which relates the supershear initiation distance L to loading conditions by introducing a dependence of the critical slip distance d_0 on normal pressure. This modified theory yields a better agreement with the experimental data. This transition provides a mechanism for nucleation of supershear ruptures in a 2-D problem. Although such transition has been reported for some earthquakes (e.g., 2001 Kunlunshan earthquake), confirmation of it must await further studies.

S42A MCC: Level 1 Thursday 1330h

New Views of Seismic Hazard in Cascadia III Posters *(joint with G, T, V)*

Presiding: **T M Brocher,** U.S. Geological Survey**; A J Calvert,** Simon Fraser University

S42A-0139 1330h POSTER

Spatial and Temporal Correlation Between Nonvolcanic Low-frequency Tremors and Slow Slip Events Detected in the Southwest Japan Subduction Zone

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Megathrust earthquakes of magnitude greater than 8 have repeatedly occurred in southwest Japan due to the subduction of the Philippine Sea plate. Recently, non-volcanic seismic tremors have been discovered in the fore-arc side of the subducting plate (Obara, 2002) by analyzing the continuous records of the high-density high-sensitivity seismograph network, NIED Hi-net. The tremors are not distributed homogeneously in the narrow belt along the strike of the slab but spatially clustered. The major activity of the tremor is also clustered periodically, with a period of 2 or 3 months in the east and middle part of Shikoku area, and about 6 months in the west of Shikoku. Every Hi-net observatory is equipped with a high-sensitivity accelerometer, which has wide range in frequency response. Output from horizontal components of the accelerometer can be analyzed as tilt movement. In the west of Shikoku, we found that step-like tilt changes occurred four times in two years of 2001 and 2002 associated with periodic major tremor activities. Each tilt change continues for a few days at the stations near the source area of the tremor. The duration of the tilt change is simultaneously associated with the major activity of the tremor. The tilt step is about 0.1 micro radian in maximum. Based on the observed tilt step the slow slip event is estimated to occur on a reverse fault at around the interface of the subducting Philippine Sea plate. The simultaneous activity of the tremors and the slow slip events is very similar to ETS (Episodic tremor and slip) detected in Cascadia subduction zone (Rogers and Dragert, 2003). Both observations in young subduction zones might be important for understanding the condition of the transition zone on the plate boundary and monitoring the stress accumulation at the locked section of the slab.

S42A-0140 1330h POSTER

Why is the Cascadia subduction zone backarc hot? Numerical tests of mantle wedge flow

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Understanding mantle wedge processes is critical for constraining thermal and petrological controls on in-slab earthquakes and the behaviour of the deep subduction thrust fault. Observational constraints indicate that the mantle wedge at the northern Cascadia subduction zone is extremely hot. Below the volcanic arc, temperatures greater than 1300°C are required for magma generation. In the backarc, surface heat flow, seismic velocities, thermal isostasy and xenolith studies suggest temperatures of 1200°C at 60 km depth for a distance of 500 km. The landward limit of the backarc is the abrupt contact with the thick, cold North America craton, making high backarc temperatures even more surprising. An initial compilation of thermal data shows that most other backarcs are similarly hot. Finite element thermal models are used to investigate the backarc mantle flow structure that maintains these high temperatures. Two principle driving forces for flow are: traction along the top of the subducting slab and buoyancy forces due to lateral thermal heterogeneities, such as cooling by the slab and Rayleigh instabilities. In this study, we primarily deal with traction-driven flow, using Cascadia subduction parameters. A thick (>200 km) lithosphere was introduced at the landward backarc boundary, consistent with the presence of the North America craton root. For an isoviscous mantle, the craton deflects hot material from depth into the wedge, resulting in a warmer wedge than models without a craton, although the temperatures are 150-300°C lower than inferred from observations. Decoupling of the wedge from the over-riding plate increases the backarc Moho temperature by over 100°C; temperatures below the arc are relatively unaffected. With a more realistic stress- and temperature-dependent viscosity, high velocity flow originates from great depths along the landward boundary, even without a craton. Flow is strongly focussed into the wedge corner, leading to much higher sub-arc temperatures (>1250°C). However, the flow pattern produces low backarc mantle temperatures and heat flow, inconsistent with observations. For all models, full coupling between the subducting plate and wedge was assumed. If partial decoupling occurs, due to the presence of hydrated mantle or serpentine/talc, wedge flow velocities will be slower, and the wedge will be cooler than predicted by the models. None of the traction-driven flow models simultaneously produced high temperatures below the volcanic arc and a uniformly hot backarc. Numerous studies indicate that the mantle wedge viscosity is less than 10^{19} Pa s. Initial tests suggest that at such low viscosities, wedge flow driven by thermal buoyancy may be more important than traction-driven flow.

S42A-0141 1330h POSTER

Spherical Viscoelastic Finite Element Model for Cascadia Interseismic Deformation

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We have developed a 3-D spherical viscoelastic finite element model for the Cascadia subduction zone to study temporal and spatial variations of interseismic deformation. Previous 3-D viscoelastic finite element models of subduction zone earthquake cycles all use the Cartesian system, with the surface of the earth map-projected on to a horizontal plane. For earthquakes that rupture very long plate-boundary segments, such as the 1700 Cascadia, 1960 Chile, and 1964 Alaska great earthquakes, the Cartesian approach is inconvenient and less accurate. 3-D analytical solutions take into account the spherical geometry of the earth but have difficulty dealing with realistic plate boundary structure. For the new spherical finite element model, we use 27-node tri-quadratic isoparametric element. The resultant large sparse matrix system is solved by the stabilized bi-conjugate gradient method with ILUT preconditioning of fill-in level 6. Our experience suggests that lower order elements in the spherical system would result in unacceptable numerical errors unless one set of mesh lines is strictly radial. For the great Cascadia earthquake, we employ a smooth coseismic rupture model inferred from thermal data and results of tsunami models of the 1700 event, but we test different slip distances. For interseismic deformation, we use the conventional backslip approach. The contemporary deformation of the Cascadia margin consists of interseismic strain accumulation and a geological secular motion that can be described by a rotation of the forearc relative to North America. To isolate the interseismic deformation, we remove the secular motion from both the model formulation and geodetic data. The model predicts decreasing margin-normal shortening rates throughout the interseismic period as a result of stress relaxation in the viscoelastic mantle. The rate of decrease depends on the assumed mantle viscosity. With a viscosity of 10^{19} Pa s, model surface deformation at 300 years after the great earthquake agrees with geodetically observed contemporary deformation very well. The model also confirms the previous finding based on a Cartesian model that an inland region continues to move seaward several decades after the great earthquake.

S42A-0142 1330h POSTER

Source Parameter Studies of Historical and Recent Earthquakes of the Cascadia Subduction Zone and Mendocino Triple Junction Region

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We are comparing the seismograms of recent (post-1989) earthquakes to those of historic earthquakes (pre-1966) recorded at the same (or similar) station locations to determine how comparable the historic earthquakes are to recent events with well determined hypocenters and rupture parameters. The seismograms of recent events will be used as empirical Greens functions in a deconvolution process to more accurately determine the directivity and rupture process of the older events. Our initial work in the Cascadia Subduction zone has focused on earthquakes within the subducting Pacific plate occurring in 1939, 1946, 1949 and 1965, in locations similar to the 1999 Satsop and 2001 Nisqually earthquakes. Preliminary analysis of waveform information suggests that the 1949 Olympia earthquake has a different rupture history to the east and south of the epicenter, as compared to the Nisqually earthquake. In the Mendocino Triple Junction region, we have focused on modeling smaller magnitude earthquakes using an earth simplification transform. We will calibrate the technique using several intermediate magnitude events that have occurred on the Mendocino fault and within the Gorda plate.

S42A-0143 1330h POSTER

Northern Cascadia Earthquake Catalogue, 1980-Present

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The Cascadia subduction zone trancends the international boundary between Canada and the United States. This is where the Juan de Fuca plate subducts beneath the North America plate from Vancouver Island, British Columbia in the north and extending south through Washington, and Oregon. Seismicity catalogues exist for each side of the border: the Western Canadian Earthquake Catalogue (Geological Survey of Canada at the Pacific Geoscience Centre (PGC), Sidney, BC) and the Pacific Northwest Earthquake Catalogue (University of Washington (UW), Seattle, Washington). It is desirable for many kinds of studies and displays to have one catalogue. To this end we have merged the two catalogues together into one, which is consistent in location and magnitude. Earthquakes have been tagged as to whether they occurred in the North America plate or the Juan de Fuca plate. The northern Cascadia Earthquake Catalogue has proven extremely useful for research, plotting, and display of the seismicity patterns in this region. Cross-sections of seismicity perpendicular to the subduction front and running through Port Alberni, BC, Victoria, BC, and Seattle, Washington clearly show variations in the angle of dip of the subducting plate. Magnitude comparison between the two networks required a magnitude correction for the smallest events. For UW magnitudes less than 2.6, M_L(PGC) = M_C(UW) - 0.1; for UW magnitudes greater than or equal to 2.6, M_L(PGC) = M_C(UW).

S42A-0144 1330h POSTER

Physical Property Correlations and Radiocarbon Ages Illuminate Cascadia Earthquake Recurrence Patterns

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We have been investigating the recurrence pattern of Great Earthquakes along the Cascadia margin using the record of turbidites deposited after margin-wide shaking during great earthquakes. We have previously suggested that virtually all the turbidite record is the result of great earthquakes, based on identical numbers of events in widely separated cores, and relative dating techniques that demonstrate synchroneity of the triggering mechanism. We are now testing this correlation with radiocarbon ages and physical properties of the core sediments. We observe a systematic variation of turbidite ages as a spread of ages that is greatest in the mid-Holocene, tapering off toward both the early and late Holocene. The pattern could represent either systematic earthquake behavior, or a systematic variation of the "reservoir age" of the ocean water in which the microfossils we are dating live. We suspect the latter, as the dated events pass other correlative tests that strongly suggest synchronous triggering. We also are testing the correlation of events using physical property measurements of the cores containing the turbidite record. We find that a reasonably good stratigraphic correlation can be made between three key core sites at Juan de Fuca, Cascadia, and Rogue Channels using Gamma density and high-resolution magnetic susceptibility records of these cores. This correlation is independent of other correlation methods including the Mazama ash datum, event number comparisons, the "confluence test" of synchronous triggering, and radiocarbon ages, but is consistent with them. That we are able to correlate physical property "wiggle" plots between turbidite channels that are not connected, implies that something of the earthquake shaking signal may be contained in these records. With strengthened correlations, and improved estimates of the reservoir correction, we infer that the pattern of Cascadia Great Earthquakes appears to include a repeating pattern of a long interval ending in an earthquake, followed by a moderately long interval, then 1 or 2 shorter intervals. Over the last 9000 years, the pattern appears to have repeated four times, with the most recent AD 1700 event being the third of three events following a long interval between events T4 and T5. This long interval is one that is also recognized in many of the coastal records, and may serve as an anchor point between the offshore and onshore records.

S42A-0145 1330h POSTER

Thermo-Mechanical Modeling of Forearc Evolution and Implications for Subduction Zone Earthquakes

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Sediment-rich subduction zones, such as the Cascadia and Nankai Margins, are overlain by large subduction wedges that show a distinctive structural morphology defined by four margin-parallel domains. From trench to arc, the domains are (1) the trench slope, with piggy-back style slope basins; (2) the continental shelf, a region with little surface deformation and deposition of up to several km of sediment in local basins; (3) a subaerial forearc high; and (4) a more interior forearc basin, which marks the landward limit of the subduction wedge. We use a thermo-mechanical model with a visco-plastic rheology to explore the conditions needed to develop these structural features, with a focus on implications for decollement strength and great thrust earthquakes. We find that successful models must have the following features to reproduce the observed morphology: a frictional-viscous rheology, a weak basal decollement, flexural compensation and sedimentation. Our modeling suggests the following factors are responsible for each of the structural domains. (1) The trench slope forms as new sediment is frontally accreted above the more seaward and shallowly-dipping part of the subduction thrust. Piggy-back basins are superimposed upon the trench slope as strain is localized in seaward-vergent shear zones. (2) The more steeply-dipping slab landward of the trench slope permits slip on the decollement without upper plate deformation and forms a local topographic high on the shelf edge. Sedimentation in this region forms the continental shelf and forces this region into a mode of stable growth where newly accreted material is underplated beneath the shelf thus preserving the relatively undeformed nature of the shelf basins. (3) The landward termination of the continental shelf coincides with the thermally-activated transition from frictional to viscous deformation at depth. The viscous deformation allows an effective near-horizontal detachment to develop that promotes the growth of a topographic forearc high. (4) A more landward forearc basin forms by flexural loading due to the growth of the forearc high. Other studies argue that subduction zone earthquakes are commonly initiated beneath the shelf region. Our model suggests these earthquakes are starting beneath the stable part of the wedge, where the wedge is strongest relative to the decollement. Also, the limits of the seismogenic zone are thought to be largely temperature controlled. Our model provides an indication of the importance of advective heat transport associated with accretion and within-wedge deformation on estimating temperatures along the subduction thrust.

S42A-0146 1330h POSTER

Tectonic Surfing: Evidence of Rapid Landward Transport in the Cascadia Subduction Wedge, NW Washington State

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There is considerable evidence now that over the last 15 m.y., the Cascadia subduction wedge along the Olympic Peninsula has been in a flux steady state, where the accretionary influx is balanced with the erosional outflux from the forearc high. This steady state condition implies that the size and shape of the wedge have also been in steady state as well. If correct, we can use the steady-state flux $F_a \sim 45$ km^2/m.y. and the present shape of the wedge to predict the average transit time τ through the wedge, given by $\tau(x) = A(x)/F_a$, where x is the landward distance from the front of the wedge and A(x) is the area of the wedge seaward of x. Given the present bathymetry of the wedge, z(x), we can relate age to depth (τ to z) for accreted material moving through the wedge. These relationships predict an age-depth history that is remarkably similar to that determined for the Coastal unit of the Olympic Structural Complex (OSC) (Hoh assemblage), which consists of accreted sediments presently exposed along the west coast of the Olympic Peninsula. For this comparison, we have determined new estimates of paleo-water depth using paleobathymetric interprations for benthic forams by Ingle (1980), together with published benthic foram reports by W. Rau. The Coastal OSC was deposited at 16.5 Ma at water depths >2000 m, which is similar to the 2500 m depth of the modern trench. The Coastal OSC is highly deformed and imbricated, consistent with its origin by subduction accretion. Thermal indicators show that the unit never experienced temperatures $>\sim 100$ C, so this structural unit must have been accreted near the front of the wedge and transported landward just beneath the surface of the wedge. Exploration wells on the shelf west of the Olympic Peninsula drilled through a coherently bedded sequence and into the underlying Coastal OSC. The base of the coherent sequence is middle and late Miocene (15 to 10 Ma) and was deposited at >2000 m water depth, which indicates deposition in a post-accretionary lower slope basin. The Quillayute Formation, which overlies the Coastal OSC on land, is late Miocene ($\sim$10 Ma) age, and was deposited at $\sim$1000 m depth. The upper part of the Quinault Formation, which also overlies the Coastal OSC onland, was deposited at 150 m at $\sim$4.5 Ma. The Coastal OSC is currently exposed near sea level along the west coast of the Olympic Peninsula. Geomorphic evidence in Pazzaglia and Brandon (2001) indicates that these rocks are currently moving landward at a rate of $\sim$3 km/m.y. All of these estimates compare well with our simple quantitative model, which assumes only frontal accretion in a steady state wedge. If correct, the Coastal OSC has moved landward in the direction of convergence by 135 km since its initial accretion at 16.5 Ma. Rapid landward transport may be a common feature at other accreting subduction wedges.

S42A-0147 1330h POSTER

Evidence for conjugate shear failure and time-transient strain within the Cascadia forearc

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Understanding deformation of the Cascadia forearc is key to assessing potential subduction zone earthquakes in the region. Anelastic strain, within the forearc, may limit the magnitude and/or increase the recurrence interval of such events. Strain geometries within the forearc are complex and seemingly inconsistent. Within the submarine portion of the forearc, nine left-lateral arc-oblique transcurrent faults cut the subducting Juan de Fuca plate and overlying accretionary wedge. These active faults have formed in a stress regime that is nearly perpendicular to the documented north-south compression of the onshore areas of the forearc. The relationship between the offshore and onshore mechanics of faulting and the potential temporal variability of strain within the forearc are poorly understood. An integrated study was undertaken that merged offshore geophysical mapping, onshore geology and remote sensing data to compare strain patterns across the forearc. Orientation analysis of:(1) active faults in the submarine forearc; (2) Tertiary and younger faults of the Oregon Coast Range; (3) Tertiary and younger faults of the Willamette Valley; and (4) lineaments on thermal imagery at multiple spatial resolutions; all point to a geometrically consistent record of compression across the Cascadia forearc. The strain record of the rocks is in seeming conflict with the results of GPS surveys over the past decade, borehole breakout studies and recent crustal earthquakes, which all point to north-south compression. Integration of this data, representing a recent and potentially short record, points to temporal variation of the stress field within the Cascadia forearc over relatively brief periods of geologic time.

S42A-0148 1330h POSTER

Rupture Parameters For The Pre-historic Seattle Fault Earthquake From Modeling Shoreline Uplift

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Slip during large thrust earthquake often causes surface uplift and secondary rupture. Surface uplift due to an earthquake on the Seattle Fault, an east-west striking thrust fault located under downtown at 900-930 A.D., is represented by elevation changes in the shoreline of Puget Sound. We use the sharp break in slope between the landward edge of the shore terrace and the adjoining steep hill slope as a consistent feature to define the elevation of the uplifted shoreline. The data are corrected for $\sim$1 m change in sea level during the past 1000 years and for post-seismic uplift estimated to be up to 20% of the total based on modern analogs. We first summarize the impact of various rupture parameters, such as dip, rake, fault depth, and fault segmentation, on the changes at the surface using single fault models and multi-fault models under uniform conditions. We then model in 3-D the rupture geometry of the Seattle Fault with a realistic surface fault trace by fitting the expected uplift to the measured shoreline uplift in the area. We investigate reverse, strike-slip, normal, and mixed slips on the fault and estimate the magnitude of that earthquake. Preliminary results underscore the sensitivity of the rupture parameters to elevation changes away from the surface projection of the fault. Left-lateral strike slip cannot produce the observed uplift amplitude.

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S42A-0149 1330h POSTER

The Cottage Lake Lineament, Washington: Onshore Extension of the Southern Whidbey Island Fault?

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The northwest-striking southern Whidbey Island fault zone (SWIF) is reasonably well expressed by borehole data, marine seismic surveys, and potential-field anomalies on Whidbey Island and beneath surrounding waterways. Johnson et al. (1996) described evidence for Quaternary movement on the SWIF, suggested the fault zone is capable of a M 7 earthquake, and projected three fault strands onto the mainland between the cities of Seattle and Everett. Evidence for this onshore projection is scant, however, and the exact location of the SWIF in this populated region is unknown. Four linear, northwest-striking magnetic anomalies on the mainland may help address this issue. All of the anomalies are low in amplitude and best illuminated in residual magnetic fields. The most prominent of the magnetic anomalies extends at least 15 km, is on strike with the SWIF on Whidbey Island, and passes near Cottage Lake, about 15 km south of downtown Everett. The magnetic anomaly is associated with linear topography along its entire length, but spectral analysis indicates that the source of the anomaly lies principally beneath the topographic surface and extends to depths greater than 2 km. The anomalies are likely created by northwest-trending, faulted and folded Tertiary volcanic and sedimentary rocks of the Cascade foothills, which rise from beneath the Quaternary lowland fill to the southeast of the SWIF. High-resolution Lidar topography provided by King County shows subtle scarps cutting the latest Pleistocene glaciated surface at two locations along the magnetic anomaly; scarps are parallel to the anomaly trend. In the field, one scarp has 2 to 3 m of north-side-up offset; paleoseismic trench excavations are planned for Fall 2003 to determine their nature and history. Preliminary examination of boreholes, recently acquired as part of an ongoing sewer tunnel project, show anomalous stratigraphic and structural disturbances in the area of the magnetic anomalies. Analyses are underway to determine if faulting causes these disturbances. Taken together, the SWIF and the Cottage Lake lineament extend >50 km. Thus defined, the SWIF is spatially associated along its length with an arcuate (convex to the southwest) zone of deep (>10 km) crustal earthquakes, one of several arcuate alignments of epicenters between the SWIF and Olympia, Washington.

S42A-0150 1330h POSTER

Crustal Velocity Structure From First Arrival Seismic Tomography in the Strait of Georgia, British Columbia and Washington

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Seismic refraction/wide-angle reflection data were collected in May 2002 in the Strait of Georgia, southwestern British Columbia and northwestern Washington. The experiment, part of the Georgia Basin Geohazards Initiative, provides knowledge about potential geohazards associated with near-surface crustal faulting in the strait. The last significant earthquake (M = 4.6 in 1997) within the strait reflects the regional seismic hazard. The seismic survey was aimed at studying the three-dimensional (3D) velocity structure of the shallow upper crust particularly the Cenozoic sedimentary basins, the Outer Island fault and the Lummi Island fault. The data were acquired using 48 Reftek stations deployed onshore to record the signals from a 120 cu. in. airgun fired at a nominal interval of 5 sec or 12 m. Single channel reflection data were collected simultaneously. The experiment provided useful data from 42 of the 48 stations deployed. The data quality at many receivers was very good. The average maximum source-receiver offset for first arrivals was 17 km with a maximum offset of 35 km. Preliminary 2D velocity modeling indicates three layers in the shallow upper crust down to a maximum depth of 3 km. The uppermost layer in the strait represents recent unconsolidated sediments. The second layer consists of basin fill sediments (velocity 4.1- 4.4 km/s) associated with the Upper Cretaceous Nanaimo Group. These sediments occur at the surface within the Canadian Gulf Islands but at a depth of about 700 m within the strait. The underlying basement layer (velocity 5.3 - 5.7 km/s) at a depth of 1.7 km possibly represents the volcanic Wrangellia terrane, extending from Vancouver Island beneath the strait. The wide distribution of receivers in the islands and shots in the surrounding waters provides excellent constraints for 3D inversion of first arrival travel times and hence for a high-resolution 3D image of the shallow structure.

S42A-0151 1330h POSTER

Structure of the Juan de Fuca Plate and Forearc Mantle below Vancouver Island

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LITHOPROBE multichannel seismic reflection data, recorded on Vancouver Island in 1984, provided the first images of the subducting Juan de Fuca (JdF) plate. At the western edge of the island, Line 84-01 identified the top of the JdF plate at 10 s two-way time (TWT; 30-33 km depth); in the southern part, Line 84-02 showed the plate at 11.5-12.5 seconds TWT (35-42 km depth). Data from these and two other short lines on the island plus Line 88-16, effectively a continuation of 84-01 on the mainland across Georgia Strait, have been reprocessed. Reflections from the top of the JdF crust and Moho are observed on NMO-corrected shot gathers. The new results extend mapping of the top of the subducting JdF crust and Moho to eastern Vancouver Island, where the top of the plate is identified at 13 s TWT (44-47 km depth). Our interpretation is consistent with locations of earthquake hypocenters. The results also show the position of the Cascadia forearc mantle wedge beneath southern Vancouver Island. At the end of Line 84-01 on eastern Vancouver Island, the forearc crust-mantle boundary is delineated at 11 s TWT (37 km depth). Across Georgia Strait, the forearc Moho also is identified at 11 s TWT (37 km depth) on the western end of Line 88-16. Previous seismic receiver function and refraction studies have estimated similar depths to continental Moho in this region. On the western end of Line 88-16, a band of NE-dipping upper mantle reflections is observed between 13-15 seconds TWT. This reflective unit seems to correlate with the prominent E' reflections observed on Line 84-01. To strengthen this interpretation, further processing to improve the signal coherency of E' reflections on the eastern end of Line 84-01 is in progress. Velocity models along the reflection lines on Vancouver Island are extracted from a 3-D P-wave tomographic study of onshore-offshore wide-angle data [1998 SHIPS (Seismic Hazards Investigation of Puget Sound) experiment] and earthquake data acquired north of the Strait of Juan de Fuca. Low P-wave velocities (7.2-7.4 km/s) characterize the mantle wedge at depths of 40-50 km beneath eastern Vancouver Island. We attribute these low velocities to metamorphic dehydration reactions in the crust of the JdF plate and subsequent release of aqueous fluids, resulting in hydration and serpentinization of the forearc mantle. Silent-slip earthquakes recently have been detected within this zone through continuous GPS studies.

S42A-0152 1330h POSTER

Using the Local Magnitude Scale to Determine Seismic Site Response in the Pacific Northwest

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Using new wide dynamic-range digital seismographs and accelerometers of the Pacific Northwest Seismograph Network in Washington and Oregon we have reevaluated the magnitudes of earthquakes in the Pacific Northwest using the Local (Richter) Magnitude scale, ML. We have done this by synthesizing Wood-Anderson Seismograms from broadband instruments. This procedure is a departure from our traditional use of the coda-magnitude scale. We have computed the ML of 76 earthquakes that occurred from 2000-2003 with 2.5<M<6.8 using observations from a total of 2812 seismograms. We utilized a method of Joint Magnitude Determination in which earthquake magnitudes and station corrections are determined simultaneously for all earthquakes. The computed magnitude corrections at the stations range between -0.4 to +0.4 magnitude-units. On average, the magnitude corrections are correlated with, and can be reasonably predicted from, the NEHRP soil classification assigned to each site. Computed magnitudes tend to be higher at sites where the estimated surface shear wave velocity is low. The variations in computed magnitude do not seem to depend on the presence of deep-basin structures in the subsurface. On the other hand, such structures have been shown to affect the amplitudes of very low frequency seismic waves. We suspect that this discrepancy is caused by the fact that Richter magnitudes (ML) are intrinsically sensitive to higher frequency ground motions. We conclude that variations in Richter magnitude can be used to detect shallow subsurface site conditions likely to affect earthquake shaking.

S42B MCC: Level 1 Thursday 1330h

Earthquake Alerting Systems: From Rapid Hazard Determination to Societal Response II Posters

Presiding: **Y Wu,** Central Weather Bureau, Taiwan; **C Gurbuz,** Bogazici University

S42B-0153 1330h POSTER

Istanbul Earthquake Early Warning and Rapid Response System

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As part of the preparations for the future earthquake in Istanbul a Rapid Response and Early Warning system in the metropolitan area is in operation. For the Early Warning system ten strong motion stations were installed as close as possible to the fault zone. Continuous on-line data from these stations via digital radio modem provide early warning for potentially disastrous earthquakes. Considering the complexity of fault rupture and the short fault distances involved, a simple and robust Early Warning algorithm, based on the exceedance of specified threshold time domain amplitude levels is implemented. The band-pass filtered accelerations and the cumulative absolute velocity (CAV) are compared with specified threshold levels. When any acceleration or CAV (on any channel) in a given station exceeds specific threshold values it is considered a vote. Whenever we have 2 station votes within selectable time interval, after the first vote, the first alarm is declared. In order to specify the appropriate threshold levels a data set of near field strong ground motions records form Turkey and the world has been analyzed. Correlations among these thresholds in terms of the epicenter distance the magnitude of the earthquake have been studied. The encrypted early warning signals will be communicated to the respective