Making space for magma fingers and sheet intrusions

The importance of intrusion tip velocities

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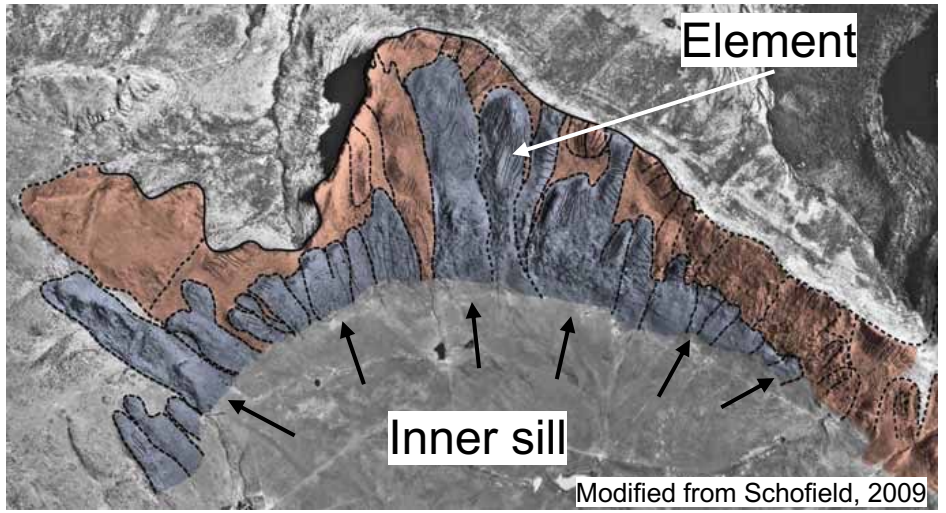
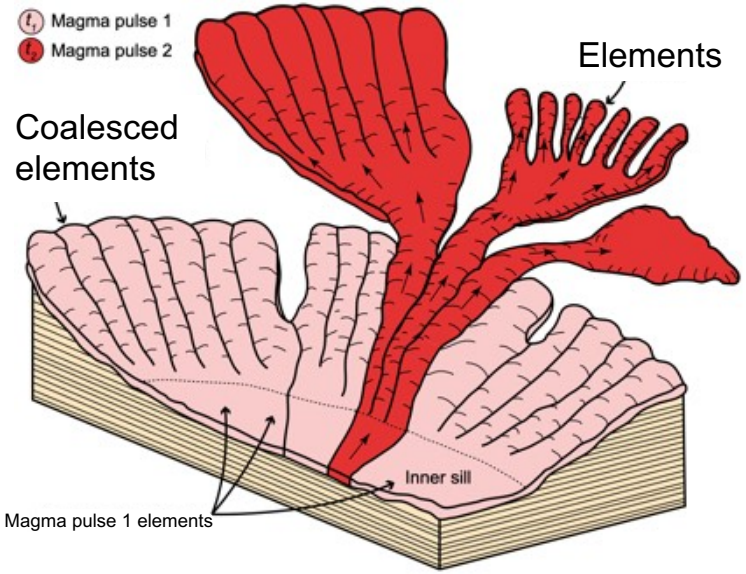
Continuous sheets and elongate elements

- Magma can propagate as a **continuous sheet** and as **elongate elements**



- Arrays of **vertically offset** or **coplanar** elements at the propagating intrusion margin



Magee et al., 2016, Geosphere

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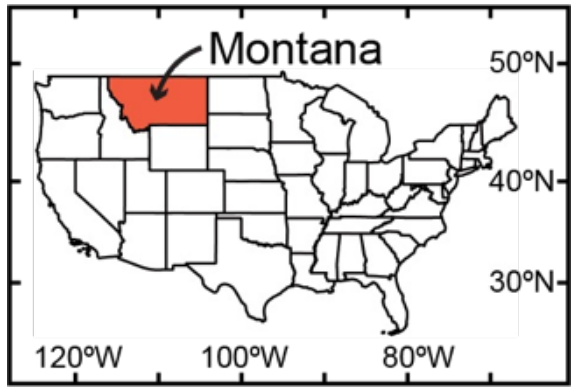
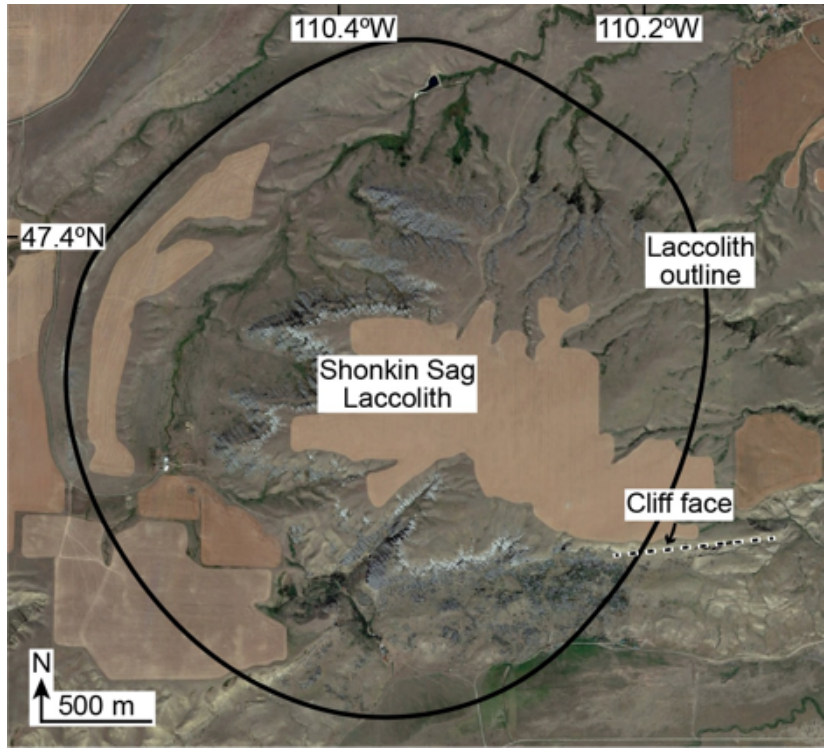
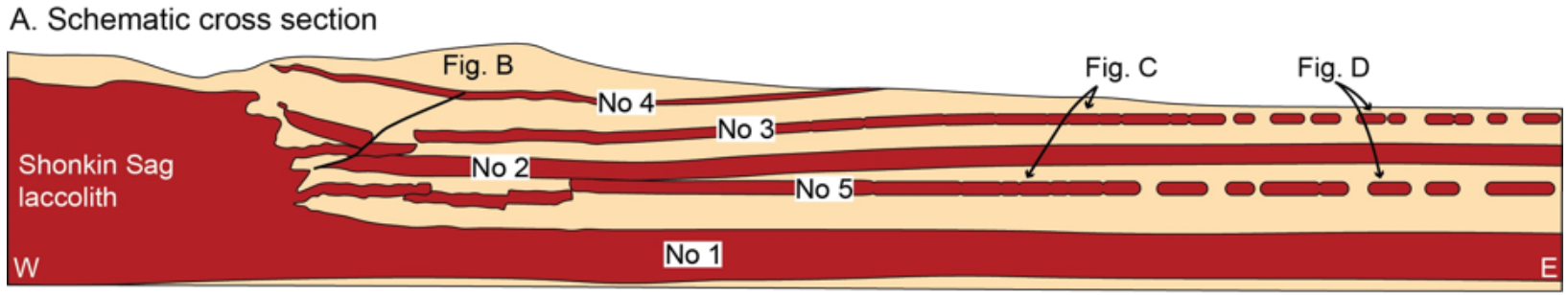
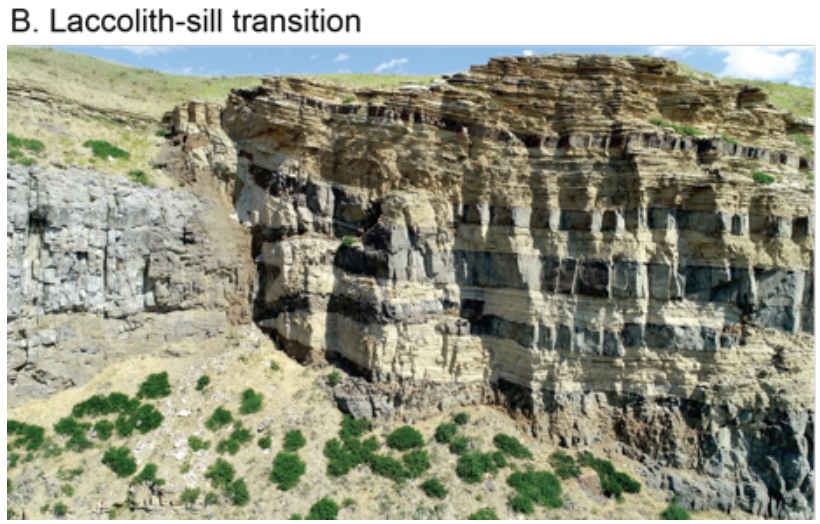
The Shonkin Sag laccolith (Montana, USA)

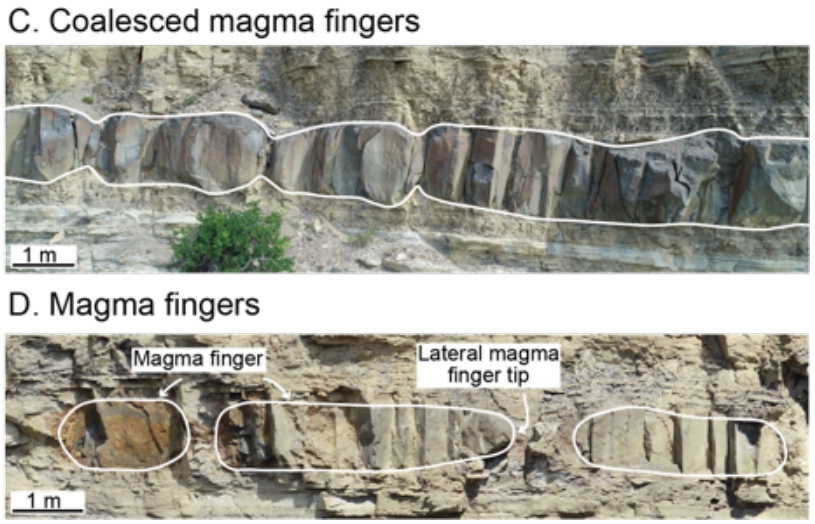




- **Mafic** igneous rocks (shonkinite)
- **Sandstone** with cm-thick **shale** interlayers



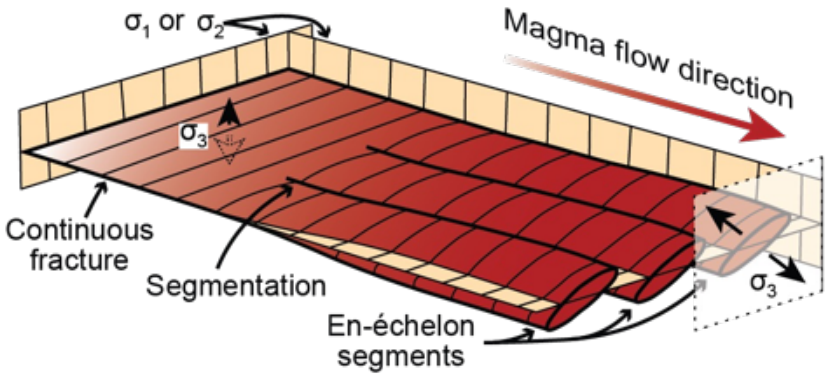




Branching of sheet intrusions

Tensile-brittle processes

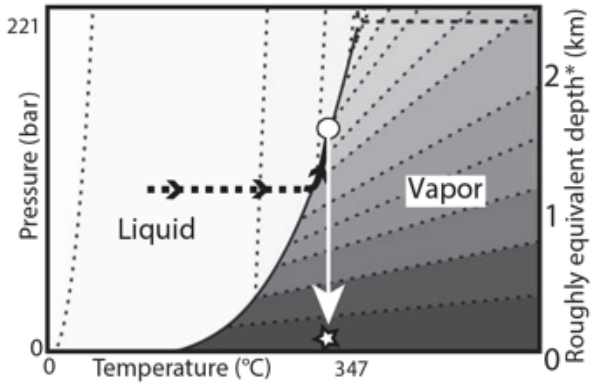
- Stress rotation



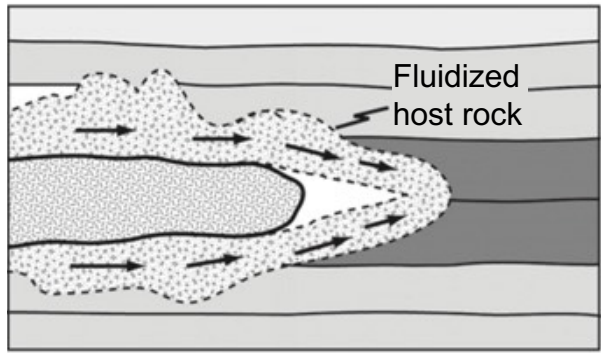
- Exploitation of pre-existing structures

Non-brittle processes

- Host rock fluidization

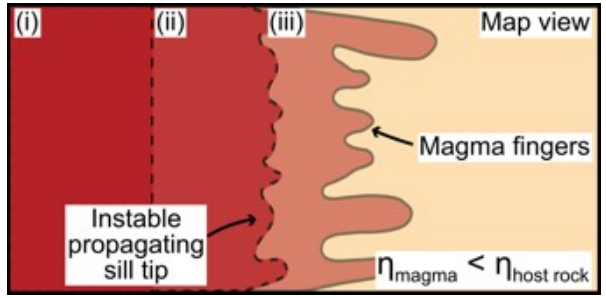


Modified after Schofield et al., 2010, Geology



Schofield et al., 2012, JGS

- Disaggregation of host rock
- Viscous fingering



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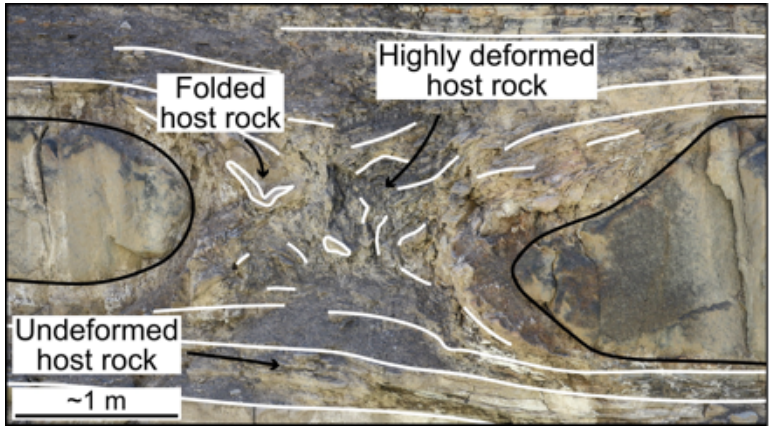
Host rock deformation

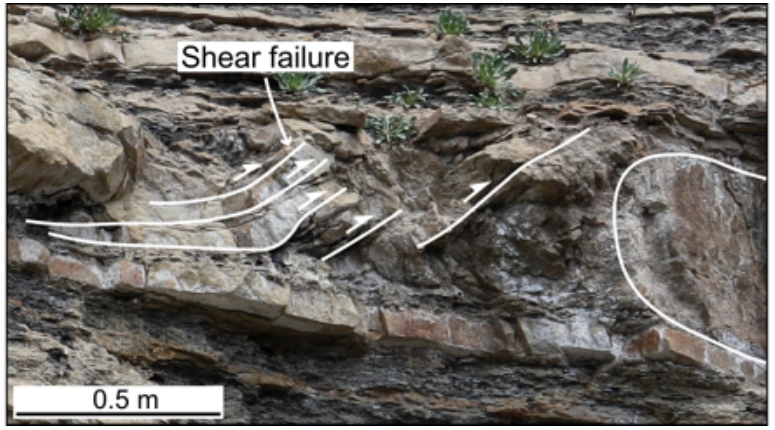
MONASH University

Brittle deformation

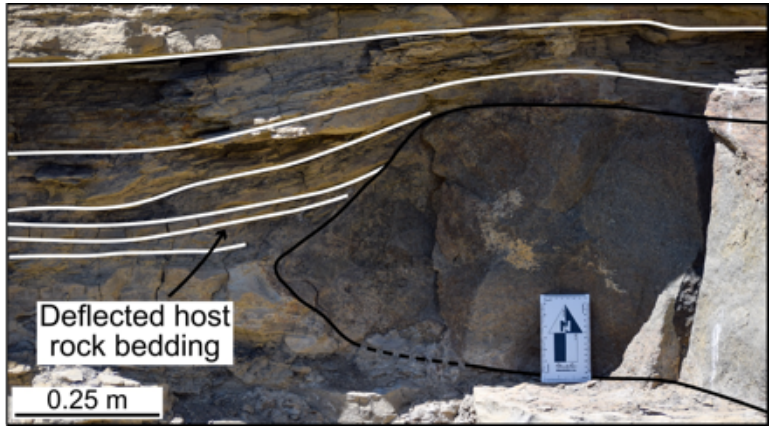
Brecciation



Shear failure

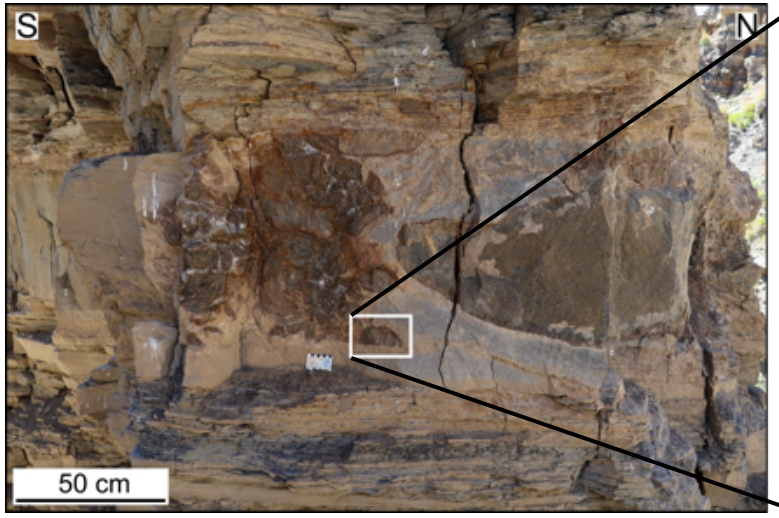


Deflected bedding

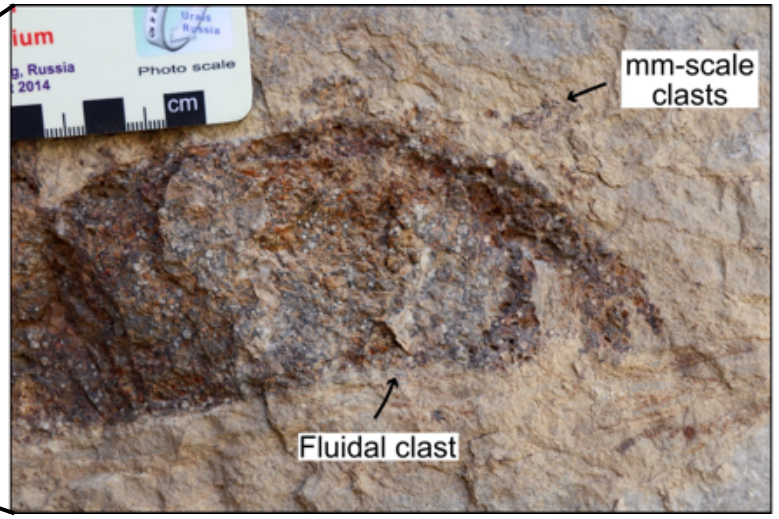


Non-brittle deformation

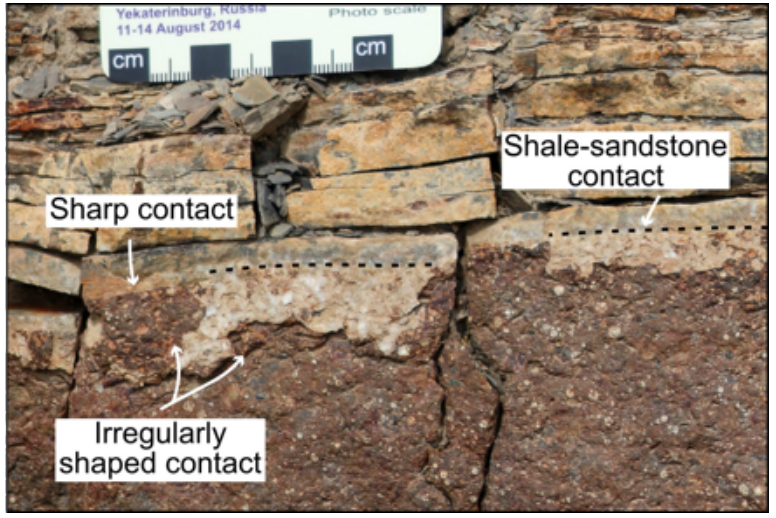
Host rock fluidization



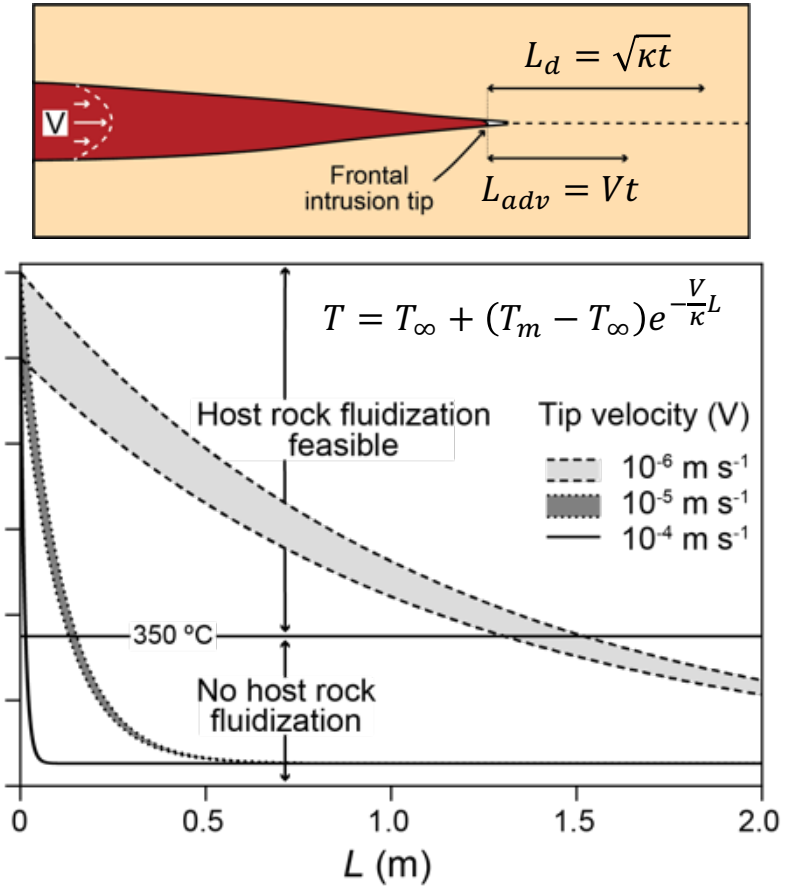
Peperite

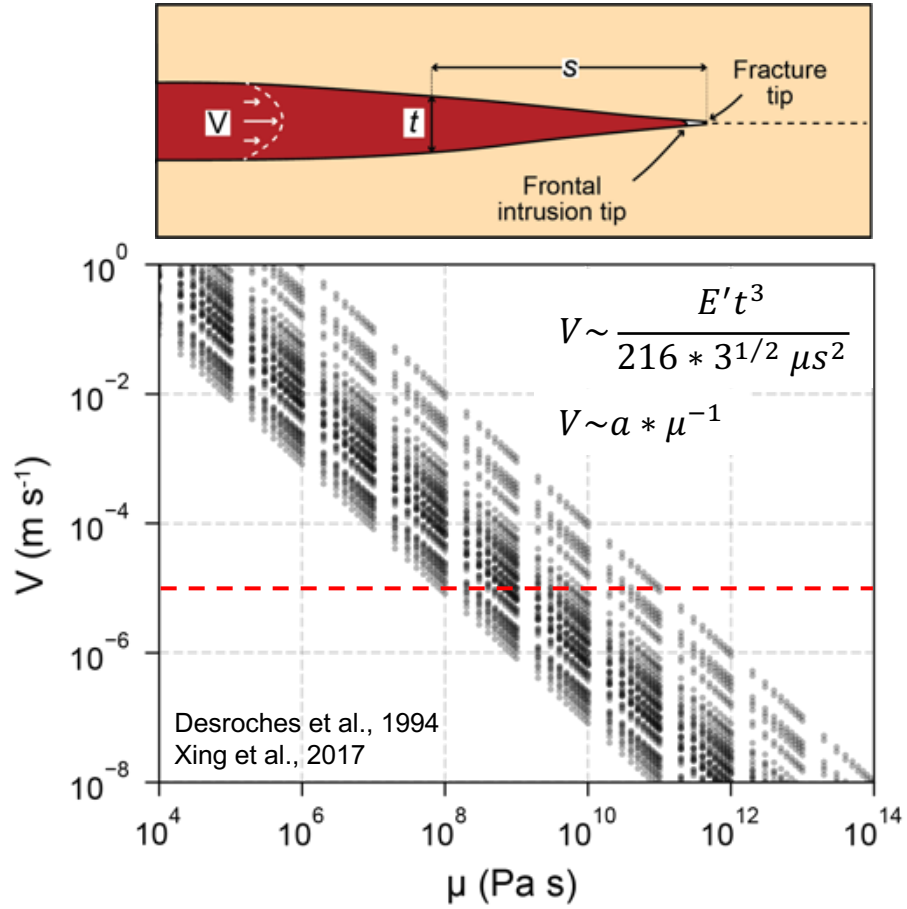


Irregularly-shaped contacts



Conditions that cause host rock fluidization





- Low tip velocities (<10^{-5} m s^{-1})
- High magma viscosities (> 10^{8} Pa s)

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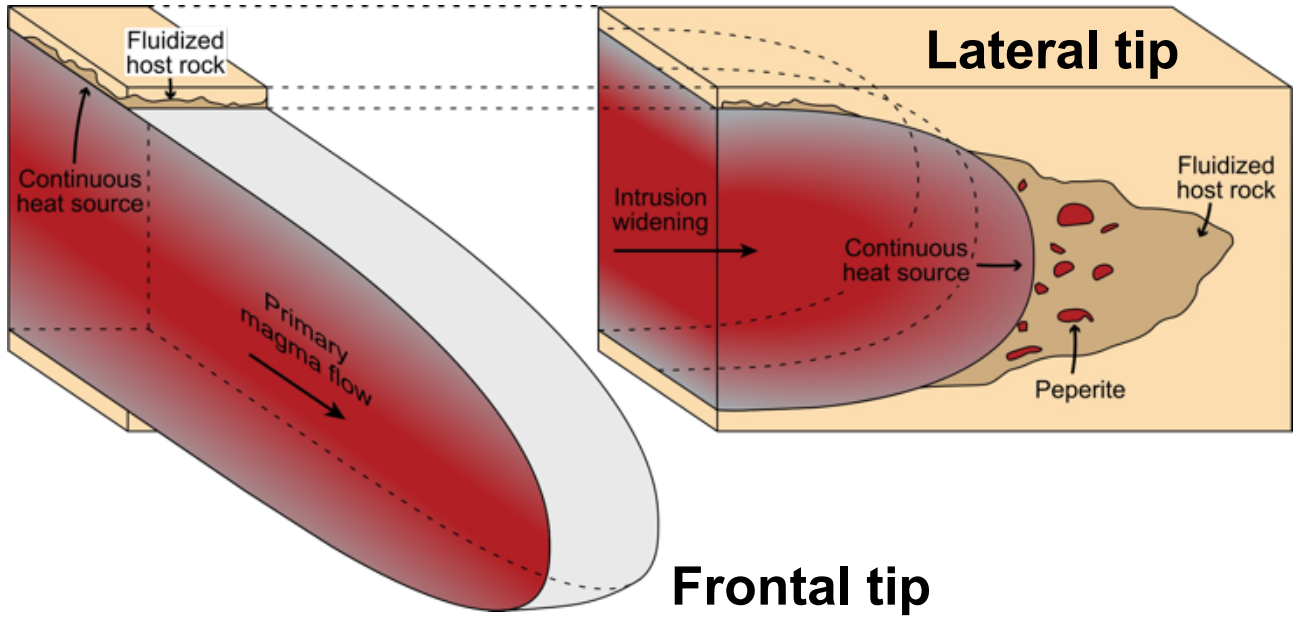
The importance of intrusion tip velocities

- **Different deformation** mechanisms occur at **frontal** and **lateral** intrusion tips.

- **High** tip velocities → **brittle**
  Low tip velocities → **non-brittle**



Distinguish between mechanisms that:

1) Initiation elongate elements
2) Accommodate growth in length
3) Accommodate growth in width
4) Coalescence of elements

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