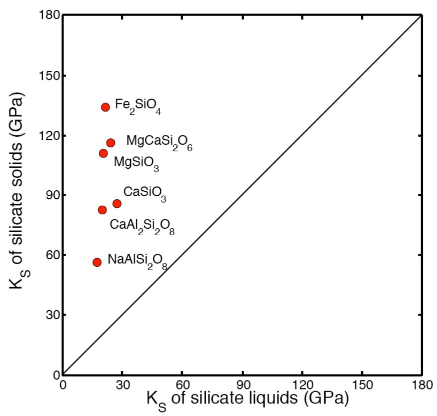
A modified hard-sphere model for the compression of silicate liquids

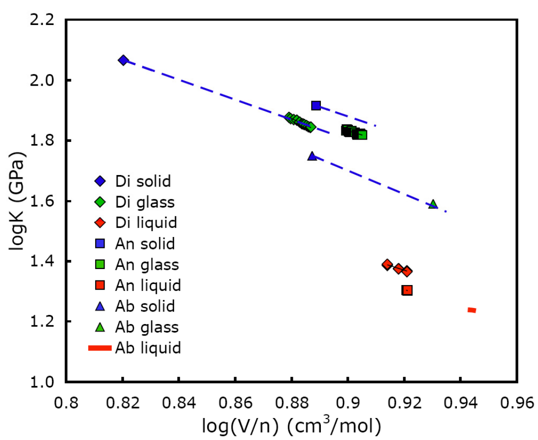
Zhicheng Jing, Shun-ichiro Karato, Yale University

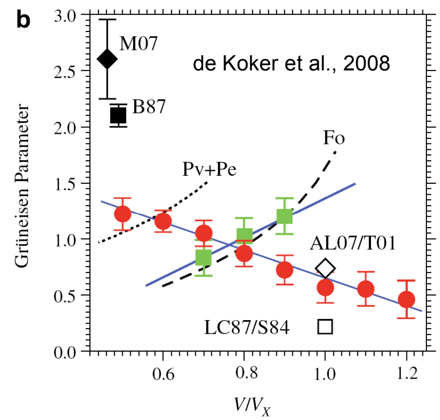
Two important compressional properties of silicate liquids:

1) More compressible than solids; 2) Grüneisen parameter increases with increasing pressure



$$K_T = -V\left(\frac{\partial P}{\partial V}\right)_T = V\left(\frac{\partial^2 U}{\partial V^2}\right)_T - TV\left(\frac{\partial^2 S}{\partial V^2}\right)_T$$





$$\gamma = \frac{\alpha K_T V}{C_V} = \gamma_0\left(\frac{V}{V_0}\right)^{1-(K_T' - \delta_T)}$$

For silicate solids and glasses:

Inter-atomic potential dominates.

$$K_T' - \delta_T = 0$$

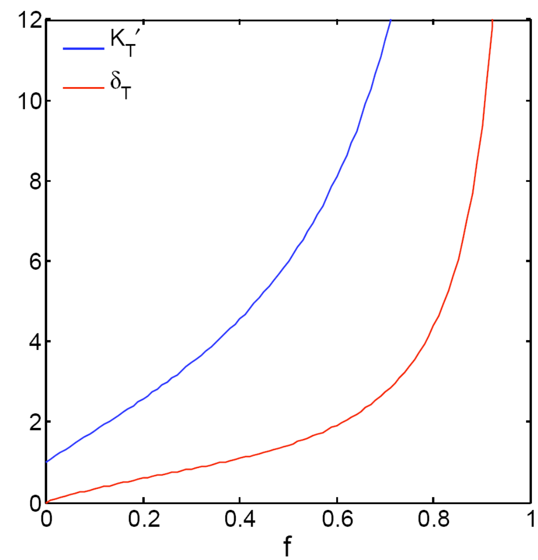
Birch's law

For liquids:

Entropy contribution is important.

Hard sphere EOS:

$$P = \rho RT\frac{1+f+f^2}{(1-f)^3}$$



$$K_T' - \delta_T > 1$$

Silicate liquids do not follow Birch's law.