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Due to U.S. Department of Interior policies related to sequestration, Corey Fortezzo was not able to attend LPSC.
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Determining the Age of the Runanga-Jörn Basin, Northeast Hellas, Mars

Abs. # 2104

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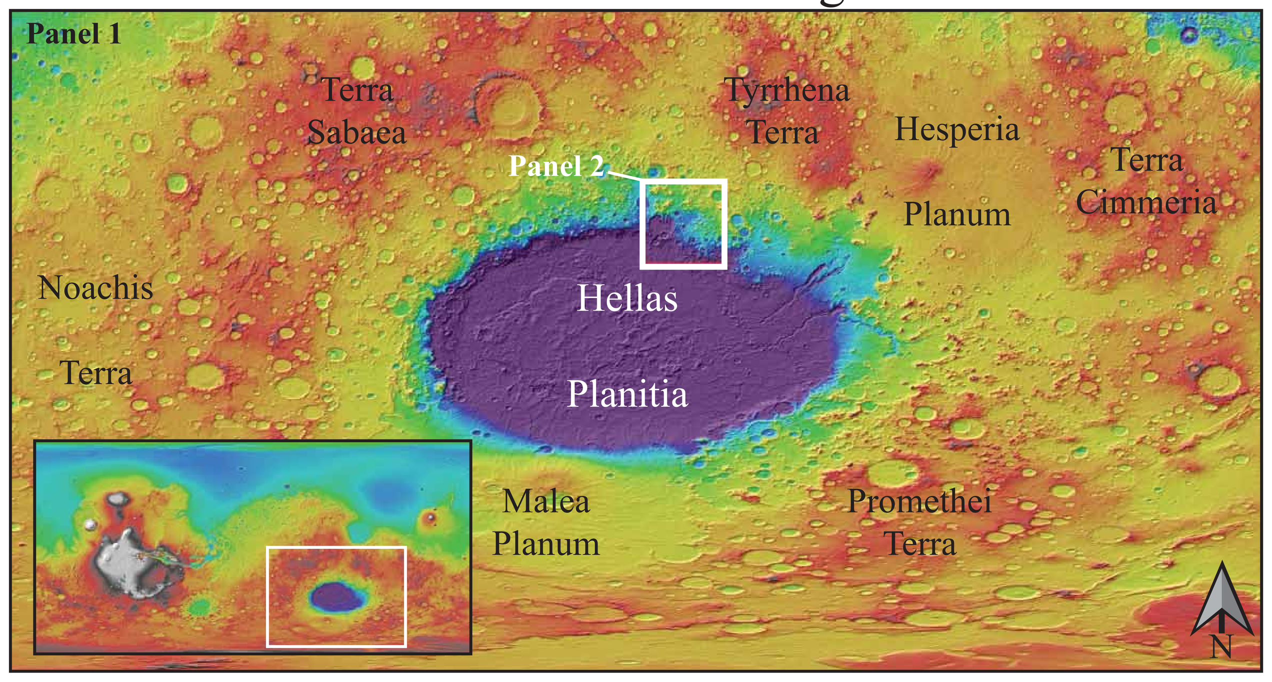
Objective: Conduct crater counts over several regional terrains to bracket the timing of deposition of the exposed layered materials within the Runanga-Jörn basin.

Methods: Using the ArcGIS addon CraterTools, craters were cataloged, down to D = 100 m on a ~6 m/pix Context Camera mosaic. Plots were made using CraterStats.



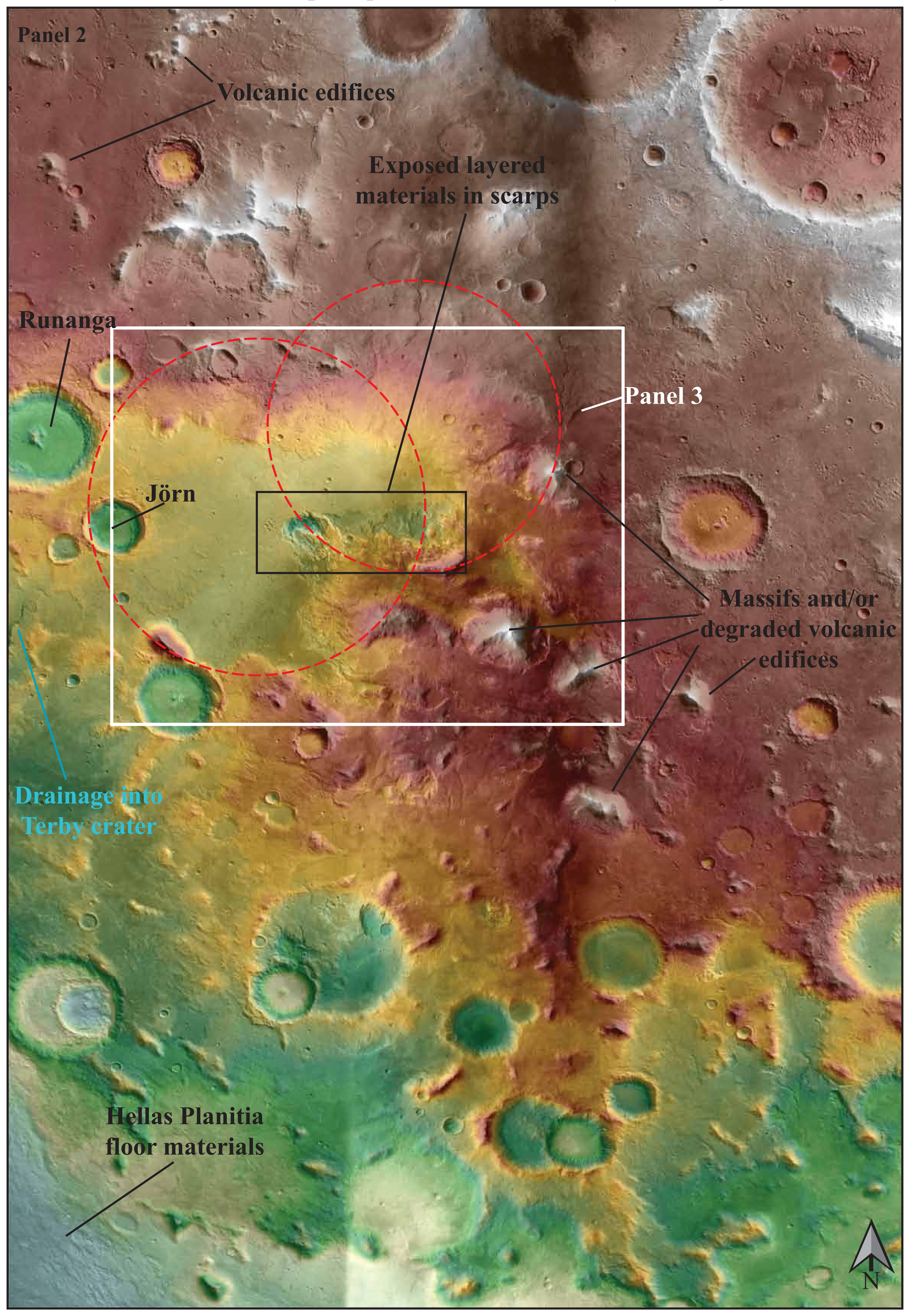
● The "Runanga-Jörn" basin is an ovoid-shaped, 160 km long by 80 km wide, mostly flat-floored depression adjacent to Terby, Runanga, and Jörn craters on the north-northeast rim of the Hellas basin (**Panel 1**).

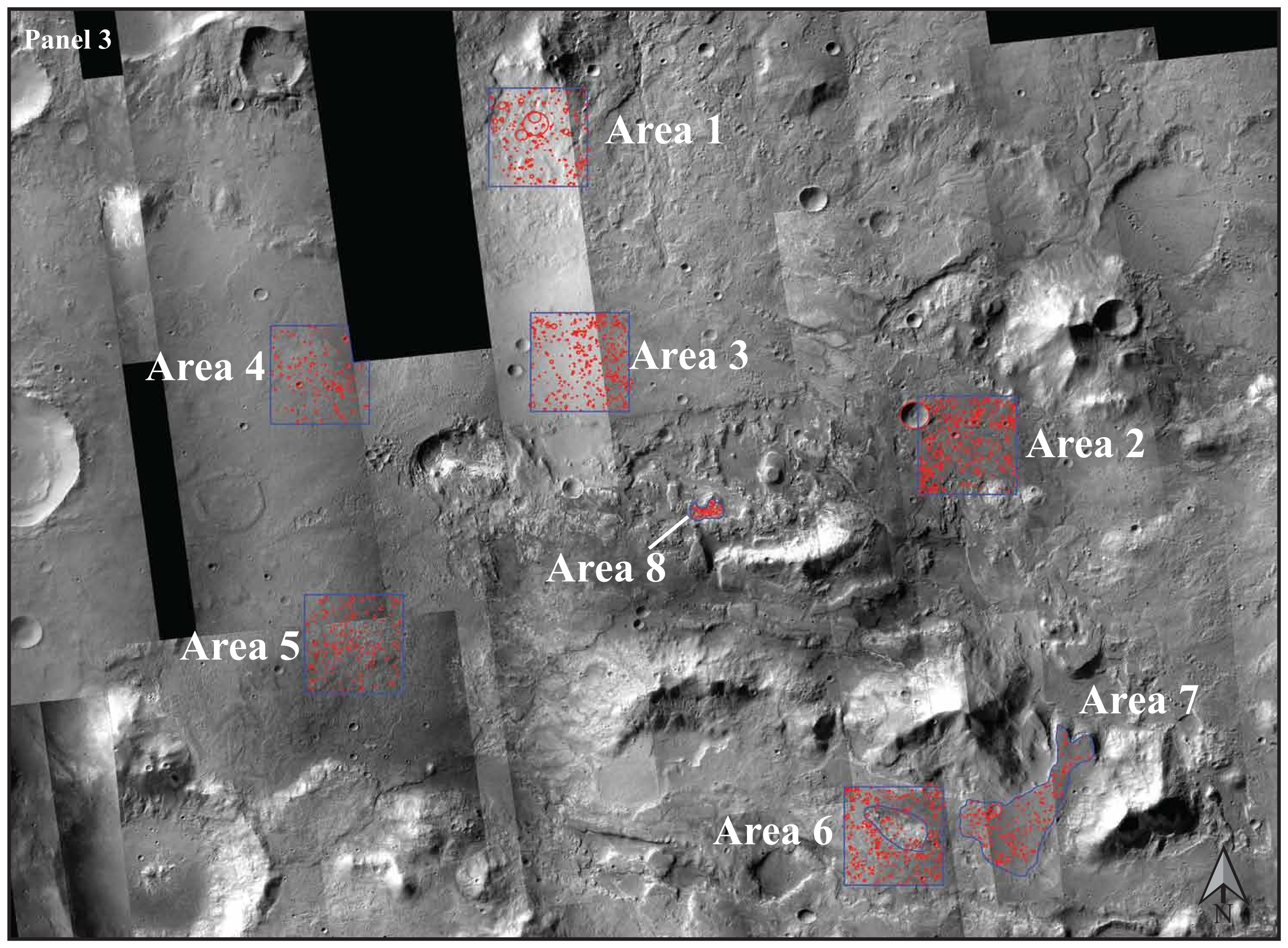
● The basin was likely formed by multiple, overlapping, ancient impacts (Red dashed circles in **Panel 2**), that were subsequently infilled with material from multiple processes over the last ~4Ga. The basin surface occupies an elevation range from -2450 to -2700 m, with a very slight west-southwest slope (<0.1°).

● The westernmost margin of the basin is marked by a single groove-like channel that debouches into eastern margin of Terby crater.

● The southern margin of the basin consists of highstanding massifs and plains, and has a different appearance than the surrounding highlands. This area contains serveral massifs and ridges we interpret to be a mix of remnant crater rims and probable volcanic edifices.

● A portion of the basin floor near the southern margin, exposes layered materials in a series of scalloped scarps and benches. The layer properties indicate a mix of volcanic pyroclastics and flows, and mutiple episodes of fluvial activity in the region.





We identified 8 representative areas to bracket the ages of within and surrounding the basin deposits: (1) transitional slope materials between the highland materials and the basin floor, (2) highland plains materials sourced from the east with deposits within the basin, (3-5) Runanga-Jörn basin flat-lying materials that embay the massifs and potentially bury the full extent of the layered materials, (6 and 7) higher-standing layered deposits that appear to embay massifs, and may have deposits that capped, or contributed to the layered materials, and (8) cap rock materials within a stereo-derived HiRISE DTM, from where the preserved, inverted channel forms appear to have been sourced.

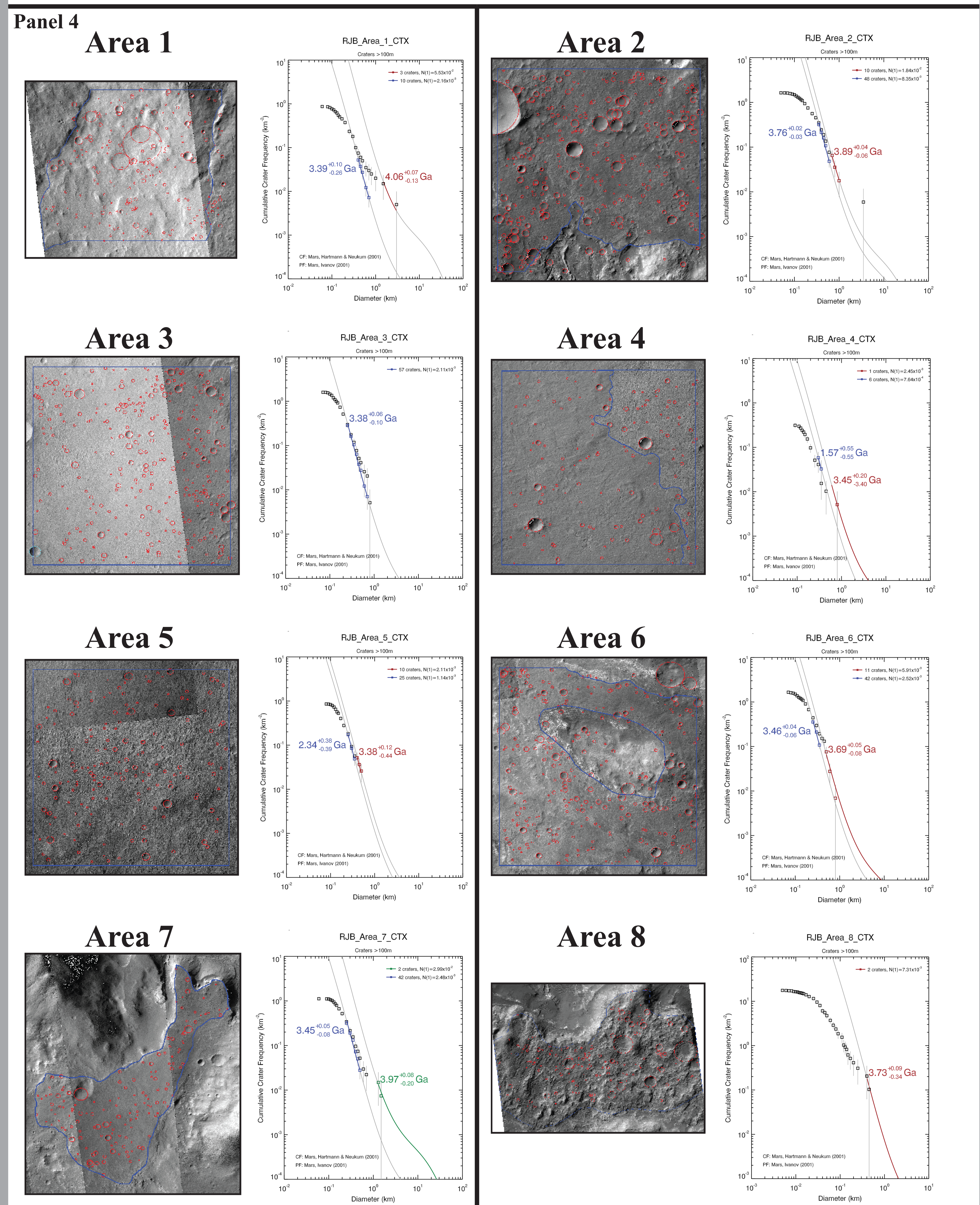


Table 1: Modeled emplacement and resurfacing ages based on crater statistics [a]

Area ID	Emplacement Age (Ga)	Error + (Ga)	Error - (Ga)	Resurfacing (Ga)	Error + (Ga)	Error - (Ga)	Area (km^2)	Number of Craters
1	4.06	0.07	0.13	3.39	0.10	0.26	200.38	205
2	3.89	0.04	0.06	3.76	0.02	0.03	169.23	283
3	NA[b]	--	--	3.38	0.06	0.10	195.22	310
4	3.45	0.20	3.40	1.57	0.55	0.55	195.22	137
5	3.38	0.12	0.44	2.34	0.38	0.39	195.22	166
6	3.69	0.05	0.08	3.46	0.04	0.06	144.91	271
7	3.97	0.08	0.20	3.45	0.05	0.08	112.85	149
8	3.73	0.09	0.34	NA[c]	--	--	9.70	173

[a] See Panel 4 for images and plots
[b] Age was based soley on 1/3 of 1 crater intersecting the area, so age was not reported
[c] Remaining craters continued to cross isochrons indicating continual resurfacing

Discussion:

● Areas 1 & 2 were chosen to put an upper limit on the age of the cratered and dissected plateau that bounds the interior deposits of RJB. Previous works established that the Hellas basin (and circum-Hellas massifs) formed between 4.13 and 3.95Ga. The ages for these areas were 4.06 Ga and 3.89 Ga. The materials in the upper reaches of the basin are possibly as old as the formation of Hellas, suggesting that the basin deposits may have started depositing near the pre-Noachian/Early Noachian boundary.

● The RJB deposits in areas 3, 4, and 5 (Fig. 1B) were chosen because they constitute the widespread basin floor materials that embay the massifs. We used three locations on the RJB surface in order to check for consistency and ensure that subtle topographic undulations on the basin surface did not arise from episodic emplacement in the basin. The results were 3.38 Ga for areas 3 and 5, and 3.45 Ga for area 4. This suggests that a widespread depositional event occurred within the basin near the Hesperian-Amazonian boundary, which effectively resurfaced older cratered and dissected plateaus that bound the basin.

● Areas 6 and 7 were chosen because they were thought to represent the upper surfaces of the exposed layer deposits. Our hypothesis was that these deposits once stretched to north and northwest, connecting to and stratigraphically above the deposits in our study area. The ages for these deposits were 3.69 Ga and 3.96 Ga for areas 6 and 7, respectively. The age for area 6 fits within the upper and lower limits established at ~4.0Ga and ~3.4 Ga. The modeled age for area 7 is very near the upper limit of the age brackets, thus making it very difficult for it to be a reasonable age given our hypothesis. The early age for area 7 could possibly be attributed do ejecta deposited when the craters that formed the Runanga-Jörn basin impacted (circular red dashed lines in **Panel 2**)

● Area 8 is within the HiRISE DTM, along the etched and cratered bench where the inverted and incised channels are likely sourced. The age for this surface is 3.73 Ga, which fits within the bracketed time, falls within Hesperian, and is on a surface that is approximately in the middle of the stratigraphic column of layered materials. This matches more closely with the 3.69 Ga age we modeled for area 6, where evidence for fluvial activity is also preserved. We will have to revisit a surface equivalent to area 7 to determine whether that older age is accurate or reexamine the techniques we used to arrive at that age.

● The crater statistics indicate that materials have accumulated in the Runana-Jörn basin since the Early to Middle Noachian, especially near the high standing regions (Areas 1, 2, and 7). These materials may be related to the formation of Hellas, or may be deposits from adjacent ancient impacts. The modeled ages within the Hesperian (Areas 6 and 8) are related to deposits that have preserved channel forms and provide good brackets for a maximum age range for fluvial activity. The youngest ages (Areas 3, 4, and 5), near the Hesperian-Amazonian boundary represent the last widespread geologic event besides recent eolian processes in the region and continued small diameter impact processes.

Future Work:

● Begin mapping at 1:1M-scale in this region, and also at 1:24K in a small region of HiRISE images

● Begin analog fieldwork in the Verde Valley, Arizona, to determine what features we are able to map at similar image resolutions within terrestrial basins and what features we should be able to map on Mars.