TARGET SELECTION & EVALUATION CRITERIA FOR CAVES ON THE MOON & MARS

Developed through discussions at the 2014 NASA/JPL Planetary Cave Workshop, Pasadena, CA

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Objectives: The establishment of evaluative criteria is required to identify the most promising cave features for robotic exploration, human habitation, and/or storage depots for supporting surface operations. These criteria will be developed: (1) in a ranking system for evaluation and identification, and (2) in a manner that facilitates integrating newly detected features into the candidate index.

Criteria for High Priority Target Selection

Science Questions

1. *Rim/regolith composition* – Does the rim of the feature offer valuable insights into the geological formation? In particular, does the rim/regolith have exposed stratigraphy that would render the feature a high priority geology target?
2. *Depth* – How deep is the feature?
   a. Shallower features should be identified for astro/speleonaut shelters.
   b. "Deeper" features for search/identification of volatiles and potential evidence of past or present life (*the latter is applicable to Mars only*).
3. *Lateral extent* – Does the feature appear to have a lateral extent? Specifically, we will develop a discussion on the likelihood of lateral extent ranging from "no clue" to supporting evidence (sinuous features, etc.) and direct measurement of some undercut distance. If cave has a lateral entrance, what is the orientation of the feature?
4. *Igneous emplacement* – Access to pristine cross-sections of volcanic rock interiors is provided by caverns within these materials.
5. What is the location? Closer to equator greater likelihood for water ice (see Williams et al. 2010).
6. *Speleogenesis* – How do extraterrestrial cave formation mechanisms differ from Earth-based processes?
7. What is the elevation of the cave? May affect the likelihood of water ice.

Engineering Challenges

1. *Rim/regolith composition* – How consolidated do the materials appear in terms of stability? What is the extent of overhanging ledges? What is the extent of loose debris at rim? Is there a way to mitigate the potential for falling debris?

2. *Terrain surrounding feature* – What is the topography surrounding the feature? Is there significant slope leading to the rim/ entrance of the feature? Does the surrounding geology permit easy access to the feature? What is the topographic relief and surface geology within a 5 km radius of the feature? What is the extent of unconsolidated regolith blanketing the area surrounding the feature? Would it be easy for a rover to reach the target?
3. *Anchoring system for access* – Do suitable rock outcrops exist for establishing an anchor system (drilled or gripper)? What is the potential for establishing a picket system within dust/sand?
4. *Power Considerations* – Does the location present any logistical issues for generating power?
5. *Landing Considerations* – What is the elevation? Conversely from Science Question #7, higher elevation may be more difficult in terms of landing a rover.
6. *Traversablity* – Can it be determined if the floor is easily traversable for robotics? Is the cave/pit floor covered with rubble? Dust-covered rubble? Smooth?

Astronaut bases

1. What's the shape of entrances/openings and what is the permeability of the host rock
2. Can the entrance be sealed and pressurized?
3. Determine the minimum ceiling overburden requirement for insulation for radiation protection?
4. How stable is the feature? In other words, does extensive loose material exist on walls or ceiling that could be hazardous to humans and habitat infrastructure?
5. *Traversablity* – Can it be determined if the floor is easily traversable for humans? Is the cave/pit floor covered with rubble? Dust-covered rubble? Smooth?