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Local Short Period Seismic Network at Villarrica Volcano

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Since its last eruption in 1984-85, the Villarrica volcano has been presenting both seismic and fumarolic activity, accompanied by an open vent and a refulgent lava lake. To study its activity, a local seismic network of 75 DSS-Cubes short-period stations was deployed at and around the volcano. During the first two weeks of March, 2012, 30 3-Component and 45 1-Component stations were installed in a 63 km x 55 km area, with spacing between stations of 1.5 km for stations inside the perimeter of the volcanic edifice, and 5 km outside this perimeter.

In total, approximately 94 volcano tectonic (VT) events with clear P- and S- wave arrivals were located to the SSW, SSE and North of the Crater at an average depth of 3 km below sea level. At least 73 events classified as “hybrids” (HB) were observed, predominantly about 2 km above sea level near or at the conduit. They present emergent higher frequencies at the beginning of the signal, and sharp S-wave at the crater stations, but a strong scattering, lower frequency content, and elongated coda on the stations along the volcanic edifice, probably due to ash layers and heterogeneities at the edifice. A few long period events (LP) with frequencies between 2-4 Hz were observed during the two weeks. Three set of groups can be distinguished for the regional tectonic events: aftershocks on the southern end of the rupture of the Maule 2010 event, with S-P wave travel time difference of ca. 30 s or more; a second group with S-P travel time difference between 10 s and 20s; and the much closer group with S-P wave difference of 10 s or less.

To determine the average velocity structure of the volcano, a cross-correlation analysis of the waves from a M6.1 event in Argentina and other regional events was performed. The model used was a cylindric model of 6.5 km radius inside the volcanic edifice, which gave a P-wave velocity of 3.6 km/s, and a region outside this radius with a velocity of 4.1 km. The network was divided into five zones (around the volcano and the top part) to apply the Near Surface Velocity approach, which gave velocities between 2.1 – 5.8 km/s, being the top the fastest part.