Principal Investigator: Dr. Leena Cycil

Title: Investigating the habitability potential of more recent subsurface environments on Mars

Summary of the project

Exploring environments for habitability is one of the primary goals of the Astrobiology Program. The rock record of Mars preserves sedimentary sequences that consist of clay minerals with superimposed sulfate minerals. This stratigraphic sequence has been interpreted as evidence for the drying of Mars, with the clay minerals representing evidence of an earlier, warmer, wetter, more habitable Mars followed by a dryer, more sulfur-rich, saltier Mars. This earlier Mars is considered to have possibilities of past life much greater than current mars. However, the habitability of the intervening time on Mars, when subsurface liquid water was likely present, but more sulfate-rich, is less easy to understand. Many hypersaline environments on Earth are habitable. However, examination of life on in these environments has largely focused on NaCl rich environments, with limited studies focusing on life in Mars-relevant Mg- and sulfate-rich brines. Salt loving Archaea inhabiting the hypersaline environments on Earth are believed to have evolved from Methanogens, a metabolism thought to have evolved on Earth over 3.5 billion years ago and potentially relevant to the subsurface of Mars. The overarching goal of this proposed work is to investigate the habitability of subsurface environments on Mars that evolved as Mars dried up. Therefore, to investigate the potential habitability of more recent subsurface environments on Mars, PI and microbiologist Dr. Leena Cycil will work with a multidisciplinary team including Mars geoscientist Dr. Elisabeth Hausrath and in collaboration with NASA Exploration Scientist Dr. Tom Bristow to test the hypothesis that ***sulfate-rich subsurface environments expected to appear as Mars dried out would be habitable for microorganisms relevant to Mars*****"**, using the following specific objectives. 1) We will test the limits of growth of Mars-relevant organisms under Mars- relevant Mg- and sulfate-rich conditions. 2) We will examine the differentially expressed genetic pathways that these organisms utilize to survive in Mg- and sulfate-rich conditions and utilize bioinformatics to examine how widespread those genetic pathways may be. The proposed work will help understand the habitability of past martian environments by putative martian life, an important step forward in understanding habitable environments and searching for life on other planets.