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Changes in the Very-Long-Period seismic source at Stromboli during and after the 2007 eruption

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The Very-Long-Period (VLP) seismic source of Stromboli is probably the mostly studied feature of its seismicity. Its mechanism is well known and has provided important information about the structure of the shallow part of the conduit and the dynamics of Strombolian explosions.
The evolution of the seismicity during the 2007 effusive eruption at Stromboli volcano has been monitored by a broadband seismic network composed of 13 stations and two dilatometers. In the course of the eruption significant variations in the VLP source were observed in relation with changes in the eruptive dynamics. The analysed parameters consist in the VLP occurrence rate, amplitude, polarization and, for some limited interval, in the seismic source function.
The first important variations were observed few weeks before the beginning of the effusive eruption (Feb. 27th 2007). A slight decrease in the inclination of the polarization direction of the VLP signals marked the rise of the magma column level. Afterwards, just after the onset of the effusive phase and the subsequent emptying of the shallow conduit, a significant increase in the inclination was observed. Also the analysis of the VLP source mechanisms shows that before the eruption the source centroids were shallower.
Starting from April 22nd (after the end of the effusive phase on April 2nd) a dramatic increase of the VLP occurrence rate (up to 70 events/hour) and a decrease in their amplitudes was observed. Simultaneously the average source centroid shifted of about 100m toward South of the previous position. This is the most important variation in the VLP source ever observed in Stromboli, since the installation of the network in Jan. 2003. This state persisted for about one month and then slowly recovered toward the normal conditions of Stromboli. Currently the polarization analysis indicates that the recovery has never completed. At some stations a difference in the polarization of few degrees still persists.
We interpret these variations in terms of changes in the fluid-dynamic regime of the shallow conduit which influence also the deeper portions where the coalescence of gas bubbles to form slugs occurs. This hypothesis has been tested with the aim of numerical fluid-dynamic simulations of the gas slug ascent in a volcanic conduit models. The simulations indicate that even a minor obstruction of the conduit with a slight pressurization, strongly reduces the efficiency of the slug expansion mechanism.
These important changes were detected only by seismological methods. For this reason we conclude that the analysis of VLP source parameters is an important tool for real-time monitoring of Stromboli and similar volcanoes.