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An experimental investigation of seismic and acoustic harmonic tremor gliding and implication for churn-like flow

Laura Spina[1], Andrea Cannata[2], Daniele Morgavi[4], Eugenio Privitera[3], and Diego Perugini[4]
[1]Istituto Nazionale di Geofisica e Vulcanologia, Sezione di Roma1, Rome, Italy
[2]Dipartimento di Scienze Biologiche, Geologiche e Ambientali, Università degli Studi di Catania, Catania, Italy
[3]Istituto Nazionale di Geofisica e Vulcanologia, Osservatorio Etneo, Catania, Italy
[4]Dipartimento di Fisica e Geologia, Università degli Studi di Perugia, Perugia, Italy

The gradual shift over time of the spectral lines of harmonic seismic and/or acoustic tremor, that is commonly known as spectral gliding, has been largely observed at different volcanoes. Despite the clear advantage of the experimental approach in providing direct observation of degassing processes and of the related elastic radiation, experimental studies on gliding tremor are lacking. To fill this gap, we investigated different episodes of gliding of acoustic and seismic tremor observed during analogue degassing experiments performed under different experimental conditions, by systematically changing: 1) analogue magma viscosity (10-1,000 Pa s), 2) gas flux (5-180x10^{-3} l/s) and 3) conduit surface roughness (fractal dimension of 2-2.99). The occurrence of gliding experimental seismic and acoustic tremor was linked to high gas flux rates and viscosities and generally associated with an increasing trend and often preceding a major burst. In a few cases we observed decreasing secondary sets of harmonic spectral lines. Results suggest that gliding episodes are mainly related to the progressive volume variation of shallow interconnected gas pockets. Spectral analyses performed on acoustic signals provided the theoretical length of the resonator. The latter was compared against the temporal evolution of the gas pockets, quantified from video analyses. The similarities between the observed degassing regime and churn-annular flow in high viscous fluids encourages further studies on churn dynamics in volcanic environments.