UNIVERSITÉ DE GENÈVE

Magma density and viscosity

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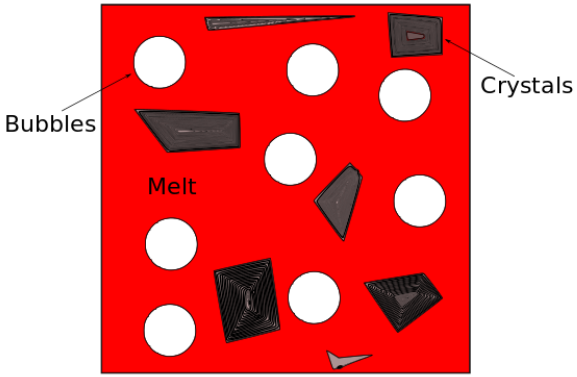
Magma density



Bulk density depends on volume fraction of crystals and bubbles

$$\rho = \rho_{\mathrm{m}} \left(1 - \sum_i \phi_i \right) + \sum_i \rho_i \phi_i$$

ρ_{m} = Melt density

- Depends on $T, P, \mathbf{X}$

i = quartz, hornblende, plagioclase etc. and H_2O, CO_2 bubbles etc.

ρ_i = Density of phase i

- Depends on T, P for bubbles
- Depends on composition for crystals

ϕ_i = Volume fraction of phase i

Melt density

$$\rho_m = \sum_i X_i M_i \left(\sum_i X_i \bar{V}_i(T, P) \right)^{-1}$$

M_i = Molar mass of component i

- Mass of 1 mol of i
- $M_{SiO_2} = 28 \text{ g mol}^{-1} + 2 \times 16 \text{ g mol}^{-1} = 60 \text{ g mol}^{-1}$
- $M_{H_2O} = 2 \times 1 \text{ g mol}^{-1} + 16 \text{ g mol}^{-1} = 18 \text{ g mol}^{-1}$

$\bar{V}_i$ = Partial molar volume of component i

- Change in mixture volume when 1 mol of i is added

Need to determine $\bar{V}_i(T, P)$ empirically

Equation of state (EoS)

Relationship between **pressure**, **volume (density)** and **temperature**
Experiments - measure volume of a sample of **X** at a different P and T.
Find **empirical** EoS

$$V_m(T, P, \mathbf{X}) = \sum_i []$$