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Earth biominerals for exobiology

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Mars is now a hyper-arid and extremely cold world but the data from several robotic - both orbiter and lander missions - seem to suggest a past climate, warmer and wetter than the present one. Dendritic channels and gullies are geological features which are, in analogy with the terrestrial case, compatible with the presence of liquid water. As liquid water is considered necessary for life, its stable presence in the past increases the possibility that simple forms of life could have developed on the surface or in the underground of Mars. If this is the case, traces of extinct life could be present in some geologic layers on the planet in the form of fossils and microfossils.

Laboratory research on biotic and abiotic minerals of exobiological interest allow us to characterize possible discriminating factors useful for distinguishing samples of biological origin from those of mineral origin. We have investigated the physical properties of calcium carbonate ($CaCO_3$), which may be present on Mars. The polymorphs of $CaCO_3$, aragonite and calcite, are interesting because on Earth these compounds are produced by abiotic processes as well as by biological activity.

In this work, we report the results of infrared (IR) transmission spectroscopic analyses directed at examining the reaction to thermal treatments of biotic (fresh and fossil materials) and abiotic particulate samples composed of calcium carbonate. We have also used a Scanning Electron Microscope for morphological and compositional studies.

Moreover, since it is important to study primitive terrestrial living organisms, in order to understand the evolution of life, we examined key fossils on Earth: stromatolites. Recent and fossil (3.5 Gyr old) samples gave us relevant information on how the different biomineralization processes have influenced the characteristics of the samples.