PREBIOTIC REACTIONS IN WATER, "ON WATER", AND IN SUPERCRITICAL WATER. V. M. Kolb, Department of Chemistry, University of Wisconsin-Parkside, 900 Wood Road, Kenosha WI 53141, USA. E-mail: kolb@ uwp.edu

Introduction: One of the major perceived problems in prebiotic chemistry is that water is a natural medium for prebiotic reactions, but most organic compounds are not water soluble. Thus, a question arises how do they react in water.

Reactions of organic materials in water: It has been recently shown that prebiotic organic reactions of water-insoluble organic compounds can occur in water. There are several mechanisms by which these reactions can proceed. One prominent mechanism is the "on-water", in which the water-insoluble organic compounds are driven towards each other when placed in water by the hydrophobic effects. A close proximity of the organic molecules may help orbital alignment of the reactants. As a result, these reactions are often faster than those in which the organic materials are soluble in water. In addition, a better stereospecificity is often obtained under the "on-water" conditions [1,2]. Many prebiotic reactions occur in this manner, including so-called multi-component reactions. Hydrophobic effect is influenced by the presence of salts, and thus the reactions in pure water or in water in which salts are dissolved may occur at different rates, depending on the type of salt [1,2]. Amino acids as salts are considered also [3]. Another mechanism by which organic water-insoluble compounds can react smoothly is when they are placed in supercritical water. Such water behaves as acetone, which is an excellent solvent for organic compounds. Supercritical water also has acid-base catalytic properties [4,5]. Numerous examples of prebiotic reactions "on-water" and in supercritical water will be shown. Many of these are general reactions which were studied as "green" chemical reactions (environmentally friendly, since they occur in water) [5].

Conclusion: Only relatively recently it has been realized that organic compounds which are water-insoluble can and do react in water, often very fast and with a high stereospecificity, due to the special mechanisms which operate in water, with salts present, and in supercritical water.

Acknowledgments: Thanks are expressed to the Wisconsin Space Grant Consortium/NASA for a steady support of our work on prebiotic chemistry over a period of years.

References: [1] Kolb, V.M. (2012) "Application of the Organic 'On Water' Reactions to Prebiotic Chemistry", *Proc. SPIE*, Vol. 8521, pp. 85210D (1-6). [2] Kolb, V. M. (2014) "Prebiotic Chemistry: In Water and in the Solid State", in Kolb, V. M. Ed., (2014) "Astrobiology, An Evolutionary Approach", CRC Press/Taylor& Francis Group, pp. 199-216. [3] Kolb, V. M. (2013) "Influence of Salts, including Amino Acids, on Rate and Outcome of On-Water Prebiotic Reactions", *Proc. SPIE*, Vol. 8865, pp 88650O (1- 6). [4] Kolb, V.M. (2015) "Prebiotic reactions in superheated water", *Proc. SPIE*, Vol. 9606, pp. 960609D (1-7). [5] Kolb, V. M. (2016) "Green Organic Chemistry and its Interdisciplinary Applications", CRC Press/Taylor& Francis Group.