ABSOLUTE AGE DETERMINATIONS FOR REGIONAL GEOLOGIC UNITS: A CASE STUDY OF THE MIDDLE NOACHIAN UNIT IN THE ARABIA-SABAEA-NOACHIS TERRAE REGION, MARS: T. Platz[1], G. G. Michael[1], J. A. Skinner[2], K. L. Tanaka[2], T. Kneissl[1] and C. M. Fortezzo[2]. [1]Institute for Geological Sciences, Freie Universitaet Berlin, Germany, (thomas.platz@fu-berlin.de), [2]U.S. Geological Survey, Astrogeology Science Center, Flagstaff, AZ, USA.

Introduction: The geologic history of Mars is currently being revised and remapped by Tanaka et al. [1]. The new global geologic map of Mars at a 1:20,000,000 scale will be completed by June 2012. Although surface morphology and contact relationships are the basis for unit identification and differentiation, crater statistics also aid in deciphering geologic units. In this study we show how combined crater size-frequency distributions of several type locations for one Noachian unit in the Arabia-Sabaea-Nochais Terrae region can be utilized to derive its representative model ages.

Mapping: Global photogeologic mapping is based primarily on the global MOLA digital terrain model (460 m/px) and THEMIS IR day/nighttime global mosaics (100 m/px). For this study we selected the middle Noachian unit (*mNh*) prevalent in the Arabia-Sabaea-Nochais Terrae region. Its preliminary mapped extent in the study area is shown in Figure 1.

The Middle Noachian unit (*mNh*) is a widespread, rugged, and densely cratered unit with intermediate to bright daytime IR surfaces. It is dominated by impact craters with topographically subdued, discontinuous, or absent rims and unidentifiable ejecta blankets. Crater floors are generally smooth, horizontal, and locally fractured. Inter-crater regions are characterized by rugged, hummocky, and undulating surfaces. The unit contains <100 km-wide outcrops of slightly lower-standing planar surfaces. Ridges and irregularly shaped slope breaks and scarps are common, though their topographic prominence, spatial density, and planar orientation are widely variable.

Six representative areas of *mNh* spread over the study area were chosen by the mappers for crater counting based on homogeneous surfaces within the selected areas and to cover a range of observed morphologies.

Crater counting: Craters were counted on HRSC imagery (12.5 m/px) using the ArcGIS extension *cratertools* [2]. THEMIS IR global mosaics and HRSC and MOLA digital terrains models were also utilized, for example, to examine whether partially buried impact structures are present. Exported files were analysed in *craterstats* [3]. After crater bins were fit to derive model ages, partially by applying resurfacing corrections [4], each counting area was checked for randomness using the procedure of [5]. If craters in a diameter bin within the fit range were found to be clustered refitting was performed accordingly.

Results: Model ages for the six locations of unit *mNh* show a base age in the larger crater diameter range from 3.87-4.01 Ga with resurfacing ages between 3.49-3.79 Ga. Combining all six counts, a base model age of 3.94 Ga and a resurfacing age of 3.57 Ga results (Fig. 2).

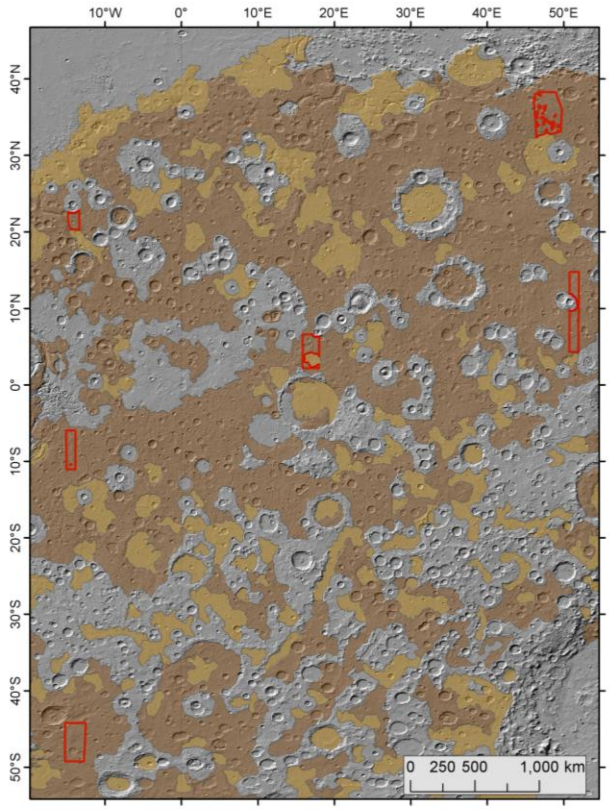

Fig. 1: Current mapped extent of Middle (brown) and Late (pale brown) Noachian units in the study area [1]. HRSC counting areas are shown in red outlines.

Discussion: Geodynamic processes forming regional-scale geologic units act on different timescales depending on, for example, latitude and altitude, topographic gradient, provenance of material, and presence of large craters/basins. Therefore, erosion, sedimentation, reworking, and redistribution forming the same geologic unit can be finalized in one area and still be ongoing in another region. The crater counting method returns the age where a major geologic process (here prevalent on a regional scale) terminated, leaving a stable surface where impact craters randomly accumulated over time. The onset of unit formation cannot be determined, but in some cases the maximum duration of a resurfacing event can be estimated.

In the case of the Middle Noachian unit the base age difference is narrowed to within 140 Myrs whereas the determined resurfacing age varies over 300 Myrs. The variation in resurfacing ages is not surprising given the fact that the unit extends over more than 90° latitude.

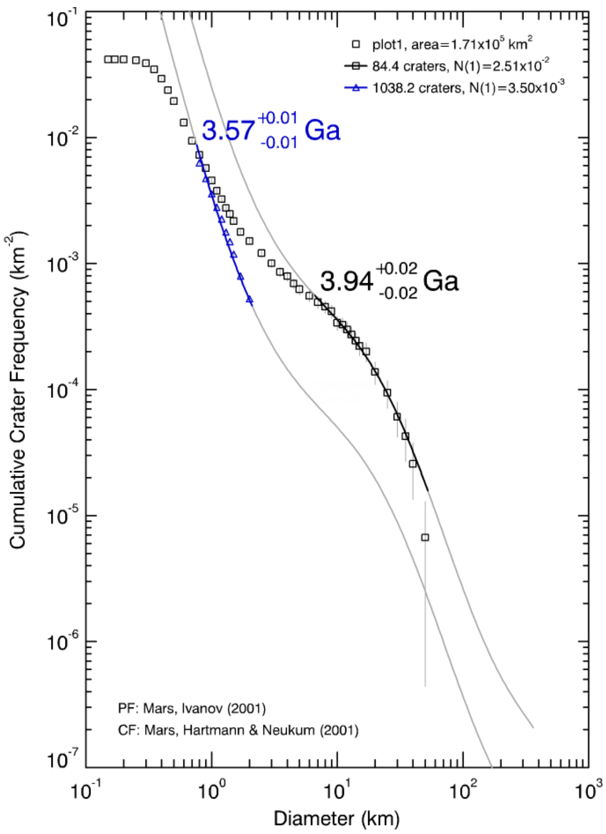

Fig. 2: Crater size-frequency distribution of six representative counting areas of unit *mNh*. Model ages were determined using the Hartmann and Neukum chronology function [6] and production function of Ivanov [7]. The younger age (blue) represents the resurfacing age for which a resurfacing corrections was applied [4]. The small error bars of 10-20 Ma are a statistical effect by combining large crater populations of several areas and are distinct from the precision of the calibration.

The combined plot of six independent counting areas results in a homogeneous crater population (Fig. 2) which can be used to extract reliable base and resurfacing ages. This result is encouraging as detailed crater counts of a few carefully selected and representative areas are sufficient to determine confident unit formation ages.

If detailed high-resolution crater counts are applied to all regional geologic units of Tanaka's new global geologic map, this approach appears promising to place major geologic units in a chronostratigraphic sequence. In addition, this procedure may also succeed in revising and improving the current and widely used Martian production function of Ivanov [6].

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