

Chapter 16

Volcano Sound Files

This document summarizes the volcano sound files and spectra included in this supplement. All original files, except the ones for Stromboli, were originally infrasonic and have been sped up and processed to enhance tonal features. This collection was started in 1994 and encompasses eruptive activity that ranges from hawaiian (Kilauea) to plinian (Tungurahua). Please refer to Table 16.1 in Chapter 16.

The sonification process usually begins with identifying the features of interest of a signal. PSDs and spectrograms are valuable tools for this initial assessment. Please view the accompanying spectrograms to get a sense of the original signature character. If the signals are originally infrasonic, it is necessary to speed the signals up into the audible range. Array processing helps with isolating the signals of interest from *clutter* – coherent signals that may be produced by surf, thunder, microbaroms, aircraft, etc. and interfere with the volcanic signatures. Such clutter is usually reduced through bandpass filtering, and the remaining sounds are often coarse. The next steps are often more creative than scientific, and may involve hiss reduction, amplitude scaling, modulation, and whatever else needs to be done to bring a volcanic voicing to a realm of tolerable harmony.

All records are best appreciated through a good sound system with a healthy dose of bass. Small computer speakers or ear buds may yield disappointing results. If playing through an mp3 player such as an iPod, make sure to correct the unit's low-frequency suppression by boosting up the low end.

Stromboli Volcano Sounds

These recordings were made on a quiet, windless night from a ridge ~150 m from the active vents. The sounds were recorded in July 1994 with a Casio DA-2 DAT recorder at 48 kHz, with a flat frequency response from 10 Hz to 20 kHz, using an ACO condenser microphone cartridge 7046, preamp 4012, with a frequency response of 5 Hz to 20 kHz. Care was taken to correct for the frequency response of the system during analysis. The selected sounds have been digitally improved by reducing extraneous noise and optimizing the dynamic range of the amplitude. The sounds are otherwise unchanged.

The Stromboli sounds do not have accompanying spectrograms, but the energy spectrum of various transients at Stromboli is provided (stromboli_spectrum_1995.jpg; Garcés, 1995).

- stromboli_is_bb_combo.mp3
Explosions and jetting.
- stromboli_is_lf-bkgrnd.mp3
Background sounds between explosions and jetting – methinks a truly open vent is seldom quiescent. With lots of low-end sound, this is a good file for a big subwoofer.
- stromboli_is_mhf_exp1.mp3
Explosion, middle and high frequencies. Listen for the falling of ashes later in the record.

- stromboli_is_mhf_exp2
One-two shot.
- stromboli_is-is_lmf_jet.mp3
Jetting, broadband.
- stromboli_is-mhf_jet.mp3
Jetting, broadband.

Seismoacoustic directory: one channel is infrasound, the other a short period seismometer.

- stromboli_is-seis_mf_exp.mp3
- stromboli_is-seis_vlf_combo.mp3
- stromboli_is-seis_mf_jet.mp3

Arenal Volcano Sounds

These sounds were recorded by B&K 4193 low-frequency microphones connected to a 24-bit Reftek digitizer and sampled at 20 Hz. Station range of ~2 km. The audio files contain explosions and harmonic tremor signatures with different effects and speed-up rates. Despite rather inadequate microphones, the records for Stromboli and Arenal provided an inspiration for future recordings using superior instrumentation.

- Arenal_explosion_200x_rev.mp3
- Arenal_explosion_400x_rev.mp3
- Arenal_tremor_100x_rev.mp3
- Arenal_tremor_200x_hp_rev.mp3
- Arenal_tremor_200x_rev.mp3
- Arenal_tremor.jpg

Kilauea Volcano Sounds

These sounds were recorded by two different arrays of Chaparral 2 pressure sensors connected to 24-bit Reftek digitizers and sampled at 40 Hz. Flat passband down to 0.1 Hz. The kipu array was 2.4 km from Puu Oo, and the mene array is ~13 km from Puu Oo and ~7 km from Halemaumau. Mene has been running continuously since 2006. As all other sounds hereafter, they have been sped up and processed to enhance tonal structure. The following collection was assembled in May 2008 by the author after identifying the sources. It took 2–3 years between signal ID and paper publication.

- kipu_070422_1333-1620_200x_puuoo_uber_final_stereo.mp3
Sped up 200 times, this is the signature of a new vent that emerged along the Puu Oo lava tube system before its collapse. This vent, with its intermittent signature, was discovered acoustically, so we got to name it Uber vent.
- kipu_070427_0500-0900_200x_puuoo_chant_final.mp3
Puu Oo crater complex signature before its collapse in May 2007.

- mene_070511_0100-0300_200x_bench_collapse_final.mp3
Bench collapse near the coast.
- mene_070608_0900-1100_200x_puuoo_spatter_stereo_final.mp3
Spattering along the Puu Oo lava conduit in June 2007.
- mene_070618_0430-0630_200x_puuoo_collapse_final.mp3
Puu Oo crater collapse in June 2007.
- mene_070619_1000-1100_200x_episode56_final.mp3
Episode 56 fissure opening. The March 2011 Kamoamoa fissure eruption produced a somewhat similar but more complex (and interesting) signature.
- mene_070721_0930-1330_200x_eastrift_birth.mp3
Opening of East Rift fissure on July 2007.
- mene_080225_1200-1400_200x_eastrift_gaspiston_final.mp3
Gas pistoning at East Rift, February 2008.
- pele_chant_080319_N00x_pc.mp3
Sped up N00 times, this unique record marks the opening of Halemaumau in 2008.
- pele_chant_080410_0830-0930_200x_hgv_2nd_burst_stereo_final.mp3
Second burst at Halemaumau.
- pele_chant_080416_1330-1430_200x_hgv_3rd_burst_final.mp3
Third burst at Halemaumau. We stopped counting soon thereafter.

Spectra:

- spec_kipu_070422_1300-1700_puuoo_uber.png
- spec_kipu_070427_0500-0900_puuoo_chant.png
- spec_mene_070511_0100-0500_bench_collapse.png
- spec_mene_070608_0800-1200_puuoo_spatter.png
- spec_mene_070618_0430-0830_puuoo_collapse.png
- spec_mene_070619_0900-1300_episode56.png
- spec_mene_070721_0930-1330_eastrift_birth.png
- spec_mene_080225_1100-1500_eastrift_gaspiston.png
- spec_mene_080319_1230-1630_hgv_birth.png
- spec_mene_080410_0800-1200_hgv_2nd_burst.png
- spec_mene_080416_1200-1600_hgv_3rd_burst.png

Mount St. Helens Sounds

These sounds were recorded by an array of MB2000 pressure sensors connected to a 24-bit Nanometrics digitizer and sampled at 40 Hz. Flat passband down to 0.01 Hz, range of 13.4 km.

- msh2_041111_2100-2200_200x_LP_events.mp3

LP 'drumbeat' events

- msh2_050116_1100-1200_200x_aseismic_eruption.mp3
Aseismic eruption signature, suggesting seismoacoustic coupling can be more complex than we might imagine.
- msh2_050309_200x_1hr_eruption.mp3
Eruption signal, 1 h long record sped up 200x.

Spectra:

- msh2_spec_041111_2000-2400.png
- msh2_spec_050116_1000-1400.png
- msh2_spec_050309_0000-0400.png

Tungurahua Volcano Sounds

These sounds were recorded by an array of Chaparral 2 pressure sensors connected to a 24-bit Nanometrics digitizer and sampled at 40 Hz. Flat passband down to 0.1 Hz, station range of 37 km.

- rioe_060511_400x_tremor_volcals.mp3
Harmonic tremor associated with strombolian activity.
- rioe_060817_0400-0630_200x_vulcanian-plinian.mp3
Transition from vulcanian explosions, through a subplinian eruption, culminating in a plinian stage accompanied by a shift to lower frequencies. Another good sound file for a big subwoofer.

Spectra:

- rioe_spec_060511_1000-1400.png
- rioe_spec_060817_0300-0700.png

Credits

All files supplied courtesy of M. Garcés, Director, Infrasound Laboratory (ISLA), HIGP, SOEST, University of Hawaii at Manoa. Keisuke Irie provided invaluable assistance in the audio processing as part of the Cornell University Field Program in Earth and Environmental Systems.