$$D_f \propto V^2 \ell^2 ; P \propto D_f V \implies D_f \propto \frac{P}{V}$$

$$\frac{P}{V} \propto V^2 \ell^2 \implies P \propto V^3 \ell^2 ; P \propto N$$

$$N \propto V^3 \ell^2$$

depth of displaced $H_2O \propto \ell$

volume of displaced $H_2O \propto \ell^3 \propto N \implies \ell^2 \propto N^{2/3}$

$$N \propto V^3 \ell^2 \propto V^3 N^{2/3} \implies V^3 \propto N^{1/3}$$

$$\therefore V \propto N^{1/9}$$