PIPING STRUCTURES ON EARTH AND POSSIBLY MARS: ASTROBIOLOGICAL IMPLICATIONS.

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Terrestrial surface and subsurface environments are linked to specific biologic habitats with variable compositions of microorganisms. Many of these environments are similar to water-enriched environments on Mars that have dynamic geologic and hydrologic histories. Many researchers have hypothesized that Mars may contain fossilized or extant microbial life in similar surface or subsurface settings where water may support life now or have supported it in the past. A primary goal of astrobiology is to find suitable deposits on Mars that may support extant life or have supported life in the past.

Pipe-like structures within the Jurassic Entrada and Navajo sandstones of Utah (Fig. 1), which have physical vertical and horizontal dimensions ranging from tens to hundreds of meters are known to have supported fungi either during formation in the Jurassic or during diagenesis in post-Jurassic time. These fluidization pipes are considered to result from gas/water release under pressure in ancient wet aeolian environments, possibly related to magmatism and/or tectonism. Our work shows that materials within the pipes contain greater concentrations of life when compared to the surrounding host rock, the microbial life having been entombed within the piping materials during and after their formation. The Utah sandstones have considerable porosity, allowing the ingress of living plant structures and microorganisms, remnants of which were entombed in precipitates and clay mineral coatings on detrital grains of sand and silt. Host-rock detrital clasts are of similar composition and size, and also contains fossil microorganisms, but of greatly reduced frequency when compared to the pipe materials. Field emission electron microscopy (FESEM) and energy-dispersive spectroscopy (EDS) examination of sands from numerous pipes, for example, reveals the presence of fossil forms of microorganisms resembling fungal filaments, some with hyphopodium-like structures resembling modern tropical leaf parasitical fungi. The paleogeography of the sandstones is consistent with a tropical origin of the fungi, which supports a northern movement of North America since the Jurassic. The fossil fungi are embedded in a silicized precipitate along with minor amounts of $CaC0_3$ and Fe and in some cases with a Si/Al ratio consistent with smectite. They are interpreted to be pseudomorphs of fungi, completely depleted of N, and adhering to the surfaces of sand and silt grains of quartz, orthoclase and mica.

Fig. 1. Three-dimensional perspective using a USGS Digital Orthoquad image at 1 m pixel^{-1} centered over longitude 111.107°W and latitude 37.182°N near Lake Powell, Kane County, Utah. A discussion of the terrestrial topography is in Mahaney et al. (2004).

The presence of aqueous environments on Mars is based on stratigraphic, paleohydrologic, paleotectonic, and geomorphic evidence (Mahaney et al., 2004; e.g., Fig. 2). In the northern plains, where vast dune fields have been identified in places, volatile-charged and sediment-laden outflow channel floodwaters of enor-

mous magnitudes are believed to have rapidly ponded, resulting in possible water bodies ranging from lakes to oceans (Dohm et al., 2001; Fairén et al., 2003).

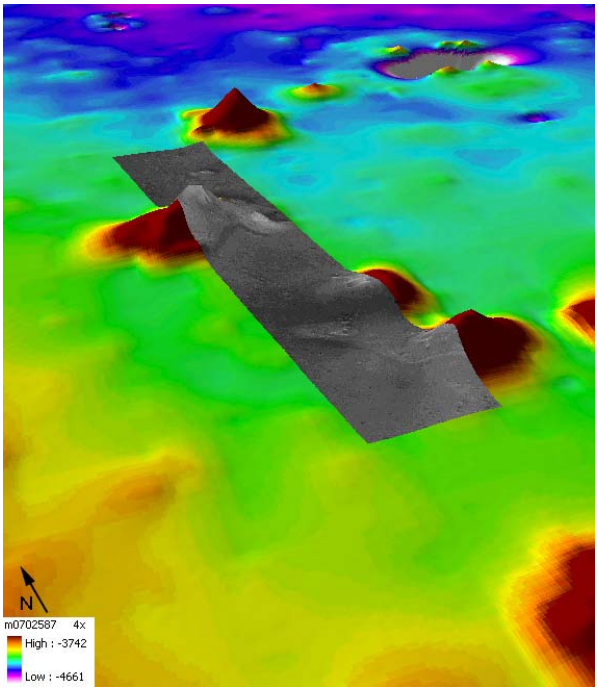

Fig. 2. This 3D perspective displays MOC narrow angle image m0702587 draped over 128 pixels per degree MOLA topography (vertical exaggeration is 4 times). Distinct promontories and associated aprons are shown.

Many promontories in the northern plains (some referred to as pseudocraters) appear to be constructional with heights and widths ranging from meters to kilometers. Hypotheses to explain their formation include volcanism, subsurface volatile release resulting from tectonism and/or magmatism (e.g., hydrothermal activity), and the rapid release of trapped volatiles through a sediment lid following a flood episode. As such, many of these features may be analogous to the piping structures observed in Utah, and thus are considered here to be “easy to get to” sites for the exploration of extant or fossilized life.

References: Dohm, J.M.,, et al., 2001. *JGR*, 106: 32943-32958. Fairén et al., *Icarus*, 171: 53-67. Mahaney, et al., 2004. *Icarus*, 171: 39-53.