focal mechanisms. While GPS data has been used in similar studies, this is the first application of stress field observations to this problem. We construct a simplified version of the southern California fault system, and model the surface velocities using a block model with elastic strain accumulation, following Meade et al. (2002). Additionally, we model the stress orientations at seismogenic depths, assuming that the stress field results from the loading of active faults. An inversion for fault slip rates is performed to simultaneously fit the GPS and stress observations. The model fit to the data is good in general, indicating that a simple mechanical model can capture both observed interseismic strain and stress accumulation. We evaluate the sensitivity of the slip rate solutions to the different datasets and identify "anomalous" fault segments with stresses that deviate from our simple loading model.

T52A-0247 1330h POSTER

Reinterpreting Stress Orientations Near the San Andreas Fault

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The strength of the San Andreas Fault (SAF) and the orientation of stress in its vicinity are controversial. Two end-member models have been proposed: the strong fault model (SAF strength equivalent to laboratory samples) and the relatively weak fault model (SAF an order of magnitude weaker than the surrounding crust). These two models predict maximum compressive stress axes at low angle (~30°) or at high angle (~80°) to the fault strike, respectively. Several recent studies have attempted to test these models by inverting the focal mechanisms of small earthquakes for stress orientation near the SAF, but are inconsistent as to which model is supported. Particularly at odds are two studies in southern California (Hardebeck and Hauksson, 1999, 2000; and Townend and Zoback, 2001) that use identical focal mechanism data but reach opposite conclusions. We investigate whether the disagreement between studies comes from discrepancies in the observed stress orientations, which would indicate flawed methodology, or from differences in interpretation. Townend and Zoback proposed that the stress orientations reported in their study are different from those of Hardebeck and Hauksson due to the use of different schemes for spatially binning the seismicity for inversion. We test this idea by comparing the results of the two studies over the entire region, and find that the stress orientations are actually very similar, usually to within the uncertainty of the inversion results. The largest differences occur in regions with few earthquakes, as the two techniques mainly differ in how stress orientations are assigned to the areas between earthquake clusters. The inconsistency between the studies therefore lies in the interpretation. The stress orientations reported by both studies are often at intermediate angles (~40-60°) to the SAF, not consistent with either the high angle or the low angle model, which understandably has confused the interpretation of these results. We perform two additional stress inversions on a high-quality focal mechanism data set for southern California, obtained using a new focal mechanism technique (Hardebeck and Shearer, 2002.) In one inversion, we stack stress orientation vs. distance profiles across all segments of the SAF, to cancel out signals not related to the SAF. In the other, we bin the seismicity using cluster analysis. In both experiments, we again obtain intermediate angles near the SAF. Similar intermediate angles have also been observed in central and northern California (Provost and Houston, 2001, 2003). Neither the strong fault nor the relatively weak fault model satisfactorily describes the SAF. Alternative models are needed which can explain the intermediate stress angles along much of the fault. One such model is a slightly weak SAF, with a coefficient of friction approximately half that of strong faults, or containing pore fluids at elevated but sub-lithostatic pressure. Alternatively, observed stress rotations caused by earthquakes suggest low deviatoric stress magnitude at depth, and variable stress orientation through the seismic cycle due to tectonic loading and seismic release. In this low-stress model, all active faults must be weak, and the observed stress orientations along the SAF reflect its loading state and earthquake history, not its strength.

T52A-0248 1330h POSTER

Absolute Strength of the San Andreas Fault Inferred From 3D Loading Simulation and Seismological Data Analysis

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Heat flow observations and inferred tectonic stress orientations along the San Andreas fault system in California have raised a controversy about its absolute strength. In the last decade many mechanical models of the San Andreas fault have been proposed to explain the orientations of the axis of maximum horizontal compression. In this study we numerically computed the absolute stress fields around the San Andreas fault on the basis of the elastic dislocation theory and examined the relation between the pattern of the stress field and the absolute fault strength. We also investigated spatial changes in seismic activity and orientation of the axis of maximum horizontal compression around the fault to estimate the absolute fault strength. The strike of the San Andreas fault system is nearly parallel to the direction of relative plate motion (N40W) except for the big bend segment in Southern California. In Northern and Central California the San Andreas fault is simply modeled by an infinitely-long, pure strike-slip interface that divides the elastic surface layer overlying a viscoelastic substratum in two plates. In tectonic loading simulation we specify an absolute fault strength distribution on a model segment of the plate interface. The driving force of this system is steady slip at 40 mm/yr on the remaining parts of the plate interface. Through this simulation we can realize a steady stress field around the fault, caused by the steady slip with a frictional resistance at the plate interface. The background absolute stress fields in Northern and Central California are obtained by adding the litho-static pressure to these steady stress fields. From comparison of the computed absolute stress fields and spatial seismicity changes, we can estimate relative strength of these segments (e.g., the northern locked segment is about three times as strong as the central creeping segment), but not absolute strength. At the big bend segment in Southern California, on the other hand, the fault strike is oblique by 20 degrees to the direction of relative plate motion. In this case we model the fault system by an oblique transcurrent fault segment that connects the northern and southern semi-infinitely long, pure strike-slip plate interfaces. The driving force of this system is steady slip at 40 mm/yr on the northern and southern semi-infinite plate interfaces. At the oblique transcurrent segment the relative plate motion has a convergent component, which cannot be released by fault slip motion. Therefore, in tectonic loading simulation, the stress field caused by the convergent component increases linearly with time. In reality, the background absolute stress around the big bend segment is maintained at a constant level, since the tectonic stress caused by plate convergence is accommodated by inelastic crustal deformation and/or thrust faulting in the surrounding area. On the basis of such an idea, we computed the absolute stress field around the big bend segment, and compared the results with observations to determine the absolute strength of the San Andreas fault in Southern California.

T52A-0249 1330h POSTER

Detailed Stress Analysis of the Tjörnes Fracture Zone in Northern Iceland, Using Microearthquakes.

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The Tjörnes fracture zone in northern Iceland is an oblique, right-lateral transform zone connecting the offshore Kolbeinsey Ridge to the west with the Icelandic Northern Rift zone to the west. Seismicity is mostly confined to two major zones, the Grimsey lineament to the north and the Husavik-Flatey fault to the south. The Husavik-Flatey fault is an old, well established strike-slip fault whereas the Grimsey lineament is considered to be the early stages of the formation of a new major fault. This study presents a detailed mapping of the state of stress in the Tjörnes fracture zone using inversion of large numbers of microearthquake focal mechanisms. We show significant variations in the direction of the stress field along strike of the Husavik-Flatey fault and also in the Grimsey lineament. These variations are interpreted in terms of plate boundary deformation. We apply two different methods of stress inversion, one of which is sensitive to the strength of the fault system, and present an analysis of the results in terms of relative fault strength.

T52A-0250 1330h POSTER

New Insights on Stress Rotations From a Forward Regional Model of the San Andreas Fault System Near its Big Bend in Southern California

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Understanding the stress field surrounding and driving active fault systems is an important component of mechanistic seismic hazard assessment. We develop and present results from a time-forward 3-dimensional model of the San Andreas Fault system near the Big Bend in Southern California. We assess the model boundary conditions by comparing model and observed tectonic regimes, and explore the forward model of earthquake generation along these fault segments to target measurable properties. We investigate how slip along the faults perturbs stress orientations, and how stress orientations may allow inferences on the stress state. We use a quasi-static fault model [Fitzenz and Miller, 2001], where GPS-constrained tectonic loading drives faults modelled as viscoelastic bodies embedded in an elastic half-space [Fitzenz and Miller, 2003] mostly sealed from the surrounding rocks and subjected to ductile compaction and shear creep. We show that a transpressive tectonic regime develops southwest of the model Big Bend as a result of the loading boundary conditions and migrates toward the Bend due to slip along the model fault. Stress transfer from fault slip is shown to transiently induce significant perturbations in the local stress tensors (where the slip profile is very heterogeneous). These result in off-fault tectonic regimes and optimal orientations for faulting that differ from those generally prevailing in the area around the faults. These transient perturbations in the local stress field then disappear when subsequent model earthquakes smoothen the slip profile. Maps of maximum shear stress show artificial stress concentrations near the bend, and emphasize that future models should include a more continuous representation of the model faults. When no material weakness is considered, results show that hydrostatically pressured intact rock is very difficult to break from the loading boundary conditions.

T52B MCC: Level 1 Friday 1330h

At the Seismogenic Front: Dynamic Processes at Convergent Margins IV Posters *(joint with G, S)*

Presiding: **K Gamage,** University of Florida**; C Rowe,** University of California, Santa Cruz

T52B-0251 1330h POSTER

Receiver Function Study of the Hellenic Subduction Zone

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We use data of recently installed broadband seismographs on the islands of Crete, Gavdos, Santorini, Naxos and Samos to constract receiver function images of the crust and upper mantle from the south of Crete into the Aegean Sea. The subducting African plate is clearly imaged at 44km below Gavdos, about 70km below Crete and nearly 100km beneath Santorini. The Moho depth is determined from direct conversions and crustal multiples. It is 31-34km deep below southern and eastern Crete, and 32-39 below western and northern Crete. The Moho signal in western and northern Crete is reversed, possibly indicating velocity reduction instead of increase at the Moho. This phenomenon could be caused by hydration and serpentinization of the mantle peridotite in the forearc. The crustal thickness at Gavdos, south of Crete in the Libyan Sea is only 26km. The Moho in the central and northern Aegean, at Naxos and Samos is at 25 and 28km depth, respectively. S receiver functions are at present analysed to produce an image of the upper mantle unspoiled by crustal multiples.

T52B-0252 1330h POSTER

Seismic Structure of the Middle Japan Trench Subduction Zone by Airgun-OBS Experiment

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In the middle part of the Japan trench subduction zone, the off-Miyagi area, large interplate earthquakes with M>7 is known to regularly recur with about 40 years interval. The most recent event occurred 25 years ago (the 1978 Miyagi-Oki earthquake M7.4) and the Japanese government evaluated that the next large earthquake may occur within 20 years from now with over 80% possibility. Most of the past large events in this area, including the 1978 earthquake, did not rupture the shallow (less than 20 km) part of the plate interface, although active background microseismicity is observed in the shallow thrust zone. Analyses of the historical records of the tsunami caused by the 1793 earthquake, one of the off-Miyagi series, suggest that the rupture area of the earthquake extended to the shallow part of the thrust zone and that the size of the event was much larger (M>8) than the other earthquakes in the series. In the northern part of the Japan trench subduction zone, we recently found a significant relation between the seismic reflection intensity of the surface of the subducting oceanic plate and the interplate seismicity along the interface; the wide-angle reflection arrivals are observed with remarkably strong amplitudes in the region of low interplate seismicity. This finding suggests that the appearances of the seismic reflections from subduction plate boundary can be a good indicator of the seismic coupling strength. As an application of this idea to the shallow seismogenic zone of the off-Miyagi region, we made an airgun-OBS seismic experiment to observe the wide-angle reflections arrivals from the plate boundary in 2002. The surveyed area was in the trenchward extension of the rupture area of the 1978 earthquake and its size was 150 x 40 km in the strike and dip directions of the trench system, respectively. 39 OBSs were deployed in the area and a 3,400 cu airgun-array was shot along the four survey lines. The spacing of the OBS stations was 10 km and the airgun shot interval was about 150 m. The quality of the OBS record sections is good and we can trace the first arrivals up to at least offsets of 80 km. There are two groups of evident later arrivals on the record sections. Preliminary travel time analysis based on a reference structure model in this region presented by Miura et al. (2002) indicates that these later phases are wide-angle reflections from the subducting oceanic crust, which are of our most significant interest. The appearances of these later arrivals are quite different from a station to another, indicating that there seems to be a spatial variation of the reflection intensity of the plate boundary as we found in the northern part of the Japan trench.

T52B-0253 1330h POSTER

Microseismicity in the rupture area of the 1994 Sanriku-Oki Earthquake determined by long-term ocean bottom seismographic observation

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Long-term seismic observations to monitor spatial and temporal variations of seismic activity are essential to understanding seismogenic processes along fault zones. Therefore, in subduction plate boundaries where most of the interplate earthquakes occur beneath the ocean, long-term observations on the seafloor are necessary. In recent years, a pop-up type ocean-bottom seismometer enabling us to conduct long-term observations for more than one year has been developed (e.g., Kanazawa et al., 2002). By using five long-term ocean bottom seismometers (LTOBS), we carried out a seismic observation in the rupture area of the 1994 Sanriku-Oki Earthquake, in the northern Japan Trench area, for about nine months from October 2000 to July 2001. Here we report the hypocenter distribution relocated by combining the arrival time data obtained by the LTOBSs and the land seismic network operated by Tohoku University. Owing to the LTOBSs data, resolution of the hypocenter distribution is much improved and most of the hypocenters are relocated along the landward dipping plane corresponding to the plate boundary. In the Japan Trench subduction zone, Uchida et al. (2002) identified many groups of similar earthquakes. They interpreted these similar earthquakes as repetitive failures of tiny asperities along the plate boundary although it was difficult to obtain precise hypocenter locations only from the land network data. Our LTOBSs observed one of the repeating events for several similar earthquake sequences and we are able to relocate their hypocenters. The hypocenters of the repetitive similar earthquakes are within the concentration of earthquakes along the landward dipping plane, supporting the idea that these events are taking place along the subduction plate interface.

URL: http://www.aob.geophys.tohoku.ac.jp

T52B-0254 1330h POSTER

Offshore extension of the Great Sumatra Fault revealed by seismic, bathymetric and seafloor imaging

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The northwestern Sunda Arc is cut by two giant dextral shear zones, which accommodate the oblique subduction of the Indo-Australian Plate against Eurasia along this portion of the Sunda Arc. These are the Sumatra Fault Zone on Sumatra Island and the Mentawai Fault Zone off west Sumatra. The strike-slip shear zones bear a high earthquake risk potential. Several Indonesian-Japanese-German marine expeditions focused on the tectonics and the evolution of the Sumatra and Java forearc region. Now a dense grid of multi- and single-channel reflection seismic profiles, high resolution bathymetry and seafloor direct observations using submersible SHINKAI 6500 allow tracing the Sumatra and Mentawai Fault Zones south off west Java. The geometry of transtensional basins, transpressional horst structures and elongated ridges and valleys clearly shows the dextral sense of motion and the splay character of the fault zones in the study area. Multichannel reflection profiles image the deep structure of the major strike slip faults which originate from reactivated thrust planes within the Java accretionary wedge. During SHINKAI 6500 dives one master fault could be followed. Recent offset along the fault is documented on sea floor images by young unweathered fault scarps.

T52B-0255 1330h POSTER

Combined Interpretation of Receiver Functions and Rayleigh Phase Velocities: Implications for Lithospheric Structure in the Area of Crete (Greece)

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We investigate the lithosperic structure in the forearc of the Hellenic subduction zone from the surface to the depth of the subducted African Moho by Rayleigh fundamental mode dispersion and teleseismic receiver functions. Both methods are primarily sensitive to the S-velocity distribution, but also complement each other: Receiver functions can outline sharp velocity discontinuities, but contain no absolute velocity information, while the shape of Rayleigh phase velocity curves depends mainly on the average S-velocity. A combined interpretation of the consistent results from both methods points to significant lateral variations in structure between western and central Crete. We use data from several temporary short-period networks on Crete as well as from permanent GEOFON broadband-stations in the southern Aegean. Short-period data from dense networks broaden the frequency range available for phase velocity determination and increase the spatial coverage of receiver function profiles. Beneath Crete, we find evidence of two Mohos, the continental Aegean Moho and the oceanic Moho of the subducted African lithosphere. The African Moho can be imaged continuously at 55 km depth by both methods. An intracrustal discontinuity is observed in both western and central Crete at depths between 10 and 20 km. Below, western Crete is characterized by nearly constant crustal S-velocities to a depth of 50 km and no distinct continental Moho signal. Central Crete shows crustal velocities down to about 30 km depth which are followed by the Aegean Moho and a region with upper mantle velocities above the slab. This means that the slab is separated from the Aegean crust by a mantle wedge beneath central Crete, while beneath western Crete a thickened crustal region extends down to the subducted oceanic lithosphere at 50 km depth. This thickened crust is interpreted as indication of return-flow in a subduction channel. Besides, lateral variations among receiver function waveforms indicate structural heterogeneity between 25 and 45 km depth below western Crete.

T52B-0256 1330h POSTER

Low-velocity Oceanic Crusts at the top of Subducting Plates Beneath Japan Islands Imaged by Tomographic Method Using the NIED Hi-net Data

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In the original grid-type tomographic method (Zhao *et al.*, 1992), the resolution of the images is equal to the grid spacing. It is more realistic to use as many grid nodes as possible for representing heterogeneous velocity distribution. However, the increasing of grid nodes introduces the instability in tomographic image having an artificially rough structure. We introduce correlation among velocities at surrounding grid nodes (Matsubara *et al.*, 2001) to stable the solution. Thus the obtained structure might be more close to the real. We apply this modified method to 1,125,272 P- and 854,717 S-wave arrival times from 21,656 earthquakes recorded by 664 stations of the high-sensitivity seismograph network of Japan, NIED Hi-net, during 2000 to 2002. In the inversion process, the configuration of the Moho discontinuity is fixed according to Yoshii *et al.* (2002) without considering the upper boundary of the Pacific plate. A high-velocity (high-V) zone is imaged as the Pacific plate in the northeastern (NE) Japan arc. A low-velocity (low-V) layer above the high-V zone with about -(4-10)% velocity anomalies, considered as oceanic crust, coincides with the upper part of the double-seismic zone in the upper part of the slab. A high-V zone at depths of 20-60 km beneath the southwestern (SW) Japan is imaged as the Philippine Sea plate. Low-V zones, as oceanic crust, are found beneath the central and SW Japan except around the collision zone of Izu Peninsula at the northern edge of the Izu-Bonin arc. In the Kanto region, the central part of Japan, the Pacific and Philippine Sea plates subduct beneath the North-American plate and the velocity structure is complicate. We also find that the low-V zone of the Pacific plate is harmonious with the existence of the S-wave reflector found by Obara and Sato (1988). The low-V oceanic crust of the Philippine Sea plate is consistent with the results obtained from the block-type tomographic method (Ohmi and Hurukawa, 1996). The V_P/V_S ratio above the Philippine

Sea plate is about 1.90 corresponding to the serpentined wedge mantle by Kamiya and Kobayashi (2000). Beneath the Tohoku region, NE Japan, low-V zones of the Pacific plate coincide with the oceanic crust with velocity 6% lower than that in the mantle wedge by the analysis of P-to-S converted waves (Matsuzawa *et al*, 1986). Low-V oceanic crusts of the Philippine Sea plate beneath Chubu, southern Kinki, and western Shikoku region, the central and SW Japan, are consistent with the result of the analysis by channel waves (Hori, 1990). The low-V zone beneath the Shukoku region is harmonious with the model derived from receiver function analysis (Shiomi, 2002). Low-V zones are also continuously subducted beneath the volcanic front at a depth of 40 km in the shallower part of the mantle wedge with -(3-7)% anomalies in the NE Japan.

T52B-0257 1330h POSTER

Low Intensity Characteristic of Plate-Boundary S-S Reflections Within a Region of Strong Plate-Boundary P-P Reflections and low Seismicity Along the Japan Trench Subduction Zone

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It has been pointed out that the epicenters of the microearthquakes along the forearc slope of the Japan Trench are not uniformly distributed but clustered in seismically active zones that are oriented perpendicular to the trench axis. One of the clear seismic-aseismic boundaries of such seismic clusters can be identified in latitude 39°N. A seismic survey was conducted in 1996 with one profile running across the boundary and parallel to the trench axis, and a P-wave velocity structure model was obtained by travel-time inversion (Fujie, 1999). A strong anti-correlation between the seismicity and the intensity of the plate-boundary P-P reflected waves was found: strong plate-boundary P-P reflected waves were observed in a region where seismicity is quite low, and vice versa (Fujie et al., 2002). They discussed that a thin layer of low P-wave velocities (3 4 km/s) with its thickness up to a few hundred meters along the plate boundary could explain the intensity of the reflections. Results of finite-difference waveform calculations support this estimation (Moghaddam, 2002). Another seismic survey was carried out in 2001 with 7 trench-parallel profiles in the same region as the 1996 survey in order to map and verify the strong anti-correlation. The strong anti-correlation was observed over the seismic-aseismic boundary region, and it was inferred that a thin layer with low P-wave velocities along the plate boundary exists beneath the aseismic zone in the region. Understanding the characteristics of plate-boundary S-S reflections in addition to those of P-P reflections would greatly help put better constraints on the physical properties along the plate boundary. Substantial P-to-S conversion at the base of the sedimentary layers was observed. S-wave velocities, especially those of the sedimentary layers, should be precisely determined in order to have good estimates of the arrival times of the plate-boundary S-S reflected waves. The S-wave velocities of the sedimentary layers were obtained by the tau-p analysis of the OBS horizontal-component waveforms. The Vp/Vs ratios within the sediment layers were estimated to be 5.2 and 2.3 from top to bottom. The Vp/Vs ratios within the deeper structure were assumed to be 1.8 to 1.74 as the Vp varies from 4.5 km/s to 8.0 km/s. The calculated travel times explain well the observed travel times of P-S-converted refraction arrivals. Expected arrival times of the plate-boundary S-S reflected waves were calculated with respect to the obtained Vs structure. Such intense amplitude as observed for the plate-boundary P-P reflections was not identified for the S-S reflections. Irregularity of the interfaces within the structure or differences in the reflectivity coefficients between P-P and S-S reflections at the plate boundary does not explain the opposite appearances of those reflections. Although the strong plate-boundary P-P reflections could be explained by putting a thin low-velocity layer, some additional features for S-S reflections along the plate boundary may be required, such as very low Q values (high attenuation) for the S-wave propagation.

T52B-0258 1330h POSTER

Stress Accumulation and Dissipation in Subducting Lithosphere and the Origin of Double and Triple Seismic Zones

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A striking feature of plate tectonics is the seismicity caused by subduction of oceanic lithosphere known as the Wadati-Benioff Zone (WBZ). In many subduction zones the seismicity at intermediate depths (70-300km) splits up into two or three distinct layers forming double (DWBZ) or triple (TWBZ) Wadati-Benioff Zones. A 1D “constant force” lithosphere visco-elastic model has been used to investigate the accumulation and dissipation of stress at intermediate depths in subducting lithosphere slab due to the contributions of down-dip slab pull, phase transformation from basalt to eclogite, bending and unbending of the slab, and thermal expansion due to heating. This model has been used to explore processes contributing to double and triple seismic zones within the Wadati-Benioff Zone. Beneath NE Japan, based on focal mechanisms, a triple Wadati-Benioff Zone (TWBZ) has been proposed, partitioning seismicity into an upper layer with down-dip extension, a middle layer with down-dip compression, and a lower layer with down-dip extension. In order to predict the NE Japan TWBZ seismicity pattern, the 1D “constant force” lithosphere visco-elastic model requires the contribution of the basalt to eclogite phase transition in all cases, together with either contributions of slab unbending (c.f. Wang 2002) and thermal stresses, or slab unbending or thermal stresses alone. Down-dip slab pull is not necessary in all models to generate the NE Japan TWBC pattern, depending on the magnitude of unbending and/or thermal stresses. In contrast beneath N Chile, based on relative relocations, a separation of the Wadati-Benioff Zone into two zones has been observed with down-dip extension in both layers. All successful models of this N Chile DWBZ seismicity pattern require the contribution of the basalt to eclogite phase transition and slab pull, together with only small contributions from bending stresses and little or no thermal stresses. The contribution of slab pull, bending/unbending stresses and thermal stresses to stress accumulation in the TWBZ of NE Japan and the DWBZ of N Chile appear to be substantially different, and there is ambiguity regarding the contributions of thermal and slab bending/unbending processes. The relative contributions of thermal, bending/unbending mechanisms to the accumulation of stress within the subducting slab is critical to developing a unified model of Double and Triple Seismic Zones. Additional constraints on the contribution of bending/unbending stresses are required to resolve this ambiguity. Rates of stress accumulation from slab bending/unbending may be derived from observations of Wadati-Benioff Zone curvature.

T52B-0259 1330h POSTER

Passive Seismology On- and Offshore Costa Rica

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The theme of the National German Research Center SFB 574 ”Volatiles and Fluids in Subduction Zones” subproject A2 is to understand the nature of coupling and mass transfer between upper and lower plate of the subduction zone in central Costa Rica. An amphibious seismic network, consisting of 23 ocean bottom sensors and 15 landstations, was deployed in the coastal Pacific region of central Costa Rica near Jaco in April 2002. The network was moved south-east towards Quepos in October 2002 and operated until spring this year. Our main objective is to detect and evaluate the seismicity induced by the convergent dynamics between the subducting oceanic lithosphere and the Caribbean plate. The spatial dimensions of the joined marine and land networks are designed to register events associated with the downgoing plate. We report details on the campaign and show first results of the standard investigation of the data (i.e. determinatin of hypocenters, magnitudes, polarities and focal mechanisms), including first interpretations.

URL: http://www.geophysik.uni-kiel.de/~geo43/research/projects/sfb574.html

T52B-0260 1330h POSTER

Patterns of Heat Loss and Hydrothermal Recharge and Discharge Within 20-24 Ma Seafloor Offshore of the Nicoya Peninsula, Costa Rica, From Collocated Thermal and Seismic Data

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The TicoFlux II expedition investigated seafloor hydrothermal activity in the Cocos Plate offshore the Nicoya Peninsula, Costa Rica, and its influence on the thermal state of the upper lithosphere prior to subduction. This program focused on the role of seamounts in guiding hydrothermal recharge and discharge, and complements a regional study completed a year earlier in which the nature of the thermal transition between East Pacific Rise-generated and Cocos-Nazca-generated seafloor was documented. In this presentation, we analyze seismic and heat flow data to illustrate characteristic thermal patterns associated with rapid fluid flow in upper basement rocks. Fluid flow can perturb the thermal state of the oceanic crust, depending on flow rate, flow depth, and proximity to points of recharge or discharge. Hydrothermal recharge and discharge in this area is strongly guided by seamounts and other basaltic outcrops that penetrate regionally thick and continuous sediments. Areas of recharge are characterized by low heat flow values and subsequently low basement temperatures, with both heat flow and basement temperatures increasing with distance from recharge points. Areas of discharge are characterized by higher heat flow values, particularly in the vicinity of basement outcrops, and basement temperatures that remain relatively constant as the sediment-basement interface rises towards the seafloor. We also observe sites where local convection, confined to sediment-covered basement, homogenizes upper basement temperatures.

T52B-0261 1330h POSTER

Shallow Subduction Zone Structure in Northern Costa Rica From Receiver Function Analysis at CRSEIZE Stations

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CRSEIZE (Costa Rica Seismogenic Zone Experiment) is a collaborative effort to better understand seismogenic behavior at the Costa Rican convergent margin using data from land and ocean bottom seismic networks, oceanic fluid flux meters and GPS receivers. In a continuing effort to refine images of the velocity structure of the subduction margin in this region, receiver function analysis of land and ocean bottom seismic data has been performed, providing information on the depth to and velocity and density contrasts across sharp horizontal discontinuities. Supplementing the CRSEIZE network offshore and across the Nicoya Peninsula with broadband stations of the Arenal Volcano seismic network and Geoscope station JTS, provides station coverage that spans from oceanward of the Middle America Trench to the volcanic arc across northern Costa Rica. Conversions and reflections from two dominant discontinuities are evident in the receiver

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functions from the Nicoya Peninsula land stations. The depth of these discontinuities increases as the distance between the station and the trench increases, indicating that the discontinuities are likely associated with the subducting oceanic lithosphere. We interpret these reflectors as the boundary between oceanic layer 2 and layer 3 and the oceanic Moho respectively. Thus, we are able to provide constraints on the depth to the subducting slab and details of its velocity structure. Our modeled P-wave velocities for oceanic layer 2 are anomalously low for oceanic crust of 20-25 Ma but are consistent with previous refraction and seismic tomography results. These low velocities possibly suggest a high degree of hydration of the oceanic crust. The degree of hydration of oceanic crust and the fate of the water carried in this crust are not well known but are potentially very important to the processes of earthquake generation and magma genesis. We interpret our receiver functions in conjunction with results of a 3D local tomographic study for the Nicoya Peninsula region in order to better understand the structure and mechanics of the Costa Rican subduction zone.

T52B-0262 1330h POSTER

Outer Rise Stress Changes in Central Chile related to the 1985 Mw 7.8 Valparaíso Earthquake

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Although intraplate seismicity in the outer rise region is less common than seismicity associated with interplate subduction zone earthquakes, a significant level of seismicity has occurred between the trench and JF Ridge (JFR), in Central Chile, during the past 20 years. Our study focuses on the April 9, 2001 (Mw=6.8) event and its aftershocks. We determine its focal mechanism, depth and source time function by waveform inversion from teleseimic broadband data. The results indicate tensional faulting with a strike of 36°, a dip of 43°, and a rake of −87°. The source time function has a duration of 11 s, with a seismic moment of $2.5x10^26$ Dyne cm. The depth of 15 km, obtained using oceanic velocity model, localizes this event below the Moho. This result, together with the depth distribution of the first 2 days of aftershocks, determined by the permanent local seismic network, indicates that the neutral stress surface must be located below 40 km depth. The strike of this event is very well constraint by SH waveform modeling and is parallel to the main local bathymetric structures including the JF Ridge. A clear SW to NE directivity source effect is also observed, in good agreement with the 2 days aftershock distribution, confirming that the strike of the focal plane is not parallel to the main trench direction. This is a main result that shows the interaction between JF Ridge and the initiation of the subduction process at the trench. Other outer rise events have occurred during the last 20 years in front of the rupture covered by the 1985 Mw 7.8 Valparaíso Earthquake. To understand the relation between these earthquakes and the state of stress of the lithosphere, we use detailed bathymetric data in the hypothesis of a purely elastic plate to model the shape of the outer rise oceanic lithosphere assuming that the deformation is due to the bending prior to subduction and the loading by JF Ridge. The outer rise aftershocks are located in the upper tensional part of the lithosphere, shifted seaward of the trench because of JF Ridge. Previous compression events occurred 20 years before at 30 km depth in the same area. This enables us to propose a temporal migration at depth of the tensional/compressive limit within the lithosphere.

T52B-0263 1330h POSTER

Combined wide-angle and multichannel seismic survey at an asperity of subduction earthquakes in the Japan Trench

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Recent progress of seismic wave form inversion revealed overlapping asperities of large earthquakes in the Japan Trench, e.g., the 1994 Sanriku-Haruka-Oki earthquake (M=7.5) and 1968 Tokachi-Oki earthquake (M=7.9). It is also recognized that the epicenters (initial break) of both earthquakes are situated at the trench-ward edge of the asperities, and the aftershocks were observed only around the asperities. Investigating structural factor controlling these asperity and seismicity pattern is believed to provide important and fundamental information to the physics of earthquakes. In August, 2003, we acquired wide-angle and multichannel seismic data covering the entire asperity region. The purpose of this study is to image structures of the asperity, and investigate the structures affecting the distribution of the seismicity pattern. Part of MCS data was processed onboard. We made CDP stacks by applying multiple suppression and poststack time migration. From the migration section of the dip profile, we recognized several key structures related to a subduction process; e.g., 1) the top of subducted oceanic crust can be traced up to 80 km from the trench axis. This reflector is recognized at 10 s twt to 70 km from the axis, rising up to 9s at 75 km then again down to 10 s farther than 75 km, 2) from 30 to 50km and 70 to 75 km, a weak reflector which is parallel to the top of the oceanic crust is identified. This might be the base of subducted crust, 3) located 35 to 45 km from the trench axis are several sub-parallel reflectors at 1 s above the top of the oceanic crust. These sub-parallel reflectors are also recognized at a central part of a strike profile, however there reflectors are not clear at the northern and southern end of the profile.

T52B-0264 1330h POSTER

GPS Velocity Field in the Nicaraguan Forearc: Results from 2000-2003

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Oblique convergence between the Cocos and Caribbean plates along the Middle America Trench has been indicated by several studies. Partitioning of strain/slip between an arc-normal component and an arc-parallel component has been proposed as a consequence of the obliquity of the convergence direction, resulting in northwest directed translation of a forearc sliver. We present results from the first detailed GPS geodetic survey of surface velocities in the Nicaraguan forearc. A network of 12 campaign sites in the forearc region and 4 campaign sites in the backarc region was established in late 2000/early 2001. Eleven of these sites were reoccupied in August 2002 and the entire network was reoccupied in February 2003. Data from 5 continuously operating GPS sites in the Central America region were also analyzed for this project. The observed horizontal velocities for campaign sites in the Nicaraguan forearc have an average magnitude of 15.7 ± 4.0 mm/yr with azimuths ranging from ∼ 280° to ∼ 325° in close agreement with the value of 14 ± 2 mm/yr to the northwest predicted by DeMets (2001). The observed horizontal velocities for campaign sites in the near backarc region are also directed to the northwest, but the average magnitude of these velocities is only 2.6 ± 1.8 mm/yr; essentially near zero within error. The continuous GPS site MANA is located along the arc and has a northwest directed velocity of 8.4 ± 2.4 mm/yr; intermediate in magnitude between the forearc and backarc sites; lending robustness to the campaign veloctiy solutions. The surface veloctiy field observed in the Nicaraguan forearc strongly supports the previously proposed northwest-directed movement with respect to the stable Caribbean plate of the forearc sliver models and is indicative of strain/slip partitioning along this section of the Middle America Trench.

T52B-0265 1330h POSTER

New Maps of Magnetic and Gravimetric Anomalies in Costa Rica and Nicaragua

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During the past decade, a large number of scientific cruises collected high quality magnetic and gravimetric data along the Middle America Trench offshore Costa Rica and Nicaragua. The datasets underwent a thorough processing which included a correction for daily variations of the magnetic data. The merged data from 8 cruises provide a good coverage of the Pacific offshore area of Costa Rica and Nicaragua. In addition, we digitized detailed maps of aeromagnetic data and land-based gravity data. Combined with the marine data, we obtained maps which clearly show the magnetic and gravimetric expressions of a large number of tectonic features and thus provide insight into the complex tectonics of the convergent margin.

T52B-0266 1330h POSTER

Discontinuous accretion in the Tokai segment of Nankai Trough.

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The Eastern Nankai Margin was investigated within the framework of the KAIKO-SFJ project by 3D reflection imaging and dense OBS surveying, which yield complementary images of the margin above the seismogenic zone. The margin is divided in three units, the forearc basin, the active splay fault zone, and the active accretionary wedge. The forearc basin sediments are deposited over Eocene (Shimanto) accretionary wedge. The observed structure, age constrains from drilling, and seafloor sampling indicate accretion was not steady state and a scenario consistent with the plate tectonic context is proposed. The initial stage is the massive Eocene to Oligocene accretion of the Shimanto belt accretionary complex. Our interpretation of the seismic profiles is in good agreement with a rate of subduction in Nankai going through a relatively stagnant phase 14-9 Ma but then increasing again at 8-5 Ma. Accretion likely restarted during the Late Miocene, forming a wedge that now corresponds to the active splay fault zone. This wedge is overlain by forearc basin and slope deposits straddling the Pliocene-Miocene boundary contemporary with the middle forearc sequence. The small active accretionary complex is estimated to have started not later than 2 Ma and more probably less than 1 Ma. Finally, the small volume of material accreted between 15 and 2 Ma (barely the volume of the quaternary wedge) suggests that significant accreted volumes have been eroded.

T52B-0267 1330h POSTER

Southern extension of the Sumatra Fault and its tectonic significance

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Mode of slip partitioning in a fore arc of Sunda Arc between near trench normal thrusting and trench-parallel strike-slip faulting has been postulated mainly from the study of earthquake slip vectors and slip rate of the strike slip Sumatra Fault. However, there is no dependable geomorphic data, despite great attention for the area off the Sunda Strait which represent the junction between normal subduction off Java and oblique subduction off Sumatra. New single channel and bathymetric data were obtained by R/V Yokosuka, YK01-02/YK02-07 cruises and they provide a quite different geomorphologic view to the previously knowledge. New discovery of the southern extension of the Sumatra Fault is an example. In the southern extension, Shinkai 6500 dives allow us to identify more or less a meter of vertical topographic displacement along the SSE-trending active fault. Several amount of mud diapir mounds and a few sink hole are first recognized in the area where corresponds to a significant negative Bouguer anomaly zone. A methan content anomaly is detected in the summit of the mounds and bottom floor of the sink hole, together with Calyptogena colony. On the other hand, geomorphologic feature in the junction area is quite different to those of forearc setting; the area is covered by a bundle of tectonic blocks including the Genteng Bank, that well demarcated by the SSE- and east-trending conjugate lineaments. The junction area extending toward SSE occupies between the fore arc basin and the outer arc high and is demarcated by faults. The boundary fault cuts the preexisting geomorphology including trench-parallel strike slip fault in the outer arc high; e.g. Mentaiwai Faults. Consequently these geomorphic feature, as an accumulation of crustal deformation (plastic strain), is most likely to be caused by stretching of the fore arc crust. This study suggests that strain (plastic) partitioning in a fore arc occurs within the localized (or concentrated) area such as the junction, although elastic strain is uniformly spread over the entire fore arc.

T52B-0268 1330h POSTER

Seismic Reflction and Wide-Angle studies across the Hikurangi Subduction Zone Offshore New Zealand

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The North Island GeopHysical Transect (NIGHT) was conducted in 2001 to study the Hikurangi subduction zone. The study included a multichannel seismic (MCS) reflection and a wide-angle seismic survey with ocean bottom seismometers (OBS) and offshore-onshore stations. We will present stacked and time-migrated images of the MCS. We used velocity information form the wide-angle experiment to stretch theses images to depth. A subducted seamount is displayed about 40 km landward of the trench. A small accretionary prism is forming seaward of this seamount. An up to 10-km-thick sedimentary basin seems to be present landward of the seamount. The margin is underlain by oceanic crust of the Hikurangi Plateau, a large igneous province. We estimate its thickness at 10-12 km based on wide-angle arrivals in the OBS records. The Hikurangi Plateau is being subducted at a dip of 2-3 degrees close to the trench. A pronounced increase of subduction dip about 120 km away from the trench is displayed in MCS sections. The change of dip of the subducted plate appears to coincide with the eastern termination of the sedimentary basin as well as a stratigraphic high; the Lachlan Ridge. From the offshore-onshore data, we infer the presence of a low velocity zone above the subducted plate at this location. We speculate that the increase of subduction dip may be linked to a major tectonic process shaping the East Coast of New Zealand's North Island, perhaps normal faulting of the Hikurangi Plateau caused by loading from the overriding plate. The low velocity layer may mark sediments entering the subduction zone.

T52B-0269 1330h POSTER

The Intersection of the Nootka Fault Zone with the Continental Margin off Vancouver Island

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The Nootka Fault Zone extends from the margin offshore from Nootka Island, near Vancouver Island, at a fault-trench-trench triple junction, marking the intersection of the Juan de Fuca, Explorer and North American plates. The presence of the fault zone itself was initially inferred from magnetic anomaly analysis and substantiated by observations of focused seismicity, reflection seismic profiles, gravity and bathymetric data. Differential motion of the Explorer region seems to require its independence from the Juan de Fuca plate, though this has been subject to debate. The triple junction itself has not previously been examined in detail. Previously available field data at the Nootka fault zone itself are sparse. In fact the precise location and trend of the Nootka fault zone is not well confined. The Nootka fault is an example of an active fault subducting under an accretionary prism where the consequences of frequent earthquake shaking might be examined. For example, there is evidence of several mud volcanoes present in the basin and active venting on the margin. Further study is imperative in preparation for the NEPTUNE ocean floor observatory and potential future IODP drill holes. Furthermore, more accurate velocity models are required for improving earthquake location in this region since all current monitoring stations are land-based and to the east of the fault zone leading to systematic biases in epicenter locations, of tens of kilometers to the northeast, in routine locations. Here we present new seismic reflection data integrated with previous work for a new characterization of the seafloor approaching and on the deformation front.

T52B-0270 1330h POSTER

Transient Stages of Suppression for Total Strike-Slip Partitioning Induced by Pre-existing Variable Topography and Overload.

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3D sandbox modelling is used in this paper to investigate the mechanics of doubly vergent Coulomb wedges, deforming along highly oblique convergent margins that are affected by unbalanced topography and variable overload. During the experimental procedure, a pre-existing topography was generated by a first phase of subduction in one direction. A second phase of subduction was then initiated in the opposite direction (simulating a subduction flip). Animations of experiments will be displayed trying to show how a distinct feedback mechanism between mechanical conditions existing at the outboard region basal décollement and retrothrust activity control how deformation is partitioned within the wedge. Both timing and mode of retrothrust activation are crucial factors in influencing critical wedge mechanics as a whole. These may control localisation of compressive stress surpluses in the divide region, thus temporarily suppressing margin-parallel wrench faulting. In addition, experimental results suggest that differential disequilibrium characterising the topographic profile with respect to a given basal/internal coefficients of friction ratio will have a strong impact on the wedge growth history.

T52B-0271 1330h POSTER

A Magmatic System as an Indicator of Tectonic Stresses around Plate Boundary; Crustal Deformation in and around Izu-Oshima Japan Derived from Continuous GPS Measurments

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The area around Izu peninsula Japan is situated in a boundary region between the Philippine Sea plate and a continental plate. There are a number of things that bring a complexity to the tectonic setting of the region; the proximity to a triple junction of a continental and two oceanic plates and a volcanic front running through being accompanied by a line of volcanic islands and several major volcanoes on land. There still remain a number of questions yet to be solved. The crustal deformation data set provided by continuous GPS measurements is one of the key pieces of information to understand the ongoing complex tectonic processes in the region. Among the results, an interesting and even intriguing finding from GPS is that a large horizontal strain is not seen in and around the northern part of Izu peninsula which is thought to be the plate boundary. A high rate of shear strain accumulation is found between the peninsula and Izu-Oshima, which is a volcanic island located in further south of the plate. Even in the historical period several earthquakes as large as M7.0 and a number of eruptions of the volcano were recorded. A simple estimation of the accumulated strain suggests that there is an enough energy to produce at least M6 earthquake in the area. As a first step to understand the tectonic situation we are interested in the temporal and spatial change of strain field in the region. We find an interesting interaction between the magmatic system of the volcano and surrounding tectonic situation. We detected an inflation of the island suggesting a swell of a magma chamber located at about 5 km depth beneath the caldera. The trend of the inflation changed when Miyakejima, which is another island volcano about 70 km to the south of Izuoshima, erupted in 2000. The eruption was associated with a huge dike intrusion which deformed the crust within a distance of about 200 km. Another interesting finding is the episodicity of the inflation which is correlated with the occurrence of earthquake swarm. The focal mechanism of the swarms is accordant with the surrounding tectonic situation. Those suggest a multi-layered interaction between the magmatic system and the tectonic stresses around it. In the presentation we will discuss the details of the relationship between crustal deformation and seismicity in Izu-Oshima volcano revealed by multidisciplinary geophysical monitoring.

T52B-0272 1330h POSTER

Anatomy of Eastern Nankai accretionary prism toe at Tenryu deep-sea canyon by submersible surveys and various physical tests

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Detailed geologic structures, physical properties and soil mechanical tests of the superficial part of the Nankai accretionary prism toe along the Tenryu deep-sea canyon on the eastern Nankai Trough were disclosed as follows. The proto-thrust was observed at seabed on the Nankai Trough floor as a fresh fault cliff of 3-4 m height, which is likely to be deformed in brittle fashion as the very recent expression. The Tenryu frontal thrust zone of approximately more than 200 m wide as a fault breccia zone is composed of small mounds and ridges of 2-3 m relief, where highly deformed sedimentary rocks are exposed. The coherent unit zone is composed of several 10 cm thick turbidites with small displacement by sharp microfault. These strata form an open fold and thrust system. Uniaxial compression brittle strengths of rock samples in coherent unit zone attain approximately 1.1-1.2 MPa, whereas the rock samples of the Tenryu frontal thrust are deformed ductilely at a yield stress of 0.6 MPa. Maximum burial depths of the rock samples of the Tenryu frontal thrust zone and coherent unit zone were estimated by consolidation test as approximately 350 mbsf and 200 mbsf, respectively, corresponding to the burial depth estimated by their physical properties, e.g. porosity being 40-50% , P-wave velocity being 1.7-1.8 m/s, etc. This means that the prism toe in this area was up-lifted from 200-350 mbsf due to the upward push by the Paleo-Zenisu ridge collision/subduction during accretionary stage.

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T52B-0273 1330h POSTER

Controls on the Morphological Variability of the Decollement in the Nankai Trough Subduction Zone

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Decollements form plate boundaries at subduction zones, hence the details of their initiation are of fundamental importance in the development of large fault systems. A key question at Nankai is does the decollement initiate and remain in a singular layer or jump around and if so why? To investigate this issue, we analyzed 3-D seismic reflection data collected off the Muroto Peninsula by a US-Japanese consortium in 1999. We examined seismic profiles and correlated our interpretations to core and log data from ODP sites 1173, 1174, and 808 to determine the physical properties of the decollement from the undeformed incoming sediment to the deformation front. These seismic profiles indicate that substantial along-strike variability characterizes the decollement in the Nankai Trough subduction zone. The decollement forms a series of overlapping splays above an elongate basement high that is approximately 1 km wide, rises 100-150 m above the adjacent low areas, and trends northwest across the survey area. Seismic profiles show the amount of overlap along the decollement above the basement high ranges from 80 m seaward of the deformation front to 40 m at the frontal thrust. These initial observations suggest the basement relief significantly influences the undulating character of the decollement, becoming less of a factor with increased subduction. Other possible influences on the decollement morphology include the variation in stress orientation caused by the basement high and differences in overpressure resulting from along-strike differences in sediment loading. Determination of these factors will provide a better understanding of the controls of decollement formation.

T52B-0274 1330h POSTER

Diagenetic Phase Boundary at the Nankai Trough, SW Japan: Relationship to the Decollement/ Proto-Decollement

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In the subduction environment, phase changes within sediments may affect their subsequent deformation during the accretion process. At the Nankai trough, off Cape Muroto, southwest Japan, a phase change from cristobalite to quartz occurs near the depth of the decollement zone, with a prominent seismic reflector marking this diagenetic boundary between the upper and lower Shikoku Basin facies. Outboard of the trench this reflector is initially at greater depth than the projected proto-decollement but migrates upward to transgress it before reaching Ocean Drilling Program Site 1173 in the landward direction. This effectively encases the entirety of the decollement in a lithology depleted in cristobalite and enriched in quartz. Creation of a depth section within a three-dimensional seismic reflection volume enabled this diagenetic reflector to be mapped relative to the oceanic basement reflector, the seafloor reflector, and intervening stratigraphic reflectors. Within areas of recent sedimentation in the trench the diagenetic reflector diverges from the basement reflector and rises vertically in the section. This upward migration of the diagenetic reflector follows a similar upward migration of the isotherms. Thermal gradients in the Muroto region are increased by proximity to the Shikoku Basin paleospreading center axis. At subduction regions with lower thermal gradients the cristobalite zone could be expanded to greater depths, allowing sediments untransformed by this diagenetic process to be incorporated into the toe of the prism and potentially altering initial accretionary structures.

T52C MCC: Level 1 Friday 1330h

At the Seismogenic Front: Dynamic Processes at Convergent Margins V Posters *(joint with G, S)*

Presiding: **H DeShon,** University of California, Santa Cruz**; T Ike,** University of Hawaii

T52C-0275 1330h POSTER

Numerical Modeling of Dewatering of Underthrust Sediments, Costa Rica Subduction Zone

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Drilling-related investigations at the Costa Rica subduction zone have provided constraints on dewatering processes and overpressure generation during initial subduction. The 380 m thick incoming sediment section, which is composed of 160 m of hemipelagic mudstones overlying 220 m of pelagic carbonates, is nearly completely underthrust beneath the margin wedge. Within the first 1.6 km of subduction, drilling results indicated that the upper, hemipelagic unit and the lower, pelagic carbonate unit thin to 67% and 80%, respectively, of their original thickness, presumably due to dewatering. Despite the observed thinning, laboratory consolidation tests suggested that the underthrust sediments are only partly drained in response to rapid loading beneath the margin wedge. In this investigation, we simulated the progressive loading, fluid migration, and compaction of sediments during their initial subduction by combining a loading model with a transient fluid flow model. Results of the modeling indicate that previously measured permeabilities of the hemipelagic sediments are sufficiently high to allow the observed dewatering while being low enough to maintain elevated pore pressures. In contrast, the modeling suggests that the laboratory-determined permeabilities of the pelagic carbonates are too high to be representative of large-scale in situ permeabilities, because the laboratory-derived permeabilities would allow much greater dewatering and compaction than observed.

T52C-0276 1330h POSTER

Development of Overpressures at Nankai Accretionary Prism, Ocean Drilling Program Sites 1173 and 1174

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In this study, we used a one-dimensional model of sedimentation, initial prism loading, and fluid flow to examine the development of overpressures at the toe of the Nankai accretionary complex. A permeability-porosity relationship was established for hemipelagic sediments from laboratory measured permeabilities as an input to the model. Vertical permeabilities were measured for 10 core samples from the Ocean Drilling Program (ODP) Leg 190, Sites 1173 and 1174, from the upper and lower Shikoku Basin facies. Both sites were drilled along the Muroto Transect through the dècollement zone or its equivalent. Site 1173 is located 11 km seaward of the deformation front and it represents the undeformed incoming sediments, where as Site 1174 represents sediments within the proto-thrust zone. Although turbidite-rich sediments dominate the Nankai accretionary prism, the dècollement and underthrust sediments are primarily composed of hemipelagic muds. Using the permeability-porosity relationship, our modeling results indicate excess pore pressures that are greater than 30% of lithostatic pressure at the toe of the prism at a convergence rate of 4cm/yr. These values are slightly lower than previously inferred excess pore pressures estimated from porosity data. Additional runs were conducted to simulate a 10-m thick low permeability barrier at the dècollement where vertical fluid flow is restricted. The low permeability barrier required a permeability less than 1×10^{-19} m^2 to generate excess pore pressures greater than 50% of lithostatic pressure. Modeling was further extended to test the significance of variable prism loading rates due to uncertainties in the convergence rate and affects of lateral stress above the dècollement.

T52C-0277 1330h POSTER

Permeability and strength structure around an ancient exhumed subduction-zone fault

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Investigating the transporting properties of subduction zone faults is crucial for understanding shear strength and slip-stability, or instability, of subduction zone faults. Despite the influence of pore pressure on a wide range of subduction-zone fault processes, few previous studies have evaluated the permeability structure around the fault placed in a well-defined structural context. In this study, the aim is to gain the entire permeability and the shear strength structure around the ancient subduction zone fault. We have conducted a series of permeability measurements and shear failure experiments in seismogenic environments using intact rocks sampled at the outcrop of an exhumed fault zone in the Cretaceous Shimanto accretionary complex, in Shikoku, SW Japan, where a typical evidence for seismic fault rock of pseudotachylyte has been demonstrated [Ikesawa et al., 2003]. This fault zone is located at boundary between the sandstone-dominant coherent unit of the Nonokawa Formation and the Okitsu mélange. The porosity of each rock sample is less than 1 %, except for the shear zone. Cylindrical test specimens (length = 40 mm, diameter = 20 mm) were cored to an accuracy of within 0.02 mm.
Most of values of permeability were evaluated at confining pressure P_c of 140 MPa and pore pressure P_p of 115 MPa simulating the depth of 5 km (suprahydrostatic pore pressure). It is found that the permeability at room temperature shows the heterogeneous structure across the fault zone. The permeability of sandstone-dominant coherent unit is the lowest (10^{-19} m^2) across the fault zone. In contrast, high shear zone has the highest permeability (10^{-16} m^2). Following the increase in temperature, permeability evolution has been investigated. The permeability at 250°C continuously decreases with hold time for all types of rock specimens, and the reduction rate of permeability against hold time seems to become small with hold time. It seems that the reduction rate does not significantly depend on the rock types.
The specimen was loaded at a strain rate of 2×10^{-6} /s under the conditions (P_c, P_p, T) = (140 MPa, 105 MPa, 250°C) to conduct the shear fracture experiments. High shear zone has a minimum value in strength profile. In contrast, the largest shear strength is observed at sandstone in coherent unit.
From the seismic reflection surveys in the Nankai Trough, Park et al. [2002] delineated reflections with negative polarities beneath the Nankai accretionary prism 20-60 km landward of the frontal thrust, which are located deeper than the negative polarity décollement near the frontal thrust. They interpreted that the DSRs indicate the elevated fluid pressures. The fault zone studied in this paper is consistent with the duplex-model, and corresponds to the area where the décollement near the frontal thrust stepped down. Present results show the possibility that the coherent sandstone acts as a cap rock for fluid flow, and shear zone as a conduit for the flow, which leads to the elevated pore pressures along the roof thrust.

T52C-0278 1330h POSTER

Spatial and Temporal Variations of Sediment Input to the Cascadia Subduction Zone

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The abundance of expandable clay (smectite) in subducting sediments is an important parameter to consider during studies of plate-boundary seismogenic zones because the mineral has an unusually low coefficient of internal friction. Furthermore, interlayer