WESTERN NOACHIS TERRA CHLORIDE DEPOSITS: AQUEOUS MINERALS WITH HIGH ASTROBIOLOGICAL PRESERVATION POTENTIAL.

J. R. Hill[1] and P. R. Christensen[1], [1]Arizona State University, Tempe, AZ 85287, jonathon.hill@asu.edu.

Introduction: The chloride deposits located in western Noachis Terra at 350.5°E, -37.2°N represent the closest occurrence of chloride deposits [1] to glacier-like forms [2] on the Martian surface separated by potentially traversable terrain and located within the human exploration zone latitude and elevation constraints. Chloride deposits provide ideal conditions for the long-term preservation of biosignatures in the form of fluid inclusions, microbial fossils and organics [3]. Glacier-life forms (GLFs) are indicators that near-surface water ice, shielded by dust and regolith, is present and has undergone deformation in the recent geologic past [2].

The exposed chloride deposits are located at the center of an ~40km diameter basin with both inlet and outlet channels, suggesting it was once an overfilled paleo lake system where water would have ponded and evaporite minerals could have formed. The basin lies in Middle Noachian-aged terrain and the proposed exploration zone contains contacts with surrounding Early Noachian and Late Noachian surfaces [4].

A ~25km diameter crater to the southeast of the proposed landing site contains many morphologic features associated with subsurface water ice, including lineated valley fill [5], pasted terrain [6], viscous crater fill [7], gullies [8], and possibly recurring slope lineae [9] along the eastern rim.

Table 1: Landing Site Characteristics

Coordinates (Center)	350.5785°E, -37.4214°N
Elevation	1,181 m – 1,219 m
Area	28.3 km^2 (3 km radius)
Slope	0.0997° – 1.1488° (MOLA)
Thermal Inertia	206 – 286 J m^{-2} K^{-1} s$^{-½}$
Albedo	0.15

Table 2: Regions of Interest - Science Requirements

Requirement	ROIs
High Preservation Potential Deposits	1
Potentially Habitable Environments	2
Noachian Rocks in Stratigraphy	3,4,5,6
Aqueous Mineral Deposits	1
Contacts and Superposition Sites	1,3,4,5,6

Table 3: Regions of Interest - Resource Requirements

Requirement	ROIs
H_2O (<100MT) ISRU Feedstock	7,8
H_2O (>100MT) ISRU Feedstock	9
Metal/Silicon ISRU Feedstock	10

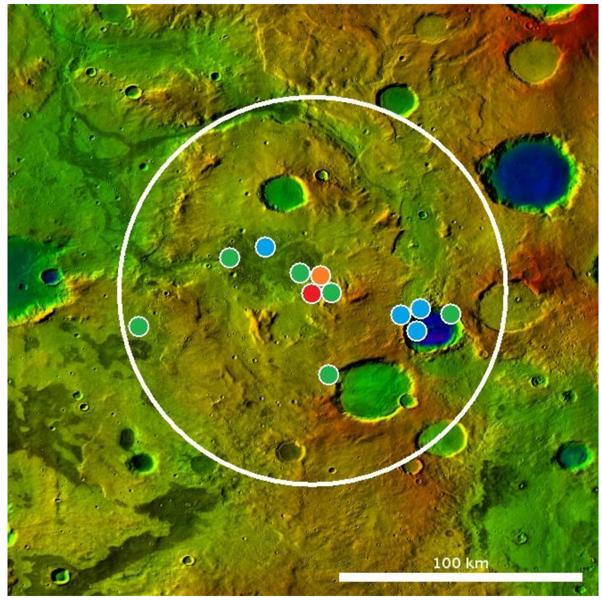

Figure 1: Location of the proposed exploration zone (white), centered at 350.5°E, -37.2°N, west of Argyre Planitia in Noachis Terra, including the proposed landing site (red), habitation site (orange), science ROIs (green) and resource ROIs (blue). MOLA [10] topography over THEMIS Day IR mosaic [11].

Chloride Deposits: Deposits of chloride bearing materials were first identified on Mars by their distinctive appearance in THEMIS decorrelation stretched infrared images [12] (Figure 2). A global survey of the deposits revealed that they are almost exclusively constrained to Noachian and early Hesperian terrains in the southern highlands, usually occur in local topographic lows, are consistent with formation via ponding of surface runoff or groundwater upwelling, and are likely the result of one or more globally ubiquitous processes early in Mars' history [1].

Additional studies have shown that the chloride deposits often occur along phyllosilicates [13,14] and that both their near-infrared [15] and thermal infrared [1,16] spectra are consistent with chloride minerals mixed with basaltic material.

The existence of chloride mineral deposits on Mars has significant astrobiological implications. As noted by [1], studies of ancient terrestrial chloride salt deposits have demonstrated that they preserve microbial fossils [17], cellulose fibers [18], halophilic microorganism biomarkers [19], and fluid inclusions that preserve water chemistry and can serve as long-term refuges for halophilic microorganisms [20,21,22,23,24,25,26].

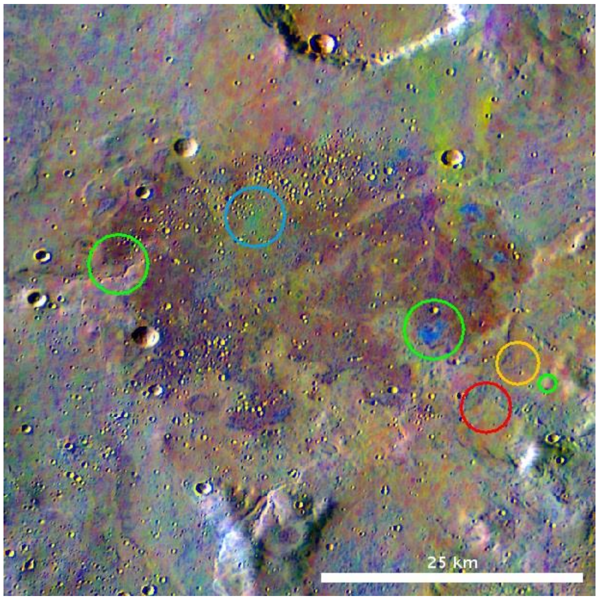

Figure 2: Chloride deposits (dark blue units) with the proposed landing site (red), habitation site (orange), science ROIs 1, 3, 6 & 10 (green), and resource ROI 10 (light blue). THEMIS DCS 875 mosaic [27].

Regions of Interest: The proposed exploration zone surrounding the western Noachis Terra chloride deposits contains a wide variety of potential science and resource regions of interest (ROIs).

ROI 1: Chloride Deposit. The largest of the exposed chloride deposits [1] provides access to geologic materials with high astrobiological preservation potential [3] that were emplaced in an aqueous environment that may have been habitable. Distance from landing site: ~10km.

ROI 2: Gullies and Potential RSL. The eastern rim of the ~25km diameter crater to the southeast of the proposed landing site has been incised by numerous gullies and may be the location of some limited recurring slope lineae (RSL) activity. Distance from landing site: ~60km.

ROI 3: Middle Noachian Outcrop. An outcrop sample of the Middle Noachian materials surrounding the chloride deposits may be obtainable from a high thermal inertia region to the east of the proposed landing site. Distance from landing site: ~6km.

ROI 4: Early Noachian Outcrop. Outcrops of Early Noachian materials may be available in a high thermal inertia region to the south of the landing site. Distance from landing site: ~45km.

ROI 5: Late Noachian and Remnant Magnetism Outcrop. Outcrops of Late Noachian material that lie within a region of remnant crustal magnetism [28] may be obtainable from a high thermal inertia region east of the landing site. Distance from landing site: ~75km.

ROI 6: Channel with Exposed Stratigraphy. The outflow channel from the chloride deposit basin potentially contains a large cross-section of exposed stratigraphy. Distance from landing site: ~40km.

ROI 7: Lineated Valley Fill. Two small (~100m x ~1.25km) channels with possible lineated valley fill (LVF). If the presence of lineated valley fill in these channels can be confirmed, it would represent a large concentration of subsurface water ice in relatively close proximity to the proposed landing site. Distance from landing site: ~35km.

ROI 8: Pasted Terrain. Larger deposits of subsurface water ice are likely available in the form of pasted terrain along the upper rim and south-facing ejecta slopes of the ~25km diameter crater to the southeast of the landing site. Distance from landing site: ~40km.

ROI 9: Viscous Crater Fill. The largest potential source of subsurface water ice in the exploration zone is on the floor of the ~25km diameter crater in the form of viscous crater fill material similar to concentric crater fill (CCF). Distance from landing site: ~45km.

ROI 10: Silica Enriched Material. The basaltic material that surrounds, and presumably lies stratigraphically above, the exposed chloride deposits contains a ~25km^2 area of silica enrichment identified in TES spectra. Distance from landing site: ~30km.

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