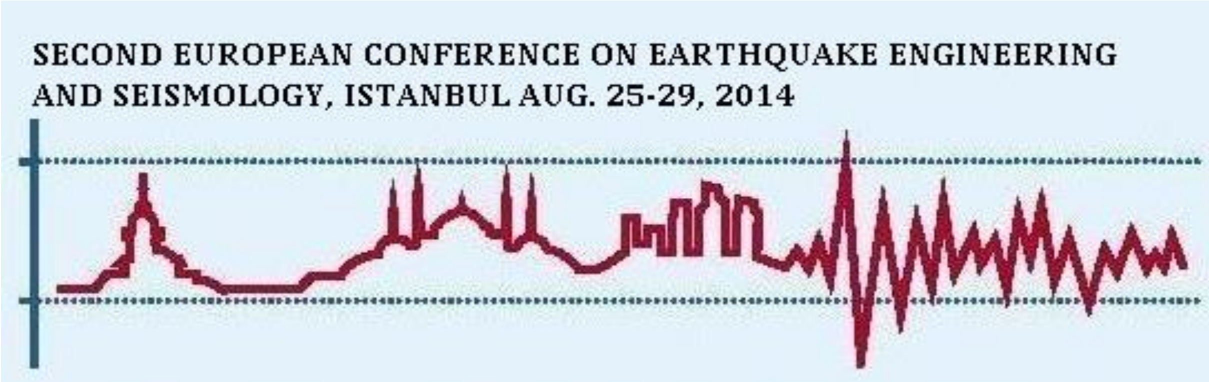

ACTIVE STRESS FIELD OF THE SOUTHERN AEGEAN SUBDUCTION AREA FROM THE INVERSION OF FAULT PLANE SOLUTIONS

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The main target of the present work is to study the active stress field of the Southern Aegean subduction area using data collected from the EGELADOS temporary network, the largest amphibian seismological network ever deployed in the Aegean area between October 2005 and April 2007. The study area (Southern Aegean subduction area) is one of the most active tectonically region of the western Eurasia that lies at the convergence zone of the Eurasian and Nubian lithospheric plates. In this region, the Eastern Mediterranean lithospheric plate subducts under the Aegean microplate, which in turn overrides the Mediterranean plate (e.g. Papazachos and Comninakis, 1971, McKenzie, 1978, Le Pichon and Angelier, 1979). The most prominent tectonic features of the area are the Hellenic trench and the inner volcanic arc (fig.1). The South Aegean active deformation is driven primarily by the fast moving (~35 mm/yr) Aegean upper plate, which overrides a nearly stalled (~5 mm/yr), Mediterranean-Nubian lower plate system (Papazachos et al., 1998; Ganas and Parson, 2009). A well-developed Benioff zone (fig.1) has been identified (e.g. Papazachos et al., 2000), with medium-to-large transpressional intermediate-depth events, mainly occurring in the depth range of 60-90km, with maximum depths of the order of 180km.

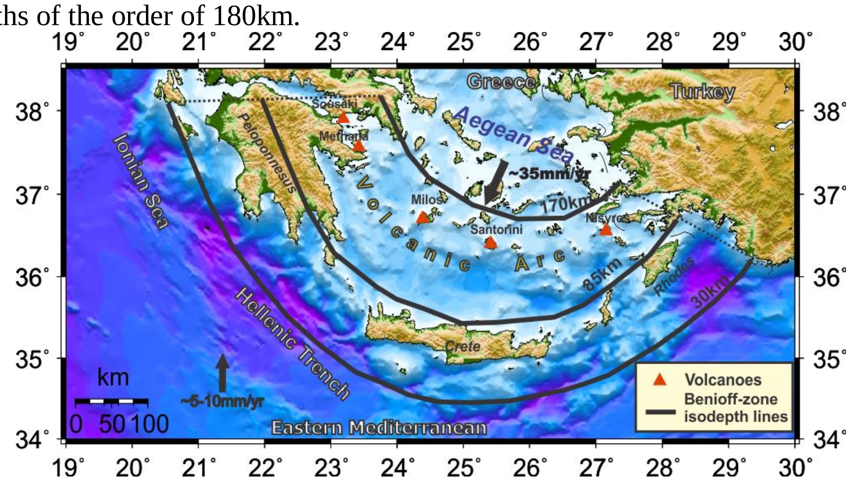

Figure 1. Schematic geotectonic map of the southern Aegean subduction area. Plate motions are depicted by solid vectors. The volcanic arc and the Benioff-zone isodepths are also shown

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Due to the tectonic complexity of the Aegean Sea we have applied the RAPIDINV algorithm (Cesca et al., 2010) in order to determine a large number of new focal mechanism solutions using the EGELADOS network data. These solutions were used to create an updated database, complemented with all previously available focal mechanism solutions for the study area (Southern Aegean Sea). The new database provided the basis for a more detailed examination of the stress field, as this is indicatively suggested by the distribution of P and T axes. The method of Gephart and Forsyth (1984) for inverting earthquake focal mechanism data has been applied in order to determine the active stress field (e.g. fig. 2). The grid search inversion approach of Gephart (1990a, b) has been used for the stress inversion, incorporating the P and T axes of selected focal mechanisms. To confirm the reliability of the results and to provide initial estimates for the stress tensor inversion procedure we have also applied the method proposed by Papazachos and Kiratzi (1992), which is based on the calculation of the "average focal mechanism tensor" (fig. 3).

Combined application of both methods was attempted in selected clusters of focal mechanisms that have occurred in the study area. The results confirmed earlier findings, but also provided a locally revised and more detailed view of the active stress field in the broader Southern Aegean subduction area. In general, 5 main types of active faulting and stress patterns are recognized:

a) Thrust faulting at depths up to 60 km with a dominant NW-SE direction, following the general local trend of the outer Hellenic arc along the Eastern Mediterranean-Aegean subduction front (blue focal mechanisms in fig. 3). The estimated P-axes have a constant strike, almost perpendicular to the arc-strike in its western and central parts, and sub-parallel to the arc in its eastern part,

b) Normal faulting, with T-axes showing ~NNW-SSE to NNE-SSW extension, almost perpendicular to the strike of the volcanic arc, with events occurring in the Aegean crust (depths up to 30 km, red focal mechanisms in fig. 3),

c) Normal faulting with a roughly N-S direction along the sedimentary Aegean arc (Peloponnesus, Crete, Karpathos Island, western Rhodes Island, green focal mechanisms in fig.3). The obtained focal mechanisms exhibit sub-horizontal T-axes, showing along-arc extension, running almost parallel to the strike of the arc, with most events occurring at crustal depths (up to 30 km),

d) Strike-slip faulting with a significant thrust component, corresponding to intermediate-depth events along the subducted Benioff zone (black focal mechanisms in fig. 3). The focal depths are gradually increasing from 50km (in the Crete-Kythira area) to ~100-120km along the southern Aegean volcanic arc and,

e) Strike–slip faulting along the south-eastern edge of the Hellenic arc (brown focal mechanisms in fig. 3), including the Strabo and Pliny trenches, with events extending at depths down to 60 km.

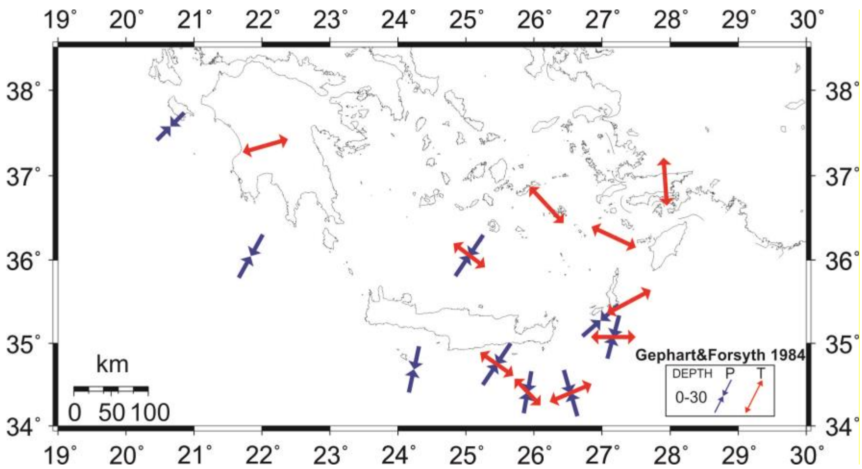

Figure 2. Horizontal projection of P-axes (converging arrows) and T-axes (diverging arrows) from the method of the Gephart and Forsyth (1984) for shallow events occurring at the depth range 0-30km.

In general, the obtained results show a good consistency with small azimuthal differences for the P- and T-axes between the two employed methods (fig. 2 and fig. 3). Moreover these results are in good agreement with the previous knowledge for the study region, showing additional information, such as the dominant dextral character of the Strabo and Pliny trench seismicity, the overlapping of shallow thrust faulting and transpressional focal mechanisms due to down-dip extension in the SW Aegean (Kithira) area and the consistency of the normal fault orientation along the volcanic-arc with the local arc trend (red focal mechanisms, fig. 3).

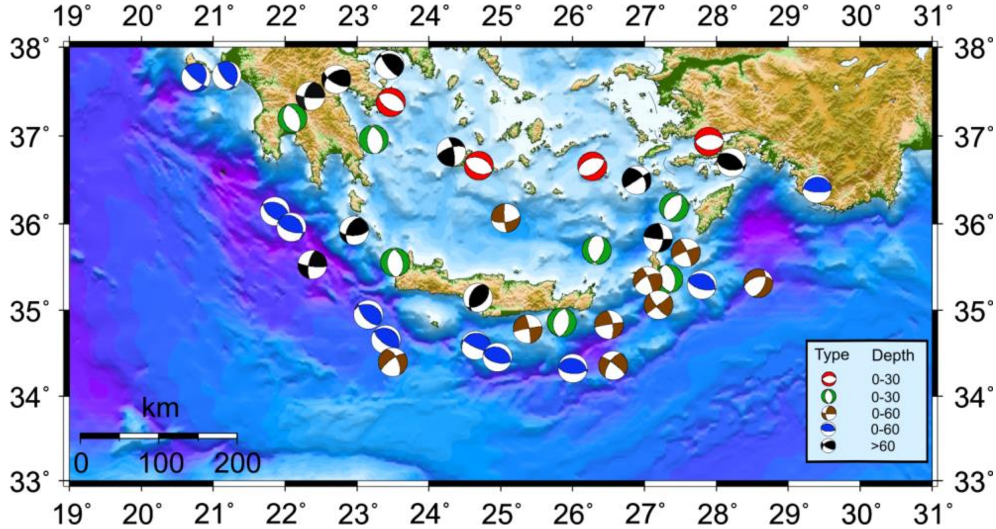

Figure 3. Average focal mechanisms for the broader southern Aegean subduction area using the approach of Papazachos and Kiratzi (1992). Focal mechanisms are classified into 5 main groups, according to their faulting type, associated stress field and hypocentral depth range (see text for explanations).

This work has been partly supported by the 3D-SEGMENTS project #1337 funded by EC European Social Fund and the Operational Programme "Education and Lifelong Learning" of the ARISTEIA-I call of the Greek Secretariat of Research and Technology.

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