Source mechanism of explosive eruptions: seismic moment tensor inversion coupled with infrasound analysis

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Using high quality data recorded on two exploding volcanoes we investigate source dynamics using seismic moment tensor inversion and infrasound observations. The use of infrasound, coupled with seismic analysis is critical for understanding volcanic processes during low level explosive activity. Seismic moment tensor inversion provides insight to physical processes of source regions deeper in the volcanic conduit, whereas infrasound signals may be used to infer onset times and physical properties of vent explosions. The two, very different volcanoes presented here are Tungurahua, Ecuador, and Karymsky of Kamchatka, Russia. Tungurahua volcano exhibited a massive swarm of volcanic explosions in May, 2010, when eruption style ranged from Strombolian to Vulcanian. The active vent radius was 100 m, exhibiting intense infrasound (> 100 Pa). Stations at Tungurahua were deployed at about 5-km distance during this eruption episode. Observed seismic signals included low frequency waves (2s - 10s) at the onset of surface explosions, and long coda of LP waves followed by tremor. Karymsky volcano, an andesitic cone with a 80-m wide vent, exhibited vigorous Strombolian activities during the observation period 1997 to 1999. Infrasound amplitudes ranged up to 10 Pa at 1-km distance from the vent, much smaller than that of Tungurahua. Karymsky seismic signals are characterized by a leading impulsive signal associated with the explosion often followed by long quasi-periodic volcanic tremor. The dominant frequency of the explosive signal was 1 Hz, higher than those recorded at Tungurahua. In this study, seismic moment tensor inversion is applied to observations from both volcanoes, and source time functions and focal mechanisms are derived. Onset times of the surface explosions were estimated by origin times of infrasound and compared with the excitation of the seismic source time functions. We present here detailed results and discuss physical mechanisms of the different styles of eruptions of these two volcanoes.