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Spectral analyses of long period earthquakes with extended coda recorded at Mt. Spurr, Alaska, by use of the Sompi method

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During the summer of 2004, an increase in earthquake activity beneath the summit of Mt. Spurr, Alaska, was detected as a notable departure from the background seismicity of the volcano. The rate of activity was greater than any observed since the last eruptive period in 1992, averaging 20-30 events each day with magnitude less than 1.5 and, depths mostly between 0 and 6 km below the sea level. A moderate number of deep (15-40 km) long period (LP) events was also observed. Most of the activity took place beneath the summit of Mt. Spurr while relatively few earthquakes were located beneath Crater Peak vent, the site of the 1953 and 1992 eruptions. We present the results of analyses of unusual LP earthquakes, recorded between July and September 2004 at Mt. Spurr volcano; the waveforms of these events are characterized by quasi-sinusoidal signatures of long duration (up to 40 sec) with slowly decaying coda amplitudes. Energy is spread in the band 0.5-4.0 Hz and amplitude spectra are marked by sharp and isolated peaks, reflecting the quasi-monochromatic nature of the signal. The temporal variations of the complex frequencies have been investigated by use of the Sompi method, a parametric method for the spectral estimation of low-frequency seismograms, based on a homogeneous autoregressive equation that addresses the problem of resolving the decaying harmonic components of a time series corrupted by noise. The dominant mode has been resolved, and its Q factor estimated for each available event. Dominant frequencies are found in the band 0.8-2.2 Hz, and Q factor changes between 25 and 100. The variations of the complex frequencies show an overall decline with time. The dynamic response of a shallow fracture filled with bubbly water to the increasing flux of hot gases from depth, is proposed as a possible mechanism for the generation of the observed waveforms.