rocks, and are very similar to Miocene leucogranites from the High Himalaya. The Ulugh Muztagh intrusive rocks yield Ar/Ar ages of from 10.5 to 8.4 Ma. Welded tuffs, geochemically identical to the intrusive rocks (metaluminous alkalic (potassic) leucorhyolites), yield Ar/Ar ages of about 4 Ma. These rocks are interpreted to be related to crustal thickening that must have begun beneath the northern part of the Tibetan Plateau during Miocene time and continued at least to Pliocene time. Active crustal thickening is occurring farther north along the norther margin of the plateau accompanied by major left-slip faulting.

T11A-02 0915H

On the thermal characteristics of the southern Tibet orogenic belt

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In southern Tibet, crustal thickening due to the India-Asia collision has led to the formation of two granite belts. One is located at the southern edge of the accretionary wedge of Tethyan sedimentary rocks, close to the contact with basement gneisses of the Tibetan slab. The other is found within the wedge itself, close to the Kangmar thrust trace. Available ages suggest that the granites appeared first in the southern belt and then in the Kangmar belt. This sequence seems to violate the chronology of thrusting. Other features are that melting started only about 20 Ma after the onset of thickening and that a steep inverted metamorphic gradient is observed across the basement gneisses above the MCT. We give a thermal model, which explains these features. The model relies on the geometry of a sedimentary accretionary wedge bounded by low-angle thrust faults and on the existence of a thermal conductivity contrast between old basement and young sedimentary rocks. The wedge of sedimentary rocks acts as an insulating cap and its southern edge heats up along the contact with basement rocks. On a horizontal cross-section, there is a temperature maximum along this southern edge, which explains why melting starts there. The early thermal evolution is sensitive to local conditions and granites first appear in the vicinity of the most radiogenic parts of the basement. The distribution of granites in space and time is seemingly random, reflecting different melting events in different radiogenic environments in the heteregeneous basement. This model predicts a relationship between radioactivity and age which is compatible with available data. The results emphasize that there are large horizontal temperature variations across a thickened region and that granite ages are not related simply to the timing of tectonic phases.

T11A-03 0930H

Constraints on the age of normal faulting, north face of Mt. Everest: Implications for Oligo-Miocene uplift.

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A two-mica granite which cuts a E-W down-to-the-north normal fault on the north face of Mt. Everest has been dated by U-Pb and $^{40}Ar/^{39}Ar$ methods. Four zircon fractions contain a component of inherited Pb*, indicated by $^{207}Pb/^{206}Pb$ ages from 440 to 1090 Ma. Zircon saturation systematics indicates a melting temperature of 720 ± 30°C. Two fractions of monazite, when corrected for initial ^{230}Th disequilibrium, plot on concordia at 22-25 Ma. A third monazite fraction is normally discordant (~20%) and yields a $^{207}Pb/^{206}Pb$ age of 344 Ma, confirming the potential for inherited Pb* in monazite. Biotite and muscovite yield $^{40}Ar/^{39}Ar$ isochron ages of 17.1 ± 0.1 and 16.7 ± 0.2 Ma, respectively. The K-feldspar has two plateaus; the first 49% of ^{39}Ar released yields a plateau with an age of 16.2 ± 0.1 Ma (T_c = 235 ± 10°C), rising to a closure age of 22 Ma (T_c = 400 ± 25°C) over the last 46% of ^{39}Ar released. These data indicate motion on this conspicuous normal fault, interpreted to be the result of topographic loading, is at least as old as 22 Ma. The rapid cooling from 350 to 230°C, indicated by the muscovite, biotite, and lower K-feldspar plateau ages, suggests rapid uplift, perhaps during a second faulting event on the MCT or a similar structure at ca. 17 Ma. A biotite-K-feldspar gneiss from ~95 km WNW of Mt. Everest has biotite $^{40}Ar/^{39}Ar$ age of 21.5 ± 0.1 Ma and a minimum $^{40}Ar/^{39}Ar$ K-feldspar age of 18.6 ± 0.2 Ma (T_c = 295 ± 10°C). The timing of the cooling of this rock through 300°C is also suggestive of rapid uplift in the early Miocene. These results are consistent with thermochronologic studies from the Gangdese batholith, 400 km to the ENE which demonstrate a pulse of very rapid uplift (>2 mm/a) in the interval 20 to 17 Ma.

T11A-04 1000H

Qinghai-Tibetan Plateau and the Qinling Orogenic Belt: A Rendezvous

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(Sponsor: J. Armbruster)

The northeast corner of the Qinghai-Tibetan plateau meets the Qinling orogenic belt at the intersection of China's three provinces: Qinghai, Gansu and Sichuan. The Qinling orogenic belt is a natural geographic and geologic divide, separating northern and southern China. Its western end terminates at northern China's largest river, the Yellow River, which flows down from the Qinghai-Tibetan plateau, makes a 180° turn and returns to the northwest.
The structures and rock strata of the Qinghai-Tibetan plateau and the Qinling orogenic belt extend to the Yellow River valley. The sides of the river valley have markedly different rock strata and structures. In the valley proper, blocks of Paleozoic, Mesozoic and early Tertiary rock strata are mixed chaotically together.
We propose a major NW-SE trending late Cenozoic left-lateral strike-slip fault along the Yellow River valley. Movement along the fault has offset rock strata and structures, including an E-W trending late Triassic suture zone, by more than 500 km. In the tectonic setting of intracontinental convergence between India and Eurasia, this fault zone is one of the main paths along which the Caidamu block slid southeast past the Talimu-Huabei block.

T11A-05 1045H

Late Triassic to Recent Orogenic History of the Longmenshan, Sichuan Province, China

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Most terminal collisions result from the opposition and suturing of basement complexes of adjacent plates, as in continent-continent, continent-arc, and arc-arc collisions. The general assumption is that progressive shortening between the relatively more rigid basements of the opposing blocks controls to a large degree the deformational history of orogenic belts. The Late Triassic (Indosinian) terminal collision in the Longmenshan of South China results from an unopposed collision between the passive continental margin of the Yangtze platform with a thick pile of primarily later Triassic turbidites (Xikang Group) incorporarted within the Songpan Ganze accretionary complex. Collision is recorded by the influx of thick, westerly-derived foreland basin deposits (Xujiahe Fm) onto the Yangtze Platform. Late Triassic regional deformation is recognized within the Songpan-Ganze but not as yet within the Yangtze platform proper. The Triassic of the Songpan-Ganze is completely detached from the Paleo-Tethyan oceanic basement upon which it was deposited, and therefore collision in this region did not involve opposition of adjancent basement complexes.
The geometry and structural style of the post-collisional shortening in the Longmenshan is remarkably similar to that of the Alps, including analogs for the Pennine (Xikang Group), Aar (Pengguan Complex), Helvetic and Pre-Alps ('klippen belt'), Swiss Plains molasse basin (Chengdu Basin), and the Jura (Chengdu Hills). There is no analog in the Longmenshan to the Austral-Alpine thrust sheets. Although uplift in the Longmenshan orogenic belt is recorded by the development of thick Jurassic to Quaternary molassic sediments, the present large-scale geometry appears to be a result of only the ?Late Cretaceous to recent shortening. We present comparitive cross-sections across the Longmenshan, Alpine and Appalachian orogenic belts to demonstrate corresponding elements within each of these systems.

T11A-06 1100H

Paleozoic Tectonics and Sedimentation, Northern Xinjiang Autonomous Region, China

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The Bogda Shan-Tian Shan and adjacent Junggar basin of Xinjiang Autonomous Region, China, are morphotectonic elements reflecting the most recent episode (Neogene) of foreland deformation related to the long history of tectonic accretion at the southern Asian continental margin. The record of the earliest phases of accretion, in the middle and late Paleozoic, is obscured by the overprint of subsequent events, but stratigraphic and sedimentologic data suggest that suturing of the Tarim and Siberian cratons may have been more complicated than generally perceived. Specifically, a geologic transect across the eastern Junggar basin and the Bogda Shan reveals striking similarity in Carboniferous stratigraphy, with arc volcanics overlain by carbonate sedimentary rocks. The carbonates comprise shelf deposits in the Junggar basin to the north and turbidites bearing southerly directed paleocurrents in the Bogda Shan to the south. Circumstantial evidence suggests that the Junggar-Bogda Shan terrane appears to represent a single mid-Paleozoic tectonic entity, separated from Siberia to the north by a poorly studied belt of melange and related rocks exposed in northeastern Xinjiang, and separated from the pre-Cambrian basement-cored Tarim block to the south by a fundamental fault. Thus, the Junggar-Bogda Shan terrane may represent a microcontinent caught in the mosaic of the Tarim-Siberia suture in the late Paleozoic.

T11A-07 1115H

Intraplate Deformation and Himalayan Uplift, ODP Leg 116

LEG 116 SHIPBOARD SCIENTIFIC PARTY, Ocean Drilling Project, College Station, Texas 77840.

Three sites were drilled on the distal Bengal Fan in order to determine a) the timing and nature of lithospheric deformation, b) the uplift history of the Himalayas, and c) sedimentation processes on the distal fan. The first two topics will be addressed here. Intraplate deformation was investigated by drilling a pair of sites on one of the fault blocks that make up the tectonic fabric of the region. Site 717 was located at the lower end of the block to obtain a complete section of syn-deformation sediments where the unconformity marking the onset of deformation appears to have become conformable on seismic records. Site 719 was located part way up the block where the syn-deformation sediments are thinner. Sediments at the two sites correspond closely and distinctive individual turbidites and turbidite sequences can be correlated. Detailed correlation indicates that attenuation of the section occurs through a combination of the pinching out of beds and the thinning of individual turbidites. Some intervals show marked reduction in thickness while others are less attenuated. However, in general, it appears that the process has continued steadily and that motion on the fault has been gradual and fairly constant. There is some indication that the rate of motion may have increased slightly with time. The seismic horizon marking the onset of motion was dated at 7 Ma.
Site 718, on the next fault block south where the post-Miocene sediments are thin, provided an opportunity to probe farther back in time. A sedimentary section was obtained to 960m, penetrating 775 of the 1200m of pre-deformation sediment. At the base of the hole, fan sediments of Lower Miocene (17 Ma) were still being penetrated with no evidence of reaching the base of the fan. The Bengal fan was thus well established and delivering sediments including coarse sand sized grains to the Leg 116 sites, 2500 km from the Ganges delta by that time. This implies that major uplift of the Himalayas occurred earlier than has been generally reported.

T11A-08 1130H

Seismotectonics of the Burma Subduction Zone

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The geometry of the Burma Wadadi-Benioff zone (WBZ) has been revealed by fitting a trend surface provided with 8 effective degrees of freedom to 184 well-located hypocenters. The dip of this surface, which passes through the "middle" of the WBZ, varies from about 48° in the north near the eastern Himalayan Syntaxis to about 30° in the Bay of Bengal area. Axial trends of the landward concave bend of the Indo Burma Ranges approximately follow the 60 km depth contour of the Burma WBZ and are enhanced by the late Cenozoic shortening. Two tightly constrained solutions of intermediate depth earthquakes within the Burma WBZ indicate that the subducted plate

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