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VELOCITY STRUCTURE OF THE UPPER CRUST OF WEST CORINTH GULF FROM P AND S ARRIVAL TIMES USING 3D RAYTRACING

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The Gulf of Corinth (Greece) is one of the most active extensional continental regions in the world. The high rates of seismicity of this continental rift have brought the Corinth Gulf into the spotlight of international seismological research. This active asymmetric half-graben, trending WNW-ESE, has an approximate length of 120 km and width of about 25 km. It is dominated by normal faults trending approximately E-W with N-S extension (King et al., 1985; Rigo et al., 1996; Bernard et al., 1998). Some well-known features are the Psathopyrgos, Helike and Xylokastro faults, dipping north and striking E–W, located along the southern shore of the Gulf. The long history of repeated large earthquakes and the existence of high level background seismicity (Papadimitriou et al., 2010; Makropoulos et al., 2012) led to the installation of several digital three-component seismographs around the Gulf by the Seismological Laboratory of the University of Athens, aiming towards the accurate monitoring of the activity. Additional stations are located in the region, belonging to the Hellenic Unified Seismological Network (HUSN), initiated in 2008. Furthermore, the Corinth Rift Laboratory (CRL) operates at the western part of the Gulf during the last decade, at an area where the dense station coverage allows the accurate hypocentral location and the determination of a velocity structure using the weighted P- and S-wave arrival times. Additionally, later arrivals are identified and used to the construction of a crustal velocity model which plays a key role in revealing the mechanisms that contribute to both the crustal deformation and the tectonics of the upper crust.

In the broader region of Corinth Gulf more than 8000 earthquakes were manually located since 2011, using the Hypoinverse algorithm (Klein, 1989). The seismicity covers approximately the whole area, but is mainly concentrated within the Gulf, with a depth distribution mainly varying from surface to 12 km. In addition, earthquake clustering has been observed.

Ray-tracing and inversion techniques are applied to determine the velocity structure. A first order selection of the manual events is performed and 3500 earthquakes are selected, fulfilling the following criteria: at least 8 P- and 3 S-wave arrival times for each event, good quality of traces (high signal to noise ratio), azimuthal coverage, variety in both depth distribution and in range of epicentral distances. Due to the high density of hypocenters in certain areas, a supplementary selection was performed, yielding 1050 earthquakes with the best possible spatial distribution (minimum inter-event distance required). The SW3D software is used to determine the crustal structure of the study area, allowing the computation of rays, their times of propagation, the slowness vector, the ray-theory amplitudes and the synthetic seismograms in 3D laterally inhomogeneous models (Cerveny et al., 1984, 1988; Klimes, 1990; Bulant, 1999; Bucha, 2006). As a first step, the initial model that is used for manual locations, is parameterized and smoothed to be suitable for ray tracing (Klimes, 2000; Bulant,

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2002). Two-point 3-D ray-tracing is then performed and synthetic travel times are calculated. A non-linear inversion is applied for the final velocity model determination. Additionally, to verify the results, seismic profiles are constructed in certain azimuths with satisfactory station coverage. This procedure requires the selection of events where, apart from the direct P- and S-waves, reflected and refracted phases can clearly be identified. Theoretical hodochrones and observed traces are plotted in different azimuths. The differences between the observed and calculated travel times, common between the profiles in certain locations and azimuths, indicate the need for the required modifications of the velocity model. The use of the above-described techniques aims to the identification of discontinuities and lateral heterogeneities for the determination of a 3-D velocity model.

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