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New inferences from spectral seismic energy measurement of a link between regional seismicity and volcanic activity at Mt. Etna, Italy

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The existence of a relationship between regional seismicity and changes in volcanic activity has been the subject of several studies in the last years. Generally, activity in basaltic volcanoes such as Villarica (Chile) and Tungurahua (Ecuador) shows very little changes after the occurrence of regional earthquakes. In a few cases volcanic activity has changed before the occurrence of regional earthquakes, such as observed at Teide, Tenerife, in 2004 and 2005 (Tárraga et al., 2006). In this paper we explore the possible link between regional seismicity and changes in volcanic activity at Mt. Etna in 2006 and 2007.

On 24 November, 2006 at 4:37:40 GMT an earthquake of magnitude 4.7 stroke the eastern coast of Sicily. The epicenter was localized 50 km SE of the south coast of the island, and at about 160 km from the summit craters of Mt. Etna. The SSEM (Spectral Seismic Energy Measurement) of the seismic signal at stations at 1 km and 6 km from the craters highlights that four hours before this earthquake the energy associated with volcanic tremor increased, reached a maximum, and finally became steady when the earthquake occurred. Conversely, neither before nor after the earthquake, the SSEM of stations located between 80 km and 120 km from the epicentre and outside the volcano edifice showed changes.

On 5 September, 2007 at 21:24:13 GMT an earthquake of magnitude 3.2 and 7.9 km depth stroke the Lipari Island, at the north of Sicily. About 38 hours before the earthquake occurrence, there was an episode of lava fountain lasting 20 hours at Etna volcano. The SSEM of the seismic signal recorded during the lava fountain at a station located at 6 km from the craters highlights changes heralding this earthquake ten hours before its occurrence using the FFM method (e.g., Voight, 1988; Ortiz et al., 2003).

A change in volcanic activity – with the onset of ash emission and Strombolian explosions – was observed a couple of hours before the occurrence of the regional earthquakes. It can be interpreted as the magmatic response to a change of the distribution of tectonic stress in the edifice before the earthquake. In the light of this hypothesis, we surmise that the magmatic system behaved similar to a dilatometer and promise news lines to forecasting the volcano activity.

References

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