of this basin, the extension of the Leech River fault is clearly mapped to a depth of 3 km. At the eastern end of SJF, the Port Townsend basin with a sediment thickness of approximately 7 km is clearly identified in the velocity model. The eastern margin of this basin is bounded by the South Whidbey Island Fault. In SG, the Georgia basin with a maximum sediment thickness of 9 km is mapped prominently. A sharp south dipping lateral velocity contrast separates the low velocity sediments in the southern part of Georgia basin from the high velocity material in the north. This coincides with the location of a series of recent earthquakes, including the magnitude 4.6 event of June, 1997.

S71D-06 0945h

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Observations from a year-long (1998-1999) deployment of portable broad-band seismic observatories across the Kamchatka peninsula are used to constrain vertical profiles of seismic velocity in the crust and upper mantle of the region. Ps converted waves in teleseismic P coda are isolated using multiple-taper correlation (MTC) receiver functions. Backazimuthal and epicentral-distance gathers of receiver functions (RFs) are examined for presence of Ps phases associated with major impedance contrasts within the crust and the upper mantle. To identify near-surface resonances particular attention is paid to the correlation of RF features across backazimuthal bins, and their temporal moveout with epicentral distance. The P-SV wavefield (radial RFs) is hampered by near-surface resonances more often than the P-SH wavefield (transverse RFs). For most stations we can identify either the crust-mantle transition or the top of the subducting slab (for stations near the volcanic front), as well as interfaces within the crust.In central Kamchatka we find clear converted phases at ∼4.5 - 5 sec delay that we associate with the crust-mantle transition at depths of ∼40km. Broad and/or complex Ps pulse shapes suggest that the Moho is either gradational or has a layered structure. Similar crustal thicknesses are evident at some sites on the western coast of the peninsula, as well as at a site north of the junction with the Aleutian Arc, where active subduction terminates. Converted phases consistent with a velocity interface at ∼40-km depth are seen along the volcanic front on the east coast of Kamchatka as well. These may be associated with the Moho, but are less clearly expressed. Conversions from the upper part of the slab, identified by their moveout with backazimuth, are seen at most sites along the volcanic front. In addition, most RFs contain phases indicative of midcrustal interfaces (∼15–25 km depth), and RFs in the central part of the peninsula show features that could be associated with structures at depths of 75–100 km.

URL: http://www.geology.yale.edu/∼vadim/kamch.html

S71D-07 1020h

Seismic Attenuation in and around the Carpathians, Romania, from K2 Network Data

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We measured seismic attenuation along paths from intermediate depth Vrancea seismicity, and from shallow earthquakes in the Carpathians region, to the recently installed K2 network via the S-to-P spectral ratio method. The Romanian Institute of Earth Physics' K2 seismic network of three component short period seismometers and accelerographs has been in operation since 1998. The 30 station network is centered on the Vrancea seismic zone, the most active concentrated source of seismicity in continental Europe. Earthquake locations and the K2 station distribution allows a comprehensive study of seismic attenuation in the populous Moesian and Scythian Platforms, the Carpathian bend zone, the Transylvanian Basin, and the Black Sea Coast region.

Spectral amplitudes of P and S were windowed visually on the vertical and horizontal (SH) seismograms, and an estimate of the spectral amplitudes of pre-signal noise was also determined to ensure that fitting of the slope of the log of the spectral ratio was performed only on signal clearly above ambient noise levels. We then calculated natural logs of the S-to-P ratio, plotted the latter against frequency and determined a best-fit (linear least-squares) line to the resulting spectra to calculate Qs, the shear wave attenuation.

Our preliminary results indicate important differences in seismic attenuation between the Moesian and Scythian Platforms, the Carpathian Bend Zone, and even the Transylvanian Basin: the highest Qs, around 1000, was found at stations in the eastern Moesian Platform, especially in the vicinity of Bucharest. Qs values at Scythian Platform stations were also relatively high for two events, around 800. The Carpathian Bend Zone, in contrast, is apparently characterized by lower Qs, around 400-600. Finally, a single measurement of Qs at the lone K2 station in the Transylvanian Basin was very low, around 200.

S71D-08 1035h

2-D Nonlinear Travel Time Tomography by Multi Scale Search : Imaging an Overthrust Structure in Southern Apennines (Italy)

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We present a new method of 2-D nonlinear inversion of travel time aimed at imaging complex geological structure like volcanoes or overthrust regions. The forward problem is solved by a fast estimator of the first arrival time (Podvin and Lecomte, 1991). The medium is described by a grid of control points of a bicubic spline interpolation function. The search of the minimum of the objective function is realized by step with a hybrid algorithm, mixing downhill simplex and montecarlo strategies. Then the inversion proceeds iteratively, increasing step by step the number of inversion parameters. This approach, called multi scale search, allows us to retrieve first the large and then the shortest wavelengths of the medium. This technique provides a fast convergence of the solution and does not need any reference model. The use of the only first arrival time limits the investigation in depth. The introduction of a joint inversion with an arrival time of a reflected phase stabilizes the inversion. After the presentation of synthetic tests, we show an application to a data set acquired in the Southern Apennines overthurst belt by the Enterprise Oil S.p.A. The medium is very complex with interbedded low velocity layers, confirmed by surface geology and log information of a borehole located near the profile. The joint use of first arrival and early reflected phase times improves the image resolution up to the interface depth. Later reflected phases can be introduced in order to extend the investigation in depth.

S71D-09 1050h

Separation of Source, Path and Site Effects from the HNET borehole data in Kansai, Japan. Part 1: Estimation of Q-values in the Seismogenic and Aseismic Layers

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The difference between seismogenic and aseismic zones is thought to be related to the brittle-ductile boundary in the crust. This should result in higher Q for upper seismogenic zone and lower Q for deeper aseismic zone. To check this point we estimated Q-values in both zones using high quality HNET data. HNET network consists of 100m- or 200m-borehole seismometers with high dynamic range. This network is just installed in Japan, and this is one of the first presentations of results based on these data. Method for the separation source, path and site effects developed by Iwata and Irikura, 1988, is applied with the modification: we allow Q to be variable with depth in the layered model of the medium with constant Q in each layer. Path lengths in layers are calculated using ray approximation. Accurate calculation of the geometrical spreading term is also included. Inversion is made in two steps. At the first step, we estimated Q-value in upper zone assuming only one-layer Q model and using only shallow earthquakes with depths < 20km. At the second step, we used two-layer Q model, 0-20km and 20-70km, and deep earthquakes with depths 20-70km. In the second inversion Q-value for upper layer was constrained by results of the first step inversion; thus, Q-value for the deeper layer was determined.

For this work we selected data of earthquakes in Kansai area, Japan, with JMA magnitude 3-5, depth 0-70km and distance range 0-75km, for the period June-December, 1999. Data of one earthquake swarm was excluded to avoid shifting of results for Q. Total number of the records is 554. Direct not scattered S-waves were used to calculate Fourier amplitude spectra in the high frequency range 1-20Hz. Station Nokami (NKMH) was used as the reference station. As a whole, the results of inversion for Q are consistent with previous studies in this area, but show a remarkably higher Q in the upper, seismogenic layer: $Q(f) = 190f^{0.8}$ for seismogenic layer and $Q(f) = 70f^{0.7}$ for aseismic layer. This large difference appears due to the accurate calculation of the geometrical spreading term. In the presence of velocity discontinuity on the boundary of the thin (3km depth) low-velocity near-surface layer, the geometrical spreading term is smaller and Q-value is larger for first inversion. These results support the model of the crust with a brittle seismogenic zone and a ductile aseismic zone.

S71D-10 1105h

Bright Reflective Layer Beneath the Fault of an M 5.0 Earthquake That Occurred in Sendai, Northeastern Japan

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A shallow earthquake(M 5.0) with reverse fault type occurred at 12 km depth beneath Sendai city, northeastern Japan, on 15 September 1998. Its focal mechanism and fault plane location suggest that it is a slip at the deepest portion of Nagamachi-Rifu fault. Temporary seismic observations, including array observations, are made after its occurrence. Distinct later arrivals are detected in seismographs of aftershocks at many stations of the Tohoku University seismic network surrounding the focal area and and at stations of the temporary observations. Observed features of these phases show that they are generated by reflections at some sharp velocity boundaries in the midcrust. We estimated the locations of reflectors from arrival time data of these reflected waves by using the image station method of Matsumoto and Hasegawa(1996). The estimation shows that there exist several bright reflective layers and they distribute in the depth range of 12-21 km right beneath the fault plane of the M 5.0 event. One of the reflector thus estimated distributes beneath the fault plane over an area of 10*10 km**2 at depth of 15-21 km. It inclines toward the NNE at an angle of 25 deg. Several other reflectors with smaller dimensions are also detected. Many of them distribute at depths of 12-18 km between the fault plane and the above reflector with a larger dimension. The reflected waves presently detected have large amplitudes, often larger than the direct S wave, suggesting that the reflector bodies are filled with fluids. Data from the array observations are analyzed to estimate a spatial distribution of relative scattering strength. Obtained scattering strength distribution by assuming single S-S scattering show that strong scatterers distribute at a depth of 10 km and at depth of 15-20 km, the latter corresponding to the location of the reflector mentioned above.