MARS CRATER DENSITY TOOLS: PROJECT REPORT. T. Hare[1], J. Skinner Jr.[1], E. Liszewski[1], K. Tanaka[1], N. Barlow[2], [1]U.S. Geological Survey, 2255 N. Gemini Dr., Flagstaff, AZ, 86001, thare@usgs.gov, [2] Northern Arizona University, Flagstaff, AZ.

Introduction: Crater density plots provide researchers the means to interpret the age and geologic history of planetary surfaces. Last year we started a project to provide a set of Mars crater density tools for the planetary community. Here we provide a brief progress report for the project.

Motivation: Impact craters on planetary surfaces, Earth included, provide important constraints about the early evolution of the Solar System as well as a systemic record for investigating the age and geologic character of the impacted surface. Crater densities are fundamental for determining the surface age of geologic units on the Moon, Mars, and other planetary bodies, based on an assumed population of crater-forming bodies as a function of time since the formation of the Solar System. As such, size-frequency distributions provide a proxy for the age of a given planet's surface.

GIS-based studies allow rapid statistical delineation of crater populations based on spatial associations and groupings. For example, by identifying a population of degraded craters and a spatially-correlative population of "pristine" craters, researchers are able to assess the age, intensity, and in some cases, the duration of surface processes. Moreover, GIS-based analysis provides a means to determine the geologic character of the impacted surface. For example, the size-frequency distribution of fluidized crater ejecta compared to ballistic (or dry) crater ejecta provides a proxy for assessing the distribution of subsurface ground-volatiles. Multi-dataset statistics performed within a GIS allow repeatable, documented geologic and temporal associations that are critical to assessing the history of planetary surfaces [1-3].

Method: Our crater density tools will be built as a plug-in for the GIS application ArcMap and ArcMap Server by Environmental Systems Research, Inc (ESRI). By using ArcMap Server, we can allow anyone with a web browser and an Internet connection to freely access these tools. Over the last several months, we have made progress learning how to interact with the ArcMap Server 9.1 software. We also plan to beta-test the next generation of ArcMap Server, version 9.2, in early 2006, which will give us access to a suite of new geoprocessing tools. Geoprocessing tools enable the assembly of a simple chain of processing tasks to build a very high-level functional tool.

We have built the prototype on-line crater density tool which can be seen in Figure 1. In the current application, we have included a MOLA color shaded-relief for context [4], the Mars 1:15M scale global geologic map [5], and the original version of Nadine Barlow's crater catalog [1, 6]. We plan to update the interface with additional base images (e.g. MDIM 2.1 [7]), the updated and registered 1:15M global geologic map [8], additional geologic maps [e.g. 9], and Barlow's revised crater catalog.

Thus far, we have added a several specialized tools and will continue to improve their functionalities. Currently, the user is offered the standard set of tools to zoom in and out, query, measure and select features. The new "crater" icon will initialize the crater density tool dialog. For the simplest case, the user can select existing polygons from the 1:15M Mars geologic map which in turn selects the intersecting craters and returns crater density chart (cumulative or relative), the N(5) and N(16) crater density values [3, 10], and a sorted tabular list of the crater statistics. The chart and the table can be easily saved or plotted using their own software. Other added functions, include the ability to allow the user to select geologic units by age (i.e., Noachian, Hesperian, or Amazonian), by unit type, or by building their own query from the available fields. Craters used on the selection can also be constrained based on their characteristics. For example, the user can constrain the craters based on preservation states, diameters, latitude and longitude ranges or other available fields.

Conclusion: We believe this tool will be of great value to the planetary community to help generate crater density statistics from a common crater database and surfaces of geologic significance. In addition, as feedback is elicited from the user community, we intend to upgrade the tools to meet science- and mission-driven needs.

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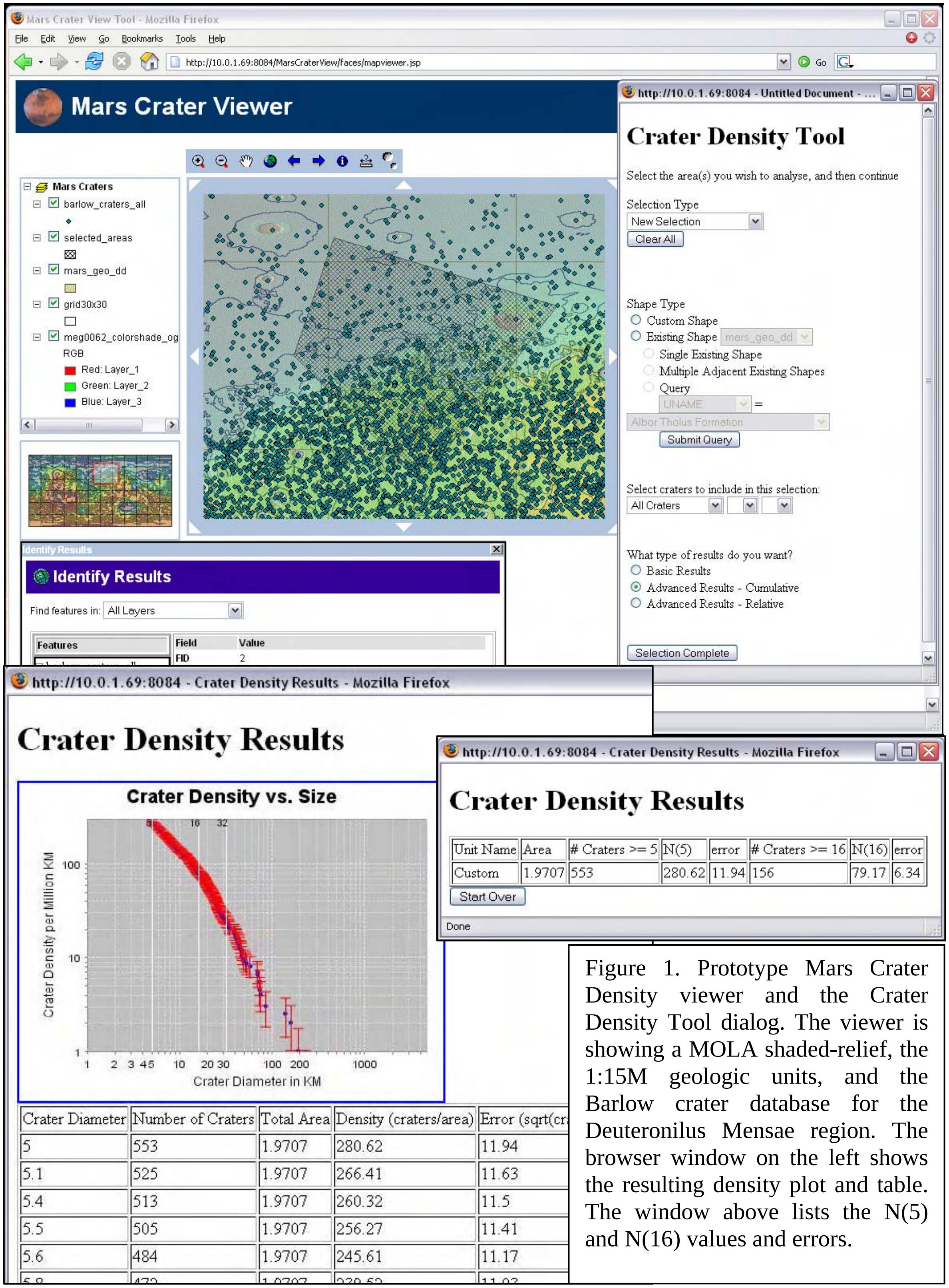

Figure 1. Prototype Mars Crater Density viewer and the Crater Density Tool dialog. The viewer is showing a MOLA shaded-relief, the 1:15M geologic units, and the Barlow crater database for the Deuteronilus Mensae region. The browser window on the left shows the resulting density plot and table. The window above lists the N(5) and N(16) values and errors.