Session 9

Poster session 2

S09-1 POSTER

COMPOSITIONAL HETEROGENEITY OF THE CONTINENTAL UPPER MANTLE HIDDEN IN SEISMIC MODELS

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Global seismic tomography models as well as mantle gravity anomalies reflect large-scale compositional variations in the mantle; however they are substan¬tially masked by temperature anomalies. Data on the thermal regime of stable continental lithosphere provides an exceptional information on lithospheric properties as it permits to separate thermal and non-thermal effects in global geophysical models. Global surface-wave (Shapiro and Ritzwoller, 2002) and body-wave (Grand, 2002) seismic tomography models are analyzed jointly with thermal model for the upper 250 km of the continental mantle. Both seismic and thermal models for the continental upper mantle outline the same regions of thick continental lithosphere and indicates large variations in lithospheric thickness on the continents. Thermal model is used next to calculate "synthetic" model of seismic velocities at depths between 50 and 200 km: based on laboratory data, mantle temperatures are converted into velocities with account for anelasticity effects. Significant difference between "synthetic" and observed seismic velocities can be attributed to large-scale compositional and structural heterogeneity of the continental upper mantle. In agreement with xenolith data, strong mantle depletion is clearly seen for all of the cratons; however it shows strong lateral variations in the amplitude (Artemieva, Lithos, in press). The results are compared with the residual mantle gravity anomalies, which represent compositional density anomalies in continental lithospheric mantle after the effect of thermal expansion being excluded (Kaban et al., EPSL, 2003).

S09-2 POSTER

OBSERVATIONS OF SEISMIC ANISOTROPY IN THE GULF OF CALIFORNIA REGION AS EVIDENCE OF LITHOSPHERE-ASTENOSPHERE INTERACTION

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New observations of S-wave splitting (SWS) in the Gulf of California region using SKS waves are combined with teleseismic receiver function observations, reported previously by Obrebski and Castro (2008), to infer possible lithosphere-astenosphere interaction in this region.

We extended the analysis of Obrebski et al. (2006) and Van Benthem et al. (2008) who reported the first SWS observations in northern and southern Gulf of California region, respectively, using SKS waves. To obtain a robust characterization of seismic anisotropy at stations in the southern region of the Golf of California we complemented our dataset including new splitting observations of S waves from intermediate to deep events. We also extended our analysis using records from the North Baja Transect (NBT) (Astiz et al., 1998), an east-west transect deployed at ~31º latitude between 1997 and 1998.

The region under study encompasses three structural domains defined by Stock et al. (1991) that divide the northern and central Baja California Peninsula (BCP) into the Transpeninsular Strike-Slip Province (TSSP), north of the Agua Blanca fault, and the Stable Central Peninsula (SCP) south of it. The third domain, located east of the above two, is the Gulf Extensional Province (GEP).

We found that the SWS fast direction is consistent with the results obtained by Obrebski et al. (2006) on the northern BCP and the E-W pattern reported farther north along the former trench in southwestern USA (Ozalaybey and Savage, 1995; Polet and Kanamori, 2002). The new results show that the fast direction abruptly changes toward the GEP, where it aligns with the trend of the transtensional rift. This rapid change in the anisotropy pattern is well resolved along parallel 31º using the data of the NBT transect and is geographically consistent with the limit between the SCP and the GEP provinces. In the eastern GEP, the fast direction is consistent with Miocene extension indicated by geologic features, although modern flow in asthenosphere conducted by the North American plate motion also satisfies this pattern, as proposed earlier by Obrebski et al. (2006) and van Benthem et al. (2006).

The results obtained from the receiver function analysis indicate that the three structural provinces studied have anisotropic characteristics markedly different and are the result of different kinds of lithosphere-astenosphere interactions.

S09-3 POSTER

SEISMIC ANISOTROPY OF THE CRUST AND UPPER MANTLE BENEATH EAST AFRICA FROM JOINT INVERSION OF SKS AND P RECEIVER FUNCTIONS

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The analysis of the crust and upper mantle anisotropy revealed by seismic waves provides an unique way to obtain constraints on the lithospheric strain state and on the geometry of the asthenospheric flow. Previous studies of upper mantle anisotropy around the East African Rift relied either on splitting of SKS types waves or on surface wave tomography. Nevertheless, these approaches yield rather poor vertical and lateral resolution, respectively. Therefore fast 3D variations expected around a plate boundary may have not been detected. Recent improvements in the methodology have shown that high lateral and vertical resolutions are achieved by performing joint inversion of both receiver functions and SKS waveforms. Our preliminary results at permanent stations ATD, FURI and KMBO are encouraging. Unambiguous evidences of splitting have been detected in SKS waves, in agreement with previous similar studies in this region. On the other hand, the waveform of the Q (Sv) and T (Sh) receiver functions exhibit azimuthal variations that are dominantly produced by anisotropy, as indicated by azimuthal filtering.

S09-4 POSTER

PERMIAN RHYOLITIC VOLCANISM IN THE SIRINIA BASIN (SE ROMANIA-EASTERN EUROPE) - VOLCANOLOGICAL FEATURES

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Extensive volcanic activity characterizes the lacustrine Sirinia Basin during Lower Permian times. The intracontinental basin lying on the Danubian metamorphic units in the south westernmost part of the Carpathians (SE Romania) is oriented N-S, as affected by Alpine tectonic movements. It was a result of extensional tectonics that started with mollase type sediment accumulation.

Permian volcanic activity is entirely acid (rhyolitic) and volcanologically very complex. The volcanic area in spite of folding processes associated to Alpine tectogenesis is well preserved and encompasses a mountain area which rises up to 600m above the surroundings and has an approximate dimensions of 6 x 10 km. Permian volcanic deposits are nested toward east on top of Carboniferous detritic sediments, including coal and basaltic volcanic rocks.

Permian volcanism has been formed most likely as the result of intrusion along a dyke system of a rhyolitic magma body underneath. Initial subaqueous dome forming processes led to the generation at their margins of hyaloclastic breccias that turn unstable forming marginally turbiditic hyaloclastite aprons. Raising to shallower waters and then to subaerial the volcanic activity turned progressively to be highly explosive, generating phreatomagmatic eruptions that formed probably several craters, however not possible to be actually documented. The result of this activity is most impressive, draping the former morphology represented by terrigeneous deposits and hyaloclastic domes and their products with a thick sequence of various deposits represented by proximal pyroclastic flow (dominantly non-welded and welded ignimbrites), pyroclastic surge and fall out rich in accretionary lapilli (with rare impact ballistic structures). The deposition was dominantly in the subaqueous environment, as suggested by the intensive diagenetic processes that changed the ash and glassy pumices in a green greasy secondary mineral or aggregate of minerals. Rare thick welded pumice and lithic rich ignimbrite deposits may suggest proximity of the vent area. At the distal, marginal part of the volcanic area the epiclastic, mostly lahar deposits are dominating, sometimes including layers up to meter size of fallout deposits with accretionary lapilli, that suggests their contemporaneous formation. The end of volcanic activity was effusive subaerial and several domes have been generated, the most imposing being the Trescovãþ dome situated in the central part of the volcanic area. Columnar jointing and cm size flow bending, sometimes suggesting turbulent flow is characteristic.

S09-5 POSTER

ATTENUATION AND SEISMIC TOMOGRAPHY STUDIES IN THE TRES VIRGENES VOLCANIC AND GEOTHERMAL REGION, BAJA CALIFORNIA SUR, MÉXICO

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We analyzed the spatial distribution of the seismicity recorded during October of 1993 at the Tres Vírgenes volcanic and geothermal region, Baja California Sur. As a first result, it was determined that most of the seismic activity occurred at the Caldera El Aguajito and along the La Virgen fault. Focal depths determined for 85 % of the located events range from 3 to 7 km. We also estimated quality factors from coda waves (Qc) and from P (Qp) and S (Qs) waves using a single-scattering attenuation model and the spectral ratio method, respectively, in the frequency range from 4 to 24 Hz. The values of Qc at six, out of seven analyzed stations, showed quite similar trends at all frequencies. The seventh station (E1), located in a densely fractured area with hydrothermal manifestations, showed a trend that differs, in the low frequency range, from the rest of the stations. With a relation of the form Qc(f) = Qo f h and data from the six stations having similar Qc trends, we obtained Qc(f) = (50.0 ± 3.0) f (0.65 ± 0.20) for the entire region. At the station E1, Qc may be approximated by Qc(f) = (3.0 ± 0.5) f (1.48 ± 0.06). From the body wave attenuation analysis, low values of Qp and Qs were determined. At all frequencies considered, the P wave attenuation was stronger than the S wave attenuation, suggesting a partially fluid saturated upper crust in the region. It was found that the frequency dependence of Q may be approximated by Qp(f) = (4.0 ± 3.0) f (0.97 ± 0.29) and Qs(f) = (10.0 ± 3.5) f (1.04 ± 0.14) for P and S waves, respectively, showing that Qp and Qs increase with frequency, in the same manner as Qc does.

A simultaneous inversion of hypocenter and seismic velocity structure was also performed in a zone with volume 20 x 24 x 10 km3 that includes the Tres Vírgenes volcanic complex. Low velocity zones we determined at the south flank of the La Vírgen volcano and at the south portion of the Caldera El Aguajito. One of this low velocity zones is located at the El Azufre Canyon area and on the hydrothermal zone. In the zone of the volcanoes the determined velocities are uniform both horizontally and vertically, suggesting quite similar velocity structure with depths larger than 8 km. The larger lateral velocity variations, which are observed up to 7-km depth, were associated with the El Azufre Canyon. The velocity variations that were determined within the inversion volume could be, among other reasons, due to effects of the inhomogeneous volcanic cover, the fractured granitic basement, the high temperatures in the volcanic zones and the fluid content of fractures in the geothermal zone.