Measuring the habitability potential of Mars: an evolving state of the art

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Introduction and Approach

The habitability potential (HP) of an environment is a measure of its suitability to support life. Because we only know life as it is found on Earth, we cannot make an exhaustive determination of another planet's capability to support life that we do not know, however it is possible to use the requirements for life that we do know as a benchmark.

For Mars, what Viking began nearly forty years ago [1] has become the basis for the present habitability assessment campaign of NASA's Mars Science Laboratory (MSL) [2].

A number of diverse chemical and physical attributes of the present environment have been measured with sufficient frequency to better probe the diurnal and seasonal environmental dynamics of Mars, and we've also begun to grasp a little more of the past habitability potential of Mars, particularly with the rover missions: the Mars Exploration Rovers and MSL. Mobility and the capability to measure multiple samples have allowed us to sample more of Mars at close range, measuring local phenomena that might be beyond the sensitivity and resolution of orbital measurements.

Meeting the chemical requirements for life (specific elements, oxidation state, phase state, etc.) is only part of what characterizes a habitable environment. The physical conditions that thermodynamically and kinetically constrain the chemical reactivity at the environment under study provide strong constraints on its habitability potential. Such metrics include maximum and minimum temperature on both a diurnal and seasonal basis, ionizing radiation, wind speed and direction, rock porosity and permeability, atmospheric pressure, etc.

Discussion and Implications

The surface of Mars has a low HP relative to at least one environment observed in the martian past [2]. This does not preclude subsurface environment with higher HP.

The ability of the MSL payload to measure the exposure age of rock [3] facilitates a distinction between preservation of paleoenvironments and habitability potential as represented in the rock record.

[1] Klein, H. P. (1979). *Rev Geophys*, **17** 1655-1662 [2] Grotzinger *et al* (2013) *Science* **342** [3] Farley *et al* (2013) *Science* **342**