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THE KEFALLINIA ISLAND EARTHQUAKE SEQUENCE JANUARY- FEBRUARY 2014

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A significant earthquake sequence was initiated on 26 January 2014 at the western part of the Kefallinia Island. The study area is located in the Ionian Sea (W. Greece) at the northwestern end of the Hellenic Arc – Trench, in a region dominated by the Kefallinia - Lefkada transform fault, which exhibits dextral strike–slip motion at a rate of 2–3 cm year^{-1} (Kahle et al., 1996; Cocard et al., 1999). This region is situated between the Hellenic subduction zone to the south and the Apulia - Eurasian collision zone to the north. Focal mechanisms reveal right-lateral strike-slip motion (Anderson and Jackson, 1987; Jackson and McKenzie, 1988), coherent with geodetic data, according to which the slip motion has a NNE–SSW direction (Cocard et al., 1999; Jenny et al., 2004).

During the historical period, until 1900, 13 earthquakes with magnitude M≥6.0, have been reported in the Kefallinia region. The strongest event, of magnitude 7.4 and intensity X at Lixouri, occurred on 4 February 1867 (Papazachos and Papazachou, 2003; Stucchi et al., 2012). Major destructions were reported at the villages of the Paliki peninsula, while in Lixouri only two houses did not collapse. Ground ruptures were observed, as well as a tsunami of small height. Rock falls and liquefactions also occurred. In the Paliki peninsula 2612 houses collapsed, while only 4 in Argostoli, the capital and major town of the Kefallinia Island. Since 1900, 11 earthquakes with magnitude Ms≥6.0 occurred (Makropoulos et al., 2012) in the region. Five of them took place in 1953, four of which during August. The largest event had a magnitude equal to 7.3 and maximum intensity X+ in Argostoli. This earthquake was preceded by two strong events (Ms=6.1 and 6.8). The Ionian islands of Kefallinia, Zakynthos and Ithaca suffered very severe damages. Among the 33300 houses, 27659 collapsed. The highest intensities (IX-X) were observed, among other locations, at Argostoli, Lixouri and Valsamata. Thirty years later, on 17 January 1983, an event with magnitude Ms=7.0 occurred approximately 30 km SW of Lixouri, causing moderate damage. The most recent moderate event (Mw=5.6) occurred on 25 March 2007, 5 km NE of Mirtos Bay.

On Sunday 26 January 2014 (13:55 GMT) a strong shallow earthquake of magnitude Mw=6.1 occurred in the study area. The epicenter is located about 2 km NE of Lixouri. It is worth noting that no significant earthquake sequence was recorded at the Paliki Penisula during the last decades. The main shock and the aftershock sequence were recorded by seismographs of the Hellenic Unified Seismological Network (HUSN), which involves the Seismological Laboratories of the Athens and

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Ground motion of the 26-1-2014 mainshock (Mw=6.1) was recorded by three permanent accelerographs located in Argostoli, Lixouri and Vassilikiades (ITSAK-EPPO, GI-NOA) with the response spectra in Lixouri indicating high horizontal acceleration. Moreover, the vertical component exhibited high spectral acceleration at a lower period when compared to the horizontal ones. Similar pattern is observed for the next strong event, which occurred on February 3, 2014 (Mw=5.9). A temporary accelerograph installed complementary to the permanent stations by GI-NOA in Chavriata, south of Lixouri, recorded an effective acceleration of 1g for the latter event, surprisingly exceeding the Greek Seismic Code provisions (0.36 g), being the highest recorded in Greece.

The aftershock sequence was intense, while five hours after the mainshock, an aftershock of magnitude Mw=5.2 occurred. This sequence continued for a week with more than 30 events having magnitude greater than 4.0, till the occurrence of a strong earthquake of magnitude Mw=5.9. Its epicenter was located at the northwestern part of the Paliki peninsula. The earthquake sequence consists of more than 2000 events, the focal depths of which range mainly between 4 and 18 km. The aftershocks spatial distribution indicates that the activated seismogenic area is about 30 km length, in a NNE direction, located onshore in Paliki peninsula. At least three clusters can be distinguished. It is bounded to the south by the Vardiani islet and to the north by Myrto's bay.

The source parameters determination of the two strongest events were determined using body-wave modeling and teleseismic recordings. Synthetic waves are calculated by the trial-and-error method to determine the focal mechanism, the focal depth, and the seismic moment for a single trapezoidal source time function (Papadimitriou et al., 2006). Focal mechanisms of the strongest aftershocks have also been determined using the moment tensor inversion method developed by the Seismological Laboratory of the University of Athens (Papadimitriou et al., 2012). The data used are digital waveforms, recorded in regional distances by stations of HUSN. The observed seismograms were band-pass filtered between 0.02 Hz to 0.08 Hz. Following, Green Functions were calculated using the method proposed by Bouchon (1981). The inversion method revealed strike-slip focal mechanisms, in agreement with the fault plane solutions of the two main shocks. The results point out a dextral strike-slip rupture, oriented in a NNE-SSW direction. Taking into account both the aftershock spatial distribution and the focal mechanisms, it is concluded that the activated area does not coincide with the regional catalogue seismicity that is attributed to the Kefallinia - Lefkada transform fault, located offshore. Hence, activation of a sub-parallel major fault can be considered, compatible with the active tectonics of the region, which is crucial for its seismic hazard.

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