

Finding traces of life, and proving that life existed on another planetary body, are not trivial tasks. There is a long history of NASA missions looking for traces of past or extant life on Mars. Complex and multicellular life produces an unambiguous record; however, it seems evident that Mars did not host any complex life. Mars might have been inhabited during its early history, when liquid water was present at the surface and the climate was warmer. Early life on Earth was microbial and developed in the absence of oxygen. If similar life evolved on Mars, research needs to be focused on biosignatures that single-celled anaerobic life would leave behind. The goal of this work is to evaluate if biosignatures in minerals produced in the presence of bacteria (biogenic) are different from signatures preserved in abiotic minerals precipitated with organic molecules. In the proposed research, we will focus on iron sulfide minerals, which form in anoxic environments on Earth, and are likely to be present in the subsurface of Mars. This research will characterize the shape, size, mineralogy and trace elemental composition of iron sulfide minerals precipitated with or without bacteria using high-resolution transmission electron microscopy, and characterize chemical bonding between organic molecules and minerals using X-ray absorption spectroscopy.