

The goal of this EPSCoR project is to investigate the utility of two planetary life detection concepts for the search for extraterrestrial life on Mars and Europa. One concept consists of identifying microbial motility using the holographic microscope, which, unlike the light microscope, has few moving parts and thus can be miniaturized. The second concept entails looking for minerals that only form in the presence of bacteria and can be considered microbial equivalent of dinosaur bones. We tested these ideas in a hypersaline pool at Death Valley because it simulates the brine chemistry of Mars and Europa and is teeming with microbial life. Our results validated both concepts. In field deployment, the holographic microscope successfully distinguished particles that actively swim or move purposely from those that move passively, a finding that is ground-truthed by genomic analysis of flagella-making genes and by examining the same sample using the light microscope. Similarly, salt-loving bacteria in Death Valley are prolific biomineral producers. Three different biominerals were found in the culture of just one bacterium isolate. These include calcium carbonate spherulites, struvite (magnesium ammonium phosphate), and guanine crystals. Continued collaborations with NASA centers are planned to further advance these life detection concepts for possible eventual deployment on Mars and Europa.