CROP & FOOD RESEARCH
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LIFE SURFACES: characterising molecular interactions at catalytic surfaces

Catalysts establish chemical pathways

Reversible interactions between reactants and mineral surfaces can produce prebiotic compounds. Often multiple and competing reaction sequences are likely. The affinity of reactants for a catalytic surface may determine which sequence "wins".

Analytical affinity chromatography is a way of measuring the thermodynamic and stoichiometric parameters of reversible interactions. Hence, it may be used to characterize and predict reactive pathways that predominate among competing prebiotic chemistries.

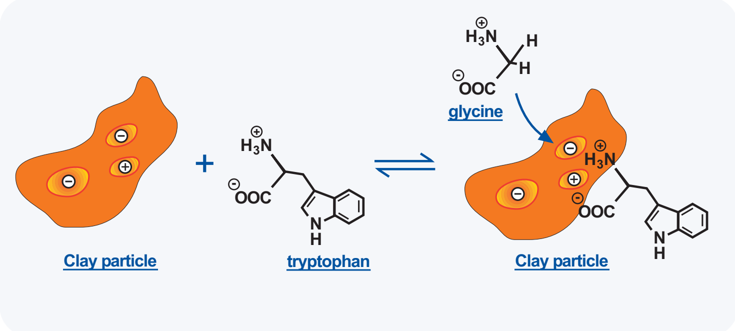

Fig 1. Amino acids binding to clay surface

	Dissociation Constant (molar)	Free Energy (kcal/mol)	# Binding sites (nmole/g)
l-tryptophan	3.35E-6	-7.5	40.2
glycine	4.75E-7	-8.6	

Table 1. Thermodynamic and stoichiometric parameters for amino acids binding to clay.

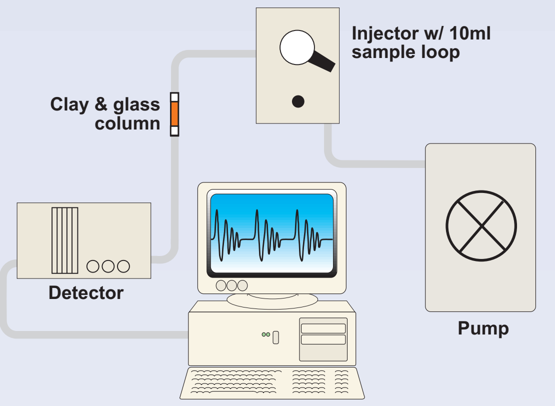

Fig 2. HPLC/Analytical Affinity Chromatography

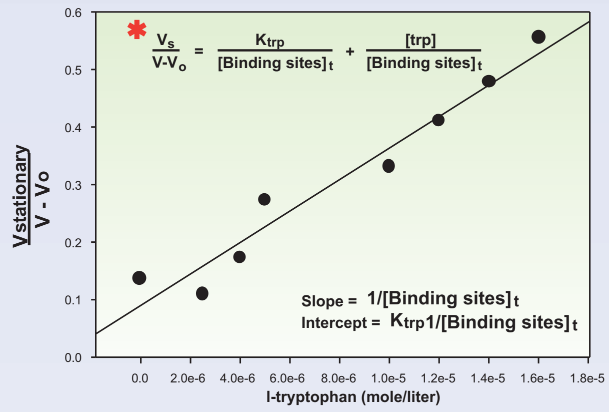

Fig 4. Replot of l-tryptophan data according to the Continuous Elution model.

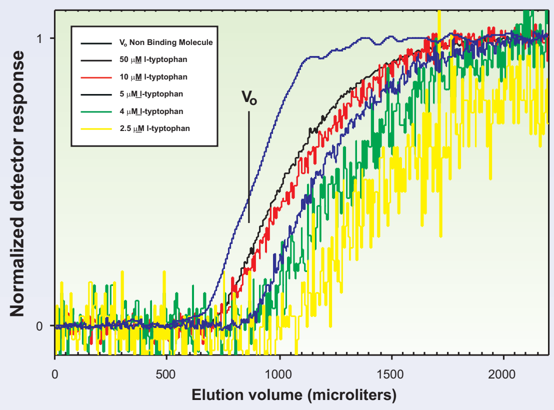

Fig 3. Elution of various concentrations of l-tryptophan from CPG-Clay column.

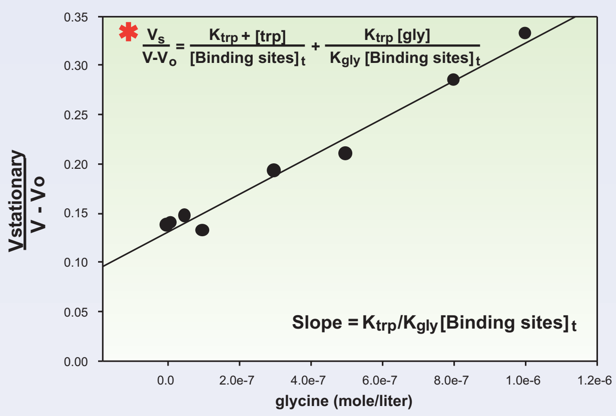

Fig 5. Competitive elution data. l-tryptophan at various concentrations of glycine fit to the Competitive Elution model.

Both amino acids displayed low to moderate affinity for the glass/clay matrix. Glycine, a small amino acid, had a slightly higher affinity and was able to displace l-tryptophan, a large hydrophobic amino acid, from the surface. Hence, we could expect glycine to be more available for surface-mediated catalysis relative to l-tryptophan in this model system. Moreover, it is clear that both amino acids compete for the same binding sites on the stationary phase.

Clays are considered by many researchers to serve as prebiotic catalysts (e.g. see http://www.origins.rpi.edu/clayandtheoriginsoflife.html). It was used in the model system presented here to show that affinity chromatography can be a useful means of characterizing putative prebiotic systems. The method is simple, versatile and low cost. As such, it offers an accessible method of testing hypothetical pathways leading to the origin of living systems.

* Chaiken, I.M. 1987. Analytical Affinity Chromatography. CRC Press, Boca Raton.

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