Multiple fracture networks are associated with growing domes.

Pristine rock

Partially fractured rock

Brittle talus
Ductile dome core

Relative rate of dome inflation
Min
Max
Fractures:
- Compression
- Extension

Future work will incorporate fracture networks and better scaling of bulk rock strength.

We need to understand how to accurately model fractured rock.

L-R: pristine synthetic rock sample pre- and post-UCS test; partially fractured synthetic rock sample pre- and post-UCS test. Contacts displayed as dark red circles in images 1 and 3. Shear fractures (pink) and tensile fractures (orange) are shown in images 2 and 4.
Right: curves of measured axial stress and strain during modelled UCS tests of samples with varying degrees of bonding between contacts.

Below: chart showing the reduction in peak bulk rock strength as the proportion of unbonded contacts in the synthetic sample increases. The colours of each data point corresponds to the colour of their associated stress-strain curve in the figure to the right.
Characterising fracture patterns at growing lava domes

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Initial assemblies created in PFC (top row). All samples have height to width ratios of 2.5 as specified in guidelines published by both the ISRM and ASTM. Figures in the bottom row show the result of a simulated uniaxial compression (UCS) test. Shear fractures (pink) and tensile fractures (orange) are shown.
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Cartoon cross-section through a lava dome with sources of uncertainty identified
Conclusions

• Unbonding a proportion of contacts represents an effective method of scaling sample strength to account for large scale heterogeneities
• There is a significant reduction in compressive strength associated with a small degree of microstructural weakening
  - Approximately 50% reduction as the proportion of unbonded contacts increases from 0% to 10%

Next steps

• Scaling results presented here need to be compared against
  - (a) introducing pre-existing macroscale fractures before starting the UCS test and;
  - (b) blanket reduction in material strength assigned at the assembly generation stage
• Results from these tests will help determine how best to model dome rock
  - Incorporate into dome growth models to better understand the impact of fractures on dome stability