# Using Interface Energetics to Probe Surface Heterogeneity of Geomaterials and Sorption Dynamics of Macromolecules in Near-Surface Environments

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Interactions of natural macromolecules (e.g. proteins, nucleic acids, carbohydrates and humic substances) at the surface-water interface of heterogeneous mineral or organic surfaces have controlling effects on the thermodynamics, kinetics and subsequent outcomes of biogeochemical reactions in our universe. It is these interactions that have been credited with critically important events (such as the origin of life) and is widely regarded as central to addressing current and future grand challenges pertaining to food, energy and climate. At the center of these interactions is a fundamental understanding of the evolution and susceptibility of the macromolecule-surface associations to biotic and abiotic transformation.

The presentation will discuss energy-centric (specifically flow adsorption microcalorimetry) methodologies for probing surface heterogeneity and macromolecule-surface interactions. The underpinning premise for this approach is that all transformations and transport of matter requires energy and by carefully studying the quantity and evolutionary characteristics of energy within a phenomena, high resolution information on the properties of the system's materials, processes, structure and functions/products can be deduced. Focus will be placed on interactions of humic substances and their interactions at the surface-water interface of metal oxides, charcoals and oxide-coated charcoals.