

Dynamic triggering of seismic activity in the Cape Verde hot spot, north Atlantic

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The triggering of seismicity, either microearthquakes or tremor, caused by dynamic stresses imposed during the passage of seismic waves, is a phenomenon well documented in several volcanic and geothermal areas. Some studies also suggest an increase in volcanic eruptions after the occurrence of large earthquakes.

The Cape Verde archipelago, located in the Cape Verde swell, has an active volcano in the Fogo Island and several submarine active volcanic structures around the western islands.

Using data from 39 broadband stations deployed in the archipelago between November 2007 and September 2008, we searched for an increase in high-frequency seismic energy (>5 Hz) during the passage of teleseismic surface waves. We analyzed time periods during the passage of surface waves generated by earthquakes that satisfied the following two criteria:

- 1 - Epicentral distance >100 km and magnitude ≥ 5.5 , corresponding to an estimated dynamic stress of the 20-second wave >1 kPa;
- 2 - Epicentral distance >1000 km and magnitude ≥ 7.0 .

We found 11 events that satisfied these criteria. Using an automatic detection algorithm based on STA/LTA, we assessed the statistical significance of the increase of high-frequency seismic activity during the passage of surface waves using a β statistics, computed according to Aron and Hardebeck, Bull. Seismol. Soc. Am. (2009). In our application, we used a 6 hours background seismicity. A value of $\beta \geq 2$ indicates that bursts of high-frequency seismic energy increase significantly during the passage of seismic waves, indicating a possible positive case of triggering. Based on the analysis of the β values, followed by visual inspection, we detected two cases of clear triggering, both in the southern and northwest islands. The triggering events are the 2008/06/30 magnitude 7.0 South Sandwich Islands Region earthquake (estimated 0.245 kPa dynamic stress) and the 2008/05/12 magnitude 7.9 Eastern Sichuan earthquake (estimated 1.243 kPa dynamic stress). The islands where triggering was detected correspond to areas known to have active volcanic structures. The increased level of bursts of high-frequency seismic energy is triggered by the passage of surface waves, but continues even after the surface wave train has ended, suggesting that surface waves trigger activity that then continues in a sustained manner.

These results offer the possibility to investigate the factors that lead to positive triggering in the Cape Verde archipelago (surface wave frequency, peak amplitude, etc.). Also, the triggered seismic activity opens a window into the characterisation of active volcanic structures in the archipelago and their dynamic.

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