8th International Symposium
on Andean Geodynamics
(ISAG)

Characterization of the seismic response of the Quito basin applying the method of horizontal components to vertical (H / V) ambiental noise

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Quito, the capital city of Ecuador, is threatened by an important seismic hazard due to different seismogenic zones surrounding the city and from the Nazca plate subduction zone. In particular, due to its configuration as a piggy-back basin, the seismic waves present a broadband amplification as it has already been shown in previous analyses (Laurendeau et al, 2017). From the analysis of accelerometric data recorded by the RENAC network, a low frequency amplification (~0.3 Hz) has been ubiquitously found in the southern part of the basin. The horizontal-to-vertical (H / V) spectral ratio of the seismic noise technique has been used widely for site-effect estimation and geophysical exploration through the soil fundamental frequency.

The main objective of this work is to study the typology of horizontal-to-vertical ambient-noise measurements (mHVSR) to determine zones having similar behavior within the basin. The data from the 759 sites of the campaign realize at 2000, were re-analyzed. They have the advantage to be numerous and well distributed in the Quito basin, but the results are limited between 1-50 Hz due to the cut-off frequency of the sensors used at that time. Additional 90 sites were analyzed from more recent measurements. These data are less numerous but the mHVSR are defined between 0.2–50 Hz. So, these data were used to complete the information of the mHVSR limited to 1 Hz.

We defined four main families with a similar typology from the mHVSR with a frequency range between 0.5-50 Hz: (1) a flat response, (2) a clear peak (SESAME peak), (3) multiple peaks, (4) small H/V spectral ratio amplitudes (peak not SESAME). Then each family were divided in sub-families according to the frequency and the H/V amplitude characteristics. At most data from 2000, small H/V spectral ratio amplitudes were identified. Further, two impedance contrasts have been detected: the first one at a shallow depth in the data of the campaign carried out in 2000 to higher frequencies (>1 Hz), and the second one between the soft sedimentary cover and the bedrock observed in recent measures to low frequencies (<1 Hz). The results of this study show that the structure of shallow quaternary layers can clearly change the shape of the H / V ratio, producing different types of curves.