Thermodynamics of protometabolism in water

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Laboratory simulations of prebiotic chemistry and protometabolism frequently employ reactive chemicals, such as glycolaldehyde, glyceraldehyde, glycerate and glyoxal, as starting materials. However, the thermodynamic data for these aqueous species are often not listed in widely available databases, which makes it difficult to evaluate the energy involved in prebiotic chemical processes. In this study, I present thermodynamic data for numerous prebiotically significant aqueous species, including the aforementioned four, which were obtained by combining equilibrium constants and temperature dependencies for reactions involving the relevant chemicals (e.g. Henry's constant), as reported in the literature. These data were used to evaluate the energetic feasibility of the intermediate steps in the UMA proposed by Ueno et al. It was found that the UMA's chemical steps are, in most cases, favourable as long as the key starting materials (e.g. formaldehyde) and oxidant (e.g. H2O2) are available at concentrations ranging from the micromolar to the millimolar level.

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