Source dynamics of vulcanian explosions analysed with a high-resolution multicomponent seismic arrays technique

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A series of sixteen vulcanian explosions occurred at Ubinas volcano, between May 24 and June 14, 2009. The explosions occurred at intervals of 2.1 hours to 6 days 8.6 hours, with a mean value is 33 hours. Considering only the first 9 explosions, between May 24 and 27, the average time interval is 7.8 hours. Most of the explosions occurring after a short time interval (<8h) have low energy, suggesting that the refilling time is not sufficient for a large accumulation of gas. All the explosions, except 4 are followed by a tremor episode coinciding with pulses of ash emission. The duration of tremor following explosion is longer for the two highest energy explosions. To better understand the physical processes associated with these eruptive events, we localized the sources of explosions using 2 seismic antennas composed respectively of 10 and 12 sensors 3 components. We used the High resolution MUSIC-3C algorithm to estimate the slowness vector for the first waves composing the explosion signals recorded by the two antennas. The initial part of the explosion is dominated by two frequencies at 1.1 Hz and 1.5 Hz for which we identified two separated sources located respectively at 4810 m and 3890 m + / - 390 m altitude. The position of these two sources is the same for the 16 explosions. This implies the reproduction of similar mechanisms in the conduit. Based on the eruptive mechanisms proposed for other volcanoes of the same type, we interpret the position of these two sources as the limits of the conduit portion involved in the fragmentation process. Seismic data and ground deformations recorded simultaneously less than 2 km from the crater show a decompression movement 2 sec prior to the explosion. This movement can be interpreted by gas leakage at the level of the cap before its destruction. The pressure drop generated in the conduit could be the cause of the fragmentation process that propagates deeper. Based on this observation, we interpret the position of the highest source as the part of the conduit under the cap and the deeper source as the limit of the fragmentation zone.