velocity model has been determined after 12 iterations during which the RMS of arrival time residuals have been reduced from 0.66 s to 0.22 s and from 0.83 s to 0.32 s for the P- and S-waves, respectively. Overall, the Taiwan region is characterized by very significant lateral and vertical variations of Vp and Vs structures as shown by many anomalous high and low velocity regions. A north-northwest dipping high velocity zone can be identified in northeast Taiwan which can be associated with the known subducting Philippine Sea plate. The relocated subduction zone earthquakes are distributed mostly near the top of this high velocity zone. A thin zone of very significant low Vp extending to a depth of 80 km can be clearly identified just above subducting slab which can be interpreted as the corresponding eclogite layer in the region. In contrast to the high velocity anomalies at depth less than 10 km, the deeper portion of the Central Mountain Range (CMR) is characterized by large scale of low velocity anomalies where seismicity is extremely low comparing to the surrounding regions. The western boundary of this large low velocity region beneath the CMR coincides with the eastern terminus of Chi-Chi aftershock sequence. Low velocity and low seismicity beneath CMR can be attributed to high temperature and high geothermal activities at depth. The velocity structure anomalies associated with the Longitudinal Valley and Coastal Range in eastern Taiwan can be traced to a depth around 30 km. Selected earthquakes are relocated simultaneously during the tomographic inversion using the resultant 3-D velocity model which has provided a very significant impact on the epicentral and depth determination. For example, the mainshock of the 1999 Chi-Chi earthquake has been relocated about 2.0 km to the west, 1.3 km to the north and 3.7 km shallower than its location determined by CWB. This suggests that the mainshock occurred at a depth of 4.3 km along the 30^{o} easterward dipping Chelunpu fault rather than near the intersection of the bottom of the Chelunpu fault and the gently eastward dipping detachment fault. The resultant 3-D Vp and Vs velocity models and the spatial distribution of relocated earthquakes provide key information to explore seismogenic structures associated with the oceanic-continental collision and subduction processes in Taiwan region

S61C-1163 0830h POSTER

The Northern Walker Lane Seismic Refraction Experiment

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We are developing a three-dimensional reference seismic velocity model for the western Great Basin region of Nevada and eastern California. The northern Walker Lane had not been characterized well by previous work. In May 2002 we collected a new crustal refraction profile from Battle Mountain, Nev. across western Nevada, the Reno area, Lake Tahoe, and the northern Sierra to Auburn, Calif. Mine blasts and earthquakes were recorded by 199 Texan instruments (loaned by the PASSCAL Instrument Center) extending across this more than 450-km-long transect. The seismic sources at the eastern end were mining blasts at Barrick's GoldStrike pit. We recorded additional blasts at the Florida Canyon and other mines between Lovelock and Battle Mountain, Nevada. The GoldStrike mine produced several ripple-fired blasts using 10,000-40,000 kg of ANFO each. First arrivals from the larger blasts are obvious to distances exceeding 250 km in the raw records. A M2.4 earthquake near Bridgeport, Calif. also produced pickable P-wave arrivals across at least half the transect, providing fan-shot data. We recorded only during working hours, and so missed an M4 earthquake that occurred at night. Events of M2 occurred during our recording to the west on the San Andreas fault near Pinnacles, Calif.; M3 events occurred near Portola and Mammoth Lakes, Calif. Arrivals from M5 events in the Mariana and Kuril Islands also appear in the records. Time-picks from these earthquakes may be possible after more work on synthetic-time modeling, data filtering, and display. We plan to record blasts at quarries in the western Sierra in future experiments, for a direct refraction reversal. We will compare our time picks against times generated from regional velocity models, to identify potential crustal and upper-mantle velocity anomalies. Such anomalies may be associated with the Battle Mountain heat-flow high, the northern Walker Lane belt, or the northern Sierran block.

URL: http://www.seismo.unr.edu/geothermal

S61C-1164 0830h POSTER

Techniques for Obtaining Crustal Structure from Inversion of Receiver Functions by Using Additional Data Constraints

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Teleseismic receiver functions contain information on shear velocity interfaces in the Earth, and the relative traveltimes of converted waves that reverberate between those interfaces. However, the interpretation of such data is hindered by velocity-depth trade-off. Independent constraints from other data are thus required. We developed three independent methods for solving this problem in the course of processing data from the Iceland Hotspot Project. These involve combining surface-wave dispersion data, local earthquake P and S waves, and receiver functions to jointly invert for crustal structures. Depending on the heterogeneity of the local structure, a joint simultaneous inversion of receiver functions and surface-wave interstation dispersion curves was developed for backazimuthally varying structures and for cases where there the volume around the stations is relatively homogeneous. In regions where there are significant structural differences between the station localities and their immediate neighbourhood we jointly model surface-wave dispersion curves and the waveforms of local earthquakes and receiver functions. We select, as the final result, the models that satisfy all three data sets best. In regions without a priori information, we first invert surface wave dispersion curves using a global searching GA (genetic algorithm) inversion. We then use the results of the GA as a starting model for the receiver function inversions. A few constraints obtained from GA inversion are introduced into the receiver function inversions. In this way we retain the long-wavelength structural features while using receiver functions to constrain local structural details. This approach helps the inversion by excluding unreasonable competing models, thereby reducing the nonuniquness of the receiver function inversion.

S61D MCC: 134 Saturday 0830h

Young Continent-Continent Collisions I *(joint with T)*

Presiding: **E Sandvol,** University of Missouri**; N Turkelli,** Kandilli Observatory and Earthquake Research Institute, Bogazici University

S61D-01 0830h INVITED

Doug Nelson's Contributions to our Understanding of Young Continent-Continent Collisions

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K. Douglas Nelson, Department Chair and Jessie Page Heroy Professor of Earth Sciences at Syracuse University, died suddenly of heart failure on August 17th, 2002, age 49. At the time of his death he was at the heights of an increasingly distinguished career, and had, just prior to his death, agreed to be an invited speaker in this session of the 2002 Fall AGU meeting.

Doug began his professional career as a field structural geologist, writing his PhD on the Newfoundland Appalachians, and as a post-doc in South Island, New Zealand. From there he went to Cornell University to join COCORP; he learned to interpret deep seismic reflection data and became hooked on the value of geophysics to the study of large-scale processes in mountain belts. He became one of the proponents of taking the COCORP methodology overseas, to the world's type example of young, continent-continent collisions, the Himalaya.

For 10 years from 1992, by now a faculty member at Syracuse, Doug provided operational and intellectual leadership to the INDEPTH program (International Deep Profiling of Tibet and the Himalaya). His talk in this session would undoubtedly have focused on our new understanding of Tibet that resulted in large part from the work that he led and supervised. From the initial conception of INDEPTH as a single reflection profile across Earth's highest mountain range and largest plateau, the program grew through three major stages to encompass a full range of geophysical and geological surveys in a transect that now reaches from the High Himalaya across Tibet. Doug more than anyone was the enthusiastic integrator in the large multinational group of investigators (from the U.S., China, Canada and Germany), not bound by a single technique, and best able to synthesize the seemingly disparate observations from all the techniques. In recent years he was particularly interested in the combination of magneto-telluric with seismic results to better constrain interpretation of deep geology. Although Doug cannot now write the synthesis of the INDEPTH-3 results from central Tibet, nor lead the final INDEPTH-4 campaign across the northern margin of Tibet that he was already planning, our picture of Tibet, and hence of all continent-continent collisions, has changed and grown far richer as a result of his efforts.

Among other things, INDEPTH has traced the top of the Indian plate descending beneath the Himalaya, located the likely limit of penetration of Indian mantle beneath central Tibet, and amassed considerable evidence for widespread melt within the Tibetan crust. The first observation, identification of the suture in an active collision, was a natural outgrowth of Doug's earlier contributions to the geometry of the Applachians and Ouachitas. The second observation directly relates to Doug's interest in the evolution of the deep crust/uppermost mantle in old orogens through delamination. The last observation, that melt is widespread in Tibet, was perhaps the most surprising result of the INDEPTH surveys, and the one that Doug used to greatest effect in his synthesis of deformation and crustal evolution around the Tertiary Indus-Tsangpo suture. Doug's articulate and enthusiastic arguments on the inferred role of low viscosity of the middle crust of the Tibetan plateau have been widely echoed in the latest generation of models by many authors that appeal to the flow of crustal material outwards from the central plateau to its southern and eastern margins. This emphasis on crustal mobility in young continent-continent collisions is already influencing our interpretations of ancient orogens.

S61D-02 0850h INVITED

Crust and Upper Mantle Structure of the Northern Portion of the Arabia-Eurasia Collisional Belt

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The Eastern Turkey Seismic Experiment (ETSE) was designed to image the crustal and upper mantle velocity structure beneath the northernmost Arabian plate and beneath the Anatolian Plateau, constraining geodynamic models for young continent-continent collision. ETSE was composed of a 29 station broadband PASSCAL array which was deployed from October 1999 until August 2001. A receiver function profile along the western transect of the ETSE array indicates that there is no significant crustal thickening across the East Anatolian Fault Zone (EAFZ). This implies that the northward convergence of the Arabian plate is being largely accommodated by the westward extrusion of the Anatolian plate. The profile does suggest, however, the presence of a crustal root near the northern part of the Anatolian plateau and across the North Anatolian Fault. Results from Sn attenuation tomography and Pn travel time tomography imply a fundamental change in the properties of the uppermost mantle in the vicinity of the Bitlis suture and EAFZ: our observations of very low Pn velocities and very high Sn attenuation beneath the easternmost Anatolian Plateau are

best interpreted to indicate that the mantle lid beneath the eastern Anatolian plateau is anomalously hot and that the lithospheric mantle is very thin. Preliminary analysis of Rayleigh wave phase velocities are consistent with these results. Shear-wave splitting analysis indicates that there is no significant change in upper mantle polarization anisotropy across the Bitlis suture or the EAFZ. There also appears to be some correlation between very slow mantle lid velocity and large splitting lag times across the eastern portion of the Anatolian plateau.

URL: http://atlas.geo.cornell.edu/turkey/turkey.html

S61D-03 0910h

The Electrical Structure of the Tibetan-Himalayan Orogen

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The Tibetan Plateau is the type location for the study of continent-continent collision. During the period 1992-2001 the INDEPTH project collected comprehensive, high quality geophysical and geological data across the entire north-south extent of the Tibetan plateau. This project was developed in large part through the perseverance, insight and efforts of Doug Nelson. While the early phase was focussed on seismic reflection acquisition, Doug Nelson was largely responsible for the inclusion of other geophysical techniques during phases II and III of INDEPTH. A key part of this diversification was the inclusion of magnetotelluric (MT) exploration during INDEPTH-II in 1995. Over four field seasons (1995-2001), MT data were collected across the entire plateau, including each of the major tectonic features of the plateau. Previous presentations have focussed on relatively local structures based on an initial analysis of the MT data. In this presentation, a more comprehensive analysis will be presented, and which uses TE, TM and vertical magnetic field data. MT data collected in Ladakh and Nepal by other researchers will also be included. Key features that the MT surveys have shown include:

(1) A high conductivity layer at a depth of 15-20 km that is present over the entire plateau. This layer extends both north-south (from Himalaya to the Kunlun Shan) and east-west (at least 78-92 degrees E) and is concluded to be due to a combination of partial melting and aqueous fluids.

(2) In the Qiangtang and Songpan Ganze terranes of northern Tibet, this layer is underlain by an upper mantle with a relatively low resistivity (10-20 ohm-m). This is incompatible with whole scale underthrusting of Asian lithosphere.

(3) In southern Tibet the conductive layer has a higher conductance, and it is thus more difficult to image the electrical structure of the underlying upper mantle. However, very long period data at some MT stations give evidence that the upper mantle is relatively resistive.

S61D-04 0925h

Crustal thickening and lateral extrution during in the formation of the Tibetan Plateau: Insights from 3D Numerical modeling

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Our understanding of the geodynamics of the formation of the Himalayan-Tibetan Plateau has been largely based on two end-member models: the viscous thin-sheet model that suggests crustal thickening as the dominant accommodation for larger than 2000 km crustal shortening following the Indian-Asian collision, and the plasticine indentation model that emphases the role of lateral extrusion of Asian continent along numerous strike-slip faults. To understand better the strain partitioning between crustal thickening and extrusion during the formation of the Tibetan Plateau, we have developed a three-dimensional finite element model with vertically variable power-law rheology and large-scale strike-slip faults, including the Altyn Tagh, Longmen Shan, Xianshuihe and the Ailao Shan-Red River faults. We simulated the formation of the Tibetan plateau resulting from convergence between the Indian and Eurasian plates during the past 50 Myr. The model assumes the Tarim block and the South China block to be relatively fixed, and the Indian plate moved northward as indicated by marine magnetic anomalies. During the early stages following the initial collision, the predicted stress states within the collision zone favor predominantly strike-slip motion, and a large extrusion conduit between the collision zone and the South China block allowed most of the shortened crustal material to be accommodated by east-southeastward extrusion. As the Indian plate continued to indent into the Asian continent, the extrusion conduit was gradually narrowed, leading to reduced rate of crustal extrusion, and increased crustal thickening and lateral expansion of the plateau. The predicted crustal extrusion is significantly greater with the strike-slip faults than without, and ductile flow within the lower crust is shown to play a critical role in reproducing the observed topography of the Tibetan plateau and surrounding regions.

S61D-05 0940h

A Franco-Iranian Program for the Study of Continental Tectonics in Iran

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Since 1997, several French (LGIT-Grenoble, LGTS-Montpellier, LGCA-Grenoble, DST-Paris, Cerege-Aix , ENS-Paris, EOST-Strasbourg) and Iranian (IIEES-Tehran, GSI-Tehran, NCC-Tehran, IGTU-Tehran) academic institutions decided for a joint collaboration for the study of continental tectonics and inferred seismic hazard in Iran. Several teams involved in tectonics, seismology, engineering seismology, geodesy, geomorphology, paleomagnetism and structural geology conduct integrated studies in specific regional targets. Two major projects address the problem of the distribution of the deformation within Iran and of the lithospheric structure from the Arabian platform to Central Iran. Part of the effort was also devoted to the study of the Zagros and the Alborz mountain belts in specific areas such as the Zagros-Makran transition, the Central Zagros, the Northern Zagros, the Central Alborz. We present a summary overview of the different ongoing projects and some preliminary results.

S61D-06 1015h INVITED

Deformation of the Northern Edge of the Australian Continent in New Guinea

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The island of New Guinea, the leading edge of the northward moving Australian continent, is dominated by the rapid oblique convergence (110 mm/yr) between the Pacific and Australian plates. The oblique convergence has produced a complex array of microplates whose motions result in rapid shear, arc-continent collision, oceanic and continental subduction, continental rifting, and seafloor spreading. We have conducted GPS studies throughout New Guinea (Papua New Guinea in the east and the Indonesian province of West Papua in the west) for the last ten years. For the first time, we integrate the information from these GPS data to gain a more complete picture of tectonic block interactions in the New Guinea region. We are inverting the GPS results along with spreading rates and earthquake slip vectors to solve simultaneously for block rotations and coupling on block-bounding faults. In West Papua a large section of the continent (the Bird's Head) is being detached along a rapid (8 cm/a) shear zone and subducted at the Seram trough. Along the northwest coast of West Papua, oblique convergence is occurring along the New Guinea trench but accommodates only a minor part (20%) of the relative plate motion. This in contrast to the eastern portion of the New Guinea Trench which appears to be taking up a high proportion of Pacific/Australia relative motion. In Papua New Guinea (PNG), Pacific - Australia convergence is even more complex, comprising several blocks, some of which rotate about neaby axes. The South Bismarck plate is rotating rapidly clockwise in response to the ongoing Finisterre Arc-Continent collision. The central part of the Highlands mountain range in PNG appears to be rotating counter-clockwise as an essentially rigid block relative to Australia, agreeing with evidence (from seismicity and geology) for active shortening in the PNG Highlands fold and thrust belt. This is in contrast to the slow rates of left-lateral strike-slip seen in the Highlands in the Western part of New Guinea. We will present results of the integrated modeling as well as GPS results through our 2002 campaigns.

S61D-07 1035h INVITED

Seismogenic Zones in Eastern Turkey: Results from the Eastern Turkey Seismic Experiment

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The tectonics of Eastern Turkey is dominated by a young continent-continent collision zone. Movement along the North Anatolian Fault Zone (NAFZ), East Anatolian Fault Zone (EAFZ) and the Bitlis Suture Zone led to many damaging earthquakes in this region. We deployed a temporary 29-station broadband PASSCAL array called The Eastern Turkey Seismic Experiment, ETSE from October 1999 until August 2001 to produce good quality seismic data in order to (a) define the seismogenic zones better, (b) investigate the crustal and upper mantle structure of the region, and (c) test the exisiting geodynamic models.

During the experiment we detected approximately 10 events every day. Furthermore, several large earthquakes (M approx 5.5)occurred within our network providing hundreds of aftershocks in the epicentral regions. We located 1165 earthquakes for the first 16 months. All hypocenter locations were classified into four different categories based on the reliability of the location. This classification is based on station residuals, total rms value, seismic gap, number of stations used, and the minimum station distance to the epicenter. We tested and calibrated our hypocentral locations and the crustal model used by a 12-ton controlled source explosion that took place in Eastern Turkey on June 5, 2001. We used the travel time data from this explosion to obtain average crustal structure and site correction terms for the stations. We found that for near-surface events, the ETSE array is able to locate events to within 1-2 km. of the true epicenter.

Our findings show that the entire region of study is seismically very active. The seismic activity clusters along the North and East Anatolian faults as expected. However, we observe that the EAFZ seismic activitiy continues into the easternmost portion of the Anatolian Plateau. The hypocenters of well-located events indicate that there are no sub-crustal earthquakes in Eastern Anatolia. The majority of earthquakes occur in a depth range between 2-10 km. The deepest event that we located to date is 32 km on the Bitlis Suture Zone. Though there is a correlation between active faults and epicenter locations, a large number of events occur in regions where no mapped surface faults has been reported.

These results will allow us to assess the seismic hazard and subsequently estimate the seismic risk. It is

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critical for the development of the region especially in the ongoing and planned major engineering structures such as large dams and oil and gas pipelines.

S61D-08 1055h INVITED

Active Tectonics of the Iran Plateau and South Caspian Basin

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We use observations of surface faulting, well-constrained earthquake focal mechanisms and centroid depths, and velocity structure to investigate the present-day deformation and kinematics of the region. Current deformation is primarily concentrated in three seismically active belts: the Zagros Mountains of southwest Iran,the Talesh-Alborz-Kopeh Dag Mountains of northern Iran, and the Apsheron-Balkhan Sill in the central Caspian Sea. These belts are separated by seismically inactive regions that act as semi-rigid blocks. The extent to which the active shortening is divided between the three belts is still uncertain. Earthquake locations in the region, particularly their focal depths which are determined from teleseismic arrival times, are poor, and reported subcrustal earthquakes have been cited as evidence for present-day subduction beneath the Zagros. A detailed analysis of earthquake focal depths in the Zagros and elsewhere in the region confirms that no substantial subcrustal earthquakes occur in this part of the Middle East except beneath the Makran subduction zone in the south and the Apsheron-Balkhan Sill in the north. The present-day N-S deformation across the Zagros is partitioned with right-lateral, strike-slip motion on the NW-SE striking Main Recent Fault, and NE-SW shortening across the Zagros. Shortening in the Zagros is accommodated by folding in the sediments (0-10 km depth), moderate earthquakes on high-angle reverse faults striking parallel to the surface folds (∼10-20 km depth), and aseismic thickening of the lower crust (∼20-45 km depth). The south Caspian basin is essentially free of earthquakes and acts as a rigid block which strongly influences the nature of the deformation in the surrounding active belts. No significant subcrustal earthquakes occur in the Talesh, Alborz, or Kopeh Dag Mountains which bound the northeast, south and west sides of the south Caspian basin, but substantial subcrustal seismicity occurs beneath the Apsheron-Balkhan Sill on the north side of the basin. Earthquakes in the Kopeh Dag occur primarily on reverse or right-lateral strike-slip, NW trending faults. The Kopeh Dag structures continue to the NW towards the Apsheron-Balkhan Sill but become increasingly buried by sediment. Focal mechanisms of earthquakes in the Alborz show either reverse motion or left-lateral strike-slip motion on faults parallel to the regional strike of the belt. Earthquakes in the Talesh indicate thrusting on almost flat faults at depths of 15-26 km with slip vectors directed towards the Caspian. We believe that the subcrustal earthquakes occurring beneath the Apsheron-Balkhan Sill indicate the onset of subduction of the high velocity (high density) south Caspian crust beneath the continental crust of the central Caspian. The conjugate right-lateral and left-lateral components in the Kopeh Dag and eastern Alborz suggest that the South Caspian Basin has a westward component of motion relative to both Eurasia and Iran. This motion enhances westward underthrusting of the basin beneath the Talesh Mountains of Iran and Azerbaijan.

S61D-09 1115h

Integrated Studies of Seismic Q and Velocity Structure in the Tethysides Belt of Southern Eurasia

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Tomographic maps of Lg coda Q that pertain to the crust, Rayleigh-wave phase velocites, and inferred shear-wave velocities in the upper mantle, are now available for nearly the entire Eurasian continent. In addition, models of the depth distribution of shear-wave Q, obtained from the inversion of fundamental-mode Rayleigh-wave attenuation are available for the Middle East and for China and peripheral regions. The most striking feature of Q maps for Eurasia is the broad band of low values that stretches through the Tethysides belt, a young collision zone in southern Europe, the Middle East and most of southern Asia. The mapped band of low Q values correlates strongly with maps of low values for shear velocity in the upper mantle. Measured values of Lg coda Q, shear-wave Q, and shear velocities also vary laterally along that band. Lowest values for Lg coda Q (about 200) occur in Turkey and southern Tibet.

Rayleigh-wave path coverage in southeastern Asia is sufficiently dense to allow the development of tomographic maps of shear-wave Q structure in three depth intervals, 0 10 km, 10 30 km, and 30 60 km. For the shallowest layer shear-wave Q attains lowest values (about 40) in the southern part of the Tibetan Plateau and the Tarim Basin and is highest in southeastern China. Shear-wave Q in the 10 30 km deep layer is lowest (about 50) in Tibet and the Pamir thrust system and highest in central China and parts of the Sino-Korean platform. Resolution of crustal variations is significantly poorer for the deepest layer than for the others, but results indicate that shear-wave Q is highest (about 180) beneath southern Mongolia and the Tarim Basin and lowest under the Pamir thrust system.

Lateral variations in Q at crustal depths can be interpreted in terms of variable densities of fluid-filled cracks and permeable material in the crust. Such fluids might originate from hydrothermal reactions in regions of high temperature in the upper mantle that might also cause reduced upper mantle velocities.

S61D-10 1130h

Improved images of the Tibetan upper mantle to test hypotheses of its dynamic origin

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Uncertainties in current models of the upper-mantle beneath Tibet prohibit choosing among the variety of competing hypotheses that have been proposed to explain its genesis. These hypotheses include large-scale convective downwelling; the northward subduction of Indian lithosphere beneath Tibet; the southward subduction of the Tarim (or other Eurasian) lithosphere beneath Tibet; and small scale convective instabilities, or "deblobbing", of thickened mantle lithosphere beneath Tibet. To discriminate among these competitors, therefore, requires focusing current models of the Tibetan mantle and reducing uncertainties. We discuss our attempts to improve upon our earlier tomographic models of the Tibetan crust and upper mantle that have been derived exclusively from surface wave data. Monte-Carlo error analysis indicates that a large share of the uncertainty in the mantle derives from trade-offs between crustal and mantle structures. To reduce mantle uncertainties requires tighter constraints on crustal structures, which we apply based on receiver function analyses of broad-band data at both permanent and portable seismic observatories in the region. Models resulting from the joint inversion of surface wave dispersion and body-wave reverberations are considerably more reliable than from either alone. We discuss how the improved model compares with our earlier models, which display low wave speed anomalies immediately beneath the crust in northern and central Tibet which, in turn, are underlain by high speed mantle material to depths exceeding 200 km. Finally, we consider how the resulting model may be used to discriminate between mantle structures that are consistent with each of the dynamical hipotheses.

S61D-11 1145h

Himalayan Nepal Tibet Broadband Seismic Experiment (HIMNT)

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Our project aims at the understanding of the mountain building processes through earthquake source and crust and mantle structure imaging. It involves the deployment of 28 broadband seismometers throughout Eastern Nepal and Southern Tibet, using broadband instrumentation from the IRIS PASSCAL facility. The stations were in place for one year from Fall 2001 to Fall 2002. The current studies with this data and their purposes are: (1) P to S converted waves (receiver functions) and teleseismic P and S arrival times will be used to decipher the general crustal and upper mantle structures under the Himalaya: to determine the presence of subduction zone and other structures under the Himalaya, (2) the arrival times and waveforms of hundreds of earthquakes under the orogen will be used to image the 3-D crustal structures underneath the Himalaya and relocate earthquakes using double difference and 3-D tomographic techniques: to determine possible major dislocation surfaces and the internal structure and rheology of the orogen, (3) seismic anisotropy under the Himalaya will be measured using shear wave splitting and P wave polarization analysis: to map upper mantle flow and lithospheric deformation, (4) focal mechanisms from regional moment tensor inversion: to determine kinematics of orogenic deformation. We seek to determine the geometry of fault ramps, where seismic events with characteristic focal mechanism concentrate, and whether the decollement can be detected through seismicity or material differences. Using teleseismic data we expect also to map features in the upper mantle underneath the orogen, such as the subducted Indian lithosphere and products of delamination. We will report on the results to date on these projects. The geometry of the source zones, the nature of the seismic slip and kinematics derived from this experiment will also help constrain the interpretation of ongoing geodetic surveying in the area.

URL: http://cires.colorado.edu/people/sheehan.anne/nepal_project.html

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S61E MCC: 121 Saturday 0830h

Slip Sliding Away: Earthquake Process *(joint with NG, G, T)*

Presiding: **J Gomberg,** U.S. Geological Survey**; J E Ebel,** Weston Observatory, Boston College

S61E-01 0830h

A Primer on Seismicity Rate Change Models

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Numerous physical models explaining the temporal response of seismicity to changes in loading, particularly the decay rate of aftershocks, have been proposed over the years. Among the most recent is that proposed by Dieterich (1994) in which earthquake failure is modeled as a frictional process obeying a particular set of empirical rate-state frictional relations. The Dieterich model predicts a simple analytic description of the change in seismicity rate due to a static stress step and/or change in loading rate, such as might result from a large earthquake affecting a population of