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2D AND 3D SEISMIC ATTENUATION TOMOGRAPHIES IN ACTIVE VOLCANOES

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One of the last major challenges in volcano-seismology has been to obtain the internal structure of volcanoes by using seismic tomographic inversions and discern the role played by the fluids involved in volcanic eruptions. Despite this progress, a few indeterminations are present in the geological interpretation based on the tomography images, due to the resolutions limits of the tomography techniques and the difficulty in associating the physical parameters deduced by the tomography with the rock properties. The most common way to solve this lack of coverage is to perform active seismic experiments. However, working with active data, P-wave tomography images are straightforward, while S-wave images, on the contrary, are almost impossible due to the lack of direct S-wave generation by shots. Moreover, the unclear association of the tomography-deduced parameters with the rock properties is a well know uncertainty of the current seismological research, which despite from lab work carried out till now, needs more advances.

A way to partly overcome these difficulties is to jointly interpret tomography images based on the measurement of different physical quantities. Thus, there are a few (but increasing) cases in which velocity tomography is associated with seismic wave attenuation imaging. This association is essential in volcanoes, where a correct interpretation of the spatial distribution of the physical properties in terms of partial melt materials is necessary.

The Coda-Normalization (CN) method is the more novel method for estimating seismic attenuation, which measures the decrease of the seismic energy. The attenuation parameter can be obtained by measuring the direct P- or S-wave energy and the coda-wave energy, calculating their ratio and inverting the given equation. On the other hand, the presence of magma in volcanic regions leads to the hypothesis that the predominant cause of seismic energy attenuation is the heat dissipation mechanism (intrinsic attenuation), but observations show that in volcanoes the heterogeneities (scattering attenuation) are the widely predominant cause of energy dissipation. Using the Transport equation in the asymptotic diffusion approximation, we are able to obtain which is the contribution of each phenomena to seismic energy attenuation and to separately obtain intrinsic and scattering seismic attenuation 2D images.

Results of the present work will help to better constrain the P-wave velocity images obtained in Deception, Teide, Asama and Stromboli volcanoes (among others) and will give soon other useful quantitative constraints for a complete geological and volcanological interpretation which will help to prepare a more accurate volcano-dynamic models.

Keywords: Seismic attenuation, Scattering, Tomography, Volcano-Seismology