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Brittle seismic damage before and after eruptions, worldwide statistical analyses: implications for prediction.

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Recent studies suggested that the seismic events prior and after an eruption follow an Omori's law similar to the one observed for earthquakes with possible different exponent values (e.g., Lemarchand and Grasso, 2007). Given these similarities, we are interested in going further into the analogy between damage triggered by earthquake failure and eruption onset, by studying the damage of the upper crust contemporary to eruptions.

First, using worldwide earthquakes and eruptions databases, we quantified the spatial scale involved in crust damage around eruptions, as a function of the size of volcanic events, i.e. as measured by VEI. Using the distribution of seismic events around the time of eruption onsets, we found that larger volumes are involved in the brittle crust damage for the largest eruption sizes.

Second, we analyzed the analogy between eruptions and earthquakes regarding crust loading and discharge, thanks to patterns of seismicity around event times. For eruptions on a given volcano, evidences for crust loading have been highlighted thanks to seismicity up to ten days prior eruption time (e.g.,Voight, 1988; Kilburn, 2003; Chastin and Main, 2003; Collombet and Grasso, 2003). For worldwide eruptions, average seismicity around eruption time, shows direct and inverse Omori's law, the same way earthquakes do but with different values of exponents (Lemarchand and Grasso, 2007). Contrarily to earthquakes Omori's law, our preliminary analysis suggests the values of these exponents to possibly vary with the eruption sizes. Given that eruption processes generally show longer failure times than earthquake rupture propagation, we are interested in the mechanical responses of the brittle crust damages as a function of the forcing rate. It possibly argues for the eruption process to impact the brittle crust the same way than a slow earthquake, with a larger number of foreshocks than the regular earthquake.

Implications for prediction of eruptions, regarding the size of events and the time of onset, will be discussed.