Set 2, Additional problem

The quantity that is minimized at constant pressure for thermal equilibrium is the Gibbs Free Energy

$$\begin{aligned} G &= H - TS \\ &= U + pV - TS. \end{aligned}$$

At very high pressures, the second term becomes important. Since increases in *pressure* cause the melting, only the second term can be involved.

If raising the pressure, causes melting, that means that raising pressure lowers G. The only way this can happen is if V_{liquid} is less than V_{solid}, which means that the liquid is denser than the solid.

This is not true for most materials, but it is true for water and sodium.