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Propagation anomalies in azimuth and apparent slowness measured by small aperture seismic arrays at Deception Island volcano

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Seismic arrays provide information about the propagation parameters (azimuth and apparent slowness) of the incoming wave-fronts. These parameters could be strongly influenced by the lateral heterogeneities of the medium. This effect is especially intense in volcanic environments where we expect to have highly heterogeneous velocity structure. If the position of the seismic source is known, then measuring the differences between the theoretical azimuth and apparent slowness and the observed by the seismic antennas, it is possible to derive information about the heterogeneities of the medium.

The TOMODEC experiment carried out in Deception Island Volcano in January 2005, deployed three short aperture seismic antennas among a big set of seismic instruments. These antennas were located respectively in Whalers Bay, Pendulum Cove and Telefon Bay neighbours. Each antenna was composed by a three component sensors and nine vertical seismometers, with an aperture of less than 250 meters in a semicircular configuration. Using the R/V Hespérides we shot about 1000 explosions inside of Port Foster Bay, over an area of about 6 x 8 km. Each explosion was analyzed by every seismic antenna using the Zero Lag Cross Correlation Method, obtaining the observed apparent slowness and back-azimuth.

Results show strong deviation from the expected of a homogeneous medium. In general correlation are high, mostly of them higher than 0.7, showing a coherent arrival of the first onset of the signal to the antennas. High correlation is obtained not only for the first arrival, but also for more than 2 seconds, showing the arrival of secondary waves following different ray paths. The spatial distribution of the apparent slowness

shows the presence of a non homogeneous velocity medium; regions located at the same distance to the array show different apparent slowness values. Using a theoretical ray path propagation model we could determine the differences between expected and observed values. Differences in azimuth between observed and theoretical values range up to 50 degrees. These differences reveal that the shallow structure of Deception Island is highly heterogeneous.