IN VITRO EVOLUTION OF DISTINCT SELF-CLEAVING RIBOZYMES FROM DIVERSE ENVIRONMENTS. M. Popović[1,2,3], P. S. Fliss[3] and M. A. Ditzler[2], [1]NASA Postdoctoral Program (NASA Ames Research Center, Moffett Field, CA, milena.popovic@nasa.gov), [2]Exobiology Branch, Space Science Division (NASA Ames Research Center), [3]Blue Marble Space Institute of Science (Seattle, WA).

Folding and catalysis by biopolymers is exquisitely tuned to the specific chemical environments in which they evolve. Understanding evolution of biopolymer function, therefore, requires a determination of the impact of the local environment on the distribution of functional biopolymers in sequence space. *In vitro* evolution experiments have long been used to evaluate the potential roles of RNA in the origin and early evolution of life; however, the conditions under which these experiments have been conducted do not reflect our understanding of chemical environments on the early earth. To test the impact of environmental factors relevant to RNA's potential role in the earliest forms of life, we evolved populations of self-cleaving ribozymes in an anoxic atmosphere with varying pH in the presence of either Fe^{2+} or Mg^{2+}. Establishing the impact of Fe^{2+} and pH on the evolution of ribozymes is relevant to RNA's role in early life due to the abundance of soluble Fe^{2+}, and wide range of pH values for environments in which life may have first evolved. Populations evolved under different conditions are dominated by different RNA sequences and secondary structures, demonstrating global differences in the underlying fitness landscapes. Our comparison of RNA populations reveals that counterion identity and pH have a dramatic impact on the evolution of RNA catalysis, and therefore represent critical factors in establishing the potential role of RNA in origin and early evolution of life.