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Seminario

Use of Distinct Element Method models to better understand volcano dynamics

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Abstract:

Certain volcano-tectonic processes, such as caldera collapse, flank spreading or sector collapse, involve large discontinuous (i.e. fault- or fracture-related) strains of rock masses. Continuum-based analytical solutions or numerical models of volcano deformation are routinely used to model geodetic data from actively-deforming volcanoes, and thus to inform hazard and risk analysis – increasingly so in real time as computing power advances. Continuum-based models have an inherent difficulty in simulating fracture or fault system development, however. Consequently, the effects of fracturing (particularly in the sub-surface) on deduced finite deformation sources may be underestimated and this may lead to misinterpretations of the observed volcano behaviour. My co-authors and I here show how models based on the Distinct Element Method, which simulate a progressive evolution from continuum to discontinuum mechanics, can successfully replicate the development of host-rock fracturing during drainage of a magma body and the subsequent collapse of the overburden to produce a surface depression (caldera). These discontinuum mechanics models further show how development of fracture systems can progressively change the shape, volume and depth of a continuum-based elastic-deformation source as estimated from displacements of the ground surface. I argue that such discontinuum models can enable a better interpretation of geophysical and structural observations at caldera volcanoes, with particular applications to recent activity at Bardarbunga volcano, Iceland, and Piton de la Fournaise volcano, Reunion Island.

Proponente: Mario Floris