Recent VT EarthquakeEswarms in Campi Flegrei (Italy)

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Abstract
A strong increase of seismic activity has been recorded in the Campi Flegrei caldera during the last few years. Thousands of VT earthquakes, often occurring as swarms of tens of events, are located in the uppermost 3 km crustal layer in the middle of the caldera. The maximum magnitude observed to date (July 2024) is M4.4. Only a very few events can be classified as low frequency (LF) earthquakes since they have features different from the classic VT earthquakes, as shown by the spectral content of the recorded seismic signals. The possible occurrence of volcanic tremor has not been recognized yet in the (very noisy) seismic signals. In this work we computed the focal mechanism of most earthquakes with magnitude M>=2.8 occurred during the last two years. Results show that all types of solutions are found, with a predominance of normal kinematics (about 50%). The mixing of earthquakes with very different kinematics located very near to each other indicates that they occur in a highly fractured volume (as expected for a volcanic environment) subjected to a varying stress field. As the normal stress acting on a fault decreases a little, the fault can move under the shear stress, and this happens with an almost random character.
The full moment tensor inversion computed for the strongest events indicates that double couple (DC) is the most important component for the analyzed events, while CLVD and ISO components take smaller values. The search for earthquakes with similar waveforms does not identify large families of seismic events but it yields several clusters composed of a small number of very similar earthquakes. The spatial distribution of released energy was computed and the result shows that during the last two years the most of seismic energy has been released in the area around Solfatara crater, about 2 km east of the place where the maximum ground uplift is observed. A comparison with the structural setting of the inner part of the caldera shows a good agreement with the most important recognized structures. Source scaling has been investigated for earthquakes with M>=2 (M_0 >= 10^{12} Nm) and results show stress drop values around 1 bar with fault size smaller than 1 km of diameter in the assumption of a circular fault.
The results of our analyses indicate that the ongoing seismicity has all features typical of tectonic type earthquakes that occur on a lot of small and very small faults activated by the ground uplift that is the most important feature of the present volcanic activity. Only a very small percentage of non-VT earthquakes betrays the role of the volcanic environment in current seismicity.