Towards more realistic values of elastic moduli for volcano modelling

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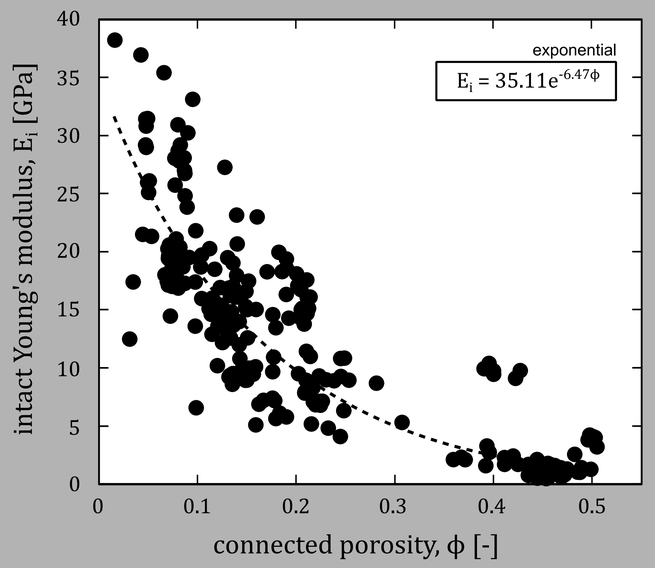
The Hoek-Diederichs (2006) equation gives the rock mass Young's modulus, E_{rm}:

$$E_{rm} = E_i \left[0.02 + \left(1 - \frac{D}{2} \left[1 + exp \frac{(60 + 15D - GSI)}{11} \right]^{-1} \right) \right]$$

D = 0 in our case, so we need to know the Young's modulus on the sample scale, E_i, and the Geological Strength Index (GSI)

Sample-scale Young's modulus

Ideally, one would measure the Young's modulus of a representative sample in the laboratory. If this is not possible, if the porosity of a representative rock is known, E_i can be estimated using the equation on the below graph. If the porsoity is not known, take a porosity of 0.15 (E_i in this case is 13.3 GPa).



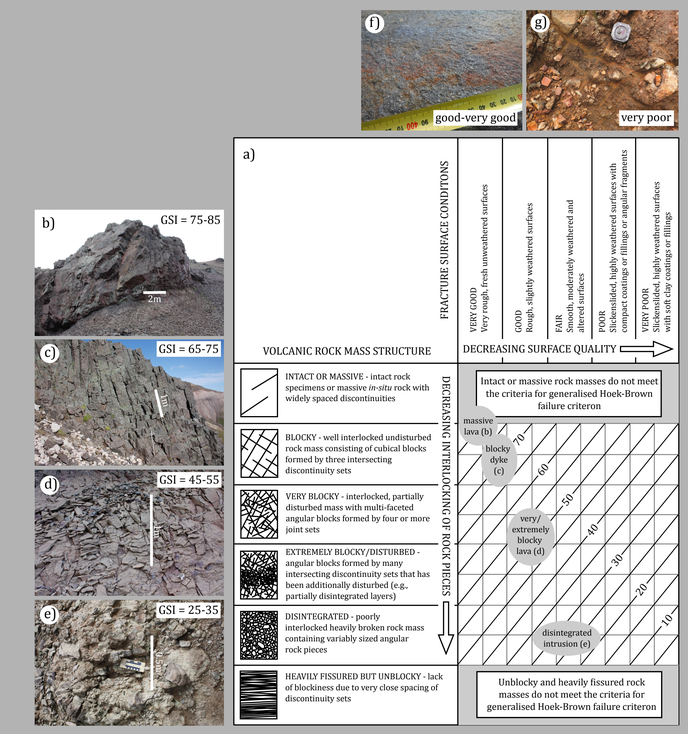
Geological Strength Index (GSI)

Ideally, one would perform a site investigation to determine the GSI (see chart below). If this is not possible, take a GSI of 55.

We present a method to estimate the Young's modulus of a volcanic rock mass for volcano modelling. This method can be improved with site-specific information, but does not rely on it. If the required information is not known, our method suggests that 5.4 GPa is the most appropriate value. Our paper (link below) provides a Microsoft Excel(c) spreadsheet that can be used to quickly and easily provide estimates of Young's modulus.

https://www.sciencedirect.com/science/article/pii/S0377027319304044

E = 5.4 GPa*



liquid-hot magma

All images are from:

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*Young's modulus without prior information