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Source Characteristics of Earthquakes along the Hellenic and Cyprus Arcs and Simulation of Historical Tsunamis

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Throughout the recorded history, earthquakes have been the most damaging natural disasters and they have affected the Eastern Mediterranean coasts. Due to the tectonic motions between African, Arabian and Eurasian plates, this region has a complex tectonic regime and intense seismic activity with strong earthquakes observed in historical and recent times. Subduction of the Mediterranean lithosphere beneath the south Aegean Sea is the main reason of the active seismicity and deformation along the Hellenic arc system. We have studied the source mechanism solutions and spatio-temporal slip distributions of the earthquakes ($M \geq 5.0$) and historical tsunami wave propagation occurred along the Cyprus and Hellenic arcs to clarify our understanding of the tectonic process and structural features in the Eastern Mediterranean region. We have used teleseismic long-period P- and SH-, broad-band P-waveforms, and first motion polarities of P- waves recorded by GDSN stations to obtain the source parameters of the earthquakes using body-waveform inversion method of Nábélek (1984) and Taymaz (1990). We have also obtained rupture histories of the earthquakes by using inversion scheme of Yagi and Kikuchi (2000). Earthquake geometry (source depth, strike, dip, rake angles), amount of slip on the centroid and the fault surface, faulting area, seismic moment (energy), location (distance from shore and centroid depth) and beach geometry (water depth and beach slope) are vital parameters of numerical models for tsunami simulations. In addition, the bathymetric configuration of the region has an important role for determining the amount of flooding or inundation that the tsunami

will cause. As a case study, we have investigated the tsunami wave propagations to obtain time histories of water surface fluctuations and water particle velocities created by historical May 1222 Cyprus (M∼7.0) and August 13, 1822 Iskenderun earthquakes (M∼7.4) in the Eastern Mediterranean sea using a mathematical model developed by Imamura (1995). The style of seismic deformation along the Cyprus and Hellenic arcs is derived from source mechanism solutions and spatio-temporal distribution of the moment release of the earthquakes. Inversion results reveal that normal and strike slip faults that are due to the known expansion of the Aegean Sea are observed in the inner part of the shallow crustal layer along the Hellenic arc. Furthermore, thrust faulting mechanisms dominate in the outer part of Hellenic trench due to the convergence between the Aegean and the Eastern Mediterranean lithospheres. Compared with the Hellenic arc, the Cyprus arc is less active. Most of the earthquakes are concentrated along the southwestern part of the Cyprus arc and earthquake mechanism parameters mostly show right-lateral strike-slip faulting with thrust component. Our studies and previous source mechanism solutions exhibit its characteristics and structural complexities associated with strike-slip, thrust and normal faulting as a result of ongoing deformation.

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