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Effects of Host-rock Fracturing on Deflation-related Volcano Deformation Sources

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Insights into the plumbing systems of active volcanoes are commonly gained by using continuum-based elastic modeling to resolve sources of volcano deformation. The geometries and depths of such deformation sources are commonly equated with those of volcano plumbing system elements, such as sills, dykes or magma chambers. We here examine how fracturing of the host rock - i.e. discontinuous inelastic deformation – may affect deformation source geometry and depth. We use two-dimensional Distinct Element Method (DEM) models to explicitly simulate fracture nucleation and development around a deflating magma body, and we then 'blindly' run the DEM model surface displacements through a typical elastic modelling scheme. The results show that host-rock fracturing may induce an asymmetric surface displacement profile that gives rise to an inclined deformation source geometry, even if the original magma body itself was not inclined. In addition, upward propagation of deformation toward the surface can, under certain conditions, cause a related upward movement of the deformation source. Consequently, the true magma body depth may be increasingly underestimated. These results may help explain upward migration and shape change in volcano deformation sources, as for example inferred for the March-April 2007 activity at Piton de la Fournaise volcano, La Reunion.