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A remarkable seismo-volcanic swarm at Teide volcano (Tenerife, Canary Islands): insight into a transient in the volcano degassing processes

Luca D'Auria (1,2), Nemesio M. Pérez (1,2,3), José Barrancos (1,2), Germán D. Padilla (1,2), María Asensio-Ramos (1), Rubén García-Hernández (4), Pedro A. Hernández (1,2,3), Eleazar Padrón (1,2,3)

(1) Instituto Volcanológico de Canarias (INVOLCAN), 38400 Puerto de La Cruz, Tenerife, Canary Islands, Spain (ldauria@iter.es), (2) Instituto Tecnológico y de Energías Renovables (ITER), 38600 Granadilla de Abona,Tenerife, Canary Islands, Spain , (3) Agencia Insular de la Energía de Tenerife (AIET), 38600 Granadilla de Abona, Tenerife, Canary Islands, Spain, (4) Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, 28040 Madrid, Spain

On 02/10/2016, various seismic stations deployed in Tenerife (Canary Islands) recorded an intense swarm of small-amplitude long-period events. Weak long-period events and tremor were recorded also during an unrest in 2004. The Oct. 2016 swarm, however, is unique because of its remarkable seismological features. The sequence, lasting for about 6 hours, consisted of more than 400 events and toward the end of the sequence, events merged into a continuous tremor whose amplitude progressively vanished after 30 minutes.

We analysed waveforms from two broadband stations, located within 15 km from the crater of Mt. Teide (the most promiment volcano of the island) and seismic phase pickings from 3 more stations. Event waveforms show a remarkable similarity, hinting for a common source for all the events. Probabilistic locations show that the source is located few km south of the Mt. Teide crater. Even if the hypocentral depth is affected by a significant uncertainty, events do not seem to be located within the shallow hydrothermal system of the volcano.

The complex spectral analysis of the waveforms shows distinct spectral components which are compatible with the resonance of a fracture filled with a mixture of H_2O-CO_2 in supercritical conditions. The temporal pattern of amplitudes and inter-event times can be intepreted using a chocked-flow model. The progressive opening of the fracture and the subsequent decay of the differential pressure explains the progressive emergence of events and the merging into a continuous, waning tremor, in the final part of the episode.

We intepret this sequence as a transient fluid discharge episode occurring in the deep hydrothermal system of the Tenerife volcanic system. This working hypothesis is discussed in a more general framework involving continuous GPS data, which shows no significant deformation and various geochemical parameters which, conversely, have shown important anomalies before and after the swarm.

Furthermore this episode suggests the needing of a high-resolution seismic monitoring of Tenerife and, more generally, the use of advanced data-mining technique in seismological volcano monitoring.