

A comprehensive plan for drilling in Martian permafrost in search of life.

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If life ever existed on Mars, a key question is the genetic relationship of that life to life on Earth. To determine if Martian life represents a separate, second genesis of life requires the analysis of organisms, not fossils. Ancient permafrost on Mars represents one potential source of preserved, albeit dead, Martian organisms. Strong crustal magnetism in the ancient heavily cratered southern highlands between 60 – 80°S and 180°W indicate what may be the oldest, best preserved permafrost on Mars. Drilling to depths of 1000 m would reach samples unaffected by possible warming due to cyclic changes in Mars' obliquity. When drilling into the permafrost to retrieve preserved Martian organisms, it is necessary to take special precautions to avoid the possibility of contamination. On Earth, and possibly on Mars, it is impractical to sterilize the entire drill. Even if initial sterilization is possible, contamination of deep layers with surface material must be considered. It is clear that the exterior of the samples taken from aseptic drilling methods are contaminated by the drilling environment. However because of the impenetrability of frozen cores, it is likely that the inner core of the sample is sterile and uncontaminated by the drilling environment. Problems with current drilling methods, techniques to trace the cleanliness of samples collected, and complications with maintaining an aseptic environment are considered here in the context of Martian permafrost drilling. . Suggestions for future research on drilling methods and tracer technique developments are considered. Mars analogs on Earth, such as the Canadian Arctic and Siberia, provide an suitable environment for testing such technologies. Advances made on Earth in aseptic drilling form the basis for the design of a Mars permafrost drill.