MARS GLOBAL CAVE CANDIDATE CATALOG (MGC³) G. E. Cushing, U.S. Geological Survey, Astrogeology Science Center, 2255 N. Gemini Dr. Flagstaff, AZ 86001, gcushing@usgs.gov

Introduction: Candidate cave entrances, in the forms of lava-tube skylights and Atypical Pit Craters (APCs), were first identified in 18 m/pixel data acquired by the Mars Odyssey THermal Emission Imaging System (THEMIS) visible-wavelength camera (VIS) [1,2]. Since that time, the Mars Reconnaissance Orbiter's Context Camera (CTX) has obsered more than 90% of the Martian surface at a resolution of ~6 m/pixel, revealing hundreds of new candidate cave entrances. MGC³ (currently in PDS review) results from a comprehensive survey of Mars' volcanic regions to locate and categorize APCs, using both CTX and VIS data.

To conduct the survey, images of each study region were selected using JMARS GIS software [3]. Raw PDS-format CTX images are then calibrated and processed (to Level-1) using USGS ISIS cartography software [4]. The non-map-projected images were carefully scanned at 1:1 resolution to identify new candidates. Each new candidate was assigned a quality rating of 0-3 to aid in future target selections. A rating of 1 signifies a feature to be a likely cave-entrance candidate, while a 3 signifies noteworthiness to record, but confidence is insufficient to suggest as HiRISE targets. Each candidate and associated metadata are then logged into a shape-file table using JMARS (Figure 1).

Results: Besides lava-tube skylights and APCs, additional cave-entrance types have been identified during the survey. Small Rimless Pits (SRPs) are collapae features that usually occur in flow channels. These candidates are given a lower confidence rating because they appear as deeply shadowed pits without direct evidence of subsurface access; however, they also appear similar to many of the terrestrial pits around Kilauea volcano that are known to contain cave entrances [5]. Another new candidate type, which we informally call 'pinholes', appear in CTX images as black spots on the surface ~2-4 pixels across and looking like small punctures, lacking any brightly illuminated adjacent pixels which would indicate either a raised rim or pit floor. Pinholes appear consistently in repeat CTX observations, and similar features observed at the 18 m/pixel scale in THEMIS VIS images typically become strong candidates when observed by CTX. Additionally, laterally oriented cave-entrance candidates have been identified at several apparent flow sources and at several pit and channel walls that may have intersected pre-existing lava tubes.

More than 1,400 CTX images were examined at 1:1 magnification, covering most the Tharsis region. In these, 1,029 candidate cave-entrance locations have been identified and categorized. 134 of these candidates are described as APCs, 217 are SMRPs, 61 are pinholes and 349 are potential lava-tube skylights that formed in at leaast 27 lava tubes with a combined length of more than 1250 km. Of the non-APC candidates, 129 features thus far have been assigned the highest quality rating of 1 and 307 received a score of 2. At this time, at least 176 of the canditates in MGC3 have been observed at high resolution by HiRISE.

Discussion: The Tharsis region appears to contain the greatest concentration of cave-entrance candidates on Mars. Preliminary surveys of other (older) volcanic regions show candidates to be much less common. Although many strong cave-entrance candidates are identified in this survey, most entrances across Mars will probably remain unknown for now because they either are too small to be resolved in 6-m/pixel data, or face laterally instead of skyward to be seen from orbit. Select images of high-quality candidates and different candidate types will be presented.

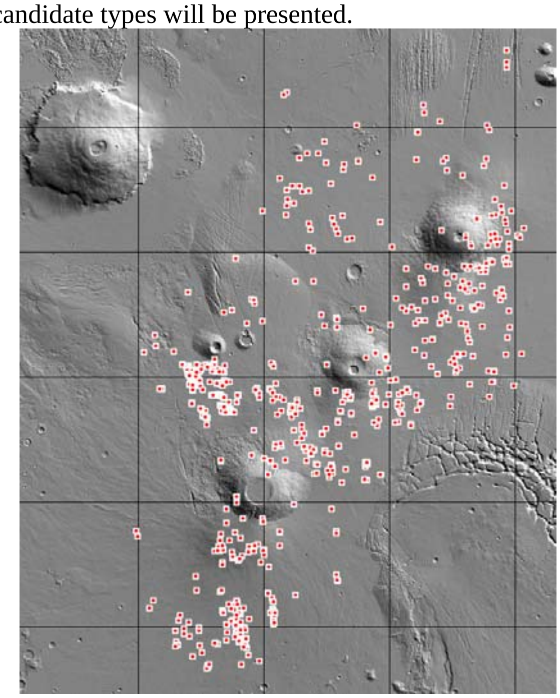

Figure 1. MOLA shaded relief of the Tharsis region showing locations of candidate cave-entrances.

References: [1] Cushing, G. E., et al., (2007) *GRL*, *34*, L17201. [2] Cushing, G. E. (2012) *J. Cave & Karst Studies*, *74*, 33-47. [3] Christensen, P. R. et al., (2009) http://adsabs.harvard.edu/abs/2009AGUFMIN22A..06C. [4] Torson, J. M., and Becker, K. J. (1997) *LPS XXVIII*, Abstract #1219. [5] Okubo, C. and S. Martel (1998) *J. Volcanol. Geotherm. Res.*, *86*, 1-18.