COMPARISON OF IMPACT CRATER DATA IN THE ORIGINAL AND REVISED VERSIONS OF THE "CATALOG OF LARGE MARTIAN IMPACT CRATERS". N. G. Barlow, Dept. Physics and Astronomy, Northern Arizona University, NAU Box 6010, Flagstaff, AZ 86011-6010; Nadine.Barlow@nau.edu, and USGS, 2255 N. Gemini Drive, Flagstaff, AZ 86001.

Introduction: The *Catalog of Large Martian Impact Craters* [1] was compiled from Viking 1:2M photomosaics around 1980 and contains information on 42,283 craters generally ≥5-km-diameter across the entire Martian surface. The *Catalog* is undergoing revision using MGS (MOLA) and Odyssey (THEMIS) data. We have completed the initial revision of northern hemisphere craters, updating latitude and longitude, revising interior and ejecta morphology classifications, and refining diameter measurements for both circular and elliptical craters.

Method: The original *Catalog* data were converted into Geographic Information System (GIS) format by Trent Hare (USGS). Hare wrote an ArcView-based program for use in the *Catalog* revision. The base map of this program used Viking images corrected to the MDIM 2.1 (MOLA-based) control network [2]. The view can be switched between Viking images and MOLA shaded relief to confirm the exact location of the rim. The switch to MDIM 2.1 resulted in the Viking-based coordinates of each crater being offset from the crater center using the new control net. The ArcView program displays locations of the old coordinates and allows the user to move the crater center to the MDIM 2.1 location. Crater diameters are remeasured by determining a best-fit circle to the crater—diameters were typically measured at least twice and averaged. The program allows measurement of a minor diameter and azimuthal angle of orientation for elliptical craters.

THEMIS data (daytime IR, and VIS when available) were used to classify interior and ejecta morphologies for each crater. Higher resolution imagery combined with improved atmospheric transparency has resulted in better classification of ejecta and interior features. Ejecta morphology was classified using recommended nomenclature from the Mars Crater Consoritum [3].

Information about crater preservation was revised using a 8-point numeric scale based on crater rim height, crater depth, ejecta blanket, interior morphology, and thermal inertia considerations [4]. On this scale, 0.0 represents a "ghost" crater whereas 7.0 is an extremely fresh crater.

Diameters and Elliptical Craters: The revised *Catalog* (*Catalog 2.0*) contains 14,225 craters ≥5-km-diameter, compared to 12,920 craters in this size range in the original *Catalog* (*Catalog 1.0*) [5]. This 10% increase in the number of craters results from (1) inclusion of craters missed in the original *Catalog* because of poor resolution or cloudy/dusty conditions, (2) improved detection of highly degraded or buried craters using MOLA, and (3) improved diameter measurements which resulted in additions of craters near the 5-km-diameter cutoff. Most craters in *Catalog 2.0* have diameters within 10% of their *Catalog 1.0* values, which was the stated uncertainty level for *Catalog 1.0*.

Elliptical craters were identified in *Catalog 1.0* solely on their appearance—only craters which were obviously elliptical in planform were included. Elliptical craters were identified in the revision based on both obvious ellipticity in crater form and on the presence of non-symmetric ejecta deposits indicating a low angle of impact [6]. As a result, the number of elliptical craters in the northern hemisphere increased from 88 in *Catalog 1.0* to 454 in *Catalog 2.0*. Most elliptical craters are only slightly elliptical: 75% of elliptical craters have a minor/major diameter ratio >0.70. Azimuthal orientation of the major axis is generally consistent over all angles, with a frequency peak in the 80°-100° range (Fig. 1).

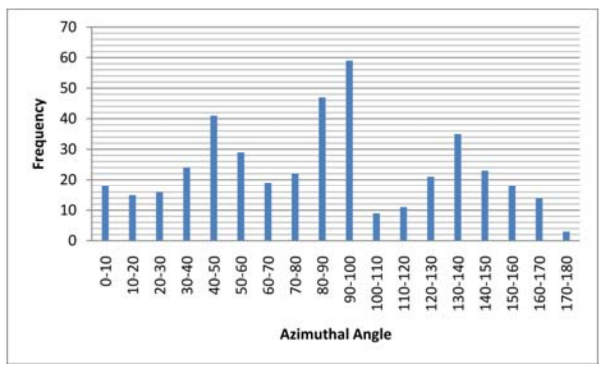

Figure 1: Frequency of elliptical craters with a particular major axis angle of orientation. Azimuthal angle is measure from north (0°) through east (90°) to south (180°).

Ejecta Morphologies: Craters with some form of discernible ejecta morphologies constituted 34% of the northern hemisphere craters in *Catalog 1.0*. Higher resolutions and improved atmospheric clarity of THEMIS data resulted in classification of 5839 craters with discernible ejecta in the northern hemisphere of *Catalog 2.0* (41% of total). Of the three major layered ejecta morphologies, the number of single layer ejecta (SLE) increased from 3372 to 3407, double layer ejecta (DLE) increased from 647 to 1117, and multiple layer ejecta (MLE) increased from 266 to 1092. The number of "diverse" ejecta, which display a layered ejecta blanket surrounded by secondary craters, increased from 56 in *Catalog 1.0* to 133 in *Catalog 2.0*.

Catalog 2.0 includes ejecta mobility (EM), which provides information about the run-out distance of the ejecta:

$$EM = \frac{(\max ejecta\ distance\ from\ rim)}{(crater\ radius)}$$

EM values are calculated for the maximum ejecta distance (measured from crater rim) for SLE, the outermost layer of MLE, and both the inner and outer layers of DLE. EM for SLE craters ranges from 0.5 to 4.0 with a median of 1.4. Figure 2 shows the distribution of EM values as a function of preservation state for SLE craters. The frequency of craters in each preservation state peaks in the 1.0-1.5 range for EM, confirming an earlier study which found no change in median EM with time [4].

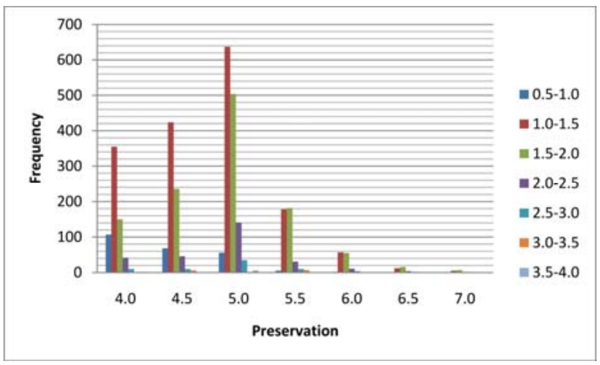

Figure 2: Frequency of SLE craters displaying a particular EM value as a function of preservation state.

DLE display two complete ejecta layers and EM values are computed for both. EM of the inner ejecta layer ranges from 0.4 to 3.3 with a median value of 1.5. EM of the outer ejecta layer ranges from 1.4 to 9.8 with a median of 3.1. The median values suggest that the outer layer, on average, extends about twice as far as the inner layer. Computing the ratio of the outer layer EM to the inner layer EM gives a range of 1.14 to 5.59 with a median value of 2.15. MLE craters display an EM range of 1.2 to 17.4 with a median value of 2.3.

Interior Morphologies: *Catalog 2.0* contains 7583 craters (53% of total) in the northern hemisphere which are classified with some type of interior morphology. This compares with only 1506 craters (12%) in *Catalog 1.0* which were classified with an interior morphology. The frequency has increased dramatically in all categories, including central peaks (1135 in *Catalog 2.0* vs 751 in *Catalog 1.0*), symmetric floor pit craters (505 vs 135), and summit pit craters (304 vs 173). Improved image resolution and quality of THEMIS over Viking reveals that most craters display aeolian, sedimentary, or volcanic deposits on their floors (5069 vs 115). No variations in central pit crater type (floor versus summit) with location or elevation is observed (Fig. 3).

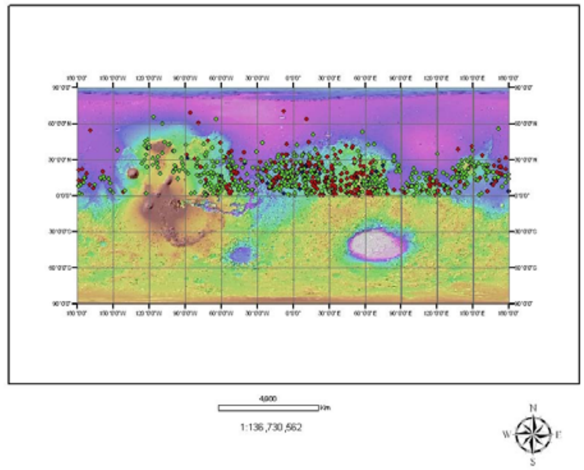

Figure 3: Distribution of summit pit (red) and floor pit (green) craters across the northern hemisphere of Mars. Background map is a colored MOLA topography map (blue/purple = low; brown = high).

Preservation: Preservation data in *Catalog 2.0* provides more information about the relative age of each crater. Figure 4 shows the frequency of northern hemisphere craters as a function of preservation.

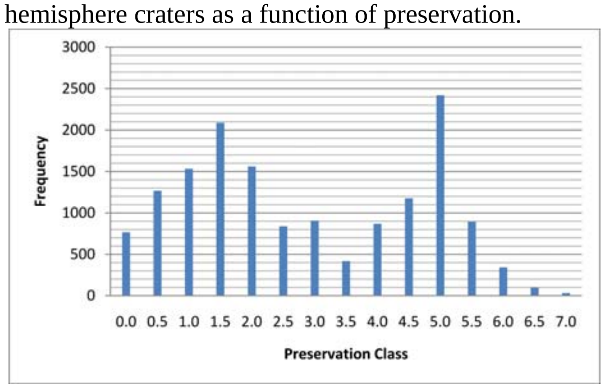

Figure 4: Frequency of craters as a function of preservation class.

Summary: The revised version of the *Catalog of Large Martian Impact Craters* is providing new insights into crater distribution, geologic history, degradation history and processes, and role of subsurface volatiles in the production of ejecta and interior morphologies. This *Catalog* promises to be a useful resource to crater-related studies of Mars.

References: [1] Barlow N.G. (1988) Icarus, 75, 285-305. [2]Archinal, B.A. et al. (2003) LPS XXXIV, Abstract #1485. [3] Barlow N.G. et al. (2000) JGR, 105, 26733-26738. [4] Barlow N.G. (2004) GRL, 31, L05703. [5] Barlow N.G. and Bradley T.L. (1990), Icarus, 87, 156-179. [6] Herrick R.R. and Hessen, K.K. (2006) MAPS, 41, 1483-1495.