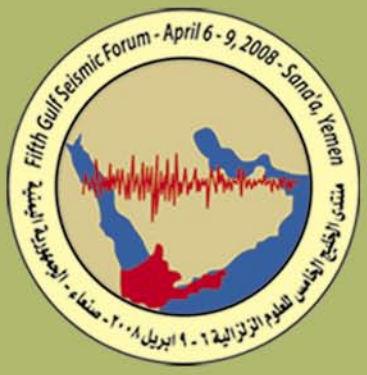

Fifth Gulf Seismic Forum

Sana'a, April 6 - 9, 2008

ABSTRACT

Prefix

Following the successful organization of the previous Gulf Seismic Forums in Al-Sharja (UAE) in 2004, Al-Ain (UAE) in 2005, Muscat (Oman) in 2006 and Kuwait in 2007; the Fifth Gulf Seismic Forum (GSF-5) is now organized in Sana'a, Yemen by the Seismological Observatory Centre (SOC) of the Geological Survey & Mineral Resources Board at the Ministry of Oil and Minerals during the Period 69- April 2008 at the Sheraton hotel.

The main objectives behind having GSF-5 in Yemen are the strengthening of the scientific and technical links between SOC and the other scientific institutes and research centers in the Gulf Cooperation Council (GCC); contribute to the GCC activities in seismology, earthquake engineering, and crustal studies in the Arabian Peninsula and the horn of Africa; and finally encourage and support scientific research and data exchange in the tectonically important regions between the Taurus mountains and the Zagros main thrust in NE Arabia; the sea spreading in the Gulf of Aden and the Red Sea associated with volcanic activity as recent as the one in Jabal Al-Tair island.

Accordingly, any regional or international cooperation along the topics of this forum will be an important foundation block in any future seismological research and mutual cooperation towards minimizing potential earthquake and volcanic risks in the region.

Table of Content

Seismic Monitoring for Indian Ocean Tsunami Warning

Hoffman, T. L. *, Hanka, W*.

**GFZ- Potsdam*

After the Mw =9.3 Sumatra earthquake of December 26, 2004, which generated a tsunami that effected the entire Indian Ocean region and caused approximately 230,000 fatalities, the German government funded the so-called German Indian Ocean Tsunami Early Warning System (GITEWS) Project. The GEOFON group of GFZ Potsdam was selected to develop and implement its seismological component. In this presentation we describe the concept of the Earthquake Monitoring System and report on its present status. The major challenge for a Earthquake Monitoring System (EMS) within a tsunami warning system is to deliver information about location, size, source parameters and possibly rupture process as early as possible before the potential tsunami hits the neighboring coastal areas. Tsunamogenic earthquakes are expected to occur in subduction zones close to coast lines. This is particularly true for the Sunda trench off-shore Indonesia, but also in the Macran subduction zone off-shore Iran. Key for an Indian Ocean monitoring system with short warning times is therefore a dense real-time seismic network in Indonesia, supplemented by a substantial number of stations in other countries and territories within and around the Indian Ocean. Up to 40 new broadband and strong motion stations will be installed until 2010 with real-time data collection using a private VSAT communication system. Among these there will be 23- stations in Yemen and Socotra. The GITEWS EMS Control Center in Jakarta will be based on an enhanced version of the widely used SeisComP software and the GEOFON earthquake information system prototype presently operated at the GFZ-Potsdam (http://geofon.gfz-potsdam.de/db/eqinfo.php). However, the Control Center software under development (SeisComP3) will be more reliable, faster and automatic but with operator supervison. It will use sophisticated visualization tools, offer the possibility for manual correction and re-calculation, flexible configuration and support for distributed processing. Its large redundancy for algorithms, modules and hardware assures easy integration into larger multi-sensor, multi-hazard control centers and decision support systems. A first prototype of the EMS Control Center software is already operational.

Yemen-GFZ Real Time BB Seismic Stations Project

Sholan,J. M.
Hakim, A.

After Sumatra destructive earthquake of December 2004 which generated a massive tsunami waves that traveled toward the coastal areas encircling the Indian Ocean a large project dealing with early warning system for the Indian Ocean was established. The Yemen-GFZ real time broad band stations project is the Yemen-German contribution to the tsunami early warning system for the Indian Ocean.

This report details the site selection, instrumentation, layout, and installation, which will be performed by researchers from Seismological Observatory Center and GFZ. This permanent instrumentation will enhance the long term real-time view of the seismic activity in the Indian Ocean, Arabian Sea, Gulf of Aden and western Arabian peninsula, through real time data that will be transmitted from field stations via satellite technology to the seismological Observatory Center in Dhamar, real time data will be transferred to GFZ (GITEWS project) simultaneously through point to point VSAT link.

Seismic Characteristics of Southern Red Sea and Arabian Shield Region

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Historical and instrumental seismicity in the southern Red Sea region for the period 1913 - 2007 has been examined in relation to tectonics and structures indicated by geologic and geophysical data. Majority of seismic activities is clustered on or near the transform faults of the deep axial trough in the southern Red Sea. The seismically active area between latitude 16.3°N and 17.4° N. is believed to extend northeastwards to the Arabian Shield. The apparent low level of seismicity in the shield area might be due to the lack of detection of small events. The frequency-magnitude analysis indicates that events above body-wave magnitude 4.2 are reliably determined in the southern Red Sea region. The b values correlate well with the tectonic environment and seem to increase gradually southwards with the opening of the Red Sea where it has 0.57 for the middle Red Sea and attains 1.06 for the southern Arabian Shield. This may reflects the heterogeneity of the crust and regional stress field.

Based on the geotectonic and seismic considerations, four seismic sources were delineated. For each individual seismic source, recurrence relationship regression constants and maxi¬mum expected magnitudes are provided. Poisson stochastic model and an appropriate attenuation relationship are involved. The results of analysis are presented in the form of Iso-acceleration maps for the return period of 475 years. PGA values on the bedrock and ground surface for southern Red Sea source are 41.1 cm/sec2 and 72.15 cm/sec2 respectively. The response spectra were calculated for different rock units at selected sites for 1%, 3%, 5% and 10% from the critical damping.

Generally, this study indicates that relative level of ground motion in southern Red Sea is found to be mod¬erate and subjected to more severe seismic hazard compared with the Arabian Shield. This study supports the mechanism of sea-floor spreading and believes that the seismic activity in the shield area and the southern Red Sea may be attributed to stresses resulting from subsurface magmatic activity and the spreading centers, respectively.

Structure and Propagation of the Western Gulf of Aden

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Seismic profiles obtained during the TADJOURADEN cruise (1995) in the western Gulf of Aden were analysed and combined with multibeam bathymetry and magnetic anomalies, in order to evidence some geometrical and kinematic features related to the propagation of the Aden rift toward Afar. Typical oceanic crust occurs east of the Shukra El-Shiek discontinuity but is absent further west. The transition with stretched continental crust is marked by a V-shaped propagation rift. An aborted rift lies further west. It has jumped southward before continuing toward Afar. The main observation is the decrease by a factor of 10 of the propagation velocity when the oceanic rift reaches the area under the influence of the Afar hot spot. This decrease is probably related to the rheological changes induced by the hot spot.

Engineering characteristics of earthquakes recorded in Dubai.

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We present an analysis of seismic data recorded by the four broadband stations in Dubai from earthquakes with magnitudes four and above. The objective in the analysis is to determine the engineering characteristics of shaking that is important for seismic design and safety evaluation of structures.

After processing the records, we calculate the peak and RMS (root-mean-square) values of accelerations and velocities, response spectra, and Arias and spectral intensities. We also determine the site amplification characteristics at the stations by using the records and the borehole logs available from nearby locations. The spectral and temporal characteristics of long period components in the records are investigated in more detail because of their significance for tall and slender buildings, whose number is increasing continuously in Dubai.

We present the predictions of shaking in Dubai for larger earthquakes by extrapolating the recorded motions and utilizing the physical (i.e., seismological) models of earthquakes. The results are evaluated in view of the current seismic provisions and the building inventory in

Ground Motion Modeling of the 13 December 1982 Dhamar Earthquake

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The Dhamar earthquake of 13 December 1982 affected a large area of northern Yemen and caused great damage and loss of life. Modified Mercalli intensities of VIII were reported over a wide area north of Dhamar (Arya et al., 1985; Plafker et al., 1987). While the magnitude of this event was not particularly large (MW = 6.28), the extensive damage and surface effects for this event can be attributed to the shallow focal depth of 7.0 km (Choy and Kind, 1987). Indeed the shallow depth of the rupture was confirmed by aftershock locations (Langer et al., 1987). Analysis of broadband teleseismic P waveforms indicates that the rupture was complex with two sub-events occurring on roughly parallel fault planes, with hypocenters separated by 7.5 km and offset in time by 3.0 seconds (Choy and Kind, 1987). In this study we will attempt to reproduce the observed ground motion intensities of the Dhamar earthquake with three-dimensional finite difference modeling. The reported source parameters will be used in a simple average plane-layered model of the region.

Deviation of the Traditional Yemeni Buildings from the Common Earthquake Engineering Concepts

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Looking at the various buildings in different parts of Yemen, we can identify about five main types of engineering structures, such as reinforce concrete frame, steel frame, stone masonry structure, Adobe structure, and block masonry. It is generally accepted that these differences are due to the variation of topography ,type of material and construction methods throughout Yemen. Each of these five types can be divided to several subtypes according to foundation, infill materials ,partitions and slabs.

Most of the traditional Yemeni structures were not built to resist the horizontal earthquake force and hence deviate of the fundamental earthquake engineering concepts. In this paper, we will present the possible outcome of applying some of the earthquake engineering concepts (such as the weight of structure, short column, partitions, infill material, shape of structure, ….etc) to the designs of these structures.

This paper aimed to clarify the importance of building structure that follows the fundamentals of earthquake engineering concepts, especially when building in the seismically active zones.

In a step forward, this paper will emphasize the importance of instrumenting historical buildings, ancient structures monuments and selected critical facilities in various parts of Yemen to monitor the structural response to earthquake forces generated by local and near field regional earthquakes.

The outcome of such an effective instrumental monitoring throughout Yemen will provide the most important required data towards the establishment of a proper Seismic Design Code for Yemen.

HISTORICAL SEISMICITY OF YEMEN The Seismo-Volcano-Tectonic Implications

Alsinawi, Sahil A. * & Al Aydrus, Ahmad **

Yemen has been affected from time to time by earthquakes along the Red Sea and its coastal tract, as well as inland. However, systematic historical records of these events are not readily available. The oldest available information of destruction in Yemen resulting from an earthquake is the destruction of the Sabeam Dam of M'arib.

An attempt was made to compile a catalogue of historical earthquakes of Yemen, This catalogue was compiled from various available sources. The historical Seismicity data for the period 1600 BC to 1900 AD was compiled and 360 events were located.. A historical Seismicity map of Yemen based on the historical catalogue was constructed. Those events are distributed among five intensity zones VI-X and correlate well with recent Seismicity

This paper will discuss and correlate the historical and recent seismicity of Yemen with emphasis on the tectono-volcanic implication.

Ambrasyes and Melville (1983) have outlined a generally continuous record of moderate- sized earthquakes that occurred in Yemen over the past 12 centuries. The Dhamar earthquake occurred in an area of active extensional tectonism characterized by horst and graben structure and Holocene basaltic volcanism, Geukens, (1963) and Thenhaus et al., (1989).

The Yemen Plateau Seismogenic Subzone with its NW-SE trending tectonic lineaments between the Ma'rib-Jawf Graben and the Tihama Escarpment. In this zone Seismicity is related to basement tectonics in the northwestern parts; and to volcanicity in Sana'a - Dhamar Basins. Hot springs and volcanic necks are seen to be geographically related to the epicentral positions and major tectonic lineaments. This zone is by far the highest seismic risk zone in the country. The microearhquake swarms in Al-Udayn area, which is located in this zone, may manifest possible precursors for future major seimicity in this area. The far field effect of the Red Sea should not be excluded.

The Yemen region had a prolonged history of volcanic activity since the Tertiary (Yemen Volcanic Series), till the Quaternary (Quaternary Volcanics), and still at present on relatively minor scale. These volcanic rocks were associated with the rifting of the Red Sea and the Gulf of Aden that are still spreading causing accumulations of stresses on the region as a whole This occurrence suggest geothermal activity at depth and the conduction of heat to the available aquifers in the region. This suggests genetic relationship between Seismicity, tectonics, volcanicity and related hydrogeothermal manifestations. . The relatively close Jabal Al Tair volcanic eruption in October 2007 should be noted.

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GROUND MOTION OBSERVATIONS FOR SINAI PENINSULA, EGYPT

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Sinai Peninsula is surrounded by two of the major and active tectonic trends of Gulf of Aqaba-Dead Sea transform and Gulf of Suez rift where, many earthquakes have been occurred. Sinai is affected by destructive earthquakes during the last two decades; the largest instrumental earthquake was recorded on November 22nd, 1995 with moment magnitude (Mw) 7.2. These earthquakes were strongly felt and caused great damages especially for Gulf of Aqaba cities. Strong motion accelerograph instruments have been deployed all over Sinai immediately after November 1995 earthquake and recorded many earthquakes till December 2006. The observed values of Peak Ground Acceleration (PGA) have been gathered and analyzed. In addition to, the earthquake intensity maps for the destructive earthquakes have been collected and processed in an attempt to get the attenuation relationships that govern the ground motion behavior for Sinai area. It is noticed that, the tectonic regime in which earthquakes occur is a fundamental factor affecting ground motion characteristics. Accordingly, Sinai Peninsula is differentiated into active tectonic regimes including both gulfs, and stable continental region covering the central part. Hence, the ground motion attenuation relationships and regression coefficients have been estimated for both regions. The analysis of ground motion data in this area permitted a significant advance in the understanding of the source characteristics, wave propagations, attenuation relations and the local site responses. This, in turn, has permitted reliable estimations for the expected ground motion from the future earthquakes to mitigate their hazardous effects at Sinai Peninsula.

The Recent Seismic activity in the Yemen Republic

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Yemen has experienced with damaged earthquakes during the history. The first documented earthquake was the Sheba earthquake (between shabwa &Marib) in 747AD. A recent example which pay attention is the earthquake of Sadah in 1941, which occurred during the Second World War and affected many places. Recently an earthquake was struck Dhamar Governorate in the 13th of Dec.1982 with ML 6 and caused losses of life for about 2000 people were killed and another two thousand injured, while 15000 houses were completely destroyed. At that time there was not any seismological network in Yemen for earthquakes monitoring. After the installation of Seismological Networks at the end of Nov.1994, Seismological Observatory Center (SOC), became responsible for monitoring earthquake activities in Yemen . Many areas had witnessed earthquake activities after the installation of the networks like Al Udyan, Al baydah, Hajjah, Sadah, Sayoon, Dahamar, At-Turbah and others and that will be describe in this paper . Low to Moderate magnitude were recorded and some of which were felt by people and caused fears to them. Most of the recent earthquakes which were recorded by YNSN concentrated in the Gulf of Aden and the Red Sea due to the continuous seismic activity in the axial trough of both the Red Sea and Gulf of Aden.. Yearly Statistical histograms has been done for each area from (19962006-) as collected from annual bulletins and the cumulative epicentral location map shows the areas of seismic activity recorded from more than three stations.

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Evidence of partial melting beneath a continental margin: case of Dhofar, in the Northern Gulf of Aden (Sultanate of Oman)

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Seismic data from 29 temporary broad-band stations spread over the northern margin of the Gulf of Aden (Dhofar area, Oman) were jointly inverted with gravity data to analyze the lithospheric structure of the Gulf.

We use a linear relationship between density and velocity to provide coherent density and velocity models from the surface down to about 250 km depth.

Accuracy of the resulting models is investigated through a series of synthetic tests and a comparison with a S-wave tomography study. The gravity edge effect on this passive margin greatly complicates the identifcation of density anomaly with depth. The analysis of our resulting models shows distinct crustal and mantle structures: (1) crustal heterogeneities that match to the main geological features at the surface, (2) low correlation coe cients between velocity and density contrasts for layers at 20 and 50 km depth due to gravity edge e ect, and disparity in anomaly depth locations (3) the presence of two low velocity anomalies in the continuation of Socotra and Alula Fartak fracture zones between 60 km and 200 km depth, and (4) evidence for partial melting (3 to 6%) within these two negative anomalies. We discuss the presence of partial melting in terms of interaction between the Afar plume and the Sheba ridge, and the ridge segmentation. We also discuss the alternative timing of the partial melting.

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Seismicity and Focal Mechanism for Jahran Basin, Dhamar Province

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The amount of information available about local seismicity in Yemen grew exponentially following the installation of the Yemen National Seismological Network. The operation of the digital seismic station in Dhamar in 1994 gave extra information about the local seismic activity is such areas like Dawran, the epicentral region of the main shock (Ms 6) on 13 December 1982.

Because of the extensional stress regime dominating the region, seismic activity in the form of recurring low to moderate magnitude earthquakes is generally observed in the central and western parts of the basin. Similar activity has also been observed north, north-east and southeast of Dhamar. This later activity appears to define another seismotectonic feature in the region.

In the present work, this suggested seismotectonic feature was investigated through the observation, spatial distribution and analysis of local earthquake hypocenters. When comparing the available information with documented seismicity of Yemen we came to find clusters of epicentres located not far from the epicentral region of past major earthquakes.

We believe that such recent miscroearthquake activities do resemble an aftershock sequence (of course with very long time gap between successive events) in areas of reported major shocks some time in the past. The outstanding phenomenon here is the fact that such epicentres are migrating as smaller magnitude events occure in what we considered as weakness zones in the structure of the assumed seismotectonic feature.

Throughout the statistical analysis and spatial distribution mapping of these smaller events we came across a set of facts based on data related to small magnitude earthquakes that could only be detected after having the digital seismological network installed and operated.

Among the important results reached, we could clearly identify a pattern of moderate to high seismic activity in the Jahran basin. Having such clusters of earthquakes in regions that suffered significant earthquakes some time in the past can be a tell sign of an ever active structural setting in the region.

Using data collected by the local digital seismic network, we attempted to identify events that occurred within the Jahran basin or in the near surroundings. Around 80 events were identified as being in the Jahran basin. The results of composite fault plane solution of these recorded microearthquakes/aftershocks showed significant agreement with the fault plane solution of the Dhamar earthquake of 13 December 1982.

Combined Seismic and Geodetic Observations of Dike Injection in the Dabbahu Rift Segment, Afar, Ethiopia

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As rifting proceeds to continental breakup, strain localizes to discrete, narrow rift segments by a combination of diking and faulting. However, the controls on the kinematics and dynamics of rifting episodes are poorly understood. We integrate new seismic and geodetic data from the Dabbahu rift segment, Afar, to constrain the location of magma sources, and the spatial/temporal variability of diking and faulting just prior to the onset of sea-floor spreading. Since 4Ma, strain in north Afar has localized to 60-km-long rift segments that are similar in size and morphology to slow-spreading mid-ocean ridge segments. In June 2006 vigorous deformation occured near Ado'Ale volcano, in the center of the Dabbahu rift segment. InSAR shows 2.5m opening along a 10km-long zone, with no evidence of deflation of shallow chambers beneath central volcanoes. Deformation is consistent with injection of a 2m- wide dike at 110-km depth. Seismic and GPS data constrain the spatial/temporal evolution of deformation. Starting midday 17th June, ML<3 earthquakes occur at the southern end of the deforming zone. After 1hr, earthquake merge into tremor, increase in magnitude, and migrate 10km NNW over 4hrs. Earthquakes are likely caused by inflation induced tension at the tip of a laterally propagating dike. Prior to June, broad deformation is observed beneath AdoAle, consistent with inflation of a source zone 1015-km deep beneath the central portion of the rift segment. The June 2006 dike is the first of 6 major intrusions in the Dabbahu rift since September 2005, a pattern similar to the 197584- rifting event in Krafla, Iceland. Our results show that during continental rupture strain is accommodated by repeated injection of dikes and induced faulting. Magma may be sourced directly to the center of the rift segment from reservoirs in the upper mantle and/or lower crust and delivered into the upper 10km by the lateral injection of discrete dikes.

Source mechanisms and source parameters of March 10, and September 03, 2007, United Arab Emirates Earthquakes.

AlMarzooqi ,Y. , Abou Elenean, K., Megahed, A. S. , Alkhatibi, E.

On March 10, and September 13, 2007 two felt earthquakes with moment magnitudes 3.64 and 3.94 occurred in the northeastern part of United Arab Emirates (UAE). Being well recorded by the UAE and Oman digital broadband stations, they provide us an excellent opportunity to study the tectonic process and present day stress field acting on this area. In this study, we determined the focal mechanisms of the two main shocks by two methods (polarities of P and regional waveform inversion). Our results indicate a normal faulting mechanism with slight strike slip component for the two studied events along a fault plane trending NNE-SSW in consistent with the closest observed Wadi Shimal fault. The source parameters (seismic moment, moment magnitude, fault radius, stress drop and displacement across the fault) were also estimated and compared based on both the regional waveform inversion and the displacement spectra and interpreted in the context of the tectonic setting.

Source process of strong earthquakes in the Gulf of Aden from regional and teleseismic waveform inversion

Sholan, J. M.
Hakim, A.

Gulf of Aden is the most active seismogenic zone in the western Arabian peninsula region where many strong earthquakes (Mw >= 5.0) occurred during the last decade. This paper presents the evaluation of available seismic waveform data recorded at regional distances and its usefulness for derive source parameters by using waveform-inversion technique. The source process is important to estimate strong ground motion near the rupture area, to assess the seismic hazard on the coastal areas, to understand the spatial variation of aftershocks and to define the tectonic setting of the area.

The Regional Moment Tensor (RMT) technique developed by Randall et al. (1995) was applied to regional seismic waveforms of strong earthquakes that occurred in Gulf of Aden and recorded by regional Broad Band seismic stations during the last decade. The generated synthetic seismograms that best fit the recorded waveforms data using appropriate velocity model for the region where the focal depth is held fixed at 10 km were used to identify the focal mechanism and moment magnitude.

The current work involves investigation of the source processes of the same set of earthquakes by using teleseismic body wave inversion technique and a subsequent comparison of the results from the two inversion techniques.

Upper Mantle Anisotropy from Shear Wave Splitting on the Southeastern Passive Margin of Arabia, Dhofar Region, Oman

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As part of the Dhofar-Socotra Broadband Seismic Experiment, eighteen broadband stations were temporarily deployed on the southeast margin of Arabia in Dhofar region, Sultanate of Oman. The Dhofar-Socotra seismic experiment stations were deployed for the period September-2005 to August-2006 and covered an area of about 250km along and 100km across the margin. The spacing between stations is about 20 kilometers. The objective of this deployment is to map the structure and rheology of the crust and upper mantle of the young Gulf of Aden passive margins. This deployment is aimed at studying the transition zone across the passive margin.

In this study we use shear wave splitting methodology to map upper mantle lateral anisotropy variation beneath the study area. We have categorically selected events that were at epicenter distances larger than 85 degrees.

The SKS and few PKS splitting results show roughly N-S orientations for stations located on the eastern parts of the study area. This agrees with observation on stations located on the exposed Arabian shield region, in the Kingdom of Saudi Arabia. Since most of the events were coming from east, this made the analyses more difficult (i.e., only one shear-wave is excited). However, a more NW-SE orientation is consistently observed on the three most westerly stations. Generally the splitting magnitudes are small (~0.6sec).

Anisotropy variations were observed to occur along the margin (not across). Such variations require careful analysis of the pre-Tertiary rocks and basement that are masked by the Tertiary deposits.

Keywords: Arabia, SKS, Shear Wave Splitting, anisotropy, passive continental margin

Source Parameters and Fault Plane Determinations of the August 17, 2007 Southwestern Kuwait Earthquake

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On 17th August 2007 the State of Kuwait was hit by a light earthquake with local magnitude of 4.3 closer to Umm Gudair oil filed (Southwestern Kuwait). This event shook Kuwait and was felt in all regions. The local and regional velocity records of that event have been analyzed for relocation, focal mechanism and source parameters. Preliminary analysis indicates that the main shock has occurred at Latitude 28.83°N, Longitude 47.67°E and a depth of about 8 km. The event has a seismic moment of Mo = 4.43X1022 dyne.cm (Mw = 4.37). The focal mechanism is predominantly reverse fault trending nearly north-south due to an east-west horizontal compression stress. The inversion results indicate an existence of considerable percent of non double couple component which might be related to local stress perturbation due to oil extraction process. The spectral analysis of short period and broad band records was performed and it gave more information about the dynamic source parameters of that shock.

Keywords: Kuwait; Source parameters; Focal mechanism; Seismic moment.

The « Young Conjugate Margins Laboratory » project in the Gulf of Aden

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A comprehensive multi-disciplinary study of the eastern part of the Gulf of Aden has been undertaken recently in the framework of the French margins program, with the long-term objective to integrate in a consistent model of evolution field observations where the margin crops out, results of marine geophysical survey where the margins are submerged, seismological observations of deep interior structure and geodetic measurements. First results show the potentiality of such an approach in this area to understand the relationships between the dynamics of rifting and spreading, the observed structures and the vertical motions of a margin in its early stages.

Among the main results, we evidence the structural and sedimentologic characteristics of the continental and oceanic domain of the margin, especially their segmentation, related to the opening obliquity, and their consequences on the oceanic spreading, the importance of the structural inheritance at both lithospheric and crustal scale. We also describe the presence of a ocean-continent transition zone with high heat flow values, of a deep thermal anomaly (170 km) and of a sub-active volcano in the deep margin, that relaunch debate on the importance of the volcanism in the margins formation. The results also emphasize that both the area of investigation and the methods should be extended to be able to describe and understand the variability and the evolution in space and time of the studied structures, notably related to the Afar hotspot. This project intends therefore to study the Gulf of Aden as a natural laboratory for the study of rifting and oceanic spreading onset processes.

The numerous already acquired data mainly on the northern margin (field studies, marine surveys ENCENS-SHEBA, ENCENS and ENCENS-FLUX, seismologic Dhofar Seismic Experiment and ENCENS-UK and GPS networks) are a solid basefor the project. The extended further ongoing investigations onland in the eastern area (Oman) and its conjugate margins in the South (Socotra island) and in the volcanic margin in the West (Yemen) allow to reach the objectives concerning: - The deep structure and thermal regime (seismic tomography, OBS, heat-flow). - The crustal structure (tectonics-sedimentation relationships, MCS, Ocean Bottom Seismometer, receiver functions on land, gravity and magnetic anomalies, dredging on the ocean-continent transition, basalts geochemistry). - The vertical motions throughout the Cainozoic (topography-bathymetry analysis, sedimentology and stratigraphy field work, apatite fission tracks and U/Th/He thermochronology) and more recent deformation (concentrations of cosmogenic elements) - The present-day opening (GPS network monitoring and extension of the network) - The thermo-mechanical modelling (numerical and analogue models).

The overall goal of this project is to build 3D images of the deep (mantle), intermediate (crust), and superficial (sediments) structures of the Gulf of Aden basin from its rifting to its present-day oceanic spreading in order to understand the mechanisms of continental margins formation.

Makran Subduction Zone Segmentation, A Recent Study

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The northern part of the Oman Sea and the onshore areas east of the Straight of Hormuz are dominated by the E-W trending Makran Accretionary Complex. The Accretionary complex is the result of long lasting, and still ongoing, northwards subduction of Neo-Tethyian oceanic crust beneath the continental Eurasian Plate.

For the first time, Stoneley (1974) proposed a subduction zone along the Makran coasts that formed the boundary between the Arabian and Eurasian Plates. Later, Shearman (1977) and Farhoudi and Karig (1977) presented data to support this hypothesis. Quittmeyer and Jacob (1979) by conducting a comprehensive study on the Makran seismicity concluded that Seismicity in the Makran region is consistent with the interpretation of this area as an active subduction zone. In addition, Page et al. (1979) by performing a field survey of the Iranian coastline, air photo analysis, and aerial reconnaissance, confirmed the tectonic model of subduction zone for Makran coasts.

Based on the present study utilizing 2D seismic reflection data the main structural provinces and elements in the Gulf of Oman are i) the structural elements on the northeastern part of the Arabian Plate and ii) the Offshore Makran Accretionary Complex Elements. On the northeastern part of the Arabian Plate five structural provinces and elements have been defined; the Musendam High, the Musendam Peneplain, the Musendam Slope, the Dibba Zone, and the Abyssal Plain. The Zendan-Minab Fault System and the Accretionary front define the western and southern boundary of the Makran Accretionary Complex respectively. The Oranch Fault system is located in the eastern side of this complex and being considered as the western boundary of the Indian Plate, while the Murray ridge system defines the offshore boundary of the Arabian and Indian plates.

The Offshore Makran Accretionary Complex consists of Accretionary Prism and the For-Arc Basin. The Accretionary Prism has been subdivided into the Accretionary Wedge and the Accreted/Colored Mélange.

Based on the study of geological setting, tectonic evolution, and main structural elements, the Makran Accretionary Complex has been classified as a major seismic active zone. Moreover, in a plate tectonic setting like that of the Makran Accretionary Complex a fairly high earthquake activity would be expected, as in many of the other major Accretionary complexes/subduction zones around the world. But this region shows relatively low seismicity in comparison with the surrounding region. The area further being complicated in sense that the occurrence of tsunamogenic earthquake in the eastern segment has been documented, but well defined large earthquakes in the west so far is lacking. This could either be that the western Makran is capable of producing great earthquakes or it could rupture as a number of segments in somewhat smaller-magnitude events. Alternatively, it is possible that western Makran is significantly different from eastern Makran and experiences largely aseismic slip at all times.

In this presentation after reviewing of main structural elements relevant to seismicity of Makran (with special emphases on the Iranian sector; based on seismic reflection data and recent seismological records), the segmentation of the eastern and western Makran will be elaborated.

Northern Oman seismicity according to Oman Seismological Network Record

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This study presents analysis of Northern Oman seismicity since the inception of Oman Seismological Network (OSN) in 2001. More than 2000 regional events were recorded by OSN since 2001 of which 990 originated in northern Oman and its surrounding region. The seismicity rate varies from year to year with fewer events recorded in the earlier years. There are 75 events recorded during 200143 ,2002- events recorded during the 2003, 230 events recorded during 2004, 147 events recorded during 2005, 227 events recorded during 2006, and 268 events recorded during 2007. The lower number of events recorded in 2003 when compared to 2002 is due to missing data (May to July). The large increase of recorded events in 2004 is due to the addition of two broadband stations in the north (Musandam and Al-Buraimi) which enhanced network coverage in the northern region. The decrease of recorded events in 2005 is due to missing data because of Satellite communication program error. The additional increase in the detection in 20062007- is due to real-time data sharing with Dubai Municipality seismic network.

Few felt events in northern Oman are recorded since 2001. These felt events include Masafi and Madha events 2002, Diba and Yity events 2004, Samad and Qasham events 2005, and Diba-Madha events 2007. The Diba event of September 13, 2007 was felt widely in northern Oman and United Arab Emirates (UAE). This event created a number of questions among northern Oman officials and residents, one of these questions is that could these earthquakes triggered by heightened rock mining and quarry blast activities in the region. The rock mining and quarrying increased in the last few years due to construction demand in both UAE and Oman. All the felt events in 2007 are offshore therefore it could not have been triggered by quarrying activities 20 km away.

Geological, tectonic and available earthquake data clearly indicate the presence of a relatively low earthquake hazard in and around northern Oman. However, the actual level of seismic hazard is not well known at this time because of short period of instrumentally recorded events, low frequency of felt report, and little archeological evidence or paleoseismic studies of past major earthquakes. Observed neotectonic features in northern Oman wadis suggestive of presently low levels of tectonic deformation. However, damaging earthquakes might originate close or within the boundaries, from the north in the Makran subduction zone and Zagros continental collision zone.

Seismic Deformation Studies on the Southern Part of the Gulf of Suez and the Gulf of Aqaba , Egypt

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The present work attempts to throw some light on the seismic deformation on the Suez and Aqaba Gulfs. To reach this goal moment tensors were calculated to estimate the rate of seismic deformation. The dedformation due to seismic activity can be estimated on the basis of the analysis of moment tensor. The complete description of the seismic moment tensor can be obtained by a combination of fault plane solution and scalar seismic moment (Aki and Richard, 1980). The entire events recorded by Hurghada Seismic Network were relocated within the southern part of the Gulf of Suez during the period from 19941998-, to get a clear view of seismicity. The resulting moment tensor provides a fault plane solution is mainly normal fault mechanism and the dominant mode of deformation is extension. The rate of extension is 3 mm/yr in the 53º ENE direction. The thinning of the seismogenic layer is 0.6 mm/yr which is consistent with the normal fault observed. There is a slight component of shear motion in the direction parallel to the strike of the gulf. The shape of deformation from the small earthquakes is in direction identical to the shape of deformation from the large earthquakes in the southern part of the Gulf of Suez, that the tension axis is nearly in the NE-SW direction with the occurrence of a normal fault mechanism. We also studied the rate and shape of deformation in the Gulf of Aqaba. The summed moment tensors correspond to a left lateral strike slip mechanism. The dominant components of the strain tensor are ε22 which corresponds to an extension in the N62ºE and ε12 which corresponds to a shear motion in the NNE direction. The corresponding velocities are 9 mm/yr for the extension in the N62ºE direction and 7 mm/yr for the left lateral strike slip motion in the direction parallel with the strike of the Gulf. The negative component ε33 indicates thinning of the seismogenic layer, equivalent to 2 mm/yr.

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EARTH FISSURING AND LAND SUBSIDANCE IN QUA'A JAHRAN (WESTAERN CENTER OF YEMEN)

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The present investigation deals with the geological evaluation of earth fissuring associated with land subsidence in Jahran Basin (Qua'a Jahran) which located in the Yemen western center. The investigations include surface mapping and water wells inventory, which are located closed to fissures.

The first major cause of this phenomena was the deflation of magma chamber when Dhamar earthquake at 13 December 1982 (M=6) occurred in the area.

The earth fissures in the area were developed as a result of land subsidence due to man-induced water level declines where pumping water from the Jahran aquifer was hydrogeologically exceeding the safe yield. This situation was produced a compaction of underlying unconsolidated sediments and formed hair fissures. These hair fissures enlarged later after flood erosion seasons and possible enhancement with hydrocompaction. The earth fissures and land subsidence cause environmental and economic problems in the area.

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CENOZOIC VOLCANIC FIELDS OF YEMEN WITH FOCUS ON JABAL AT-TAIR ACTIVE VOLCANO IN THE RED SEA

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Rift formation is one of the most important problems of the global tectonics. The Yemen rift-related area is one of these important provinces, which is connected to the rifting processes of the Gulf of Aden, the Red Sea and Afar triple junction. The result of continental extension in Yemen resulted in the extrusion of large volumes of effusive rocks (2000m thick) during the late Oligocene-early Miocene. Volcanic rocks of Yemen can be classified into two series; 1) Yemen Trap Series, which extruded from the late Oligocene to early Miocene (31.615-Ma) is associated with the synrift phase and consists of thick bimodal volcanic rocks, including alkaline to mildly alkaline basalts and peralkaline rhyolites and their associated ignimbrites and tuffs; 2) Yemen Volcanic Series, which evolved during the postrift phase (late Miocene-Recent). It is composed of basaltic volcanics with only minor differentiates, and is characterized by strato-type volcanoes, cones, domes, sheets, and lava flows. Within this series, eight major Quaternary volcanic fields are known. Three of which are found in the western province of Yemen, and four occur along the coastal plain of the Gulf of Aden, whereas the Islands Group is found in the southern Red Sea. It can be inferred that Yemen, the western part in particular is not a stable continental zone. It is characterized by some indications of elevated crustal magmas and physical thermal convective anomaly related to deep crustal fracture systems, as well as by seismic activity.

In September 30, 2007, the Jabal At Tair Volcanic Island has renewed its volcanic eruption. It is located at 15° 33' N, 41° 50' E. Jabal At-Tair forms an ellipsic island, with a total area exceeding 10 km2. It is composed of relatively thin basaltic lava flows of different colors. Chemical affinity of these lavas is tholeiitic, with silica content ranging from 46.44 to 48.53%, whereas the silica content of the older lavas ranges between 49 and 50.50%. Jabal At-Tair represents the youngest activity in the whole region and is the lonely active volcano in the Red Sea. The latest activity that happened in the nineteenth century was erupting from a central vent of the volcano, some 244 m above sea level, whereas the present eruption is rising from new central vents, aligned to the north of the former one, from an elevation of less than 230 m above sea level. The recent activity is represented by basaltic lava flows of different colors and appearance. Thickness of these lavas varies between 1 and 3 meters. The greatest part of the volcanic island is covered by pahoehoe as well as by aa lavas, in which the recent lavas are flowing over the older yellowish color pyroclastic materials. The older pyroclastic material has yellowish color due to erosin, whereas the recent lavas have dark and gray colors. Beside the lava flows, the volcano emits fumaroles from the southern and northeastern parts of the new central vents and also bluish color sulfur dioxide, and less commonly carbon dioxide. Two types of fissures are observed. The first is represented by radial fissures having different strikes, but mainly parallel to the main Red Sea trend, and the second type is represented by a newly formed N-S fissures which are found in the northern part of the island and form a parallel feature with each other. Their width is varying from centimeters to more than 1 meter. Based on our last visit in October 21, 2007; we could compare the type of activity to that of Sromboli, so the activity of Jabal At-Tair volcano will continue for months and probably for years. The basaltic rocks are porphyritic, fine to very fine-grained (aphanitic) in textures, and having porous and vesicular structures. Mineral constituents are represented by dominant plagioclase, clinopyroxene, olivine and opaque minerals.

Overview of Earthquake Prediction Activities in Iran

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The Iranian plateau is one of the most seismically active areas of the world and it frequently suffers destructive and catastrophic earthquakes. Iranian Territory has been subdivided to many different areas seismicly; the Zagros region is characterized by smaller (relative) magnitude and high frequency, while the Alborz region as large magnitude and low frequency earthquake occurrence area. This very rough subdivision has been used among other preseason as the main criteria for defining the Alborz region as location of the first earthquake precursor test-site in Iran.

The Alborz region in the central part of Iran is an active, EW trending mountain belt of 100 km wide and 600 km long. The Alborz range is bounded by the Talesh Mountains to the west and the Kopet Dagh Mountains to the east and consists of several sedimentary and volcanic layers of Cambrian to Eocene ages that were deformed during the late Cenozoic collision.

Several active faults affect the Central Alborz. The main active faults are the North Tehran and Mosha faults and their westward continuation, the Taleghan fault. The Mosha fault is one of the major active faults in Central Alborz as shown by its strong historical seismicity and its clear morphological signature. Situated at the vicinity of Tehran city, this 150 km long N100° E trending fault represents an important potential seismic source that threatens the Iranian metropolis.

The earthquake monitoring and for the possible future prediction purposes a test-site has been selected to be established in the Alborz mountain region where the proximity to the capital of Iran with high population density; low frequency but high magnitude earthquake occurrence and the proximity to active fault with historical earthquake events have been considered as the main criteria for this selection. It is important to mention that within the test-site also exist hot springs, and deep water wells which could be used for physico-chemical and Radon gas analysis for earthquake precursor's studies. At this test site the methodology planned to used are those based on IASPEI evaluation report.

In this presentation after a review of present activities (e.g. recent magnetic measurement and, application of IIEPT&MG RAS methodology for identification of seismogenic nodes for earthquakes of M _ 6.0 in the Alborz region) conducted in Iran concerning the earthquake precursors, the related test site will be introduced where within the site the ongoing establishment of i) local dense seismic network consisting of 50 stations ii) GPS network consisting of 8 instrument with 70 stations iii) magnetic network with 4 instruments iv) Radon gas and physico-chemical study on the springs and deep water wells will be explored.

Reappraisal of the Seismicity of Libya after the Establishment

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Libyan National Seismograph network (LNSN)

The tectonic evolution of Libya, located at the northern extreme of the African continent, has yielded a complex crustal structure that is composed of a series of basins and uplifts.

The present day deformation of Libya is the result of the Eurasia-Africa continental collision. Libya is not commonly thought of as a seismically active country; however, several earthquakes of magnitude greater than 6.0 on the Richter scale have occurred there within the last century, including an earthquake of magnitude 7.1 (April, 1935), one of the largest events on the African continent. The recorded number of earthquakes in Libya is not representative of the actual total number because of the small number of seismological stations in the area and the limitations on instrumental sensitivity before 1950. This scientific fact was fully proven after the establishment of the Libyan National Seismograph Network (LNSN) operated since November of the year 2005. The LNSN consists of an up-to-date 15 broadband digital national network, utilizing state of the art VSAT communication technology, and a Central Processing Center, located in the City of Ghariyan, Libya. This study aims to explain in detail the LNSN and its main objectives, discuss the first catalogue of Libyan earthquakes after the establishment LNSN, and explain the new picture of the seismicity of Libya. The newly compiled Libyan catalogue represents the main source of data through which we analytically reanalyze earthquake activity of Libya with the aim of improving the earthquake hazard assessment of the Country. Different sources were used in the compilation process within a geographical window limited by the 190 N and 350 N parallels and the 90 E and 260 E meridians. In this study we use the updated Libyan catalogue for detailed investigation that aims to focus on the seismicity of Libya through a comprehensive quantitative and qualitative earthquake analysis.

The LNSN network was designed to monitor local, regional and teleseismc activities, as well as to provide high quality data for research projects both locally and on the regional and global scale. At first glance the seismic activity map, based on the present seismic catalogue, shows dominant trends of seismicity with most seismic activity concentrated along the northern coastal areas. Four major seismic trends were quite noticeable. A first trend is a NW-SE direction coinciding with the eastern boarder of the Hun Graben. A second trend is also a NW-SE direction in the offshore area and might be a continuation of this trend. The other two trends were located in the western Gulf of Sirt and Cyrenaica platform. The rest of seismicity is diffuse either offshore or in land, with no good correlation with well-mapped faults.

Neotectonics and paleoseismicity of the southern Dead Sea Transform Fault

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The Dead Sea transform (DST) fault system (including the Levant fracture Zone) is well defined by geological and geophysical studies. It is one of the largest systems in the world. It strikes in a N – NNE direction and extends over some 1100 – 1200 km from the Gulf of Aqaba northward along Wadi Araba, Dead Sea, Tiberias, Yammouneh fault and Ghab depression to the continental collision in the Taurus – Zagros mountain belts. This transform and around area is one of the most interesting regions on earth where evidences of earthquake activity has documented for periods that dates back to several thousands years. The nature of this transform is strongly more concerned for the most earth scientists in the world. For part of its length, ~400 km, the southern DST is located in Jordan, entering the country south of the Galilee to become offshore in the Gulf of Aqaba. Numerous historical documents attest of occurrence of large earthquakes (magnitude ≥ 7) along the system. Jordan in particular, was severely affected by AD 747 earthquake, north of the Dead Sea, and the AD 1068 earthquake, south of the Dead Sea. In 1995, a magnitude Mw 7.3 earthquake occurred in the Gulf of Aqaba, responsible for few but damages in the cities around the northern tip of the Gulf of Aqaba. The long historical record of earthquakes, the physical effects on ancient building structures and the paleoseismicity provide a unique opportunity for an interdisciplinary tectonic analysis along a major plate boundary and a realistic evaluation of the seismic hazard assessment in the Eastern Mediterranean region. The identification of seismic gaps and sequences along major fault systems requires an accurate knowledge of the seismicity catalogue ideally covering several large earthquakes. A time-averaged slip rate and an understanding of the related seismic cycle also contribute to better constrain the long-term faulting behavior and recurrence interval of large seismic events. This study provides well-constrained direct slip rate on the Dead Sea Fault as well as exposure ages of an offset alluvial fan along the active fault.

Site Effect and Expected Seismic Performance of Buildings in Palestine "Case study: Nablus and Ramallah cities"

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Local site effect: Landslides, liquefaction, amplification and faulting systems play very important roles on the intensity of earthquakes. Earthquake- resistant design of new structures and evaluation of the seismic vulnerability of existing buildings involves prediction of their response to site ground motions.

Historical references to the correlation between earthquake damage and local site condition extend back nearly 200 years. Provisions that specifically accounted for local site conditions didn't appear in building codes, however until the early 1970. The local site effect can be illustrated by the following: simple theoretical ground response analysis, measurements of actual surface, by subsurface motions at the same site, and by measurements of ground surface motions from sites with different subsurface conditions.

The effects of local geology on ground-motion amplification and building damage were studied in Palestine-West Bank. Nakamura's method of microtremor analysis was applied in this study. The measurements showed significantly higher amplification in the frequency range of building vulnerability in different parts of Nablus city. This finding is consistent with the distribution of the earthquake damage grades in the urban areas struck by the 11 February 2004 earthquake (ML= 5.2) with a focal depth of 17 km beneath the northeastern part of the Dead Sea Basin. Quite large differences in amplification between around 1 and 9 were computed between the eastern and western rims of the city. The downtown built in the central part of the city on soft clay, marl and valley deposits, whereas the northern and southern parts of urban areas in Nablus city lying on mountains consist of consolidated carbonates bedrock. In the central part of the city and at the rims, where the thickness of fluvial deposits and soft formations is about 15 m, amplifications between 6.74 and 8.67 for dominant natural period range of 0.8 - 1.1 sec were obtained. On the southern and northern mountains, which are located on limestone rocks covered with a thin layer of soil, the amplification in the same frequency range was low.

Calculating the natural period of the existing common buildings (Tb) in the studied area (buildings with 1012-stories), by using the dynamic analysis method. The values of Tb obtained were much closed to the site dominant natural period (Ts).

The findings of this study indicate that the expected differences in damage grades for urban areas in Nablus city could be attributed to variations in the thickness and physical properties of Tertiary-Ouaternary sediments, which appear to be rather heterogeneous. In addition to the

site effect amplification, the geology of Nablus was the main reason behind several quite large landslides happened during ten years ago in different part of the city (eg.White Mountain area). In Ramalalh City, on the other hand, the whole urban areas lying on mountains consist of consolidated carbonates bedrock, where the amplification was low

STRUCTURAL HEALTH MONITORING

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The term "Structural Health Monitoring" refers to real-time monitoring of a structure by digital instruments. The objective in Structural Health Monitoring is to track the changes in the dynamic characteristics of the structure, and to detect and locate damage after an extreme event, such as an earthquake. In general, acceleration sensors are used for monitoring. Damage detection typically involves analysis of acceleration data to search for changes in the structure's natural frequencies and inter-story drifts. Recent data from instrumented structures have clearly shown that changes in natural frequencies are not always a reliable indicator of damage, because various environmental factors can change frequencies without damage. Similarly, the inter-story drift, if calculated from acceleration records, is not a reliable damage indicator because the errors generated by the noise in the records are exponentially amplified during the calculations.

In real-time monitoring, most of the data are of ambient vibrations, which are characterized by very low amplitudes and signal-to-noise ratios. Fourier-based standard methods that are commonly used to analyze triggered (i.e., large amplitude) data are not appropriate to analyze ambient data because low signal-to-noise ratios can cause large errors, particularly when analysis involves spectral ratios. However, ambient vibrations are always available and data can be collected continuously. In most cases, ambient records are stationary (i.e., their frequency and temporal characteristics do not change with time), and the record length can be made infinitely long. Also, since there are a large number of sources for noise and excitation, it can reasonable be assumed that both the noise and the excitation are wide-band random processes. These properties of ambient data make it possible to utilize advance stochastic techniques for data analysis, such as statistical signal processing, optimal filtering, and adaptive noise cancelling.

This presentation will introduce several new approaches to structural monitoring, damage detection, and data analysis. It will be shown that damage can be detected more accurately if we investigate not only the changes in natural frequencies, but also the changes in the propagation characteristics of waves in the structure, and any permanent changes in the structure's configuration. It will also be shown that the analysis of real-time data is equivalent to extracting low amplitude sinusoids buried in noise. By using elementary concepts from the statistical signal processing and optimal filtering theories, several new techniques will be introduced for data analysis. The superiority of the new approaches over the current ones will be demonstrated by using real records from instrumented structures.

Variations in the Frequency–Magnitude Distribution in the Gulf of Aqaba, Red Sea

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The frequency–magnitude distribution was mapped beneath the Gulf of Aqaba, northern part of the Red sea, using an earthquake from Egyptian National Seismic Network (ENSN) catalog of 4280 events that occurred between January 1997 and December 2006. The smaller value of b found in the south-eastern part the Gulf of Aqaba region (~ 0.5) at depth and a larger b-value observed to the north-western part (~ 0.8) at depth between 1 to 10 Km.

SigProce: program for signal processing, evaluation of seismic response in sites and buildings, and other engineering purposes

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The program SigProce (Signal Processing) has been written in Fortran language for Windows XP using Microsoft Developer Studio. It allows to apply many methods of signal processing. Some of these methods were presented by Erdal Safak during the 4th Gulf Seismic forum (Kuwait, 2007). So, programming these methods provide us a useful tool in application and education domains. The processing methods which can be applied are: calibration, shifting and trending correction, decimation, delete an interval, data windowing, integration and derivation, signal rotation, filtering, convolution/deconvolution, correlation and smoothing. Furthermore, the program has many graphical outputs for signals, specters, spectral ratio, projections of ground movement, polarigram and others. Finally, SigProce can be used to evaluate of seismic response in sites and buildings by the H/V method and the reference site method in simple, easy and efficient manner.

Cyber Infrastructure for uniform geophysical and geospatial data

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In the past five year, advancement in grid and cluster computing had allowed us to access and publish large data sets which was impossible to deal with before. We are able to processing and analyzing such data sets faster and over the web in some instances. The acces to such datasets had open a controvercy about standards needed, attributes and formats.

Sharing geophysical and geospatial databases became a reality for some projects like IRIS (seismic data), GEON (geological, geophysical and geospatial data), Earthscope (geophysical and geospatial data). Many of these are supported in part by National Science Foundation. Thought such interaction and data sharing between the scientific community becoming more of the norm we still need to over come many barriers to break the habits of shelfing data collected and make it available to others.

The first national datasets that I worked on and made available to the scientific community are gravity of the US and magnetic of North America, with the cooperations of both the USGS and NGA. Such datasets are accessable through the web with a search enging that allows the user to select their reasearch area and download that part of the data for more analysis. We are also developing some tools that will enable users to creat maps and download an image for analysis and interpretations. The gulf states had similar opportunity to share and combine such datasets resulting in more complete and accurate data and hence accurate research results.

Scientists may question the parameters used to creat such maps can now investigate the process through a provenance tools that captures metadata (information about each process) and determine if there is any possible errors or change parameters used to generate more accurate product.

An example of a cyber infrastructure for rapid earthquake information services at the Euro-Med scale

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Euro-Med Seismological Centre

The Euro-Med Seismological Centre (EMSC), an international non-profit NGO operates a cyberinfrastructure offering rapid earthquake information services thanks to parametric data provided by network operators. The Internet is used to collect and integrate the data, to distribute the results and more recently to automatically monitor the public reaction after an earthquake and aggregate pieces of information detained by witnesses concerning the effects of the events. This presentation will mainly focus on these last 2 points as they can be efficient, at least in some cases, to rapidly appraise the potential impact of an earthquake.

Data collection from public and witnesses is performed using 2 main ways. An online macroseismic questionnaire is currently available in a ten of languages and about 10 new versions are expected to be online in the coming months. Witnesses are also offered with the possibility to share their pictures on the effects of earthquakes. At a time when 1 billion persons worldwide have access to mobile phone equipped with a camera, it proves to be a cost-efficient way to collect field evidence from regions as diverse as Far East Russia or less technologically developed countries like Ethiopia. The second tool uses the real-time variations in time and in geographical origin of the traffic observed on the EMSC web site to identify the felt events and map the area where they have been felt. Events felt by the EMSC audience are characterised by brutal surges of traffic within minutes of the event occurrence. By tracking these surges, localising the IP addresses generating this surge and determining the significance of the increase at each geographical origin, one can estimate the area where the event has been felt within 1020- minutes of its occurrence. Theoretically, damaged areas could also be identified through the lack of connections it causes.

Regional Waveform Inversion of February 09, 2007 Dead Sea Earthquake

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The 4.4 ML Dead Sea earthquake on 09 February 2007 at 22:14 (UTC) was widely felt throughout Israel and Jordan. The observed dispersion of Rayleigh and Love waves picked from the broadband records for the main shocks of February 11, 2004 and February 09, 2007 earthquakes are used to update the Jordan Seismological Observatory model which shows a good match between the observed and theoretical dispersion. Our updated model shows small travel times residuals during our location process and present high percent of variance reduction on the regional waveform inversion analysis. The earthquake hypocentre, determined from the observed P- and S-wave travel-time data and regional waveform inversion indicate a source depth of ~10 km. This earthquake is associated with the northern fault segment of Arava fault and indicates southward rupture propagation. Focal mechanisms obtained from both first motion polarities of local observations and moment tensor inversion of regional observations show left-lateral, strike-slip faulting along a near vertical, near NNE–SSW striking fault plane whose orientation is in good agreement with the surface expression of the observed northern Arava fault. The focal mechanism for a felt foreshock shows a similar left lateral strike slip fault with a slight normal component. The seismic moment and moment magnitude of the main shock of 2007 based on the regional waveform inversion are 5.9x1022 dyne.cm and 4.4 while, the seismic moment and moment magnitude of the foreshock are 1.12x1022 dyne.cm and 3.97, respectively.

Preparing the databank of the fault- sources parameters of earthquakes in Turkey

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The main task of this study is to standartly present,compile and archieve of the fault-source parameters (Moment Tensor MT-CMT) of important earthquakes occurred in Turkey and surrounding areas is available on a web based via the Moment Tensor MT-CMT catalog search. Particularly, after 1939 Erzincan earthquake the scientific feautures of active earthquakes sources that had inferred from the determined fault parameters of the earthquakes occurred in Turkey. In this study, the databank of the earthquakes source parameters is created using the destructive earthquakes in Turkey that were strongly felt by people. In the last years, the fault- source parameters of the earthquakes could be determined reliably and rapidly using the developing instrumental equipment and digital technology. The fault-source parameters of the earthquakes with magnitudes M≥ 4.5 that occurred in Turkey during 19392006- were compiled as a form of MT-CMT catalogue and databank. The fault-source parameters of the earthquakes are determined reliably using the waveforms of three components broadband stations that have installed increasingly after 2000 years in Turkey. The fault-source parameters of the earthquakes are provided with the study in order to disseminate this information to concerned researchers on a web based programme as the important seismological centers in the world. Today, the knowledge of earthquake fault- sources is used by concerned researchers and institutions that could be obtained easily in the short time via internet.

At present, the fault-source parameters of earthquakes with magnitudes M≥ 4.5 that cold be calculated reliably using the developing instrumental seismology in Turkey at the last years. Thus, the accumulated data is provided for scientific researchs and projects. The prime result of this study is the preparation of fault-source parameters of important earthquakes during the period 19392006- and the presentation of compiled and processed data based on web to all users for scientific researches.

Seismicity and Seismotectonics of Libya: As an Example of Intraplate Environment

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This investigation covers the area bounded by Latitudes 20°-33° N and Longitudes 9.5°-25°E.The seismicity of area for the period 19002005- is evaluated. Libyan earthquake catalog is complete for the 4.4M and greater over 70-year span.The overall seismicity of Libya is found to be low to intermediate . The seismic activity is concentrated in three zones of the northern Libya.Outside of these zones , epicenters are scattered and sparsely distributed. The b-value for Libya is – 0.75. This low b- value is a characteristic feature for intraplate environment. A seismotectonic map is constructed for Libya . It shows that the epicenters agree well with the distribution of the major tectonic features. Majority of seismic activity in Libya is concentrated near to Hun graben and Cyrenaica and the locations of earthquakes are near to the transition zones between the stress domains in northern Libya. These transition zones are locations of the stress concentration. This investigation suggests that the stress concentration theory is generally considered as causative mechanism for seismicity of Libya.

Seismic Design of Structure, including soil-structure-interaction effects, , using cone models in the Gulf region

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The seismic analysis and design of structures in the Golf region requires modeling of structure, foundation, and the underlying soil.

The modeling of the structures has been well established in the seismic area, the modeling of soil, however, has been less known. In this presentation, a complete procedure to model and analyze the structures, including soil-structure-interaction effects is addressed.

The flexibility of the soil is modeled using cone models which are based on strength of material approach.
Three case studies are presented:
- Seismic design and analyses of a 28-storeys concrete building shear wall in the Gulf for a PGA of 0.3 g.
- Seismic design and analyses of a 14-storeys concrete (frame structure) building in the Gulf for a PGA of 0.3 g.
- Seismic design and analysis of a 5-storeys masonry building in moderate seismic area.

CONTRIBUTION TO THE STUDY OF HISTORICAL EARTHQUAKE IN THE MAGHREB REGION, CATALOGUE OF EARTHQUAKES IN THE REGION

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After a previous study of great earthquakes in Morocco from 846 a.c to 1960,[El Mrabet 1991] and the occurrence of very destructive earthquakes in the maghreb region during the twentieth century, El Asnam (Orleanville) earthquake 1954, Agadir earthquake 1960, El Asnam earthquake 1980, more interest was expressed concerning the long term seismicity of the maghreb region. The continuity of the geographical, tectonic and geological context in a large scale can be seen as a uniform space for global studies.

In this study, not only the geographical window was extended but also the temporal period to go to the end of the twentieth century. This stretching allowed the gathering of earthquakes data from different sources in a catalogue containing the major related texts that we will try to summarize in a table.

Evaluation of Local Site Effects using Microtremors Array Observation (SPAC) Method (Ras-Issa Peninsula - Red Sea shore – Yemen)

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Since local site effects are significantly affected by the geological structure, a details knowledge of subsurface structures beneath a target site is necessary in a reliable assessment of Earthquake strong motions. Shear wave velocity Vs near the ground surface is one of the most crucial factors in characterizing strong motion at the site .

Among the all geophysical explorations microtremors array observations is the most economic one. This technique provides a good estimate of the shear wave velocity structure Vs through surface waves inversion procedure depending on natural sources such as,(Sea waves , machines vibrations ,traffic…etc) very cheep , easy to perform it in urban areas and no need skill persons compared with other geophysical techniques .

The main object of this study is to evaluate the site response in Ras-Issa area and to understand the precision and/or limitation of the SPAC (Spatial Auto-Correlation) method for practical engineering use .

We carried out array observations of microtremors at 4 sites in Ras-Isaa peninsula - Red Sea shore , Yemen. The site consists of thick reef deposits covering tertiary volcanic rocks where the boreholes of 50m depth have already been performed, and the underground structures have been determined by geotechnical methods. That information was very helpful to check the accuracy of the SPAC method.

Four small arrays of concentric equilateral triangle designed , with radius (14.4, 29 and 50m) respectively .The high frequency of microtremors were chosen to analyze the dispersion curve of surface waves for fifty meter deep.

Through the comparisons of results from SPAC method with geotechnical information's of boreholes data using Standard Penetration Test (S.P.T) N value, we got the SPAC method could detect the subsurface boundaries of layers very clear and getting a good results of Vs with acceptable accuracy. Due to the common problems of inversion technique, we couldn't get the thin low velocity layers.

Finally, surface ground motion simulated well then the amplification factor and predominant period had been computed based on 1-D multi-reflection theory of SH wave applying the estimated velocity structures Vs by SPAC method. In conclusion shear wave velocity structure Vs estimated by the SPAC method with simple inversion procedures have sufficient precision for practical engineering use in predicting both peak frequency and amplitude.

Spatio-temporal seismic activity analysis in Northern Algeria

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The analysis of the seismicity in northern Algeria is studied in details. This analysis has been carried out on a recent compiled earthquake catalog for the region. It consists mainly of those published by the Spanish IGN, supplemented for the Algeria zone with data published by the CRAAG, and initially updated to 2006. The data published for the region by the EMSC and by the USGS have also been incorporated into the data file. The earthquake catalogue compiled covers the period time span 16732006-. All magnitude events and intensities (for historical event) have been converted to surface wave magnitude scale using an appropriate empirical relations and a new one between ML and Ms, established especially for the studied region. The non poissonian event identified using Gardner and Knopoff methodology have been removed. Using Stepp methodology, the poissonian and complete character have been established for the seismic model with seismicity M from 1980, which has been used to study the behaviour of the seismic activity using different approaches such as the distribution in time and space of seismicity, seismicity rate changes (z value), b value parameter of Gutenberg Richter power law.

The studied area has been characterized according to the obtain results.

The variation of the spatio-temporal of the b-value shows some typical behavior before and after great events, especially in some specific zones in Northern Algeria including the quaternary active basins (e.g. Mitidja and Cheliff basins).

Determination Site Effect of Zarqa City and Hashemite University Campus / Jordan Based on Microtremors Field Measurements: A microzonation Study

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Zarqa governorate is one of the important governorates in Jordan. It is the second populated after the capital Amman, the location of Zarqa gives the city a great importance because it lies on the main high ways leading to Syria, Iraq and Saudi Arabia, most of Jordan's industries, power plants and strategic projects are located in Zarqa, which gives this city a special importance.

The Nakamura's technique is applied in this study for both areas; Zarqa city and Hashemite University Campus in order to determine the resonance frequencies and amplification factors for each site then draw there maps which will be of a great use in the field of civil and structural engineering by enriching the building codes.

The results of our study show that; values of resonance frequency F are not affected by the time of recording. While values of amplification factor A can vary accordingly. Results also show that the amplification factor A varies from 0.8 to 8.55 in Zarqa city and varies from 0.4 to 9.36 in Hashemite University Campus, the resonance frequency (F) also varies between 0.37 Hz and 2.98 Hz in Zarqa city and varies from 0.59 Hz to 1.77 Hz in Hashemite University Campus, that means some constructions in the study area, in case of a major earthquake, may experience minor damages respectively.

Periodic Upward Migration Model for Intermediate-Depth Earthquakes in Vrancea, Romania

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Intermediate-depth earthquakes with a depth range of 60–160 km have frequently occurred in the Vrancea region of Romania and caused severe damages. To understand the regularity of earthquake occurrences and to predict future earthquakes, we analyzed M ≥ 7.0 earthquakes during the years 1500–2000. We propose a periodic upward migration (PUM) model where (1) the front of an active zone migrates upward starting from the deepest part with velocity of V km/year at year TS and (2) this migration repeats every TP years. We assumed that the active period lasts for T1 years at each depth. One of the optimal solutions is as follows: V = 0.7 km/year, TS = 1501.4 year, TP = 100 years and T1 = 19.4 years. We tested the model by using the Akaike information criterion (AIC) and investigated whether the model is better or not as compared to a uniform Poisson model with regard to time and space. Applying the AIC procedure in the model selection, we can conclude that the PUM model is significantly better than the Poisson model. We, therefore, propose the following regularity for the intermediate-depth earthquakes occurring in Vrancea. (1) The first M 7 earthquake occurs at a deeper segment of the seismic region (depth: 140–160 km) at the beginning of each century. (2) The second M 7 earthquake occurs at an intermediate segment of the seismic region (depth: 110–140 km) in the middle of each century. (3) The third M 7 earthquake occurs at a shallower segment of the seismic region (depth: 80–110 km) at the end of each century. This activity repeats every century. On the basis of this regularity, we can predict the following three M 7 earthquakes that would occur in the 21st century: (1) 2007.2 ± 5.5 at depth of 150 ± 10 km, (2) 2040.0 ± 3.0 at depth of 124 ± 10 km, and (3) 2086.8 ± 6.4 at depth of 98 ± 10 km. Furthermore, by referring to the source processes involved in recent larger earthquakes, the source processes of future earthquakes can be predicted as follows. (1) A pure thrust exists with a strike of NE–SW and the steep-dip nodal plane dips towards the NW with an angle of 60–80°. (2) The rupture is unilateral and propagates from the NE towards the SW. (3) The length of the fault is 30–50 km.

A Passive Seismic Array Across the Dead Sea Basin (DSB)

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Abstract: Beginning in September 2006, a temporary network of 30 broadband and 45 short-period seismic stations has been set up on both sides of the Dead Sea Basin (DSB). The aperture of the network is 70 km E-W and approximately 70 km N-S. It is anticipated that the network be kept in operation till March/April 2008. Data are continuously recorded at 100 Hz and 200 Hz sample frequency for the broadband stations and short-period seismic stations, respectively. The aims of the project are (1) to investigate the crust and upper mantle discontinuities with the receiver function method, (2) to investigate anisotropy in the crust and upper mantle from shear wave splitting,

and (3) to study local seismicity in the area. First preliminary receiver function analysis reveals a crustal thickness of about 3035- km in the eastern part of the DSB and possibly an upper mantle low-velocity layer. It also shows a basin which is mainly filled with salt about 10 km thick beneath the Lisan peninsula.

Analysis of the aftershock sequence of the 21 May 2003 Zemmouri, Algeria earthquake

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In this study, the properties of the aftershock sequence in the first month after the 21 May 2003, Zemmouri earthquake are analysed. For this purpose, b-value of the frequency-magnitude distribution of earthquakes and tempo Jose ral decay rate of aftershocks, as described by the p-value in the modified Omori law, are computed. The data reported by the CRAAG consist of 2152 events, covering the time period from 21 May 2003 to 30 July 2003, with magnitude range between 0.9 to 6.9. The obtained b-value using maximum likelihood approach is 1.10 ± 0.04, with a completeness magnitude Mc equal to 3.5, and 1.30 ± 0.06, with Mc = 3.7. Using the least square procedure b-value is 0.83 ± 0.08. Both methods give typical b-values close to 1 for aftershock sequences. The obtained p-value of the Modified Omori law is 0.93 ± 0.04, with characteristic time equal to 0.237 days.

The modified Bath's law shows that observed magnitude difference between the main shock and maximum aftershock magnitude, noted m*, is equal to 1.1, while using maximum aftershock magnitude inferred from the Gutenberg-Richter relationship by putting N(≥m) = 1, it is about 0.8. Expressing the fraction of the total energy associated with the aftershocks in terms of b-value and m*, we deduce that about 3% of the energy is dissipated through the observed aftershock sequence; nevertheless, 8% is obtained using the maximum aftershock magnitude inferred from the Gutenberg-Richter relationship.

From the correlation integral, the fractal dimension of aftershock epicenters is estimated to be 1.79 ± 0.02 which allow us to deduce a cluster around the source zone. The Aki's dimension deduce that the slip ratio on the primary rupture fault segment over the total slip in the Zemmouri fault system is in the range 5260%-.

View of Islam on Earthquakes, Human Vitality and Disaster

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Reduction of a growing risk of disaster in the developing countries requires maximum public participation, which in turn needs scientific facts and methodologies to be blended with historical traditions, religious beliefs and indigenous knowledge. The objective of this paper is to apply the richness of Islamic teaching to the process of risk reduction, in order to develop an approach to risk communication and education that can be used effectively by traditional peoples and the religious community. The paper presents the guiding principal of earthquake risk reduction; the views of Islam on earthquake, disaster, God's bounty, the Earth, good deeds, human behavior and human safety; and finally the issues of environment protection, risk management, safety and human life are discussed in terms of religious teaching. The dissemination of this type of knowledge can clear misconceptions and increase people's understanding of and knowledge about disaster-related issues. This process is necessary for disaster risk reduction, improved safety and development, all of which can be viewed as demonstrations of God's love for humankind.

It should be noted that the author of this paper is not an expert in Islamic theology, but merely one who tries to benefit from the Islam teaching in order to create a stronger incentive and will for risk reduction in the Islamic countries. Also, based on the author's understanding of Abrahamic religions (religions that believe on one God: Christianity, etc.), the introduced concepts can be related to all religions. In the future this process will need to be strengthened significantly with the input of more expert knowledge.

COMPILING AN ACTIVE FAULTING DATABASE FOR THE ARABIAN PLATE REGION

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As a general principal, Probabilistic Seismic Hazard Analysis (PSHA) involves three steps: 1) specification of the seismic-hazard source model(s); 2) specification of the ground motion

model(s) (attenuation relationship(s)); and 3) the probabilistic calculation. This proposal aims at promoting the multidisciplinary study of faults of the Arabian Gulf region and its surroundings as earthquake generators. Looking through the various available researches on seismic hazards and source parameters we find that uncertainty in the definition of the behavior of individual faults is the major problem preventing a realistic assessment of seismic hazard. As a result, most destructive earthquakes occur at an unexpected time, place, and magnitude.To accurately identify probable seismic sources (faults) in the Arabian Gulf region, it is recommended that a joint project among the region's institute be adopted to cover the region with a step-wise plan to carry out paleoseismological investigations in various geological units of the Arabian Plate that are not fully investigated or areas with faults defined by geophysical anomalies without evident active surface manifestation. This will involve satellite photo analysis, geomorphologic studies, structural analysis of major geological units in the area plus quaternary deformations evident on shallow subsurface geological markers (if any). The other major component is the plan to deploy microearthquake networks in areas which has geological indicators of past faulting activity or newly defined suspected faults through the previously mentioned paleoseismological investigation to verify the state of activity of the suspected fault systems. A proposed fault parameters database, which could be part of a more elaborate geological and geophysical database for each country in the region, will be the major resource for the entire region to compile an updated high precision fault maps on which accurate seismic source models can be proposed for the PSHA of the wider Arabian Plate region and its surroundings in general and the Arabian Gulf states in particular. The paper presents a draft proposal for a long term coordinated project executed jointly between the concerned states in the region represented by their respective seismological institutes and the geology departments which could assign their postgraduate students to implement different components of the whole plan.

The Euro-Med Seismological Bulletin: A picture of the last 10 years of seismicity in the region

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For more than 10 years, the EMSC has been working on the Euro-Med Bulletin (EMB). It aims at producing a reliable and accurate picture of the seismicity for events greater than 3 in an area from Iceland to Oman and from Morroco to Russia. It is based on more than 70 individual seismological bulletins provided by local and national network operators representing 2 300 stations and covers now the last 10-years of seismicity.

On the current integration process of the Euro-Med seismological community

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The Euro-Med seismological community has been undergoing over the last years a unique integration process. It was first initiated by the scientific community itself and led to the creation of EMSC and ORFEUS, two complementary, non-profit NGO. Today, it is supported at the political level as illustrated by the GMES (Global Monitoring of Environnement) and GEO (Global Earth Observation) initiatives and it plays a key role in the establishment of regional tsunami warning centre.

The key elements on the process are data sharing, defining standard and procedures in an open source mode to limit redundant developments and coordinating national policies. The core funding comes from the European Commission but neigbouring countries are being more and more involved and on this aspect, the recent experience of Northern African countries will be presented.

The aim of this talk will be to present this unique experience and how it could benefit the GSF community which has been pursuing similar goals since the first GSF meeting.

Seismic velocity structure of Sinai Peninsula from modelling of Rayleigh wave dispersion

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The lithospheric structure of the Sinai Peninsula is shown by means of nine shear velocity profiles for depths raging from zero to 50 km, determined from the Rayleigh wave analysis. The traces of 30 earthquakes, occurred from 1992 to 1999 in and around the study area, have been used to obtain Rayleigh wave dispersion. These earthquakes were registered by a broadband station located on Egypt (KEG station). The dispersion curves were obtained for periods between 3 and 40 s, by digital filtering with a combination of MFT and TVF filtering techniques. After that, all seismic events were grouped in source zones to obtain a dispersion curve for each source-station path. These dispersion curves were inverted according to generalized inversion theory, to obtain shear wave velocity models for each source-station path, which is the main goal of this study. The shear velocity structure obtained for the Sinai Peninsula is shown through the shear velocity distributions with depth. These results agree well with the geology and other geophysical results, previously obtained from seismic and gravity data. The obtained velocity models suggest the existence of lateral and vertical heterogeneity. The shear velocity increases generally with depth for all paths analyzed in the study area. Nevertheless, in some paths a small low velocity channel in the upper or lower crust occurs. Along these profiles, it found that the crustal structure of the Sinai Peninsula consists of three principal layers: upper crust with a sedimentary layer and lower crust. The upper crust has a sedimentary cover of 2 km thick with an average S-velocity of 2.53 km/s. This upper crust has a variable thickness ranging from 12 to 18 km, with S-wave velocity ranging from 3.24 to 3.69 km/s. The Moho discontinuity is located at 30 km of depth, which is reflected by a sharp increases in the S-velocity values that jump from 3.70-4.12 to 4.334.61- km/s.

The high-resolution gravimetric geoid of Tunisia

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In spite of the difficulty to obtain data for the African continent, the necessary measurements for the determination of a high-resolution geoid for Tunisia have been collected. The method used in the computation of the geoid has been the Stokes integral in convolution form, because it is an efficient method to reach the proposal objective. The terrain correction has been applied to the gridded gravity anomalies, to obtain the corresponding reduced anomalies. The indirect effect has been also taken to account. Thus, a new geoid is provided as grid data distributed for Tunisia; on a 401x561 regular grid with a mesh size of 1.5'x1.5' and 224961 points in the GRS80 reference system. This calculated geoid and previous geoids existing for this study area (MGG97 and EIGEN-CG01C), are compared to the geoid undulations corresponding to 12 GPS/levelling points on Tunisia. The new geoid shows an improvement in precision and reliability, fitting the geoidal heights of these GPS/levelling points with more accuracy than the other previous geoids.

ARTA GEOPHYSICAL OBSERVATORY (Rep of Djibouti) Networks, seismicity and deformations

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CERD (Centre d'Etudes et de Recherches de Djibouti), formerly ISERST, operates, in collaboration with IPGP (Institut de Physique du Globe de Paris), the Arta Geophysical Observatory since 30 years to monitor the telluric activity of the Republic of Djibouti and surrounding areas by different techniques. A permanent network of now 16 short period seismic stations distributed around Gulf of Tadjourah and Asal Rift and radio-telemetred to Arta allows to detect and analyse local earthquakes with low level threshold of magnitude (from 0 to 1.5 depending on the area). The seismicity is mainly localized in a 1015-km wide stripe oriented N45° along the Gulf of Tadjourah (a succession of deeps linked by N45°N transform faults) and emphasizes the trench of the Gulf of Aden trench till longitude 4430°E. Focal depths indicate that the brittle crust has a maximum thickness of 1215- km. In the Asal rift the seismicity concentrates mainly below the Fiale volcano at shallow deep (25- km). The fault flanking the rift on the northern side is also active. More westwards the seismicity is diffuse and affects a large part of the country, mainly the Pleistocene depressions (Hanle, Gagade, etc.) and Makarassou area. Several magnitude 5 to 6.2 earthquakes occurred during the observation period, with one volcanic eruption (Ardoukoba) in the Asal rift in 1978. Coulomb stress changes can be calculated.

After the seismo-volcanic episode in 1978 during which 2m movements were observed through the Asal rift–Ghoubbet Bay, periodic measurements were carried out, and recently permanent GPS stations have been set up. Measurements show that the northern flank of the Asal rift continues to move away at a ~1.5 cm/year rate along a main direction N45° from the south flank (Somali plate). Northern block Tadjoura-Obock follows the same direction with at 1 cm/year.

The upgrade of the seismological and GPS networks (not yet founded) have been designed with satellite transmission, broadband sensors, accelerometers and high dynamic data loggers with real time digital transmission and automatic analysis. Virtual networking with the other regional observatories would allow accurate locations of earthquakes in the whole Afar Triangle (Red Sea, Yemen, Ethiopia, Djibouti and Gulf of Aden).

Activities of IISEE and the New UNESCO Project

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The International Institute of Seismology and Earthquake Engineering (IISEE), at the Building Research Institute (BRI), Japan, was originally established in January 1962 as an organization dedicated to training to researchers and engineers in developing countries and to carrying out researchers to contribute to earthquake disaster mitigation. Currently, IISEE carries out training courses with the Japan International Cooperation Agency (JICA) and offers following three training programs: 1) Annual Training on Seismology and Earthquake Engineering, 2) Global Seismological Observation Course, and 3) Individual Course. A total of 1,320 participants from 94 countries have completed the training courses, and these courses have received high praises in Japan and around the world. The IISEE-net (information network of earthquake disaster prevention technologies for buildings), which is accessible via the IISEE website, is effectively used by participants for their follow-up studies. Our new activities are as follows.

Gigantic tsunami generated by a major earthquake off Sumatra in 2004 wreaked havoc in the coastal areas of the Indian Ocean. In response, the Tsunami Disaster Mitigation Course was established as one of the annual training in October 2006 to provide advanced education in earthquakes and tsunami, with the aim of training tsunami specialists who can apply and diffuse their acquired knowledge and techniques in tsunami disaster mitigation in their home countries.

Since October 2005, a part of the annual training course in partnership with the National Graduate Institute for Policy Studies (GRIPS) was certified as GRIPS's lecture course. Today, each trainee can get 'Master of Disaster Mitigation' certified by GRIPS and BRI if he/she acquires required credits. On September 2006, 19 participants became the first graduates under new system. With diplomas, participants secure their complete background as specialists in seismology and earthquake engineering back in their home countries.

In cooperation with UNESCO, the Japanese Government offered annual training courses from 1963 to 1972. Since 1972, the Japanese Government has continued to offer these courses independently. UNESCO sent experts to IISEE from 1985 to 1995. The outcomes of these courses were reappraised later, and UNESCO dispatches experts again in 2007. Furthermore, the IISEE and UNESCO have established the International Platform for Reducing Earthquake Disaster (IPRED) in June 2007. The IISEE acts as the Centre of Excellence of the project and assists in implementing the activities and maintenance of the platform for collaborative research, training and education regarding seismology and earthquake engineering.

Mean Peak Ground Acceleration, Spectral Acceleration and Uniform Hazard Spectrain Northern Algeria

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TA new probabilistic seismic hazard assessment for Northern Algeria has been carried out. To do it, the used catalog for this study mainly consists of those published by the Spanish IGN, supplemented for the Algeria zone with data published by the CRAAG, and initially updated to 2002. The data published for the region by the EMSC and by the USGS have also been incorporated into the data file. Afterwards, the catalog was updated to June 2003, including the 21 May 2003, M 6.8, Algiers earthquake. The non poissonian event identified via EPRI methodology have been removed, four complete and Poissonian seismic models were established and used, considering the seismic characteristics of the catalog: those with a seismicity of a)

M ≥ MS 2.5 after 1960; b) M ≥ MS 3.5 after 1920; c) M ≥ MS 5.5 after 1850; and d) M ≥ MS 6.5 after 1700. The spatially smoothed seismicity approach was used to the calculation of the seismic hazard. The reason is this methodology combines both parametric and non-parametric probabilistic methods. Besides, it is well adapted to model disperse or background seismicity, i.e., the seismicity that cannot be assigned to specific geologic structures. Initially, this approach was proposed and developed by Frankel (1995). Seismic hazard map in term of PGA with 10% probability of exceedance in 50 years are obtained for rock, which correspond to seismic hazard map for a return period of 475 years. Afterward, we have derived SA values for rock (vS > 750 m/s), corresponding to soil types A in the Eurocode 8 and S1 in the Algerian building code, damped at 5%, for different periods. The obtained results were plotted as contour maps as well. In addition to the seismic hazard assessment at different periods, we have computed the UHS at different locations. The used attenuation model allows us a high definition in the computation of the spectra.

Finally, from the computed uniform hazard spectra for different type of soils, and estimated specifically for the most important cities, those obtained for a return period of 475 years and a 5% of damping, are proposed as design spectra.

We have used the Newmark-Hall (1982) approach with certain modifications. The spectral acceleration for 0.2-sec is used to establish the spectral region for lower periods (region controlled by the acceleration), while spectral acceleration value for 1.0-sec is used to establish the spectral region for intermediate periods (region controlled by the velocity), as such it is proposed in the most recent International Building Code.

KOERI Turkish Broad-band (BB) Seismic Network Project and Application

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Turkey is one of the most seismically active countries in the continents of the world. The stress and deformation of the result of different movements of the plates has lead to a high seismic activity in the region. The distrubition and density of seismic stations are very important in order to observation and evaluation for the seismic activity of the country. After 1999 Earthquakes (Golcuk Mw= 7.4 and Duzce Mw= 7.2) it was noticed importantly of that the density of the seismic stations is not enough for reliable seismic observation.

After 2000 years, the broadband stations had installed in the southwestern and southeastern of Turkey with special projects. Today, Kandilli Observatory & ERI (KOERI) has about 75 broadband (BB) seismic stations in the whole of Turkey.

Particularly, the data transmission is provided with satellite to the center at the last installed broadband stations. In the Turkey the first braodband station had installed by KOERI-NEMC on August 17, 2002 (Kalafat et al., 2002). Now, 66 broadband stations (BB) are operated with satellite by KRDAE.

Two important studies of the NEMC is below;

If the positions and backgrounds of the short period stations is good that would changed progressively with broadband stations.

2. The select locations of seismometers and the construction of the backgrounds for

   new broadband installations.

The minimum station number was calculated with Monte Carlo method in order to determination of location parameters of earthquakes with magnitude larger than M> 3.0 that occur in Turkey. The result of this study, about 100 broadband stations are enough in Turkey for seismic observation. About 75 % of the project had just prepared to yet but all of it would be finished at the end of 2009 year.

One of the original aims of the KOERI-NEMC is to determine automatically the preliminary locations and moment tensor solutions of earthquakes with magnitude larger than M> 4.5 in Turkey. On the other hand, the case study about installation of sea bottom observatory (SBO) in the Marmara Sea and the preparation of shaking maps (SM) and the digital data bank based on GIS programme take place between important studies of KOERI for disaster management in the near future time.

SEISMIC MONITORING OF STRUCTURES - A TOOL FOR URBAN SEIZMIC HAZARD REDUCTION

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Data on the ground motion during earthquakes to which structures are exposed and behaviour of struc-tures are fundamental for seismic hazard evaluation, definition of design parameters and criteria and for all other dynamic investigations in earthquake engineering. Without such data all investigations and analysis that follow would be based on assumptions. The irregularity in earthquake occurrence makes difficult the possibility to obtain immediately the most useful data.

One of the possible ways to solve these problems is to establish a network of a greater number of in-struments for recording ground motion and response of structures during strong earthquakes. The main objective in seismic monitoring of structures (high-rise buildings, dams, power plants, bridges etc.) is to facilitate response studies that lead to improved understanding of the dynamic behavior and potential for damage to structures under seismic loading.

The installation of networks for recording of strong earthquakes and the results which are obtained from them, has become an increasing need in the earthquake engineering and has considerable contribution to the overall activities for seismic risk reduction of existing urban media and for the minimizing of the damage to these structures under the effect of disastrous earthquakes.

As a result of this understanding, design and construction practices can be modified so that future earthquake damage is minimized. Therefore, there are significant implications in (a) hazard reduction, (b) improvement of codes, (c) identification of seismic response characteristics of structural system that may be used in determination of strategies for improvement of their performances.

The application of the results is equally important both for the theoretical and fundamental investiga-tions in the field of earthquake engineering and for application and practical investigations in the earth-quake engineering.

Keywords: Seismology; Strong Motion; Seismic Monitoring; Seismic Hazard, Data Processing; Re-sponse Spectrum

The NERIES project: A major step towards a better integration of the seismological community

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NERIES (Network of Research Institutes for Earthquake Seismology) is a 12 M€ European project funded within the so-called 'Research Infrastructures' theme, part of the EC political initiative to build the European Research Area. Jointly initiated by ORFEUS (Observatories and Research Facilities for European Seismology) and EMSC (European Mediterranean Seismological Centre), the project consortium comprises 25 partners from 13 countries. The EC funding rules are constrained to networking, providing access to a number of research facilities, and research projects aimed at improving the operation of the infrastructure.

NERIES implements European real-time data exchange tools, web application tools and distributed data archive technologies making large amounts of earthquake parameter and waveform data available to the global research and the hazard mitigation community. Developing efficient data mining tools, station site response tools and exploratory OBS deployments are part if this effort. Simultaneously, NERIES research groups are developing the European reference velocity model, time varying seismic hazard models, implementing shakemaps together with loss estimation tools. The earthquake research infrastructure as aimed at by NERIES will be a key land-based segment of the GMES and the GEO 10-years implementation plan.

In this presentation we will provide a current overview of the activities and emphasize the opportunities to participate and benefit from the development also as non-consortium members within the European earthquake seismology community. http://neries.knmi.nl

THE EFFECT OF (26 DEC.2004) INDIAN OCEAN TSUNAMI ON YEMEN SEA SHORES

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In effects, Yemen located at the southern part of the Arabian plat, bounded mainly with two tectonic rifts; which are: the Red Sea rift from the west and the Gulf of Aden rift from the south .This plat divergently separates from Africa 16 mm/year in a 37 NE direction,. The earthquakes occurring along these zones are not responsible for Tsunami.

Nevertheless, as all ocean regions of the world can experience Tsunami, Yemen is among affected Asian countries along the northern coast of the Indian Ocean. Consequently, the tsunami generated by (December 26, 2004, M9.0) northwest Sumatra earthquake has attacked some parts of Yemen seashores, especially, at Al-Mahra , governorate and Socatra island Shores.

The wave's amplitude was approximately 6 meters that struck the coasts of the above-mentioned regions causing high damages to fishing boats and considerable properties. One child and one angler died, and some people injured. Many sea animals died and coral reefs destroyed. The water traveled hundred meters inland. Yemen Seismological Networks recorded seismic waves of the main event and some big after shocks picked too. Unfortunately, as we haven't any early warning oceanic system such as tidal gauge, the phenomena couldn't be predicted.

Observation of authorities and the local people indicate that the first tsunami wave hit Yemen coastline at around 2: pm local time (11: am GMT) .The second and bigger one was recorded to hit the coastline at 8:30 pm (5:30 GMT) on 26 December 2006.

Historically, the southern coast of the Arabian Peninsula has affected by a tsunami. It was resulted due to the eruption of 1883 Karkatau volcano, located in the Sunda straits between the islands of Sumatra and java.

Key words: Tsunami, Socatra Island, Yemen seashores
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