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Towards more realistic values of elastic moduli for volcano modelling

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Many volcano modelling endeavours require knowledge of the elastic properties (Young's modulus, shear modulus, Poisson's ratio, and bulk modulus) of the volcanic edifice. Unfortunately, these parameters are often poorly constrained. Our multidisciplinary team of experimentalists, geotechnical engineers, and volcano modellers plan to work together to provide a "toolbox" to better inform modelling initiatives. We have compiled a database of rock properties (elastic properties and elastic wave velocities) that contains hundreds of measurements on volcanic rock samples from volcanoes around the world. Using traditional geotechnical methods—such as the Hoek-Diederichs equation (Hoek and Diederichs, 2006)—we have upscaled these laboratory measurements to provide values that better represent a volcanic rock mass. Our initial findings suggest that the Young's modulus and shear modulus can be very low (both about 4 GPa) and the Poisson's ratio can be high (about 0.25) for a typically-porous and typically-fractured volcanic rock mass. Highly-fractured volcanic rock masses can be characterised by a Young's modulus and shear modulus as low as 1 GPa, and a Poisson's ratio as high as 0.3-0.35. More realistic elastic parameters will allow modellers to make better predictions as to the position, size, and shape of subsurface magma bodies, for example. Our toolbox aims to provide elastic properties for a range of scenarios, including when little or no information is known about the rock type, porosity, or "fracturedness" of the edifice or rock mass in question.

Hoek, E., & Diederichs, M. S. (2006). Empirical estimation of rock mass modulus. International Journal of Rock Mechanics and Mining Sciences, 43(2), 203-215.