EGU2020-3379
https://doi.org/10.5194/egusphere-egu2020-3379
EGU General Assembly 2020


# Upscaling of geomechanical properties in Discrete Element Method (DEM) models of volcano-tectonics

**Claire Harnett**[1], Eoghan Holohan[1], Mark Thomas[2], and Martin Schöpfer[3]
[1]School of Earth Sciences, University College Dublin, Dublin, Ireland
[2]School of Earth and Environment, University of Leeds, Leeds, UK
[3]Department for Geodynamics and Sedimentology, University of Vienna, Vienna, Austria

In volcanology, as in other branches of geosciences, uncertainties exist around how well rock properties constrained on the laboratory scale represent those at the field scale. For volcano deformation, scale-related uncertainties are compounded by changes in geomechanical properties as progressive deformation evolves to large strains. Furthermore, such large strain deformation is often localised along large-scale discontinuities. It is therefore difficult to investigate this deformation by using traditional continuum modelling approaches. Here we provide an overview of recent Discrete Element Method (DEM) modelling results as applied to large strain, edifice-scale deformation phenomena, such as lava dome instability and caldera collapse. The DEM is a particle-based numerical modelling approach that enables simulation of strain localisation and highly discontinuous deformation.

Upscaling the geomechanical properties of volcanic rocks from the laboratory to the field can be achieved in DEM models through a calibration process that simulates both the laboratory rock testing and field-scale examples. For lava dome collapse, through comparison of observed and modelled attributes (e.g., displacement, dome growth), we infer that field-scale bulk rock properties (i.e., strength, elastic moduli) are approximately 30% of typical laboratory-scale properties. For caldera collapse, varying the same geomechanical properties produces a range of observed styles of caldera collapse, but the properties required at the edifice scale are approximately a factor of 10 lower than typical laboratory-scale properties. Both the calibration of geomechanical properties and the structural outcomes of DEM simulations, and hence the accuracy of upscaling, are fundamentally dependent on the model resolution, which is a function of both the particle size and distribution. The chosen resolution particularly affects rock strength, fracture toughness, and crack development and propagation. Nonetheless, previously reported discrepancies between seismic and geodetic moments for certain volcano-tectonic events are consistent with the upscaled geomechanical properties in edifice-scale DEM simulations, in that such discrepancies can be explained by a similar-sized reduction in the properties derived from laboratory-scale rock tests.