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2015 NAI Early Career Collaboration Awardee
Visit to collaborate with Dr. Mary Schweitzer, NC State University
External Report
7/1/16

Any tools utilized in the search for extraterrestrial life must be capable of detecting biosignatures of both extant and extinct life. Therefore, reliable biomarkers should be: capable of being identified if modified or altered, distinguishable from Earth-based contaminating compounds, and able to be unambiguously identified in more than one laboratory assay. Moreover, ideal biomarkers should be biotically produced, with little possibility of abiotic production under normal conditions, and must be capable of being identified in sedimentary environments. Most importantly, because all current exobiological research is based on the assumption that extraterrestrial life would be similar to terrestrial life at the molecular level, molecules that are ubiquitous among living organisms and are necessary for Earth-based life should be targeted as biosignatures.

A class of molecules that is produced in abundance only in living systems and that has the potential to be preserved over time spans relevant to exobiology is the class of tetrapyrrole-based compounds that incorporate the porphyrin chromophore. Porphyrins are macrocyclic tetrapyrroles that are of extreme importance in biological systems. These molecules can be uniquely characterized using many independent analytical techniques, and are unambiguous indicators of biological activity because they are widely distributed among all living organisms on Earth. Moreover, porphyrins are stable in highly acidic environments and at temperatures up to 200 ºC, and cannot be abiotically produced in measurable quantities under normal conditions. Further, the precursors of these molecules can be directly related to well-characterized biomolecules such as heme and chlorophyll. For these reasons, porphyrins could serve as ideal biosignatures for the search for life on Mars.

From February to May 2016, I was a visiting researcher at North Carolina State University in Dr. Mary Schweitzer's laboratory. While there, I made and analyzed thin sections of samples taken from the Rio Tinto River system in Spain. The Rio Tinto River is an iron-rich, oxidizing environment that serves as an analog for the martian surface. The focus of this research was to identify organics in the Rio Tinto samples, with the ultimate goal of learning extraction, separation, and identification techniques for heme and other porphyrins present in these and other samples taken from other Mars analog environments.