Compartmentalization of the formose reaction to test metabolism-first theories on the origin of life. R. Turk-MacLeod[1], P. Nghe[2], G.Woronoff[2], D. Schnettler[2], E. Szathmáry[3], and A. D. Griffiths[4], [1]Laboratoire de Biochimie, École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, 10 rue Vauquelin, 75005 Paris, France, rebecca.turk-macleod@espci.fr, [2] Laboratoire de Biochimie, École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, [3]Parmenides Foundation, Pullach/Munich, Germany, [4]Laboratoire de Biochimie, École Supérieure de Physique et de Chimie Industrielles de la Ville de Paris, andrew.griffiths@espci.fr.

Introduction: Metabolism-first theories on the origin of life suggest that there may have been prebiotic systems capable of propagation and Darwinian evolution that were not dependent on genetic, nucleotide-based replication. However, to date metabolism-first theories are not supported by experimental evidence. We are testing this idea experimentally by observing the formose reaction compartmentalized in protocell analogues.

Using high-throughput microfluidic techniques, we generate water-in-oil emulsions that contain formose reactants and/or products, and subsequently observe the behavior of the droplets as a function of their chemical contents. Compartmentalized carbohydrate products of the formose reaction affect the osmotic pressure of the droplets, thus driving the droplets to grow at the expense of formaldehyde-containing neighbors. Furthermore, a minority population of efficient formose reaction droplets (those with rates enhanced by initial addition of reaction products) will grow at the expense of less-efficient formose droplets.

This phenomenon of growth correlated with chemical complexity may present a means of selection for especially efficient protocells, either as a result of initial stochastic differences, or of some other environmental factor perturbing the system. Accordingly, we are developing microfluidic platforms for synthesis and analysis of formose reaction droplets to exploit such size differences as a means of selection and characterization of autocatalytic cycles, which may lead to inheritance of composition in the absence of canonical genetic material.