Lysine polymerization on amorphous silica: A thermodynamic evaluation

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When, where and how did life on the Earth originate? To resolve that fundamental question, one must first ascertain the reactivity of biomolecules, and the response of reactivity to changing environmental conditions such as pH, temperature, dissolved composition, and mineral surfaces. Amino acids are building blocks of proteins, which are fundamental to life. Therefore, the polymerization behavior of amino acids has been a topic of many experimental and theoretical works (Shock, 1992).
This study focuses on thermodynamic effects of minerals on amino acid polymerization. To date, widely various oxide minerals and clays has been examined for their roles in this reaction (Cleaves et al., 2012). Results have demonstrated their positive influences with regard to reaction rate, peptide length, and the amounts of polymers synthesized. However, reported experiments have mostly emphasized catalytic properties of minerals. Consequently, in most cases, experiments have been terminated before polymerization reaches its steady state. It remains unclear whether minerals promote polymerization in thermodynamics as well as kinetics.
To examine the thermodynamic effects, we have evaluated adsorption behaviors of amino acids and peptides on minerals by using extended triple layer model (ETLM; Sverjensky and Fukushi, 2006). Obtained adsorption parameters are used, by combining thermodynamic parameters for amino acids and peptides in aqueous solution, to predict amino acid/peptide equilibria on mineral surfaces. In this presentation, we will present our findings for a lysine/amorphous silica system.

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