that the initial P-waves interfere with the tip of the fault and their energy is scattered in the process (elastic scattering) leading to a reduction in amplitude of the wave front in the shadow of the fault tip. However, the P-waves experience wave front healing during their propagate away from the fault. The drop in amplitudes and the excitation of S-waves can be used to estimate the location of the fault at depth. The accuracy of the numerical modeling depends on the availability of a priori in situ information (velocity and density) from borehole experiments in the geothermal area.

S52F MCC: Level 1 Friday 1330h

Not-So Sudden Impact: Earthquake Recurrence and Spatial Patterns Posters *(joint with T)*

Presiding: **J E Ebel,** Weston Observatory**; G A Abers,** Boston University

S52F-0172 1330h POSTER

Seismicity at Jalisco-Nayarit Border, Mexico

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Since 2002 a regional seismic network from Jalisco Civil Defense and University of Guadalalajara is monitoring seismicity at the northwest border of Jalisco block. With the installation of a seismic station on Ceboruco Volcano, by Nayarit Civil Defense, coverage of the network extends to east. Ceboruco Volcano is located on the Tepic-Zacoalco graben, the east border of Jalisco block, this allow us to begin to monitoring this area. The zone of Bahia de Banderas, between the north coast of Jalisco and south coast of Nayarit, probably on a tectonic triple point, is a region of high seismic potential. Activ tectonic structures and clusters in the zone of El Tuito and the Dam Cajon de Peñas have been identified. The seismicity in the north area of the bay is low, meanwhile in the south, where the bay is deeper, the seismicity level is higher with an East-West tendency. At the east, the Amatlan de Cañas-Ameca zone presents continue activity, here have been possible to locate events with local magnitude between 2 and 4. Tectonovolcanic events registred at Ceboruco station presents waveform with scattering. The seismic distribution of the coast of Jalisco shows parallel alignments to the trench throughout al the coast. Other perpendicular alignments to the coastline show active morphologic structures within the Jalisco block related to the subduction of the Rivera plate under the Jalisco block.

S52F-0173 1330h POSTER

Relocation of Some Large far Offshore Earthquakes of Taiwan and its Aftershocks Using the Beam-Forming Method

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The Taiwan orogeny is a result of the collision of the Philippine Sea Plate and the Eurasian Plate, and therefore there is high seismicity in onshore-offshore Taiwan. The location of the earthquake inside the seismic is well resolved, however the location of the offshore earthquake far from the seismic network would be some uncertain because of its small observational aperture of seismic network. In this study the beamforming method (Capon, 1973) is used to relocate the epicenters of some large events to determine its high resolution of source parameters and to discuss its tectonic implications. We will determine three large earthquake sequences far from Taiwan offshore. One is the 16 September 1994 earthquake occurred in the Taiwan Strait where is situated west on the Taiwan island with a low seismicity. This event is the largest event in this area in modern history. Another eastern Taiwan offshore earthquake occurred on 3 May 1998 with a magnitude of 7.5 and located in the Philippine Sea Plate, only a few small shallow events occurred. The other offshore earthquake occurred on 31 March 2002 with a magnitude of 7.0 and induced large seismic amplification in Taipei basin but not in Hualien area. Accurate locations of the main shocks and their aftershocks would help us to understand its source properties. Based on results of this study and other information, we will discuss the stress conditions of source areas and its tectonic implications.

S52F-0174 1330h POSTER

Local Seismicity at the Cocos Ridge - Osa Peninsula Subduction Zone, Costa Rica

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A local seismological network was operated from May, 1998 to November, 2001 to monitor the seismic activity in southern Costa Rica, where the Cocos Ridge is currently being subducted under the Panama block at the terminus of the Middle America Trench (MAT), leading to a rapid uplift of the Osa Peninsula. Although previous works assumed a shallow subduction angle (20-30°) or no evidences for subduction, the new seismological data show for the first time a well-defined, thick steepslab (50-55° at depths > 40 km), reaching depths up to 67 km, 60-75 km landwards from the trench. With this configuration, the subducting ridge could not be projected underneath the Caribbean coast, thus it is difficult to explain the uplift of the Cordillera de Talamanca with current models. Besides, the Talamanca adakites, located betweeen 80 to 110 km over the down-dip aseismic projection of the subducted slab, could not be produced by flat subduction, as previously suggested. A better constraining of the Cocos Ridge arrival time (models varying from 0.5 to 8 m.y.) is crucial to associate the observed geological features with the slab-window, crustal thickening by shortening due to the collision of the Panama block, or other models. The present work discuss these models in the framework of new seismological and geological data. Anomalously deep intracrustal seismicity (up to 40 km) in the Panama block was detected below the thrust belt of Fila Costeña and the piedmont of the Cordillera de Talamanca. It could indicate an anomalously cold crust with no astenospheric wedge underneath, and perhaps continuous crustal shortening. N-S dextral strike-slip faults and NW-SE thrust faults and related seismicity result from the complex stress pattern generated by the indentation effect of the Cocos Ridge in an oblique subduction, together with the Panama block movement. At least 4 strong destructive subduction-related earthquakes (M>7) in the last two centuries, and two more in the last century related to the Panama Fracture Zone, together with several seismic sequences, represent the potential seismic hazard of the region.

S52F-0175 1330h POSTER

Relationship Between Quasi-static Slips and Rupture of Asperities in the Northeastern Japan Subduction Zone: Insights From Small Repeating Earthquake Data Analyses

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We have examined relationships between quasi-static slips and rupture of asperities on the plate boundary off Sanriku in the northeastern Japan subduction zone. We assumed that cumulative slips for small repeating earthquakes expressed the quasi-static slip histories on the plate boundaries surrounding them (Igarashi et al., 2003; Uchida et al., 2003) and compared them with occurrence times of larger events. We found that repeating earthquakes near the epicenters of 1989 (M7.1), 1992 (M6.9) and 1994 (M7.6) events had been activated since 6 days, 2 days, and 8 months before the respective events. These results indicate that the areas near the hypocenters of those earthquakes had already slipped quasi-statically before the main shocks. The stresses on the asperities for the main shocks concentrated by the quasi-static slips are probably responsible to the rupture of the asperities. We also found prominent repeating earthquake activities during earthquake swarms including the 1989 and 1992 events and aftershock activities of the interplate events with M>=6. Moreover, the quasi-static slip accelerations migrated during the 1989 and 1992 earthquake swarms and after the 1994 event. These results show that the quasi-static slips play an important role for the generation of earthquake swarms and the expansion of aftershock area off Sanriku. After the 1992 earthquake swarm, the quasi-static slip acceleration further migrated toward west to reach the asperity of the M4.8 characteristic earthquake sequence off Kamaishi (Matsuzawa et al., 2002) about 2 years later. After the arrival of the acceleration, the next characteristic earthquake occurred in 1995. The recurrence interval before the last event in this case is the shortest among the 8 recurrence intervals ever known. Thus, the 1995 event was probably advanced by the quasi-static slip acceleration. These observations obtained in this study indicate that the quasi-static slips affect the occurrences of larger interplate events as well as the small repeating earthquakes.

S52F-0176 1330h POSTER

Initiation Process of Moderate Earthquakes in the Northern Miyagi, Japan, Earthquake Sequence.

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Scaling relationships between the durations of the beginning portion of P-waves and final sizes of earthquakes have been reported by several studies (e.g. Iio [1992]). These studies mainly targeted microearthquakes and moderate to large earthquakes have been analyzed in only few studies. We tried to determine whether such scaling relationships hold for larger events, because it especially important for understanding the initiation processes of large earthquakes. We analyzed several moderate (magnitude up to 5) earthquakes and two large (magnitude 6 to 7) earthquakes and concluded that there may be a scaling relationship for small to moderate events but the scaling probably does not hold for the larger events. An earthquake sequence including several moderate earthquakes (magnitude up to 6.2) began on July 26, 2003 (JST) in the Northern Miyagi region, Japan. To study characteristics of initial phases of the moderate earthquakes, we analyze 4 < M < 6.2 events in the sequence. In this study, we employ the method which we used in the past study, a source model of Sato and Kanamori [1999]. The initial rupture of an earthquake is described with two parameters in this model: trigger factor and initial crack size. The trigger factor represents the contrast of surface energy on the edge of a crack and off of the crack. A large value for the trigger factor means that very high surface energy exists only on the edge and smaller surface energy off of the edge and rupture propagates spontaneously. A smaller value means that similar values of surface energy exists on and off of the edge and rupture propagates gradually depending on the initial crack size. We can use clearly recorded data from several near source borehole stations which are operated by Hi-net, NIED. We analyze 11 events with magnitude between 4.0 and 6.2. Hypocenter locations determined by the Japan Meteorological Agency and focal mechanisms determined by F-net, NIED are used. For these events, we obtain the results that all events can be explained by a small trigger factor and their initial crack sizes are between 15 and 50m. We can see a scaling relationship that the largest event (M6.2) has the largest initial crack size. However, we can also see that similarly sized events began from various initial cracks.

URL: http://www.rcep.dpri.kyoto-u.ac.jp/~sato/

S

S52F-0177 1330h POSTER

Quantitative Evaluation of Inland Seismic Activity in Japan using GIS -Part 2-

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It is important for earthquake evaluations to quantitatively estimate the seismic activity; however, this evaluation has been seldom performed, and usually only subjective evaluations are done. On the other hand, the assessment of earthquake activity on active faults is a general public requirement today. We proposed a GIS (Geographic Information System) - method to quantitatively evaluate seismic activity (Nishida et al, 1999). And use it to evaluate the activity of inland active faults in Japan. In this investigation, we tried to evaluate the activity of the 98 major active faults listed by The Headquarters for Earthquake Research Promotion using the catalog of shallow inland earthquakes compiled by JMA from Oct. 1997 to May 2002. This method uses GIS to create buffered zones around the fault traces. A buffered zone is a region within a distance between Ri and Ri+1 from the fault. Then, the earthquakes included in each buffered zone can be tabulated. The seismic activity of the zone is expressed by using three parameters, namely, number of events, accumulated fault surfaces and released energy. Dividing total amount of these quantities by the area of the corresponding zone, the density of seismic activity can be obtained for each buffered zone. Considering the relation between the seismic activity densities and the distance from the fault trace, an effective distance can be estimated, in which the seismic activity is influenced by the existence of the fault. By adopting this definition of the effective distance, we can examine the seismic activity of each fault. For some faults, the seismic activity decreases in proportion to distance from the fault, but not for others. The inland seismic activity of southwest Japan is generally higher than that of northeast Japan. There may be two reasons. First, the main pattern of fault movement in Northeast Japan is dip-slip, and that in Southwest Japan is strike slip. Dip slip faults need more tectonic energy to move than strike slip ones. Second, there may be a difference of coupling factors. In order to remove the influence of the dip of a fault, the angle of inclination of a fault was assumed, along with the position in depth, and a position compensation for the fault was performed. Consequently, in many dip slip type faults, the effective distance of the activity, turns out to be the peak of the activity density that exists near a fault. The relation of the activity and the time from the last large (M is greater than 6.5) earthquake is also considered. Although a large amount of time may have passed since the latest large earthquake, the activity of some faults is very high. This may indicate a pre-seismic stage after a time of low seismic activity. From our results, it is thought that seismic activity characteristic to a fault can be extracted by using this technique.

URL: http://www.rcep.dpri.kyoto-u.ac.jp/~itaba

S52F-0178 1330h POSTER

A Hidden Markov Approach to Modeling Interevent Earthquake Times

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A hidden Markov process, in which the interevent time distribution is a mixture of exponential distributions with different rates, is explored as a model for seismicity that does not follow a Poisson process. In a general hidden Markov model, one assumes that a system can be in any of a finite number k of states and there is a random variable of interest whose distribution depends on the state in which the system resides. The system moves probabilistically among the states according to a Markov chain; that is, given the history of visited states up to the present, the conditional probability that the next state is a specified one depends only on the present state. Thus the transition probabilities are specified by a k by k stochastic matrix. Furthermore, it is assumed that the actual states are unobserved (hidden) and that only the values of the random variable are seen. From these values, one wishes to estimate the sequence of states, the transition probability matrix, and any parameters used in the state-specific distributions. The hidden Markov process was applied to a data set of 110 interevent times for earthquakes in New England from 1975 to 2000. Using the Baum-Welch method (Baum et al., Ann. Math. Statist. 41, 164-171), we estimate the transition probabilities, find the most likely sequence of states, and estimate the k means of the exponential distributions. Using k=2 states, we found the data were fit well by a mixture of two exponential distributions, with means of approximately 5 days and 95 days. The steady state model indicates that after approximately one fourth of the earthquakes, the waiting time until the next event had the first exponential distribution and three fourths of the time it had the second. Three and four state models were also fit to the data; the data were inconsistent with a three state model but were well fit by a four state model.

S52F-0179 1330h POSTER

Spatial Variation of Short-Term M4+ Earthquake Clusters in Southern California

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The M4+ seismicity in Southern California from 1932 to 2000 (declustered of foreshocks and aftershocks) is temporally clustered over time periods of a few days at a rate that is greater than expected from a Poisson process. An analysis of this same data set was carried out to search for those areas where M4+ earthquakes are most often followed by another M4+ earthquake in Southern California, as well as those areas where M4+ earthquakes most often take place within 5 days after another M4+ earthquake somewhere in Southern California. Places where M4+ earthquakes are most often followed by another M4+ earthquake somewhere in Southern California include: the northern San Jacinto fault, the vicinity of the Newport-Inglewood fault, the Landers area, the area of the 1952 Kern County earthquake, the Bishop area, and the central San Andreas Fault. All of these areas experienced strong earthquakes during the twentieth century. Those areas where M4+ earthquake most frequently follow within 5 days of another M4+ earthquake in Southern California include the central San Jacinto fault, the San Gabriel Mountains, the Santa Barbara area, and the Lake Isabella area. It is noteworthy that M4+ earthquakes in the transverse ranges of Southern California are seldom followed within 5 days by another M4+ earthquake in Southern California, but this east-west trending compressional zone is more likely to experience an M4+ earthquake within 5 days after another M4+ event in Southern California.

S52F-0180 1330h POSTER

Estimation of Parameters for a Recurrence Model of Small Earthquakes in Taiwan

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Taiwan, which is located on the border between the Philippine Sea tectonic plate and the Eurasian tectonic plate, has a very high level of seismic activity. For this reason, sufficient data is available for a detailed investigation of earthquake frequency-magnitude recurrence relations. The standard recurrence model is the well-known Gutenberg-Richter model (G-R model, log N=a - b M, where N: number of earthquakes, M: magnitude, a: intercept, b: slope). In this study we adopt a new recurrence model for small earthquakes in Taiwan and compare this model with the predictions of the G-R model. We used the catalog of the Taiwan Central Weather Bureau and chose earthquakes from the period 1973 to 2001 with local magnitudes of 3.0<=ML<4.0. A regression analysis of these data shows that the so-called Gamma model has the best fit to the observed cumulative probability-interval time curve for these small earthquakes. The Gamma model is described by two parameters: c and r, where c is the scaling parameter and r is the shape parameter. In this application, the parameter c represents the number of earthquakes while the shape parameter, r, describes the temporal pattern of the earthquakes. If r < 1, the earthquakes are clustered in time. Considering the seismicity of all of Taiwan, the c value of the Gamma model is very similar to the value of the G-R model. The r value is less than 1, indicating some clustering. Considering only central Taiwan, the r value is quite low due to the temporal clustering of aftershocks of the Chi-Chi earthquake. We have also compared the two recurrence models specifically for the aftershock zone of the 1999 M=7.6 Chi-Chi earthquake. We have estimated the c and r values of the Gamma model and the a and b values of the G-R model in three year time windows from 1973 to 1999. We find that the c, a and b values all show a pattern of low-high-low with a period of nine years, whereas the r value increases in the last nine years prior to the Chi-Chi earthquake. By the value and definition of these parameters, we find that the aftershock zone of the Chi-Chi earthquake was seismically quiet in the nine years prior to the Chi-Chi earthquake. The parameters c, r, a and b show systematic variations.

S52F-0181 1330h POSTER

Induced Seismicity And Earthquake Hazard Mitigation By Electromagnetic Impact of MHD Generator

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Some field and laboratory data reveal possibility of significant coupling of elastic and electromagnetic (EM) fields. Laboratory experiments related to the electromagnetic initiation of mechanical instability (slip) and EM and mechanical control of slip process are presented. For initiation of slip series of strong EM pulses were applied to the mechanical system driven close to the critical state, namely, to the (dry) rock samples (basalt), placed on the inclined supporting sample at the slope angle less than, but close to the critical slip angle. It has been found that when the EM field is parallel to the slip plane the EM impact initiates the slip with the probability P<0.07 at the voltage ΔV=1300V and with the probability P<0.2 at ΔV=10kV. On the other hand, if the EM field is normal to the slip surface, application of EM pulse hampers the slip. We also try to prove experimentally the possibility of controlling slip regime by relatively weak periodic mechanical or EM impact, in the way it is done in the nonlinear dynamics experiments on controlling chaos. Weak periodic mechanical or electrical perturbations were superimposed on the system in order to find the conditions that allow the control of slip. Quite different regimes of slip were excited depending on the amplitude and the frequency of applied weak perturbations. The observed regimes of slip vary from the perfect synchronization of slip events, recorded as acoustic emission bursts with the perturbing periodic mechanical or EM impact to their complete desynchronization. We consider the obtained results as evidence that it is possible to control slip by the application of weak periodical perturbations. The phenomenon can be explained in terms of the nonlinear dynamics and synchronization theory. Nonlinear analysis of waiting time series shows that fractal dimension and b-value increase with intensity of applied electrical field. We conclude that our laboratory experiments give a sound principal basis for the interpretation of the field data on the control of seismic regime by relatively weak natural or artificial perturbations; of course, in the earth crust the detailed physical mechanisms of coupling between tectonic forces and superimposed perturbations may be different.

S52F-0182 1330h POSTER

Earthquakes in Continental Interiors: A Review of Possible Causes

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Plate boundaries often coincide with the densely-populated margins of continents, and relatively large earthquakes occur at these boundaries. Much attention has been paid to seismic hazard assessment and earthquake preparedness in continental areas located along or near these boundaries. In contrast, a relatively small number of earthquakes, accounting for approximately 0.5% of the total global moment release (Johnston and Kanter, 1990), are not directly related to plate boundaries and are therefore termed intraplate earthquakes (Fig. 1). Though limited in number, their consequences can be disastrous, as is illustrated by a very recent example, the Mw = 7.7 earthquake of 26 January 2001 in Bhuj, India. As a result of this earthquake at least 20,000 lives were lost, more than 200,000 people were injured and nearly 400,000 houses destroyed (Rajendran et al. 2001). Whereas plate boundary earthquakes are well understood, the mechanisms that cause intraplate earthquakes are subject to considerable debate. In this paper we discuss some common features of intraplate earthquakes, and summarize hypotheses for the mechanisms that trigger these events. We conclude by describing new global datasets that may hold the key to understanding intraplate seismicity, and introduce some new research directions that we feel may be productive.

S52F-0183 1330h POSTER

Localized Weak Zones and Their Role in the Generation of Intraplate Seismic Zones: Effects of Weak Zone Geometry and Rheology

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It has been proposed that earthquake generation within intraplate seismic zones (e.g. the New Madrid Seismic Zone, NMSZ, in the south-central United States) may result from the transient relaxation of a lower crustal weak zone. As the weak zone relaxes, stress is transferred to the overlying seismogenic crust, potentially leading to a geologically short-lived burst of seismicity lasting 10,000's of years. The duration and number of earthquakes in this seismic sequence is dependent on weak zone geometry and rheology. Using finite element techniques which employ contact surfaces to model discrete faulting events, we investigate the relevant model parameter space as it effects the concentration of stress at the base of seismogenic fault. Faulting is modeled using discrete contact surfaces and failure is governed by a maximum shear stress criteria evaluated at each node on the fault surface. Investigated model parameters include weak zone geometry, weak zone rheology (Maxwell and Standard Linear Solid, SLS), earthquake stress drop, background tectonic stress, and maximum shear stress at failure. Of particular interest is the effect of model geometry and rheology. Wider weak zones transfer stress to areas potentially remote from fault leading to initially slower slip-rates. After complete relaxation, however, the cumulative moment is greater then for the narrow weak zone case. Prior models have considered only a Maxwell viscoelastic weak zone, which has no long-term elastic strength. This may not be a realistic intraplate material behavior. Thus, this study also considers a SLS weak zone which has a long-term elastic strength. This may be more realistic, though the long term elastic strength becomes an additional parameter which must be defined. Although the amount of stress available for transfer to the seismogenic zone is potentially decreased when a SLS is used, for certain parameters, 2-4 earthquakes still occur during the relaxation process. A number of different effective rheologies and geometries are considered and results have been compared to geologic observations in the NMSZ.

S52F-0184 1330h POSTER

Evaluation Of Seismic Gap To Candidate Regions For Coming Significant Earthquakes In Iran

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All historical background and instrumentally recorded earthquakes in present century indicates that Iranian Plateau is seismically active. However, the rate of activity is not uniformly distributed and changes from one place to another. For example, in Zagros structure zone, the seismic activity is high and relatively uniform, characterized by moderate earthquakes. On the other hand in Alborz mountain region the seismic activity does not indicate a regular pattern and the accumulated seismic energy is being released by relatively large and intensive earthquakes. In eastern Iran similar to Alborz, shows an irregular seismic activity pattern and several destructive earthquakes were recorded during this century. In this study taking into account both historical and present century recorded earthquakes data; we investigated the areas that show a kind of quiescent period which will increase the possibility of an occurring earthquake in these regions. This phenomenon if it is proved could be considered as a precursory and can be used as long-term prediction for the purpose of mitigation of disaster and saving human lives.

S52F-0185 1330h POSTER

Swarm Activity of Low Frequency Earthquakes beneath Ashio Region, Central Japan

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It is well known that the depths of almost all inland earthquakes are shallower than 15 km, and this cut-off depth can be interpreted as a brittle-ductile transition zone. However, a few earthquakes with depths ranging 20 km to 40 km have been observed. These anomalously deep events have lower dominant frequencies for both P and S waves than the corner frequencies expected from those magnitudes which based on ordinary earthquake source spectrum model. These events are termed Deep Low-Frequency earthquakes (DLF). Recently, a high sensitivity seismograph network (Hi-net) is installed by National Research Institute for Earth Science and Disaster Prevention (NIED), and we can obtain high-density high-gain seismic data in Japan. On 2002 March 11, we recognized swarm activity of DLF in Ashio region, central Japan. More than 140 DLF events were observed within only 4 hours. The first time we locate the hypocenters, it seemed that the hypocenters migrated westward about 2 km during this activity. This is very fast migration compared with previous study which reported that DLF hypocenters migrated toward west about 2 km during half a year. Then we obtain high resolution relative hypocenters of similar earthquakes (22 events) by cross spectral analysis method and double-difference earthquake location algorithm. Relocated DLF hypocenters didn't show remarkable migration. The distribution of DLF hypocenters like a vertical disk (with radius 700 m and thickness 200 m and the strike EW) which suggest some structure of lower crust. We analyzed some DLF events to get focal mechanisms by using a waveform inversion method. The result is that some of DLF focal mechanisms have almost the same P-axis directed west-southwest.

S52G MCC: 3009 Friday 1340h

African Superswell Province: From Core to Crust III *(joint with T, V)*

Presiding: **G R Keller,** University of Texas at El Paso**; P Maguire,** University of Leicester

S52G-01 1340h

Deep Upwelling Beneath the Northeastern Afro-Arabian Continent?

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A large low shear-wave velocity anomaly is observed at upper-mantle depths beneath the northeastern Afro-Arabian continent, from the Turkana depression, South-West of Ethiopia, to the Red sea and South of Arabia. The question of connection between this anomaly and a source of material rising from the lower mantle is of major concern for understanding how a plume associated with the African superswell could interact with the upper mantle structure in the region. Thanks to the deployment of five broadband stations in Ethiopia and Yemen (INSU-RLBM), complementing several sets of broad-band stations in Arabia, Ethiopia and Djibouti (IRIS, Geoscope, PASSCAL) we address this question by using two broadband seismological tools: 1) higher-mode surface wave tomography and 2) receiver function technique. Higher-mode surface waves tomography shows a clear low shear-wave velocity anomaly down to 400 km depth beneath the Ethiopian plateau and the Afar depression. In a paper by Debayle et al. (2001), no continuity of this anomaly with a deeper low-velocity anomaly is observed beneath Ethiopia. Instead, a deeper low-velocity anomaly (down to 500-600 km depth) was observed farther north beneath the Red Sea and South of Arabia, suggesting a possible link with lower mantle material rising there. Applying a SVD receiver function technique to a set of broad-band records from Arabia to Ethiopia, including Yemen, we discuss the above suggestion by looking at the seismic discontinuities of the upper-mantle transition zone.

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Plume, Lithospheric Interaction and Small-scale Convection Beneath Africa from Anisotropic Tomography and Geochemical Data

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A high resolution three-dimensional tomographic model beneath Africa has been derived by using seismic data provided by the French seismic experiment named "Horn of Africa" complemented by permanent (GEOSCOPE and IRIS networks) and temporary experiments in this region. By simultaneously inverting for seismic velocity and anisotropy of the upper 400km of the mantle, two kinds of mantle plumes are revealed. The first one, the Afar plume is coming from deeper than 400km (at least from the transition zone), and the second kind of plume is the consequence of the complex interaction between the asthenospheric mantle flow, the plume head and the lithosphere. If anisotropy direction is considered as a good marker of convective flow in the upper mantle, the flow in the asthenosphere (100-300km) is to first order, close to the almost South-North plate motion of the African plate except around the Afar hotspot where it is diverted and gives rise to secondary convection in the East-west direction with a wavelength around 1000-1500km. This small-scale convection can explain the existence of the Darfur, Tibesti, Hoggar and Cameroon hotspots and their geochemical signature different from the Afar hotspot. The origin of this second kind of hotspot is then confined to the asthenospheric upper mantle in the space left between african cratons.

S52G-03 1415h

Geochemical Overview of the East African Rift System

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Mafic volcanics of the East African Rift System (EARS) record a protracted history of continental extension that is linked to mantle plume activity. The modern EARS traverses two post-Miocene topographic domes separated by a region of polyphase extension in northern Kenya and southern Ethiopia. Basaltic magmatism commenced $\sim$45 Ma in this highly extended region, while the onset of plume-related activity took place $\sim$30 Ma with eruption of flood basalts in central Ethiopia. A spatial and temporal synthesis of EARS volcanic geochemistry shows progressive lithospheric removal (by erosion and melting) as the degree of rifting increases, with basalts in the most highly extended areas recording melting of depleted asthenosphere. Plume contributions are indicated locally in the northern half of the EARS, but are absent from the southern half. The geochemical signatures are compatible with a physical model in which the entire EARS is fed by a discontinuous plume emanating from the core-mantle boundary as the South African Superswell. Quaternary basaltic lavas erupted in the Afar triangle,