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Earthquake Source Rupture Characteristics Along the Hellenic Arc and Simulation of the AD 365 Crete Earthquake and its Tsunami

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We have obtained the source mechanism parameters, spatio-temporal slip distributions of the recent earthquakes (M $\geq$ 5.0) and historical tsunami wave propagations occurred along the Hellenic arc to clarify our understanding of the tectonic process and structural features in the Eastern Mediterranean region. Tsunami waves that cause extensive destruction and even significant loss of human lives can be observed when earthquakes or landslides occur on ocean floors and they set in motion the entire water column above the affected region, resulting in long-wavelength waves proceeding to strike on surrounding shores. Throughout the recorded history, earthquakes and also related tsunamis have been the most damaging natural disasters and they have affected the Eastern Mediterranean coasts. Historical studies exhibit a notable earthquake, that of 21 July AD 365 (M $\sim$8.5), which destroyed nearly all the towns in Crete and was followed by a tsunami devastating the Nile Delta (Guidoboni et al., 1994, 2005).

Teleseismic long-period P- and SH-, broad-band P-waveforms, and first motion polarities of P- waves recorded by GDSN stations have been used to obtain the source parameters of the earthquakes using body-waveform inversion method of Nábélek (1984) and Taymaz (1990). To determine the rupture histories of the recent earthquakes along the Hellenic subduction zone, the inversion scheme developed by Yagi and Kikuchi (2000) is used in this study. Tsunami propagation can be also accurately evaluated by using the high resolution bathymetry data. Futhermore, the other important parameters of numerical models for tsunami simulations are faulting geometry (source depth, strike, dip, rake angles), amount of slip on the centroid and the fault surface, fault area, seismic moment (energy), location (distance from shore and centroid depth) and beach geometry (water depth and beach slope). Thus, we have investigated the tsunami wave propagations to obtain time histories of water surface fluctuations and water particle velocities created by the July 21, 365 AD Crete earthquake (M$\sim$8.5) in the Eastern Mediterranean sea using TUNAMI-N2 and AVI-NAMI mathematical models developed by Imamura (1995) based on the method of Okada (1985). The related parameters for 365 AD earthquake are adapted by an analogy of current plate boundaries, reported field observations, and earthquake source mechanisms obtained by inversion of teleseismic P- and SH- waveforms.

Inversion results reveal that normal and strike slip faults are observed in the inner part of the shallow crustal layer along the Hellenic arc and they are related to the known extension of the Aegean Sea. Besides, thrust faulting mechanisms dominate in the outer part of Hellenic trench and indicate the convergence between the Aegean and the Eastern Mediterranean lithospheres. Tsunami wave simulation results exhibits that the largest wave amplitudes are calculated at the western part of Crete near the earthquake location and also northern Africa and Turkish coastal plains consistent with the historical documents, and of the reported field observations.

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