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SOIL GAS ANALYSIS FOR RAPID IN-SITU RESOURCE LOCATION AND GEOLOGICAL ASSESSMENT IN A MARS ANALOGUE SETTING

Abstract

Sending spacecraft, equipment and people to Mars will have strict mass and volume requirements in terms of the amount of supplies a crew is able to take with them from Earth. By rapidly locating resources such as water ice and methane near the surface of Mars, it may be possible to tap into these in situ resources and reduce reliance upon portable supplies, reducing mission costs and perhaps prolonging an otherwise short surface stay. Through the analysis of soil gas constituents such as methane and carbon dioxide, preliminary constraints can be placed on the location of geologic structures and associated resources like water and methane. A soil gas survey was performed in a Mars analogue setting at the Mars Desert Research Station (MDRS) in Utah in order to simulate working conditions of future Mars astronauts.

Air photo lineament analysis was performed to identify possible fault locations where the probability of soil gas detection is maximized. A grid of 18 hand augered holes (90 cm deep) were dug at the sample site and a galvanized steel pipe sledgehammered to a depth of 100 cm. After atmospheric evacuation of the test pipe the soil gases were measured using a portable landfill gas analyzer (GEM2000). Levels of methane, oxygen, carbon dioxide, hydrogen gas, carbon monoxide and dihydrogen sulphide were recorded along with down-hole temperature, barometric pressure and GPS coordinates. Soil gas levels were plotted geospatially and compared to regional faulting orientations predicted by air photo analysis and USGS geologic maps. Inherent complications of detecting soil gas in a Mars analogue setting are identified, and challenges such as finger dexterity and the amount of manual labour required to operate tools are discussed. Areas for refinement are proposed to improve the utility and effectiveness of future soil gas studies under similar conditions.