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MULTIPLE SEISMICITY PATTERNS AND SOURCE MOMENT TENSOR ANALYSIS FOR VOLCANIC EARTHQUAKES AT MT. VESUVIUS

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The source and time characteristics of seismic activity at Mt. Vesuvius are investigated, based on the available waveforms and on the catalogue of volcanic earthquakes recorded at the station OVO during the period 1972-2002. Different properties are considered, including a set of formally defined seismicity patterns, the changes in the b-value and in seismic energy release, as well as the features of the source moment tensor components for the largest events.

The analysis of the time variations of the b-value and of the seismic energy release evidences a well defined pattern, with a clear-cut decrease of the values of b, from about 1.8, at the beginning of the considered period, to about 1.0 in 2002. Within this general trend it is possible to identify a sub-structure in the time sequence of the seismic events, formed by the alternating episodes of quiescence and activity, where the relatively intense seismicity periods are characterised by energy rates and magnitudes progressively increasing. A similar analysis, performed using a different catalogue of Vesuvian earthquakes, as compiled from the records at the BKE station during the period 1992-2002, confirms the b-value decrement. In a further step, the presence of a set of formally defined seismicity patterns at Mt. Vesuvius, is examined, testing the possibility of intermediate-term prediction of earthquakes with $M \geq 3.0$ by means of the algorithm CN. CN, that was originally designed to identify the Times of Increased Probability (TIPs) for the occurrence of strong tectonic earthquakes, within a delimited region, is applied for the first time to the analysis of earthquakes in volcanic areas. Satisfactory and stable prediction results are obtained, by retrospective analysis, when an appropriate time scaling is introduced. The outcomes of this experiment indicate that the formally defined premonitory patterns detected by the algorithm CN for strong tectonic earthquakes can be consistently observed in the seismicity at Mt. Vesuvius.

The analysis of seismic source properties, by moment tensor inversion, for the largest Vesuvian earthquakes reveals the presence of volumetric component for some events that can be interpreted as the effect of explosion phenomena, possibly related to volatile exsolution from the cristallising magma.

The still limited period of systematic observation of Vesuvius micro-earthquakes and, above all, the absence of eruptive events during such interval of time, although permitting to evidentiate some regularities and characteristic properties of seismic activity, cannot obviously allow to outline any formal premonitory signal for volcanic eruptions. The performed analysis, however, indicates a progressively evolving dynamics, characterised by

a general increasing trend in the seismic activity in the volcanic system and by a significant volumetric component of the recent major events.