



Dynamical evolution of the seismic coda wave increments during the 2011-2012 Santorini's caldera unrest. A Non-Extensive Statistical Physics approach.

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Santorini's caldera being unrest during 2011-2012, led several studies to raise the important question of whether seismicity is associated with an impending and potential volcanic eruption or it solely relieves the accumulated tectonic energy. In the present work we study seismic coda waves generated by local earthquake events prior, during and after the seismic crisis that occurred within the caldera area. Coda waves are interpreted as scattered seismic waves generated by heterogeneities within the Earth, i.e. by faults, fractures, velocity and/or density boundaries and anomalies, etc. In particular, we utilize the three components of the seismograms recorded by three seismological stations on the island of Santorini and estimate the duration of the coda waves by implementing a three step procedure that includes the signal-to-noise ratio, the STA/LTA method and the short time Fourier transform. The final estimation was verified or reestimated manually due to the existent ambient seismic noise. Due to the nature and the path complexity of the coda waves and towards achieving a unified framework for the study of the immerse geo-structural seismotectonic complexity of the Santorini volcanic complex, we use Non-Extensive Statistical Physics (NESP) to study the probability distribution functions (pdfs) of the increments of seismic coda waves. NESP forms a generalization of the Boltzmann-Gibbs statistical mechanics, that has been extensively used for the analysis of semi-chaotic systems that exhibit long-range interactions, memory effects and multi-fractality. The analysis and results demonstrate that the seismic coda waves increments deviate from the Gaussian shape and their respective pdfs could adequately be described and processed by the q-Gaussian distribution. Furthermore and in order to investigate the dynamical structure of the volcanic-tectonic activity, we estimate the q-indices derived from the pdfs of the coda wave time series increments during the period 2009 - 2014 and present their variations as a function of time and as a function of the local magnitude (M_L) of the events prior, during and after the caldera unrest.

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