The search for life on Mars: the importance of Mars-like minerals on Earth to astrobiology

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In recent years, orbital and surface missions have provided a wealth of information on the Red Planet. In particular, the mineralogical composition of surface materials has helped to unravel the geological and climatic history of Mars. The ongoing accumulation of information and knowledge about Martian mineralogy, geochemical processes and climate history is helping to define search strategies for future missions that will specifically seek out traces of past life or evidence of existing life – two of the primary goals of astrobiology. This talk will give an overview of the importance of studying Mars-like minerals on Earth as an important step to addressing whether life ever existed on Mars.

Spectroscopic data from *Mars Global Surveyor* and *Mars Express*, as well as from the Mars Exploration Rovers show that *Ca-Mg-Fe-sulphates* are abundant and diverse at various locations. The fact that these sulphates almost exclusively require liquid water to form means they are of interest to astrobiologists. The presence of the ferric sulphate jarosite within sedimentary rocks at *Meridiani Planum* has received particular attention because this mineral only forms at relatively low pH in Earth systems. Therefore, its presence suggests that the aqueous solutions that deposited or altered these rocks were acidic. This could potentially have important implications for the development of life on Mars or for the preservation of biosignatures of early Martian life. However, jarosite has recently been discovered within carbonate sediments on Devon Island in the Canadian High Arctic. This finding shows that jarosite can form in a well-buffered environment and likely only requires localized or transient acidic conditions in order to form.

Various Ca-Mg-Fe-phyllosilicates (or clay minerals) have also been identified in some of the oldest terranes exposed at the Martian surface. Their presence suggests an early active hydrologic system, and the formation of these abundant and widespread clays would have required the presence of persistent liquid water over extended periods of time, as phyllosilicates generally form from extended periods of water-rock interaction at near circum-neutral pH. These deposits may therefore represent some of the best places to search for past habitable environments and traces of relict life on Mars. Clays are known to bind and trap organic molecules. They may also be formed by microorganisms, in some case preserving physical traces of such processes. Their catalytic properties have also been implicated in prebiotic chemistry on Earth – and perhaps Mars. However, very little work has been done on biosignature formation and preservation in clay-rich systems. It is therefore imperative that the formation and preservation of microbial biosignatures in clay minerals is studied in more detailed using analog systems on Earth in anticipation of future Mars missions.

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