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Seismicity Patterns of Microseismicity Clusters observed in the Forearc of the Hellenic Subduction Zone

D. Becker (1), T. Meier (1), M. Rische (1), M. Bohnhoff (2) and H.-P. Harjes (1)

(1) Institute of Geosciences, Ruhr University Bochum, (2) GeoForschungZentrum, Potsdam, Germany

The spatio-temporal evolution as well as the location and the reccurrence period of clusters give us insight into the physical processes at work in the seismically active volume as well as the underlying triggering mechanisms. Clusters of seismic events are known to occure in different tectonic regimes ranging from volcanic and hydrothermal regions to transform faults and subduction zones. Often their occurence is linked to the triggering effect of fluids or pore pressure anomalies while the spatio-temporal evolution within a cluster can often be explained by effects of stress triggering. The study area is situated in the forearc of the Hellenic Subduction Zone south of Crete. In the eastern part of the area oblique subduction of the oceanic African crust combined with the possible effects of slab roll back created a system of deep sea depressions (Ptolemy, Pliny and Strabo trenches) that are situated in a transtensional regime. The University of Bochum operated several temporary short period networks on the islands of Crete and Gavdos in the years 1996-2004. Subsequent cluster analysis of microseismicity data gathered during these observations revealed the occurence of a large number of clusters. While this cluster activity was evident throughout the study area ranging from the plate interface to upper crustal depths the largest activity was manifested in the northernmost transtensional structure (Ptolemy trench) where the activity follows the strike of the structure and indicates a nearly vertically dipping fault zone. The seismic activity of the clusters in this region was generally limited to only a few days or hours. A closer inspection of the largest clusters with respect to their spatio-temporal evolution and their waveform similarities was performed. In this process a relative relocation using travel-time differences derived from waveform cross correlations was incorporated. The spatio-temporal behaviour of single clusters

was investigated quantitatively. For several clusters a migration of the hypocenters was observed and it was possible to give an estimate of the velocity of the observed migration. Furthermore, the calculated cross-correlation matrices for the different clusters were plotted for visual inspection. The investigated clusters showed a great degree of variability and in several cases destinct classes of events which were active at the same time. These distinct classes indicate different source mechanisms being active at the same same. It is not possible to explain this pattern by a simple diffusion process of seismicity on a single planar rupture surface. The observed patterns indicate the simultaneous activity of differently orientated small scale features in the active volume while the general migration of the seismicity might be linked to the large scale structure of the seismically active fault.