Obliquity-related Ice Deposition in the Glaciated Martian Crater Greg, and Progress on Crater Chronometry

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Abstract

Crater count chronometry continues to be a valuable tool in interpreting Martian surface history and geological processes. We apply this and other techniques to analyze the important crater, Greg, east of Hellas. We present a new technique to discuss ages of strata and geological processes as a function of depth. Topography in the upper meters of Greg is controlled by obliquity-driven climatic episodes producing ice-rich mantles, and modulated by the solar longitude of perihelion.

1. Introduction

Detections of new, decameter-scale craters on Mars continue to give primary crater production rates overlapping rates used in isochron diagrams developed at PSI and by Neukum et al. [1, 2]. This increases opportunities to interpret geological processes affecting Martian formations. We combine techniques of crater chronometry, geomorphology, and climate modeling to investigate the remarkable glacial flow structures and mantling of the crater Greg, east of Hellas, in an area already known for debris apron flow features (Fig. 1).

2. Dataset and Method

We conducted geomorphic analysis and crater counts on images at a variety of scales, including imagery from HRSC, THEMIS, CTX, and HiRISE. We also made DEMs from HRSC imagery to measure slopes and thicknesses of glacial and mantle features. Counts on dense, cratered terrain and the ejecta blanket indicate an age of some $10^9$ y for Greg (Fig. 2), but counts on mantled terrain and the glaciers give much younger ages (Fig. 3).
Figures 3 and 4: A variety of crater retention ages, or crater survival times (as in Figs. 2-3) are plotted vs. crater depth bottom) and diameter (top), for various surfaces inside Greg. We find that (excepting mantle-free surfaces shown in top solid line) craters shallower than ~10 m survive only after the last few high-obliquity mantling episodes (horizontal solid lines, 5 to 20 My ago). This suggests that topography shallower than ~10 m has been obliterated during the last major episodes of mantling.

4. References