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The Erebus Montes, Mars – Investigation of Ages and Amazonian Erosion Rates

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Overview

Lobate debris aprons are considered to be indicators for the presence of ice and water reservoirs on Mars and are therefore sensitive to climate variability. The northern hemisphere of Mars is characterized by three major populations of debris aprons (see, e.g. [12]): (1) the Tempe Terra/Mareotis Fossae region [2, 5], (2) the Deuteronilus/Protonilus Mensae [1, 4, 8], and (3) the Phlegra Montes (PM) [3]. The broader PM area can subdivided inro a number of smaller populations dispersed across parts of Arcadia Planitia (see figure 1) of which the Erebus Montes located at 180-195°E, 25–41°N form a well-confined set of features. We here focus on age and erosional characteristics of the northern Erebus Montes (see inset in figure 1).

Our study makes use of panchromatic image data obtained by the High Resolution Stereo Camera (HRSC) [9, 6] onboard Mars Express and the Context Camera (CTX) [7] onboard Mars Reconnaissance Orbiter. Image data analyses are supported by digital terrain-model data derived from HRSC based stereo imaging [10] and from Mars Orbiter Laser Altimeter (MOLA) [11].

We performed detailed geologic mapping at a scale of 1:10,000 and analysed age relationships and erosion rates based on a similar approach as outlined in [5] for the northern part of the Erebus Montes. The aim of this study is to compare feature characteristics to other populations in order to assess timing and the overarching control of landforms evolution in the Martian northern hemisphere.

The EM compare geologically relatively well with the Phlegra Montes in terms of individual feature morphologies. The concentration based on cluster analysis (figure 1) shows an up to 10 times higher concentration of remnants per 25 km^2 area peaking at $3.4\times10-3$ features for Erebus Montes. Debris aprons show well-defined age signals ranging from 15 Myr up to 145 Myr. Some units even show continuous degradation implying active denudation of the Noachian to Hesperian-aged remnant massifs.

Based on the current status of investigations latitudinally dependent age trends cannot be observed which is likely to be related to the small extent of the northern region. Erosion rates determined at selected remnants are comparable to the Tempe Terra region with 0.1-0.3 mm·a^{-1} (100-300 B) [5], depending on the model that has been used for our calculations. An explanation for such high Amazonian rates could be that much of the apron material has not been accumulated through denudation processes but by atmospheric deposition and removal of material from high-relief areas.

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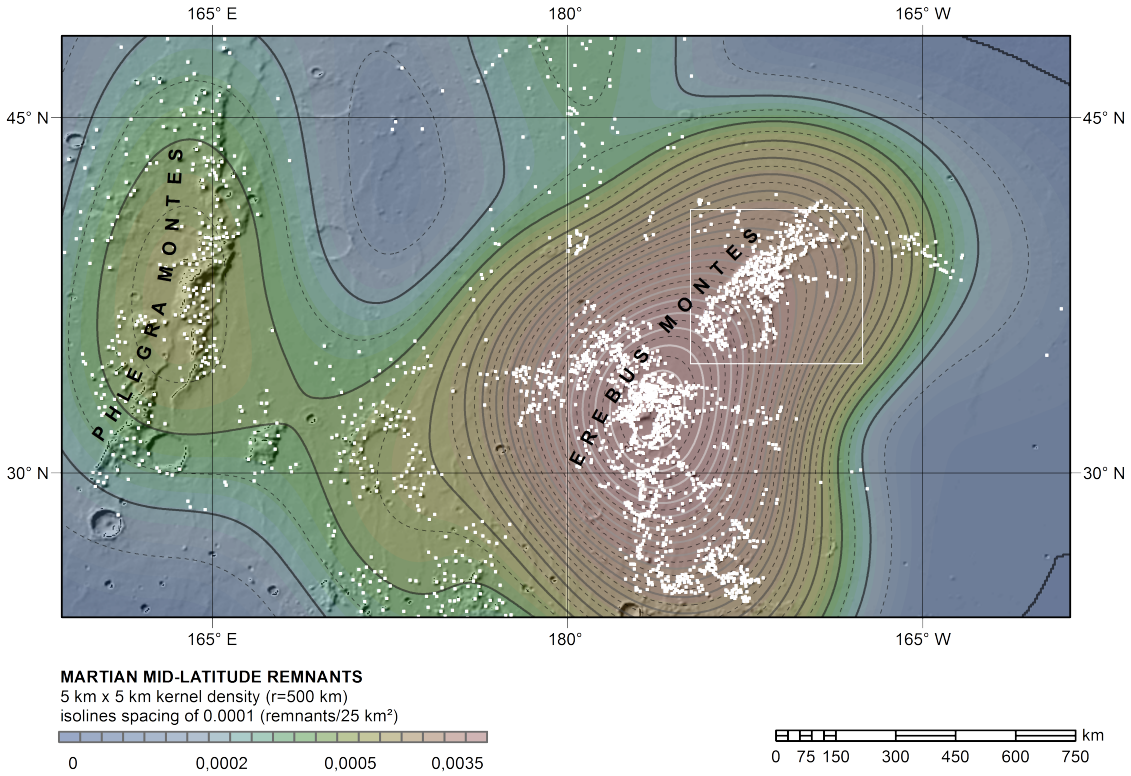

Figure 1: Distribution of remnant features in Arcadia Planitia (white dots) and kernel density plot superimposed on MOLA hillshade topography.

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