



Seismic evidence of a second submarine eruption in the north of El Hierro Island

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From the July 19, 2011 an increase of seismicity, accompanied by a remarkable process of deformation, was detected on the island of El Hierro. This reactivation process, instrumental and scientifically monitored, culminates in the occurrence of a submarine eruption, with the emergence of a strong tremor signal, in the south of the island on October 10, 2011. Both processes (unrest and eruption) have different phases and behaviors clearly evidenced by the deformation and seismicity.

This work is the result of an exhaustive analysis of seismic signals from three stations deployed on the island of El Hierro (CTAB and CTIG (IGN) and REST (CSIC)), in order to explain the behavior of the volcanic system responsible for the submarine eruption of Las Calmas sea and its evolution, as well as evidence of a second submarine eruption in the north of the island (El Golfo).

The spectral content of signals from the seismic stations in the north of the island (CTIG and CTAB) and the area around the eruption (REST) has the dominant peak at different frequencies. The amplitude modulations of the seismic noise evolved differently in CTAB and CTIG than REST being particularly significant changes in amplitude and frequency after the occurrence of events of magnitude greater than 4. The evolution of the volcano-tectonic cumulative seismic energy shows the occurrence of two similar eruptive episodes, in which two phases can be distinguished. The first phase of both cycles has a constant rate with seismic events of magnitude less than 3 to reach the energy of 10^{11} Joule. From that moment the magnitude grows rapidly exceeding magnitude 4. In the second phase the seismic events are mainly located in the south of the island, before the onset of visual evidences of the eruption (October 11, 2011) and later (November 2011) the seismic events are mainly located in the north of the island, where no visible signs have been detected. In both cases the appearance or changes in the tremor signal was observed.

The presence of a second eruptive vent in the North solves some of the most important enigmas raised from the occurrence of a seismic event of magnitude 4.6 (November 11, 2011). The sudden disappearance of the seismicity in the north of the island is due to the opening of the new eruptive vent and is similar to what happened with the seismicity in the south after the eruption in Las Calmas sea. The pattern of seismic energy release is also similar in the two cases. The strong amplitude modulations in the tremor can be explained as an oscillation in a fluid reservoir with two leaks. This same process explains the rapid oscillations detected in the deformation