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Insight into vent opening probability in volcanic calderas

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This study provides insight into the possible behavior of volcanic calderas in pre-eruptive phase and into the most probable location of the areas prone to vent opening hazard, for cases where sill emplacement is an important element of the shallow magma transport system.
We consider that the evolution of the stress field is the main factor that controls the vent opening processes in volcanic calderas and we think that the intrusion of sills is one of the most common mechanism governing caldera unrest. Therefore, we have investigated the spatial and temporal evolution of the stress field due to the emplacement of a sill at shallow depth to provide insight on vent opening probability.
We carried out several numerical experiments by using a physical model, to assess the role of the magma properties (viscosity), host rock characteristics (Young's modulus and thickness), and dynamics of the intrusion process (mass flow rate) in controlling the stress field. Results show that that high magma viscosity produces larger stress values, while low magma viscosity leads to lower stresses and favors the radial spreading of the sill.
Also high-rock Young's modulus gives high stress intensity, whereas low values of Young's modulus produce a dramatic reduction of the stress associated with the intrusive process. The maximum intensity of tensile stress is concentrated at the front of the sill and propagates radially with it, over time. In our simulations, we find that maximum values of tensile stress occur in ring-shaped areas with radius ranging between 350m and 2500m from the injection point, depending on the model parameters.
We infer that the probability of vent opening is higher in these areas.