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Determination of source parameters of explosive events at Mt. Yasur volcano, Vanuatu, using time reversal and moment tensor inversion techniques

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Description of shallow magmatic processes accompanying volcanic activity is a prerequisite to hazard mitigation. Mt. Yasur volcano (Tanna Island, Vanuatu) is characterized by unusually recurrent explosive Strombolian activity; yet, the nature of the eruption makes it an easily accessible volcano to observe and monitor unrest. Seismic, infrasound, and thermal monitoring coupled to direct observation (from the crater rim) of the 2008 explosive activity at Mt. Yasur provide a unique view into the dynamics of highly active, open-vent systems. Here in particular we investigate the physics of eruption dynamics and the burst of gas slugs (very large bubbles) filling magmatic conduits. The generation and ascent of slugs is monitored using seismic arrays (composed of one broadband and three short-period stations), whereas the slug size upon bursting at the magma/air interface can be estimated via infrasound arrays. Combination of seismic, infrasound and Doppler Radar data are used to determine the velocity of the upper structure of the volcano. Frequency-wavenumber-analysis on the seismic events allow us to validate the velocity of the upper structure and to assign the source of events to the craters in which the activity took place. Using this velocity structure, we locate the seismic source within the volcanic conduit. We use time reversal and moment tensor inversion to image the source location of long-period signals and identify their principal mechanism. Automatic hypocenter determination based on the wavefield coherence at different arrays is additionaly applied and gives the possibility to connect the parameters of the previous mentioned techniques. Finally, we identify waveform families in the seismic signals by applying cross-correlation techniques in the long-period range.