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High resolution seismic microzonation of San Cristóbal de La Laguna (Tenerife, Spain)

Germán Cervigón Tomico¹, Diana Patricia Fernández del Campo², Efrén Fernández Agudo², Andres Felipe García Salamanca^{2,3}, Rory Tisdall⁴, Iván Cabrera-Pérez¹, David Martínez van Dorth¹, Jean Soubestre¹, Garazi Bidaurrezaga Aguirre¹, Víctor Ortega Ramos¹, Luca D'Auria^{1,5}, and Nemesio M. Pérez^{1,5,6}

¹Instituto Volcanológico de Canarias (INVOLCAN), San Cristóbal de La Laguna, Tenerife, Spain

²Facultad de Ciencias Geológicas, Universidad Complutense de Madrid, Madrid, Spain

³Department of Geoscience, University of Calgary, Alberta, Canada

⁴School of Environmental Sciences, University of Liverpool, Liverpool, UK

⁵Instituto Tecnológico y de Energías Renovables (ITER), Granadilla de Abona, Tenerife, Canary Islands, Spain

⁶Agencia Insular de la Energía de Tenerife (AIET), Granadilla de Abona, Tenerife, Canary Islands, Spain

The majority of casualties associated with historical eruptions on Tenerife (Canary Islands) were linked to the seismicity preceding and accompanying the eruptive activity. Therefore, the volcano-tectonic seismicity constitutes a relevant hazard. Moreover, the tectonics of the archipelago and paleoseismological evidences in the southern part of the island, suggest the possibility of destructive earthquakes on the island and its surroundings.

The complex geology of the island also affects seismic wave propagation and can lead to local seismic amplification phenomena. Actually, a recent moderate earthquake (M_L=4.4) located east of the island, has been recorded by a dense broadband network: Red Sísmica Canaria (C7) operated by Instituto Volcanológico de Canarias (INVOLCAN) showing relevant local seismic amplification effects at different sites. For this reason, in the spring of 2019, INVOLCAN started a research program, named TFSismozon, aimed at characterizing the local seismic response of the urban areas of Tenerife with the aim of mitigating the seismic risk of the island.

The first site selected for this purpose was the town of San Cristóbal de La Laguna, declared World Heritage Site by UNESCO 1999 and partially built over lacustrine sediments, which can be responsible for seismic wave amplification. For this purpose, during the summer of 2019, INVOLCAN realized a dense seismic survey of the town, performing seismic noise measurements on 453 sites located in the downtown and its surroundings, for a total surface of about 11 km². The measurements were realized by deploying mini-arrays, composed of 3-4 elements, for a duration of 2-3 hours. These measurements were realized with the goals of obtaining H/V ratios and also to get the surface waves dispersion curves through the cross-correlation of the seismic noise. The amplification frequencies are obtained through the H/V ratio, while the joint inversion of both H/V and dispersion curve data allows for obtaining V_s profiles for each point.

This survey therefore represents the first extensive mapping of seismic amplification effects in the Canary Islands. It also allows for improving the geological models of the town, in particular providing a high-resolution map of the lacustrine deposits on which part of the town lies. The preliminary results of the survey evidenced a clear relation between the sediment thickness and the frequency of the dominant peaks in H/V ratio. Moreover, the preliminary data analysis, on the basis of the H/V ratios, showed that the south-eastern area of the survey may be similar to the lacustrine basin, although previous geological maps indicated the presence of basalts.