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Analysis of volcano-related seismicity to constrain the magmatic plumbing system beneath Fogo, Cape Verde, by (multi-)array techniques

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Fogo is the only island of the Cape Verde archipelago with regular occurring volcanic eruptions since its discovery in the 15th century. The volcanism of the archipelago originates from a mantle plume beneath an almost stationary tectonic plate. With an eruption interval of approximately 20 years, Fogo belongs to the most active oceanic volcanoes. The latest eruption started in November 2014 and ceased in February 2015.

This study aims to characterize and investigate the seismic activity and the magmatic plumbing system of Fogo, which is believed to be related to a magmatic source close to the neighboring island of Brava. According to previous studies, using conventional seismic network configurations, most of the seismic activity occurs offshore. Therefore, seismological array techniques represent powerful tools in investigating earthquakes and other volcano-related events located outside of the networks. Another advantage in the use of seismic arrays is their possibility to detect events of relatively small magnitude and to locate seismic signals without a clear onset of phases, such as volcanic tremors.

Since October 2015 we have been operating a test array on Fogo as part of a pilot study. This array consists of 10 seismic stations, distributed in a circular shape with an aperture of 700 m. The stations are equipped with Omnirecs CUBE dataloggers, and either 4.5 Hz geophones (7 stations) or Trillium-Compact broad-band seismometers (3 stations). In January 2016 we installed three additional broad-band stations distributed across the island of Fogo to improve the capabilities for event localization.

The data of the pilot study is dominated by seismic activity around Brava, but also exhibit tremors and hybrid events of unknown origin within the caldera of Fogo volcano. The preliminary analysis of these events includes the characterization and localization of the different event types using seismic array processing in combination with conventional localization methods.

In the beginning of August 2016, a “seismic crisis” occurred on the island of Brava which led to the evacuation of a village. The seismic activity recorded by our instruments on Fogo exhibits more than 40 earthquakes during this time. Locations and magnitudes of these events will be presented.

In January 2017 the pilot project discussed here will be complemented by three additional seismic arrays (two on Fogo, one on Brava) to improve seismic event localization and structural imaging based on scattered seismic phases by using multi-array techniques. Initial recordings from the new arrays are expected to be available by April 2017.