COULD AN UNMANNED ROVER FIND EVIDENCE FOR LIFE IN THE PILBARA?

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Abstract

Mars Laboratory (MSL) is a large, sophisticated mobile laboratory designed to explore by remote control Gale Crater on Mars, providing data on past and present martian processes, including the presence or absence of those indicating martian biology. Expectations for the mission are high. Other vehicles under development, for example ExoMars, will provide similar data. Despite their size, sophistication, and cost, MSL and ExoMars are still very limited with respect to the range of analytical methods they have bring to bear on a comparatively small number of samples.

Gale Crater was chosen as MSL's landing site because it contains a thick and diverse stratigraphic section from Noachian through to Amazonian. These strata may record more than 3.5 billion years of martian environmental history, in particular during the Noachian epoch, when surface conditions may have been much more hospitable and "Earth like" than at present. The challenges of recognising biosignatures in rocks of this age on Mars may have a counterpart in recognising them in rocks of similar age on Earth, such of those in the Pilbara region of Western Australia.

The equivalent rocks of the Pilbara were deposited in shallow marine volcanic and sedimentary environments with abundant hydothermal springs, as would be expected to have occurred on Noachian Mars. Possible microfossils and stromatolites were discovered more than 30 years ago and have been extensively studied since. Despite detailed investigations by scores of researchers at many sites over this this period, employing a wider range of techniques to a greater number of samples from more sites than MSL or ExoMars are every likely to, uncertainty persists as to whether life was present at ~3.5 Ga on Earth, even though the consensus is that it was. The reasons for this doubt are many, the complex history of the rocks, with polyphase deformation, multiple cycles of uplift, erosion, and burial, and a greater deal of scepticism towards the evidence than would be directed towards similar evidence in much younger rocks.

Based on this experience, even if MSL or ExoMars discover possible biosigatures on Mars, or if samples containing such biosigatures are returned by some future sample return program, it is highly likely that the results after exceptionally critical review will, at most, be seen as inconclusive. The range of analytical methods, the number of samples, and the diversity of sites investigated will all be too small to allow any degree of certainty. These limits to the basic data will mostly likely combine with an attitude that evidence of life on Mars will be seen as an "extraordinary" claim requiring "extraordinary" evidence. This conclusion is reinforced by the experience from the Viking biology experiments and the studies of possible biosigatures in Mars meteorite ALH84001 where, despite some positive indications, the consensus view is that these are at best inconclusive. Only through a very detailed and diverse field program, comparable to that carried out in the Pilbara, will it be possible to reach a consensus on the validity of possible biosignatures found on Mars.