DISTRIBUTION AND TIMING OF FLUVIAL AND GLACIAL ACTIVITY IN SOUTH-CENTRAL ARABIA TERRA, MARS. M. F. Zeilnhofer and N. G. Barlow, Department of Physics and Astronomy, Northern Arizona University, Flagstaff, AZ 86011-6010, USA (mfz3@nau.edu; Nadine.Barlow@nau.edu)

Introduction: Arabia Terra is the largest expanse of ancient terrain north of the Martian equator. It is a heavily-cratered region which dates back to the Noachian era. Arabia Terra is a unique region due to crater morphologies which show interaction with volatiles. It has been suggested that Arabia Terra is an ancient basin with long term H_2O enrichment [1]. Data collected from orbiters and the Opportunity rover show evidence that subsurface and surficial volatiles have played a major role in the evolution of Arabia Terra [2-4].

Studying impact crater interior features provides insight into: (1) the morphologies formed by the interaction with subsurface volatiles at the time of impact, and (2) morphologies resulting from the presence of surface volatiles since crater formation. Crater size-frequency distribution analysis provides constraints on the ages of the craters which show evidence of specific geological processes. This study focuses on the craters which present signs of glacial and fluvial activity across a select region in Arabia Terra.

Methodology: We have classified interior morphologies, ejecta, and preservation states of craters 1-5 km in diameter from 20^o-40^oN 0^o-30^o E and measured their depths. Craters larger than 5 km for the region have already been documented in Barlow's revised *Catalog of Large Martian Impact Craters*, but have been reanalyzed for accuracy. Diameter measurements for the craters with diameters of 1-5 km have been added in this analysis.

Using Mars Reconnaissance Orbiter (MRO) Context Camera (CTX) with a 6 m/pixel resolution and Mass Odyssey Thermal Emission Imaging System (THEMIS) with a visual resolution of 18 m/pixel and a daytime infrared resolution of 100 m/pixel the interior and ejecta morphologies were classified. Ejecta were classified into standard layered (single, double, or multiple) or non-layered (radial) [5]. Up to three interior morphologies were classified for each crater. 30 different interior morphologies were documented but the ones of interest for this study included those related to glacial (anomalous terrain (AT), hummocky fallout (HF), irregular depressions (ID), and lineated floor deposits (LF)) and fluvial (channel deposits (CD), floor channels (FC), and layered deposits (LD) processes). Lineated floor deposits have been linked to ice-rich glacial activity [6] whereas layered deposits have been linked to fluvial activity or more specifically, material deposited in crater paleolakes [7].

The preservation state of each crater was recorded using a preservation classification of 0.0-7.0 where 0.0 is a crater which is almost completely destroyed (a ghost crater) and 7.0 is a freshly formed impact crater [8]. No craters in the study area were found to display a preservation state of 7.0 but some fall close with a preservation state of 6.5.

Results: 3732 craters were analyzed during this study. Table 1 shows the number of craters which display glacial and fluvial morphologies.

Table 1: Number of craters displaying specific glacial or fluvial morphologies.

Process	Morphology	Number of Craters
Glacial	AT	161
Fluvial	CD	18
Fluvial	FC	80
Glacial	HF	228
Glacial	ID	46
Fluvial	LD	114
Glacial	LF	309

The data were imported into ArcGIS to make distribution maps of the glacial morphologies [Figure1] and fluvial morphologies [Figure 2]. The area of the region along with the crater diameters with glacial and fluvial morphologies were measured in ArcGIS and exported to Crater Stats so crater size-frequency distribution plots (SFD) could be made to constrain the ages. Younger craters with higher preservation states which did not display glacial or fluvial morphologies were used to create the lower bounds for the ages for the SFD's.

The ages for the glacial and fluvial morphologies are shown in Table 2 using both the Neukum and Hartmann chronology functions [9-10]. Figure 3 shows the SFD of craters which displayed layered deposits (fluvial activity) and Figure 4 shows the SFD of craters which displayed lineated floor deposits (glacial activity).

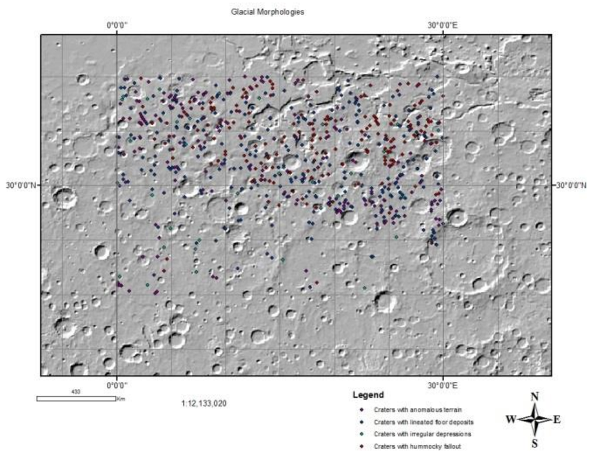

Figure 1: Distribution of glacial morphologies which include anomalous terrain, hummocky fallout, irregular depressions and lineated floor deposits.

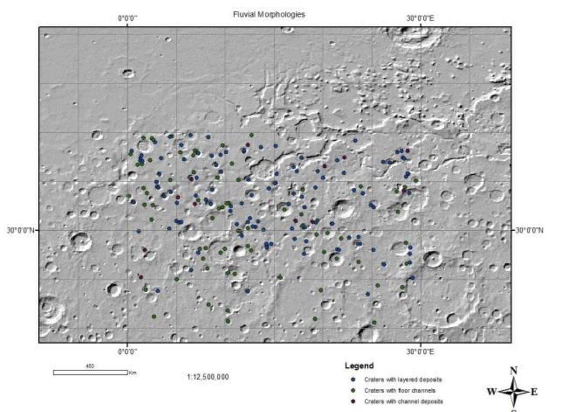

Figure 2: Distribution of fluvial morphologies which include channel deposits, floor channels and layered deposits.

Table 2: The Neukum and the Hartman ages are displayed for the morphologies. The Hartman ages are younger than the Neukum ages.

Morphology	Neukum Age (Ga)	Hartman Age (Ga)
AT	1.0	0.53
CD	1.4	1.3
FC	1.2	0.77
HF	2.4	1.5
ID	1.1	0.68
LD	1.1	0.73
LF	1.5	1.0

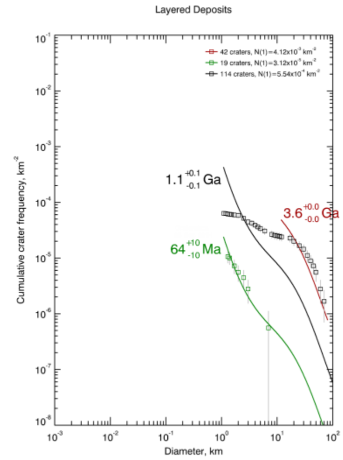

Figure 3: The Neukum age plot of craters which displayed layered deposits. Lower and upper age bounds are shown in green and red, respectively.

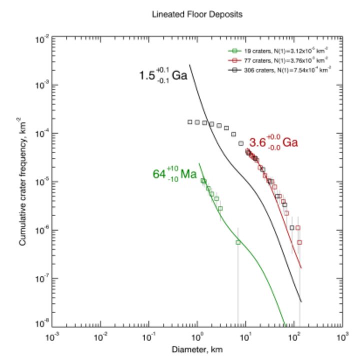

Figure 3: The Neukum age plot of craters which displayed lineated floor deposits. Lower and upper age bounds are shown in green and red, respectively.

From the information collected during this study we conclude that the glacial and fluvial activity recorded in Arabia Terra craters occurred primarily during the middle Amazonian. These data are consistent with predictions from the global circulation models of lower latitude precipitation occurring on Mars during periods of high obliquity.

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