

**CHARACTERIZING PAST HABITABLE ENVIRONMENTS AND ANY LIFE IS A UNIFYING THEME FOR MARS SCIENCE.** D. J. Des Marais<sup>1</sup>, <sup>1</sup>Exobiology Branch, NASA Ames Research Center, Moffett Field, CA 94035, David.J.DesMarais@nasa.gov

**Searching for past habitable environments and life:** The search for past life has benefited from several productive years of exploration by orbiters and landers. Orbital observations have found that potentially habitable ancient near-surface environments were diverse and relatively widespread [1, 2]. These include late Noachian massive layered phyllosilicates that exhibit stratified compositions, phyllosilicates in intracrater fans where large channels enter the craters, plains sediments that apparently contain evaporite minerals, carbonate-bearing deposits that might indicate deposition in surface waters or alteration of olivine-rich rocks at depth, intracrater clay-sulfate deposits that might have formed in lakes, Meridiani-type layered deposits indicating acidic and evaporitic conditions, Valles-type layered deposits consisting of sulfates and iron oxides/hydroxides perhaps indicating evaporite deposits derived from groundwater or hydrothermal activity, and plains near the polar ice cap that have gypsum perhaps derived from sedimentary layers within basal cap deposits..

Diverse environments and sediment types such as these would favor the existence of diverse life and the preservation of diverse types of biosignatures.

Many of these ancient aqueous environments created sedimentary deposits that might have been favorable for the preservation of biosignatures as well as indicators of environmental conditions [3].

Recent impacts and erosional activity provide access to near subsurface deposits, thus reducing adverse effects of radiation on any potential biosignatures.

Ancient sedimentary rock records have integrated and preserved the effects of habitable environments and past life, thereby creating relatively widespread, abundant and robust records of their former presence.

Furthermore, Martian climate has varied over time, perhaps ranging between more clement surface environments and more severe conditions. Accordingly strategies for the exploration of past environments have the flexibility to select sedimentary deposits that were formed during time intervals when the climates were most favorable.

A variety of deposits that represent diverse, potentially habitable ancient environments have been identified at lower latitudes and elevations. Accordingly many of these localities are feasible landing site candidates and they also favor the long-term survival of landed spacecraft [4]. Therefore the ability to land and operate missions in localities having deposits from

ancient potentially habitable environments has been fully demonstrated.

**Understanding the long-term evolution of habitable environments requires global-scale investigations of Mars as system:** Habitable environments arise from interactions between geological, atmospheric and stellar processes. The fundamental questions in atmospheric science seek to understand the processes that caused the Martian climate to evolve over time to reach its current state. The composition, structure and geological history of Mars are fundamental for understanding the solar system as a whole and providing insights about Earth. Ancient deposits that recorded evidence of early planetary evolution are probably more extensive and detailed on Mars than on Earth. Examples of key targets for geological and atmospheric investigations include the geophysical and geochemical evolution of the crust and mantle, the distribution and composition of water reservoirs, changes in hydrologic cycles, changes in atmospheric composition and photochemistry, etc.

All of the above phenomena also impact the multiple factors that are essential for sustaining habitable environments – the abundance, distribution and availability of water, nutrients, chemical and light energy, and the persistence of environmental conditions necessary for living systems to propagate.

The search for evidence of past life necessarily focuses on the need to understand the nature, distribution and long-term evolution of habitable environments. This focus, in turn, ensures that the Mars program will continue to pursue a strategy that is properly balanced between the geological, atmospheric and astrobiological sciences. Such a balanced program will lead ultimately to a deeper understanding of Mars as an integrated global system.

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