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The September 2008 five-day multiparameter experiment at Stromboli volcano

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Between the 1st and 5th of September 2008, a multiparameteric experiment was performed at the summit of Stromboli (Aeolian Islands, Italy). This volcano exhibits persistent degassing at its summit craters, punctuated by weak to mild explosions yielding gas jets and throwing ash, scoriae and lava lumps in the vicinity of the source crater 5-10 times an hour. This "normal" background activity can be interrupted by more violent, "major" explosions which can eject hot material several hundred meters from the craters. Such explosions represent a threat for tourists, guides and scientists in the summit area. Improved understanding of the processes controlling the explosive activity at Stromboli is thus a high priority for civil defense agencies.

In spite of many theoretical and field-based studies on the subject, the mechanisms governing persistently activity and also the factors that may tip Stromboli volcano out of its dynamic equilibrium into paroxysm are still not fully understood. The main unresolved issues concern: (i) the mechanism allowing bubble coalescence; (ii) the level at which the gas accumulation occurs within the magmatic system prior to an explosive event and the timing of the process; (iii) the quantitative relationships between the amount of gas accumulated and the energy involved in the explosive event and (iv) the main difference in the overall process dynamics leading to either strombolian or paroxysmal explosions.

In order to better constrain the "normal" explosive activity at Stromboli we took a multiparameteric approach, with the aim of improving our understanding of (i) the mechanisms driving the persistent activity and (ii) the geometrical characteristics of the upper plumbing system of Stromboli.

The most challenging aspect of our experiment was to couple the observations usually accomplished to study persistently active volcanoes with continuous measurements of the gravity field. We thus installed a spring gravimeter (LaCoste and Romberg D-162) very close to the summit craters, to detect changes in the density profile along the upper part of the conduit system and gain new insight into the mechanisms and timing of slug genesis associated with the explosions. The analog signal from the gravimeter was digitalized (24 bits) and stored, with a sampling rate of 10 Hz. The gravimeter we installed includes tiltmeters to identify possible pressure buildup associated to the explosive activity and driving ground deformation.

Furthermore, to study the dynamics of uprising gas slugs in the shallow plumbing system, we temporally augmented the permanent monitoring system in the summit area with additional seismic and infrasound stations. Four broad band seismic sensors Lennartz Le3D-20 sec and four condenser microphones with a sensitivity of 80 mV/Pa in the 1-20 Hz infrasonic band were deployed in a T-shaped and equilateral triangle configuration, respectively. Both seismic and infrasonic signals were acquired at a sampling rate of 200 Hz, using Nanometrics Taurus stations. The features of the explosive activity (timing, intensity, type, etc of each event) were recorded using an Omega radiometer, a portable thermal camera and the permanent infrared camera in the summit area of the volcano which is part of the of the monitoring system of INGV-CT. The different signals were time synchronized through GPS.

In this work we present a preliminary attempt to use our multiparameter dataset to develop a quantitative understanding of the physical processes maintaining the dynamical equilibrium behind the persistent activity at Stromboli.