EVOLUTION OF SEISMICITY IN CENTRAL IONIAN ISLANDS, GREECE: IMPLICATIONS OF RECENT SEISMIC SEQUENCE FOR GEODYNAMIC PROPERTIES AND SEISMIC HAZARD ASSESSMENT

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Introduction

The area of central Ionian Islands, comprising Lefkada and Kefalonia, is characterized by remarkably high seismic activity, with frequent strong ($M \geq 6.0$) earthquakes that have caused severe casualties and damage during the last six centuries since historical information is available. The spatial distribution of the most disastrous events in Lefkada and Kefalonia Islands, even with an epicentral uncertainty of some kilometers, reveals that they all occurred along a narrow corridor either side of the western coastlines of both Islands, onto fault segments constituting the Kefalonia Transform Fault Zone Fault (KTFZ). Local scale earthquake location studies of small magnitude earthquakes lend insight into seismogenic zone processes and are well suited to define the geometry and volume of the seismogenic zones and to constrain their thickness along strike and downdip. Detailed investigation of the aftershock sequences of four main shocks with $M_w \geq 6.0$ that occurred in the study area between 2003–2015 shed light on the seismogenesis and geodynamics of the area.

Results and conclusions

On August 14, 2003 the Lefkada Island (Central Ionian) was strongly affected by an M_w=6.2 earthquake. A dense temporary seismic network was installed one day after and the accurately located hundreds of aftershocks define in detail the main rupture, as well as the activity distribution on the neighbouring fault segments (Karakostas et al., 2004). Although the Lefkada fault was known as being associated with strong ($M \geq 6.0$) earthquake occurrence, its geometry was not detailed since it is the first time that accurately located aftershock hypocenters by a local digital network are available for this scope. Dipping to the east the activated fault constitutes a major threat for the constructions, since the earthquake foci are located directly underneath the urban areas of the island.

The aftershock spatial distribution revealed the activation of along strike adjacent fault segment as well as of secondary faults close to the main rupture (Karakostas and Papadimitriou 2010). The properties of the activated segments were illuminated by the precisely located aftershocks, fault plane solutions determination and the cross sections performed parallel and normal to their strike. The results help to emphasize the importance of the identification of activated nearby fault segments possibly triggered by a main rupture. Because such segments are capable to produce moderate events causing appreciable damage, they should be viewed with caution in seismic hazard assessment in addition to the major regional faults.

The spatial distribution of seismicity and fault plane solutions were further used to specify the properties of the major faults in the study area and further identify secondary active ones and to constrain their geometry and kinematics. The yielding location improvement contributes to the geometry identification of the active structures, which were previously obscured by location errors, and which constitute a critical input for the study area seismic hazard assessment (Karakostas et al., 2010).

The 2014 Kefalonia earthquake sequence started on 26 January with the first main shock (M_w 6.1) and aftershock activity extending over 35 km, much longer than expected from the causative fault segment. The second main shock (M_w 6.0) occurred on 3 February on an adjacent fault segment, where the aftershock distribution was remarkably sparse, evidently encouraged by stress transfer of the first main shock (Karakostas et al., 2015).

The 2015 M_w6.5 earthquake occurred in the geographical vicinity of the 2003 event, again accommodating right–lateral strike slip motion (Papadimitriou et al., 2017). The distribution of aftershocks implies static stress transfer to secondary faults accommodating deformation during the activation of the main faults in a

fault population. Off–fault aftershocks occurred in areas brought closer to failure by some bars, whereas the strongest of them occurred in short time lags.

The consecutive failure since 2003 of the four adjacent fault segments that are located along the western coasts of Lefkada and Kefalonia Islands and belong to the KTFZ, as it was already mentioned above, with earthquakes of $M_w \geq 6.0$, demands the examination of whether these shocks constitute a cascade triggered by stress transfer.

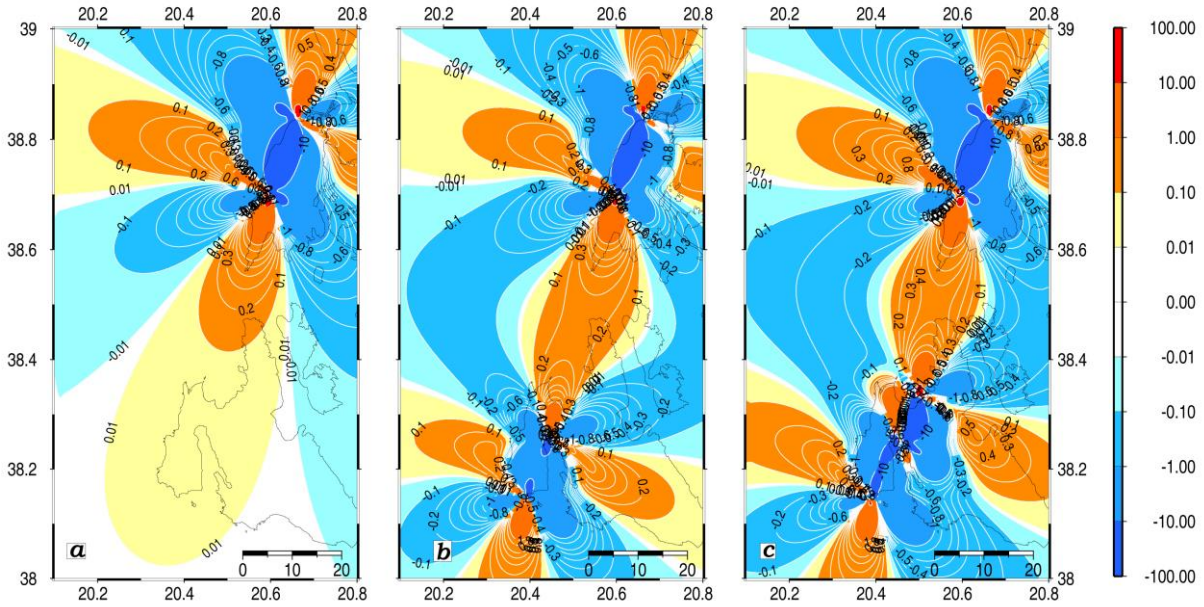

Figure 1. *Coulomb stress changes due to the coseismic slips of the M≥6.0 main shocks that occurred in central Ionian Islands since 2003, calculated at a depth of 8 km. Changes are according to the scale of the top (in bars) and by the numbers in the contour lines. The stress field is calculated according to the faulting type of the 2015 main shock and is due to the coseismic slip of (a) the 2003 main shock, (b) the 2003 and the first 2014 main shock, and (c) the 2003 and both 2014 main shocks (from Papadimitriou et al., 2017).*

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