A physical model for volcanic tremor at Stromboli (Italy)

T. Sgroi (1), R. Agrusta (2), M. Battaglia (2,3), P. Favali (1,2)

(1) Istituto Nazionale di Geofisica e Vulcanologia, Roma 2, Rome, Italy, (2) Dept of Earth Sciences, University of Rome La Sapienza, Italy, (3) U.S. Geological Survey, Volcano Hazards Team, Menlo Park (CA) USA

A flow model of non-Newtonian fluid through a fracture with elastic walls is applied to study the source of volcanic tremor at Stromboli. The flow of an incompressible viscous fluid through a fracture with movable elastic walls leads to chaotic oscillations similar to those of volcanic tremor. The parameters of the fluid and surrounding rock are tuned to generate a range of possible signals. Spectral analysis of the signal recorded by land seismometers and ocean bottom seismometers are used to discriminate between Long Period events and tremor. This analysis allows us to identify the frequency of the signals due to source effects. The spectral content of the tremor is restricted to a narrow frequency band ranging from 0.5-5 Hz. The numerical results of the model are compared with the observed signals. A non-linear inversion technique is used to determine the parameters of the fluid, rock matrix and source. Statistical tests are applied to evaluate the goodness of fit between the model and the measured signals. The tremor signal is best reproduced in the frequency band between 1.5-3 Hz, corresponding to a source depth of about 50-60 MPa.