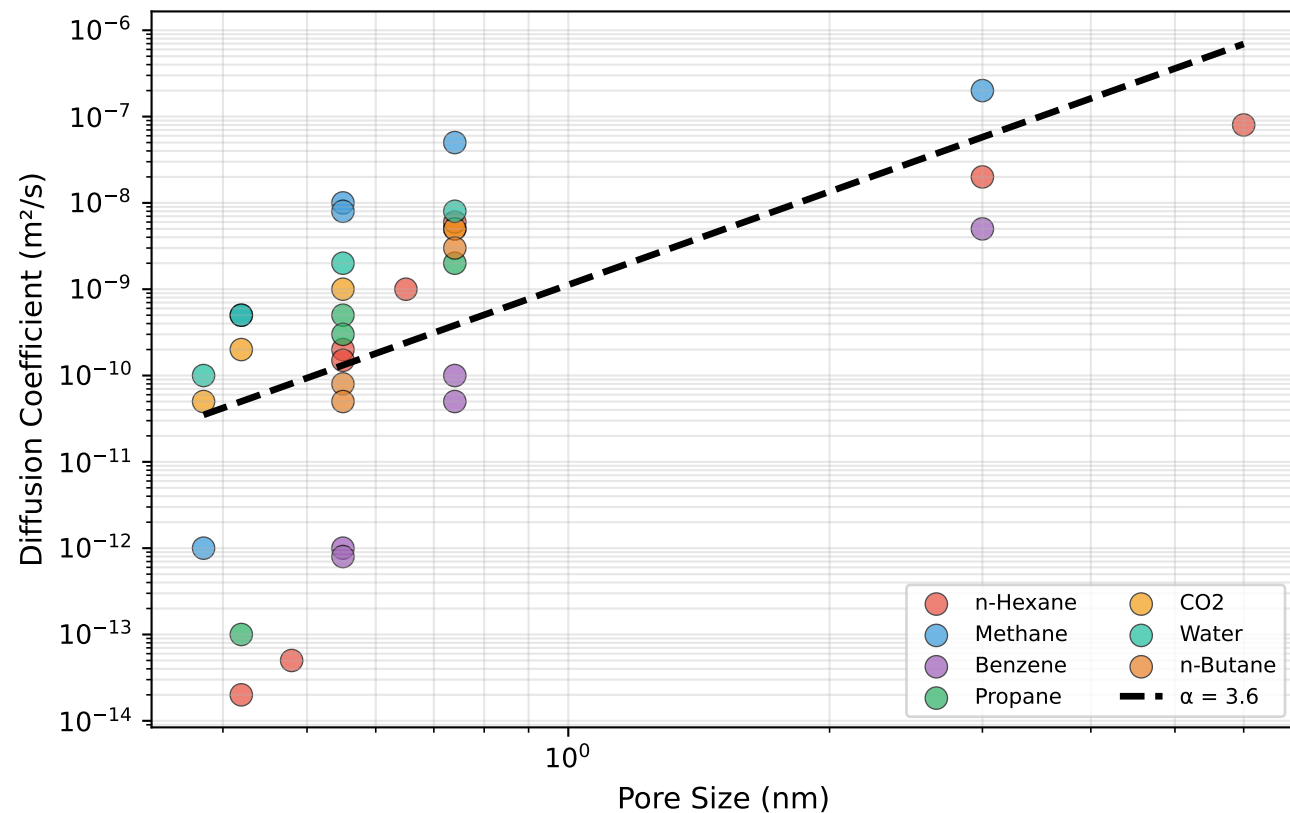
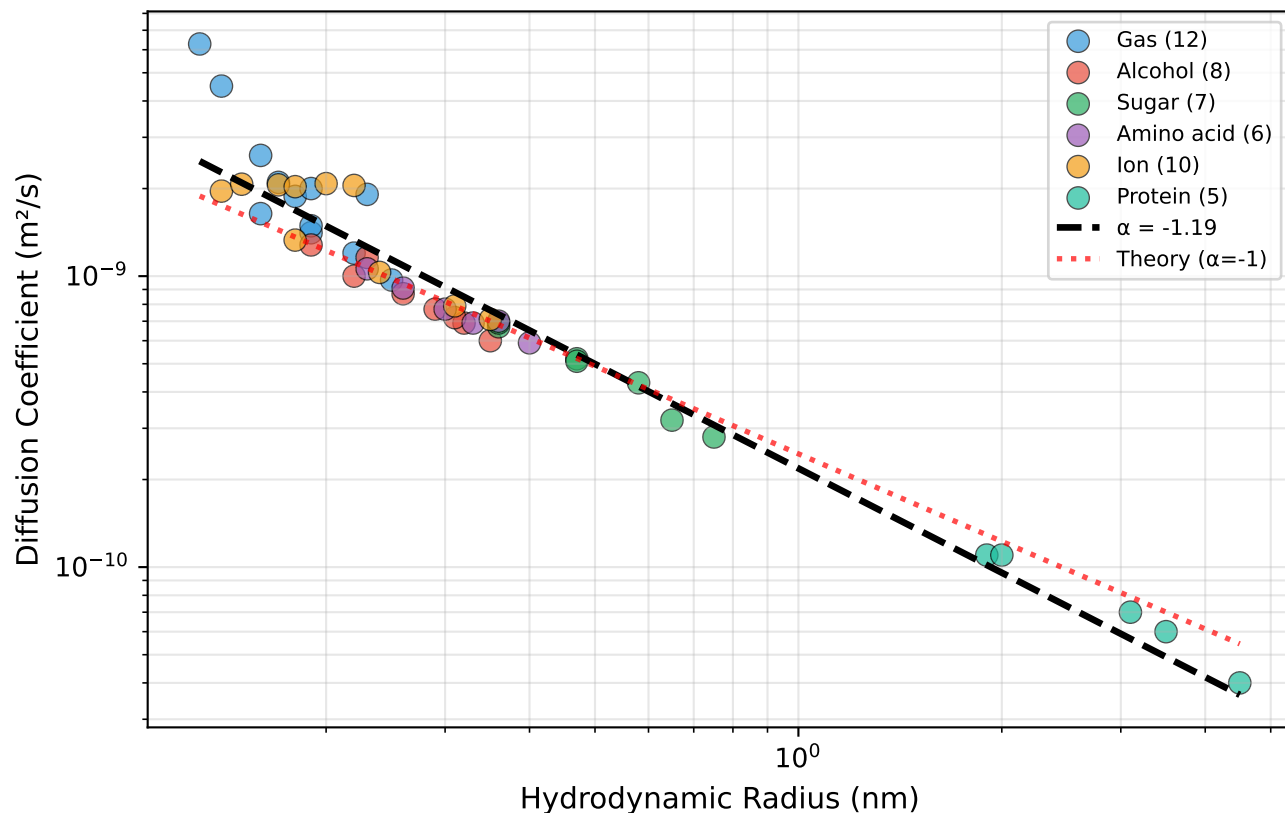


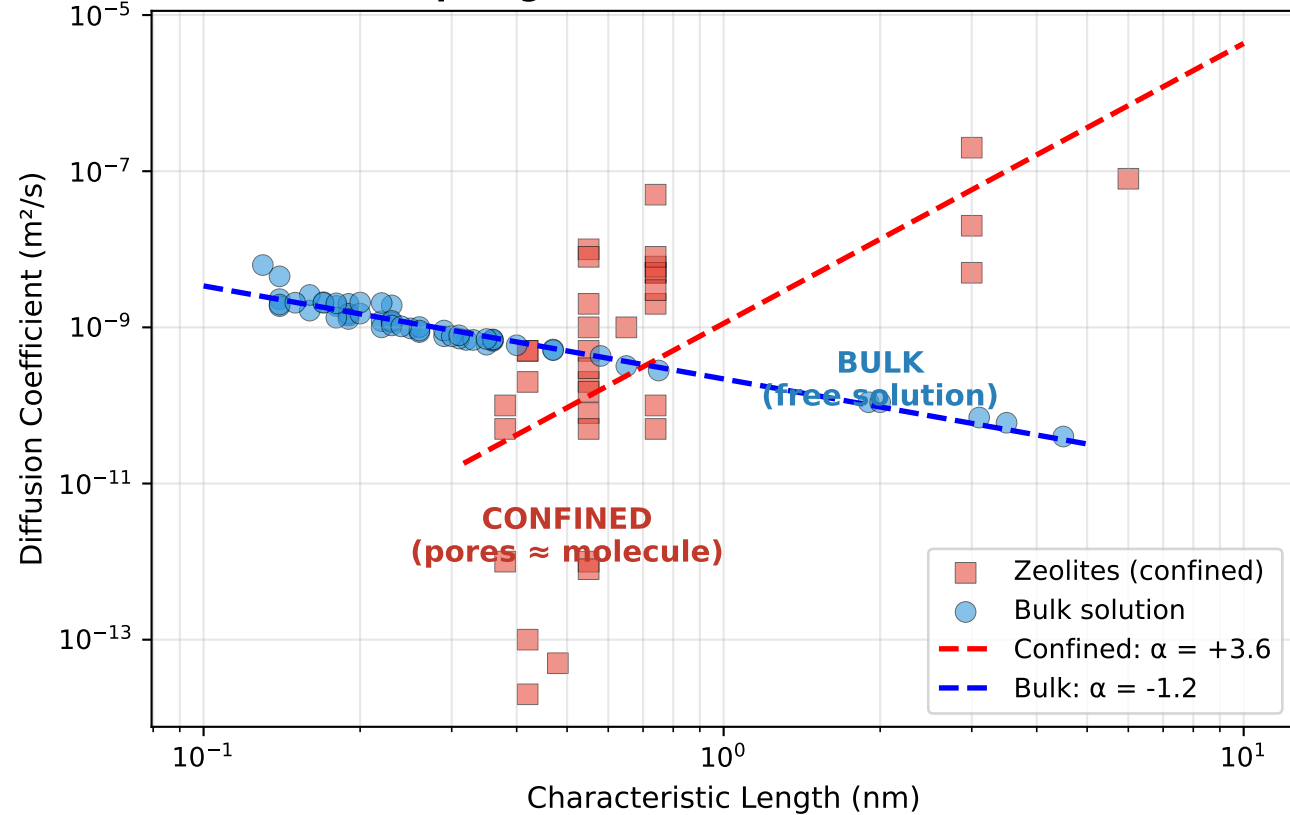
CONFINED REGIME: Zeolite Diffusion
 $\alpha = +3.6 \pm 0.9$ (n=35)



BULK REGIME: Stokes-Einstein
 $\alpha = -1.19 \pm 0.04$ (n=54)



TWO REGIMES OF MOLECULAR DIFFUSION
 α flips sign between bulk and confined!



RTM CHEMISTRY: TWO DIFFUSION REGIMES

ANALYSIS 1: ZEOLITE DIFFUSION (Configurational Regime)

- Data points: 35
- Materials: 11 zeolites (4A, 5A, ZSM-5, Y, X, MCM-41...)
- Guests: 7 molecules (hexane, methane, benzene, propane...)
- $\alpha = +3.6 \pm 0.9$ (overall)
- $\alpha = +9.2 \pm 2.5$ (microporous < 0.8 nm)
- $R^2 = 0.34$ (high scatter due to guest diversity)

Interpretation: EXTREME geometric sensitivity
Small pore change \rightarrow HUGE diffusion change

ANALYSIS 2: STOKES-EINSTEIN (Bulk Regime)

- Data points: 54
- Categories: gases, alcohols, sugars, amino acids, ions, proteins
- Size range: 0.13 - 4.5 nm ($\times 35$ range)
- $\alpha = -1.19 \pm 0.04$
- $R^2 = 0.95$ (excellent fit)
- Theory predicts: $\alpha = -1.0$ (Stokes-Einstein)

Interpretation: VISCOUS drag dominates
Larger molecule \rightarrow slower diffusion (inversely proportional)

KEY RTM INSIGHT: α SIGN FLIP

- Bulk: $\alpha \approx -1$ (bigger = slower)
- Confined: $\alpha \approx +4$ to $+9$ (bigger pore = MUCH faster)

This sign flip marks the TRANSITION between transport regimes!