seismicity,tectonics and crustal deformation inredasea region

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This work is devoted to use an integrated Global Positioning System (GPS), structural and seismological data for the investigation of recent crustal kinematics and deformations in the seismo-active Red Sea region. The seismological data were used for processing the focal mechanism solutions as a combined solution. Modeling of kinematics and dynamics of active rifting in the Northern and Southern Red Sea is addressed to relevant mechanics of early continental rifting and the current rates of opening across the rift. The Global Positioning System (GPS) -observations collected from both Egypt and Yemen are used to measure the present day styles and rates of extension, as well as rift-margin deformation along the extent of the Red Sea rift.The GPS campaigns between Egypt and Yemen were measured on April 2000 and November 2001, respectively. Planning, establishing and measurements of these stations were carried out by the author in collaboration with the staff of the National Research Institute of Astronomy and Geophysics (NRIAG), Helwan, Egypt and staff members of the Department of Earth and Environmental Sciences, Sana'a University, alongwith Geological Survey and Mineral Resources Board. Sana 'a, Yemen.Processing of the collected data played a significant role in understanding and threw much lights on the geodynamical regime of the area, and also in evaluating the general framework of the whole Red Sea region. Analyses of the first and second epoch of GPS measurements indicate that the magnitudes of the movements, together with the deformational fields of the geodetic points, are small. from the tectonic point of view, this is attributed to the shortness of the period of measurements (only two years). In order to get good results about the crustal movements, repetition of the measurements on the same geodetic points is recommended.It is worthy to mention here that the magnitudes of movements and the deformational field may reach up to 20 mm in some points close to the Red Sea, such as those in Hodiedah (Yemen) and Dahab (Egypt). This is probably due to the direct effect of the spreading movement. Moreover, the directions of movements on these points are relatively opposite to each other. Such results are in harmony with the general trend of the tectonics in the Red Sea region.Separate analyses of GPS measurements on geodetic points in Yemen relative to each others show a rate of displacement about 3 mm. In both Sana 'a and Aden, the direction of movement on Sana 'a is SW and on Aden is NE.Seismicity of the Red Sea was interpreted in relation to the African rift, the Gulf of Aden and the Arabian Sea. The most active area of the Red Sea is associated with the axial

deep trough and is located between the mouth of the Gulf of Aden and the latitude 20°N.The seismicity of the Gulf of Aden indicates a tensile stress as the main force in the region; the crustal separation took place along the center of the Gulf. The seismically active zone of the Gulf of Aden continues westward to the African Rift Zone. It does not connect with the Red Sea seismic zone by the same manner, as the latter was connected to the Mediterranean through the Gulf of Suez until late Miocene early Pliocene.The epicentral distribution of events enabled us to distinguished five seismic active regions; three regional (Gulf of Aden-Afar, -Southern Red Sea and Sheba Ridge), and two local (Yemen Plateau and Hadramout Mahra Uplands). The focal depth distribution, which gives us a good idea about the source of seismic activity in each region, was plotted as cross-sections. In the Gulf of Aden-Afar and Southern Red Sea regions, the seismic activities are controlled by volcanic activity. On the other hand, two seismic zones clearly observed in Sheba Ridge region. In Yemen Plateau, three trends were distinguished, one demonstrates a vertical trend which indicates the volcanic activity, whereas the other two trends dip towards the east with variable angles, indicating that the tectonic and deep structures are controlling this region.Focal plane solutions of about seventy eight (78) earthquakes by Harvard CMT have used to study the regional tectonic stresses. The results reveal that the Red Sea region is dominated by a tensional stress, which causes normal faults along the main trend of the rift and this stress is in semicircular direction, and its center may be located in the Arabian plate. There are different earthquake sources in Yemen, where some earthquakes are volcanic and others are tectonic.