SUPPLEMENTARY MATERIAL
Here we present a number of figures and tables that compliment part of the results discussed in the main text.

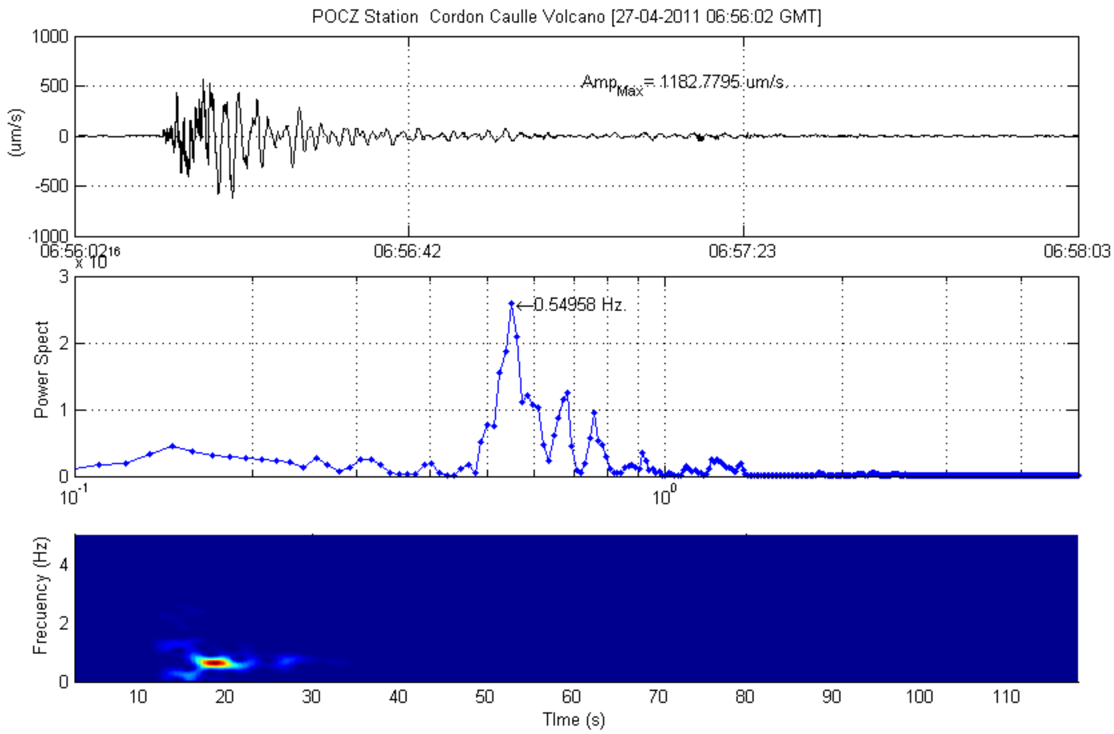


Figure S1. Typical waveform of HB events before the eruption. This example is for a HB event registered by POC station on April 27th, 2011, with an M_L:4.7. The amplitude is measurement in micrometers/second. Mid and lower panels show the spectra in seismic power and finally the spectrogram in Hz. This event was recorded throughout the Chilean National Volcanic Monitoring Network (RNVV in Spanish) from Lascar volcano, located 1950 km to the north, to Hudson volcano, 610 km to the south distant of the PCCVC.

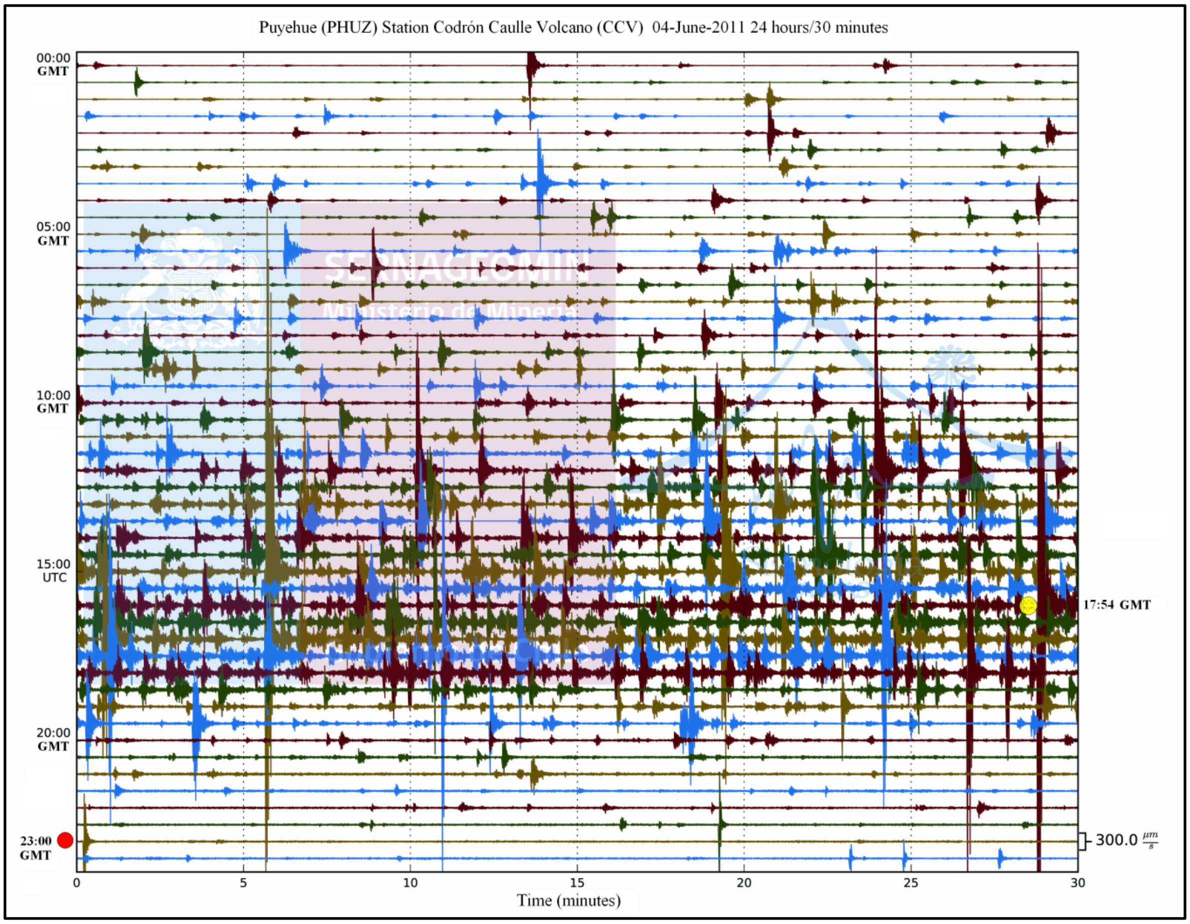


Figure S2. Continuous seismic record at PHU station seismogram (vertical component) 24 hours/30 minutes registered on June 04th, 2011.Two classes of earthquakes are highlighted given that represent the seismic onset process 4 June eruption and the subsequent post-eruptive seismic change. The first was classified as VLP recorded before the eruption (17:54 GMT, yellow dot). The second earthquake highlighted was generated after the eruption (23:00 GMT; VT; red dot). Each of them is detailed in the supplementary figures S3 and S4.

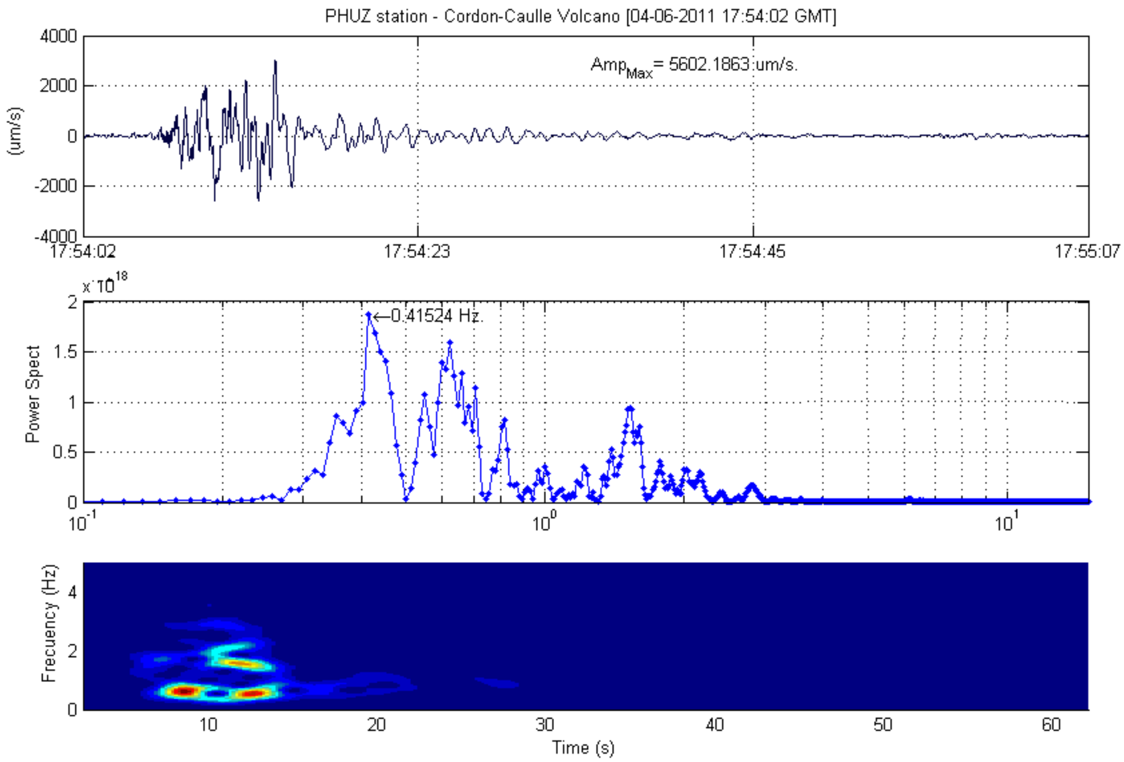


Figure S3. Earthquake classified as VLP registered by PHU station on June 04th 2011 17:54 GMT (yellow dot in Fig. S1), before the eruption. The amplitude is measurement in micrometers/second. Below, it shows the spectra in seismic power and finally the spectrogram in Hz.

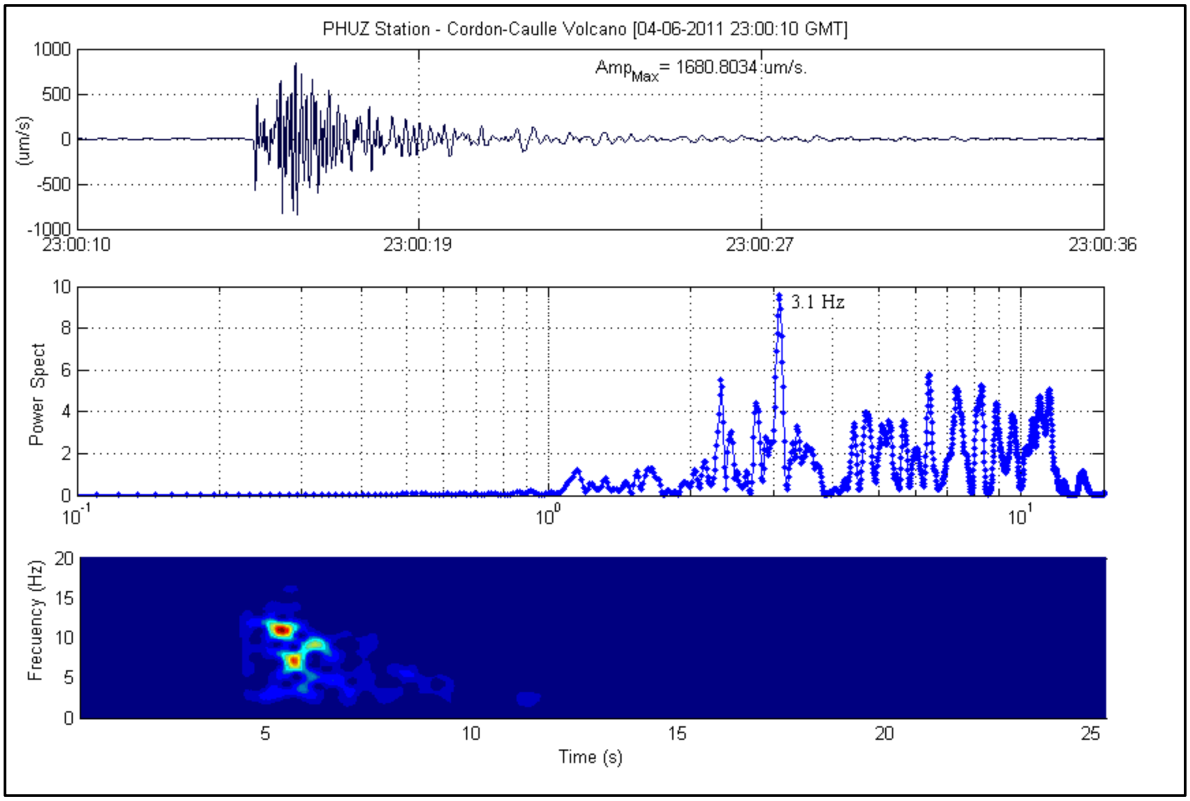


Figure S4. Earthquake classified as VT registered by PHU station on June 04th 2011 23:00 GMT, with a M_L:3.8 recorded after the eruption. The amplitude is measurement in micrometers/second. Below, it shows the spectra in seismic power and finally the spectrogram in Hz.

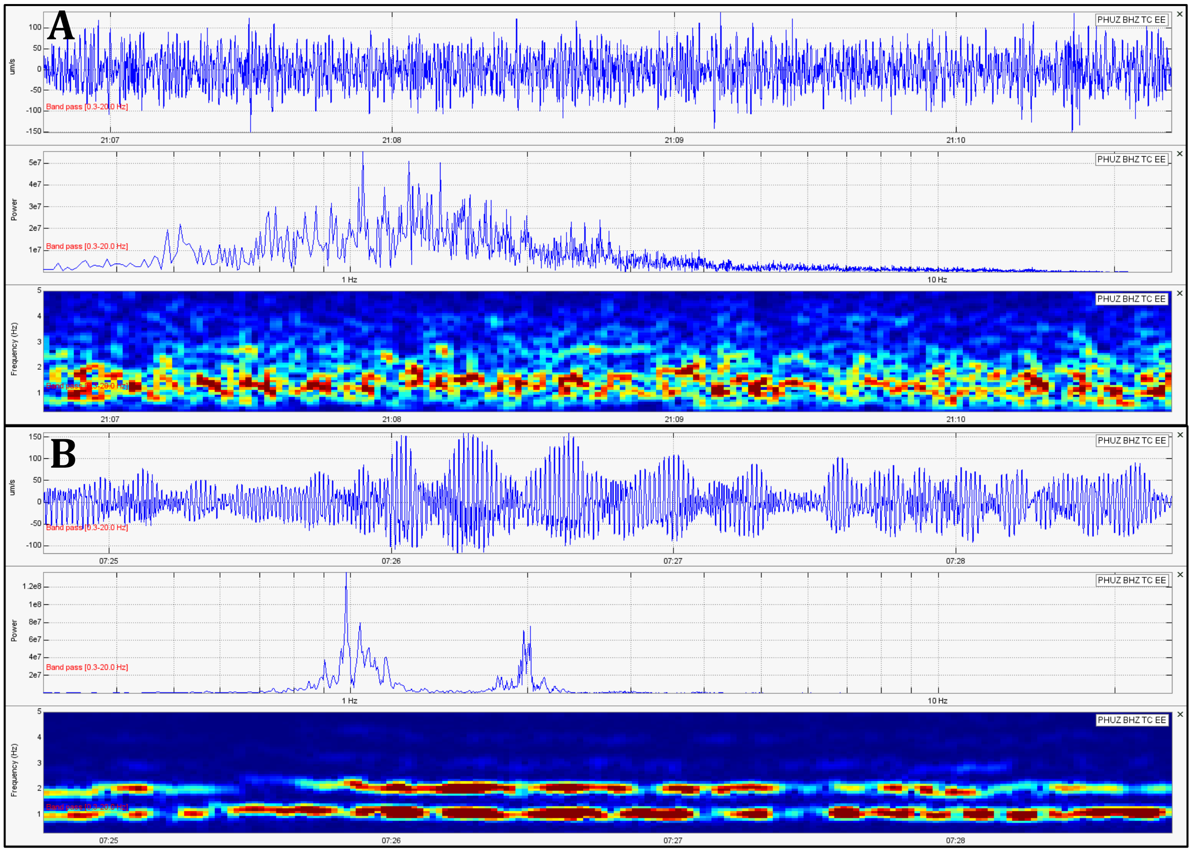


Figure S5A. The velocity seismogram of spasmodic tremor with its related spectrogram pattern. **S5B.** The velocity seismogram of tremor with its related spectrogram highlighting the quasi-harmonic pattern within the dominant frequency. PHU is the closer station to the vent (~8 km, Fig. 1).

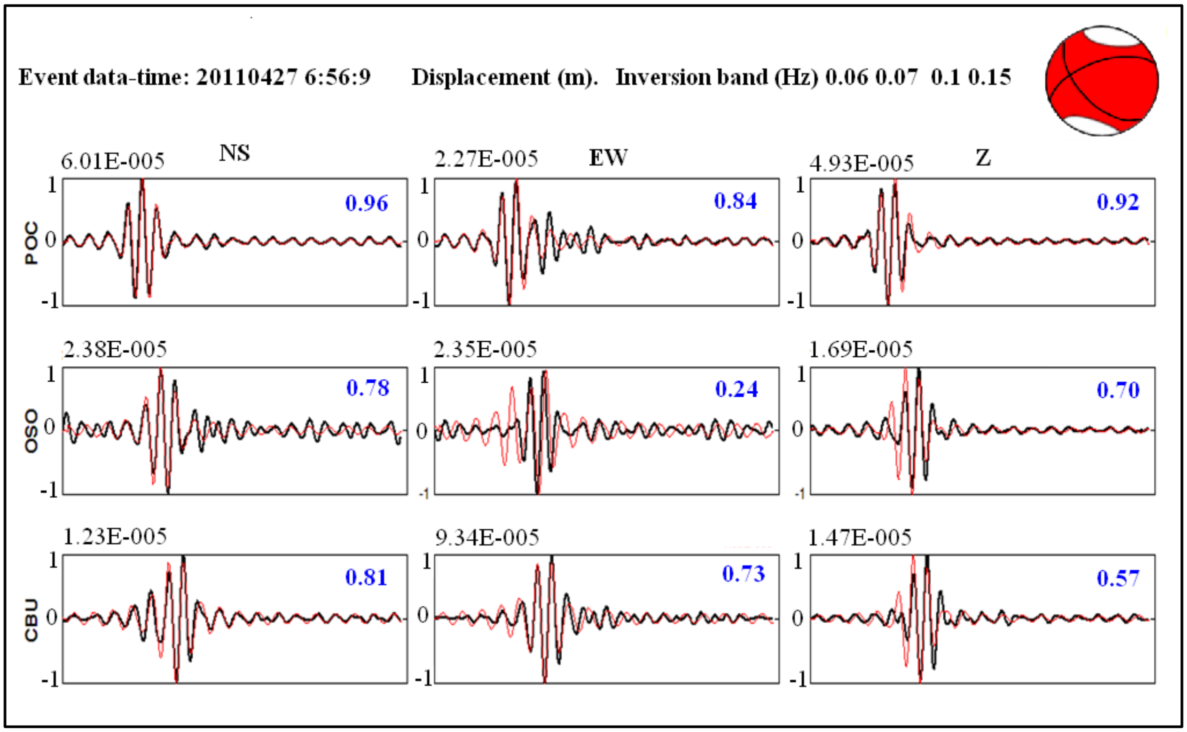


Figure S6. Hybrid (HB) seismic inversion M_L:4.7 registered on April 27th, 2011 filtered 0.06-0.15 Hz. Red seismogram shows the synthetic signal, while the black seismogram represents the signal recorded by different stations. The blue numbers represent the reduction of variance. The amplitudes of the signals are normalized and also are shown in meters. The name POC station was change by name QIR* after the eruption owing to some improvement in the received seismic signal in OVDAS.

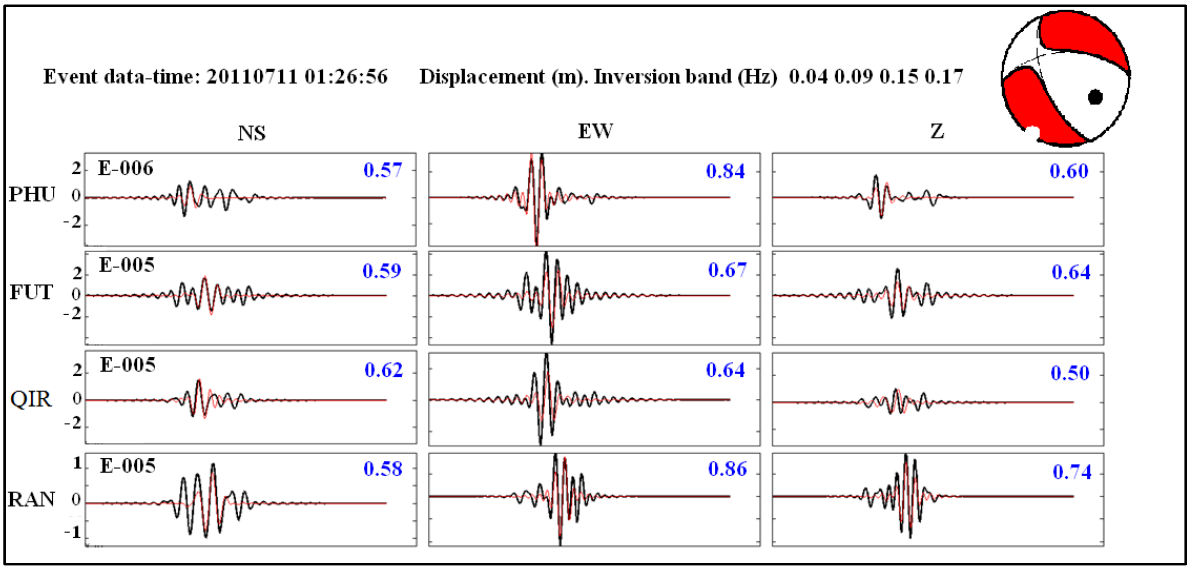


Figure S7. Volcano-tectonic (VT) seismic inversion M_L:4.1 registered on July 11th, 2011 filtered 0.04-0.17 Hz. Red seismogram shows the synthetic signal, while the black seismogram represents the signal recorded by different stations. The blue numbers represent the reduction of variance. The amplitudes of the signals are shown in meters. Ensuring the proper functioning of ISOLA software, we tested the quality of the solution using Full MT inversion. The results from the large VT earthquake were compared using waveform inversion v/s fist polarities focal mechanism, obtaining similar results (Fig. 6, focal mechanism 11/7 in red rectangle).

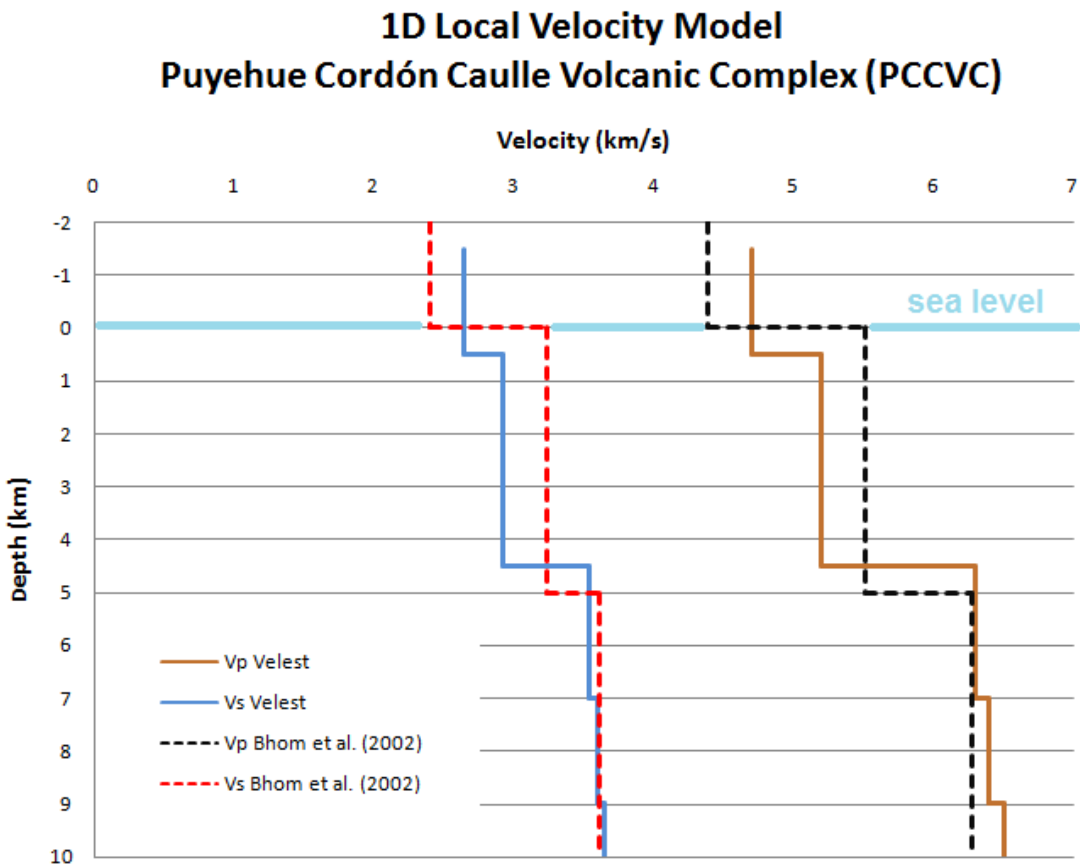


Figure S8. One-dimensional seismic velocity model (Vp red; Vs blue) obtained in this work (bold lines) compared with the one of Bohm et al. (2002, segmented line). The level 0 Km is related to the average height of the Cordón Caulle graben (-1.5 km above the sea level). The Bohm el al. (2002) velocity model started in -2 km and the 0 km is the sea level.

Local seismic velocities resulting during the seismicity relocation process, are 1-2 km/s lower than the regional model of Bohm et al. (2002) at depth shallower than 6 km, with values of Vp near 5 km/s and Vs around 2.8 km/s. This large difference gradually decreases between 6 and 10 km however, below 6 km depth, both models get closer (Fig. S9). This is not surprising, since the model of Bohm et al. (2002) is for the entire the crust between 38° and 40°S, and our model has a local significance beneath the PCCVC, located into the intra-arc volcanic domain.

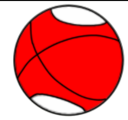
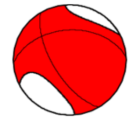
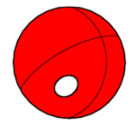
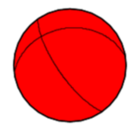
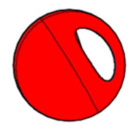
Data (time GMT)	Deep (km) Magnitude	Stations	Filter inversion	% DC v/s %CLVD+ISO	Variance Reduction & Mw	Focal Mechanism
April 27 06:56	4.3 Ml:4.7	QIR OSO CAL	0.07-0.15	DC=16.6 CLVD+ISO=83.4	0.7 Mw:4.8	
May 05 02:09	4.6 Ml:4.2	QIR PHU RAN	0.09-0.18	DC=39.6 CLVD+ISO=60.4	0.6 Mw:4.4	
May 17 14:31	4.1 Ml:3.7	QIR PHU RAN	0.1-0.21	DC=34.5 CLVD+ISO=65.5	0.62 Mw:3.9	
May 27 08:30	4.2 Ml:4.1	QIR PHU RAN	0.07-0.17	DC=9 CLVD+ISO=91	0.55 Mw:4.2	
May 30 19:36	4.0 Ml:3.6	QIR PHU RAN	0.12-0.2	DC=28.6 CLVD+ISO=71.4	0.56 Mw:3.7	

Table S1.-Focal mechanisms inversions of large HB seismic events of the Enhanced Unrest Phase. Main characteristics of the earthquakes before the eruption made with ISOLA software. It highlights its depth, Local Magnitude (Ml), the stations used in the inversions, the filter range, the percentages of the mechanism involved in the seismic source (DC-CLVD-ISO), the reduction of variance, Mw of the earthquake and finally a graph to the focal mechanism solution. The locations of these earthquakes are showed in the figure 3A. DC=double couple, ISO=isotropic, CLVD=compensated linearly dipole vector. Full wave inversion of some of these events confirmed the dominance of the NDC component. The Mw calculated by ISOLA coming from scalar moment Mo and it is equal to scalar product between observed and synthetic data. Therefore, Mo is proportional to a match value between synthetic and observed data. This could be the reason of the overestimated Mw value related with a M_L.