3 Lava Flows in Orientale Basin

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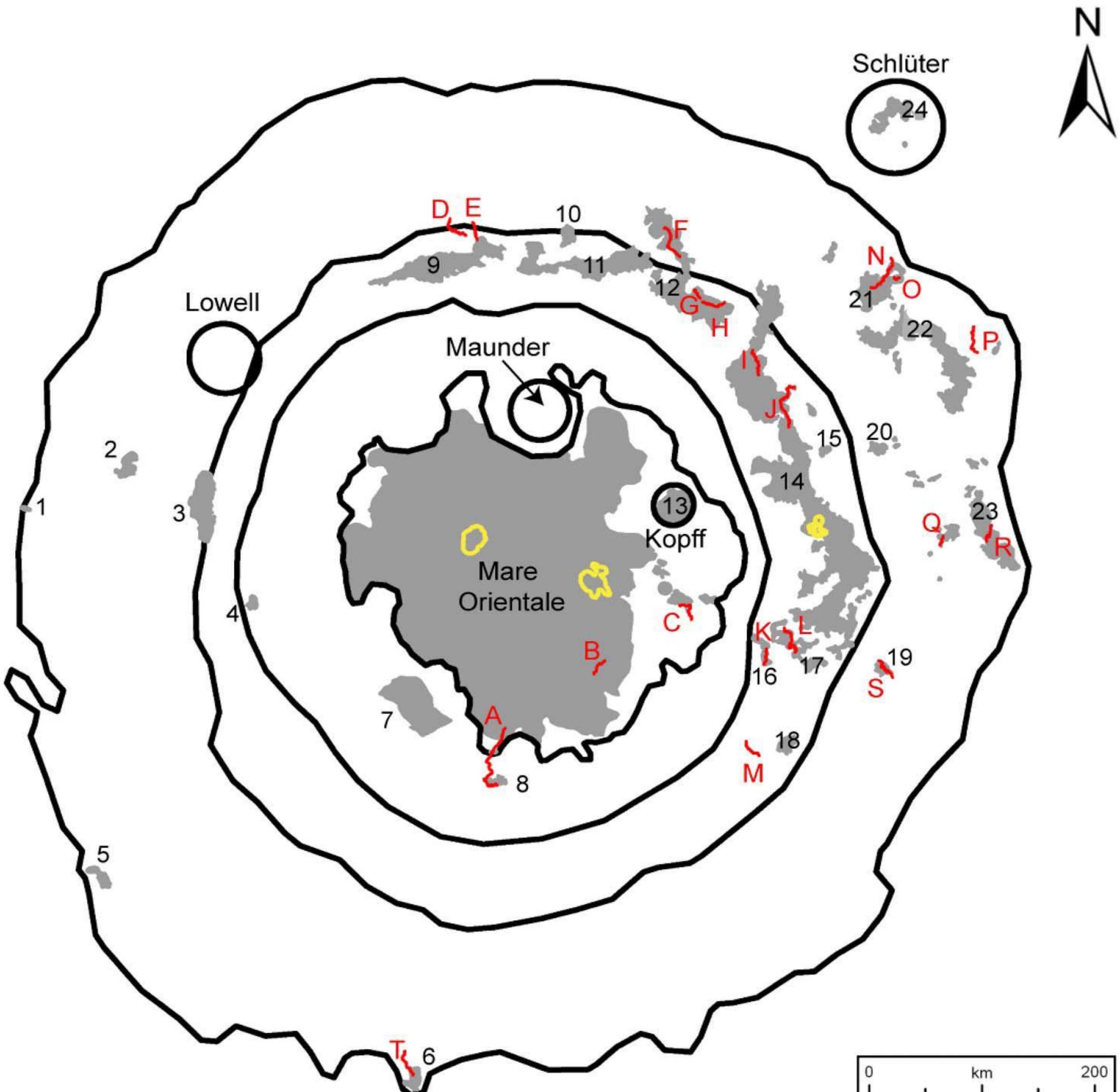
Purpose

We were interested in finding the ages (both relative and absolute) of various lava flows in the Orientale Basin. Research papers that we looked at showed similar ages for the two inner flows but different ages for the flows on the outer ring. We hoped to compare that to data from other basins; as similar patterns in ages of flows might help us to understand the timing of impacts and mare emplacement.

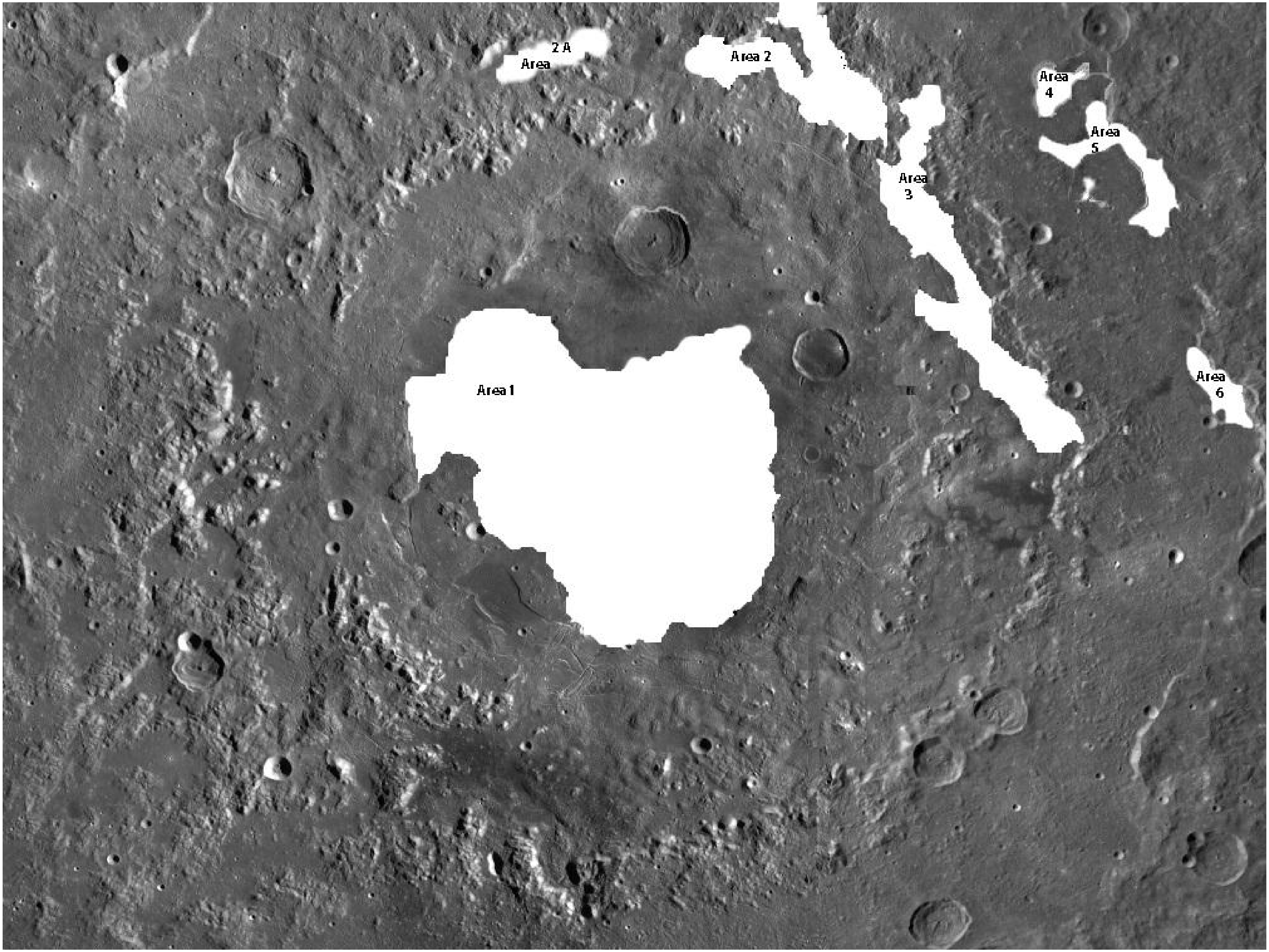
Hypothesis

One paper we read (*Whitten et. al., 2011)* indicated that all of the lava flows in the basin were similar in age, excluding those in the outer ring.

If we could find support for the same trend in other basins, it might help to answer the question of the relationship between the mare basalts and the impact basin formation.



From Whitten et al (2011)

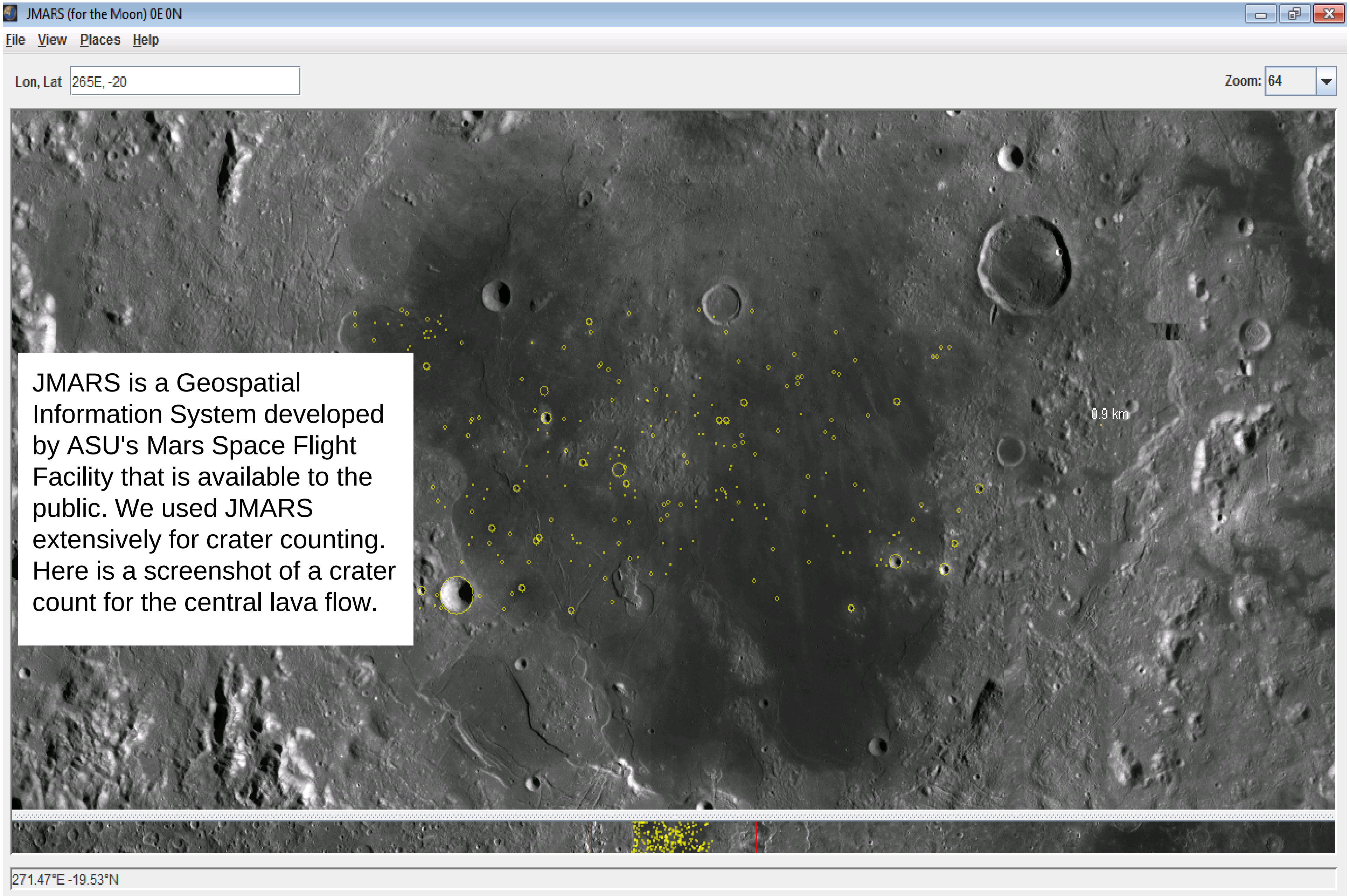

2 A
Area
Area 2
Area
4
Area
5
Area
3
Area 1
Area
6

Why We Chose the Orientale Basin:

- Impact basin and basalts
- Well-preserved
- Young age
- Lots of available papers and information on this basin

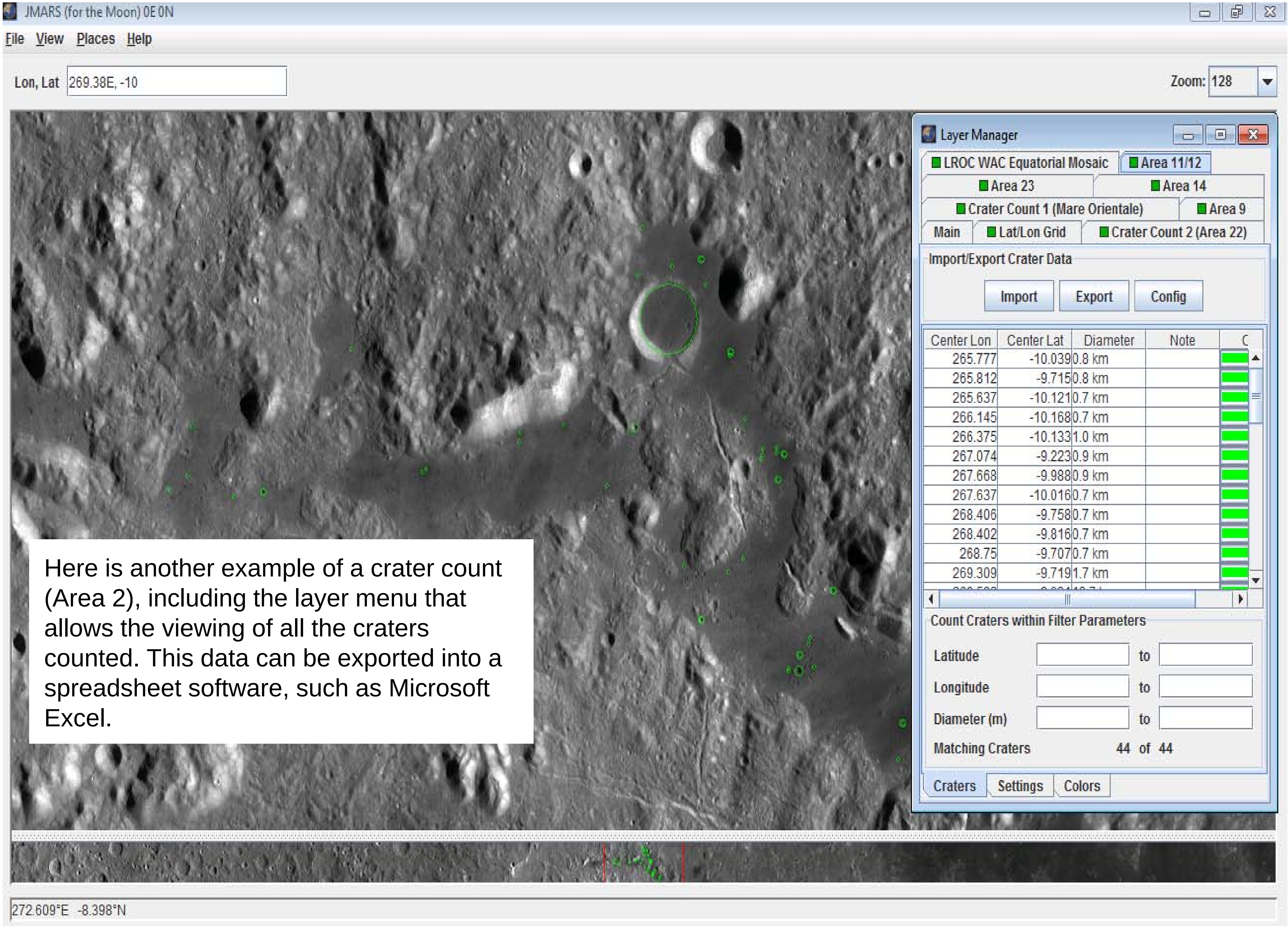
Materials and Methods

- JMARS
- Excel
- Whitten et al. paper
- Consistency
- Binning
- log-log graph (density versus size)
- Graphing for relative ages
- using Neukum et al. production function

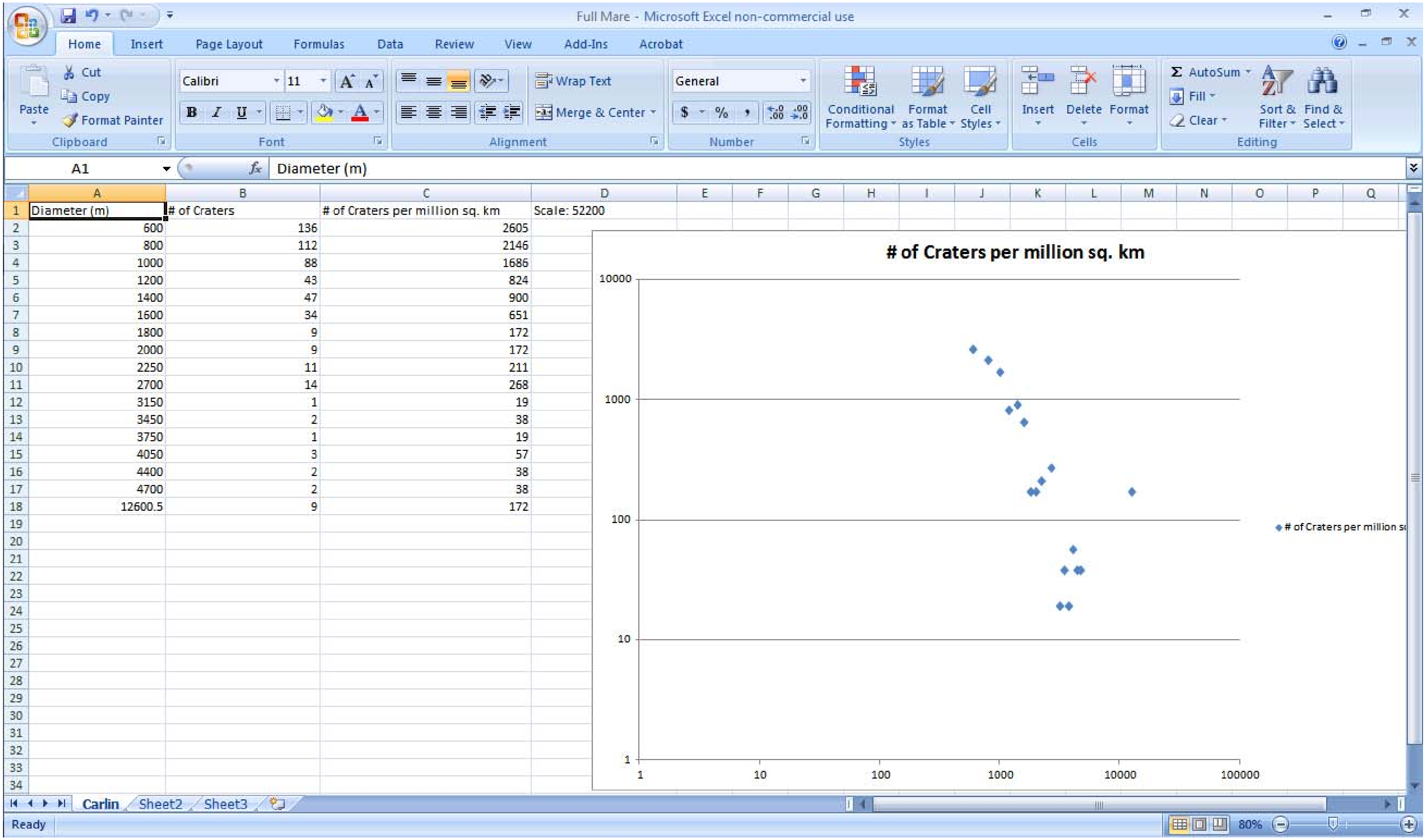


JMARS is a Geospatial Information System developed by ASU's Mars Space Flight Facility that is available to the public. We used JMARS extensively for crater counting. Here is a screenshot of a crater count for the central lava flow.

JMARS can be downloaded at http://jmars.asu.edu/

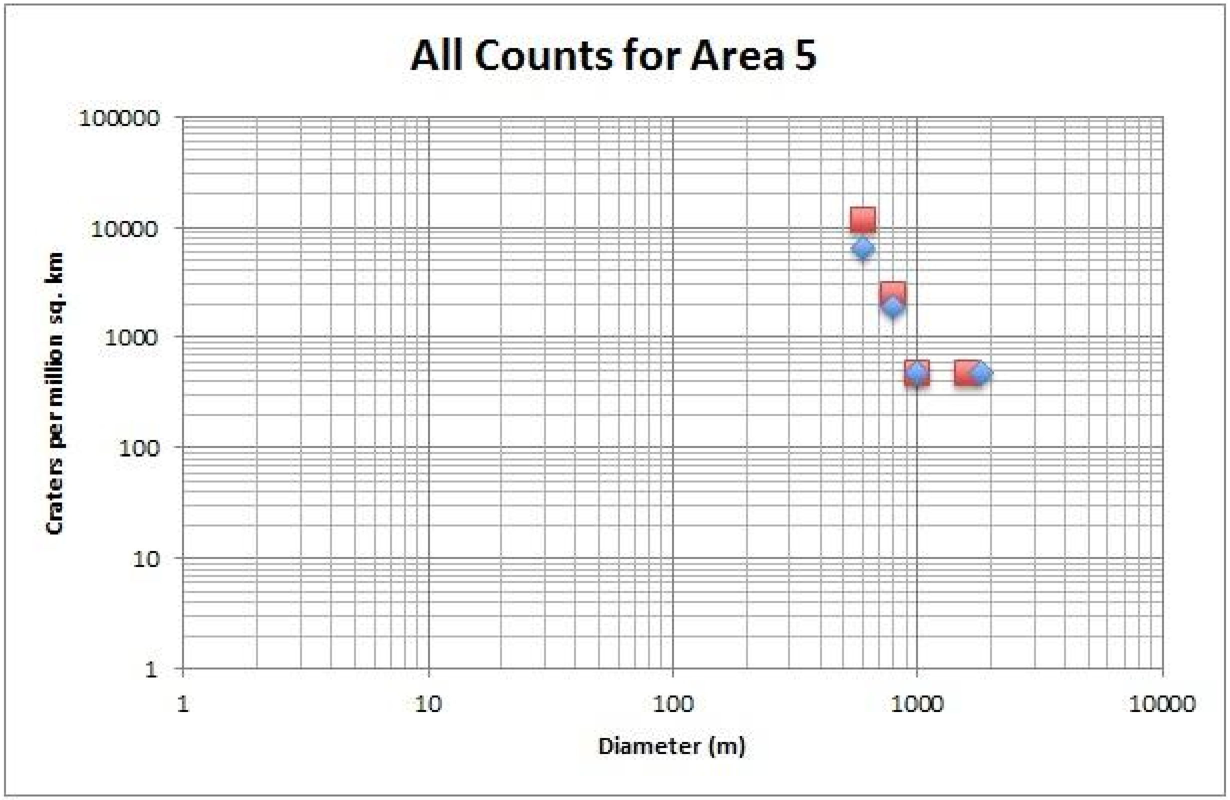


Here is another example of a crater count (Area 2), including the layer menu that allows the viewing of all the craters counted. This data can be exported into a spreadsheet software, such as Microsoft Excel.

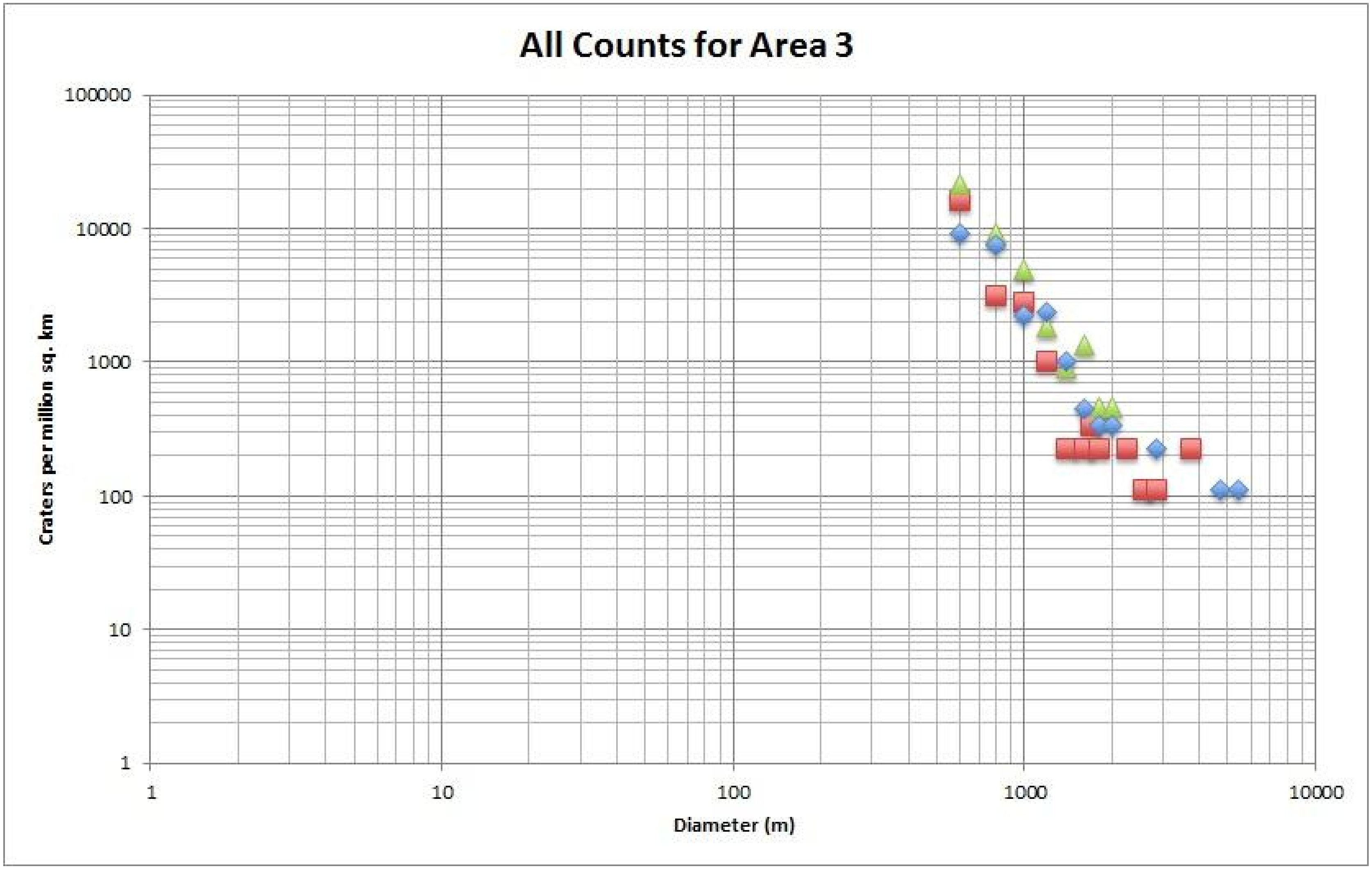


Diameter (m)	# of Craters	# of Craters per million sq. km	Scale: 52200
600	136	2605	
800	112	2146	
1000	88	1686	
1200	43	824	
1400	47	900	
1600	34	651	
1800	9	172	
2000	9	172	
2250	11	211	
2700	14	268	
3150	1	19	
3450	2	38	
3750	1	19	
4050	3	57	
4400	2	38	
4700	2	38	
12600.5	9	172	

Here is a screenshot displaying our work done inside Microsoft Excel. After binning the data, we sorted the craters by diameter and then we scaled them to determine the number of craters per million square kilometers.

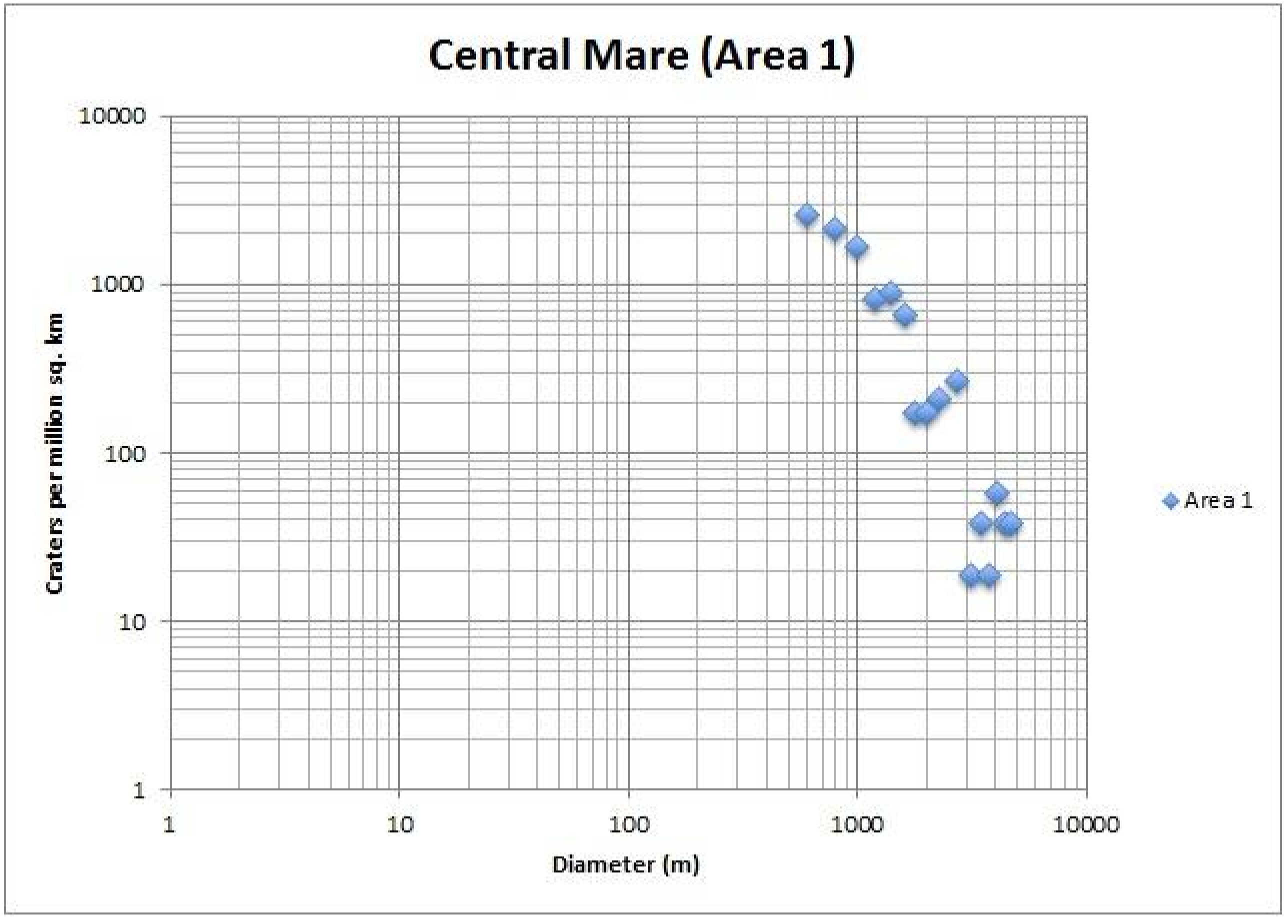


Data counts from 2 team members. We were checking for consistency in data collection.

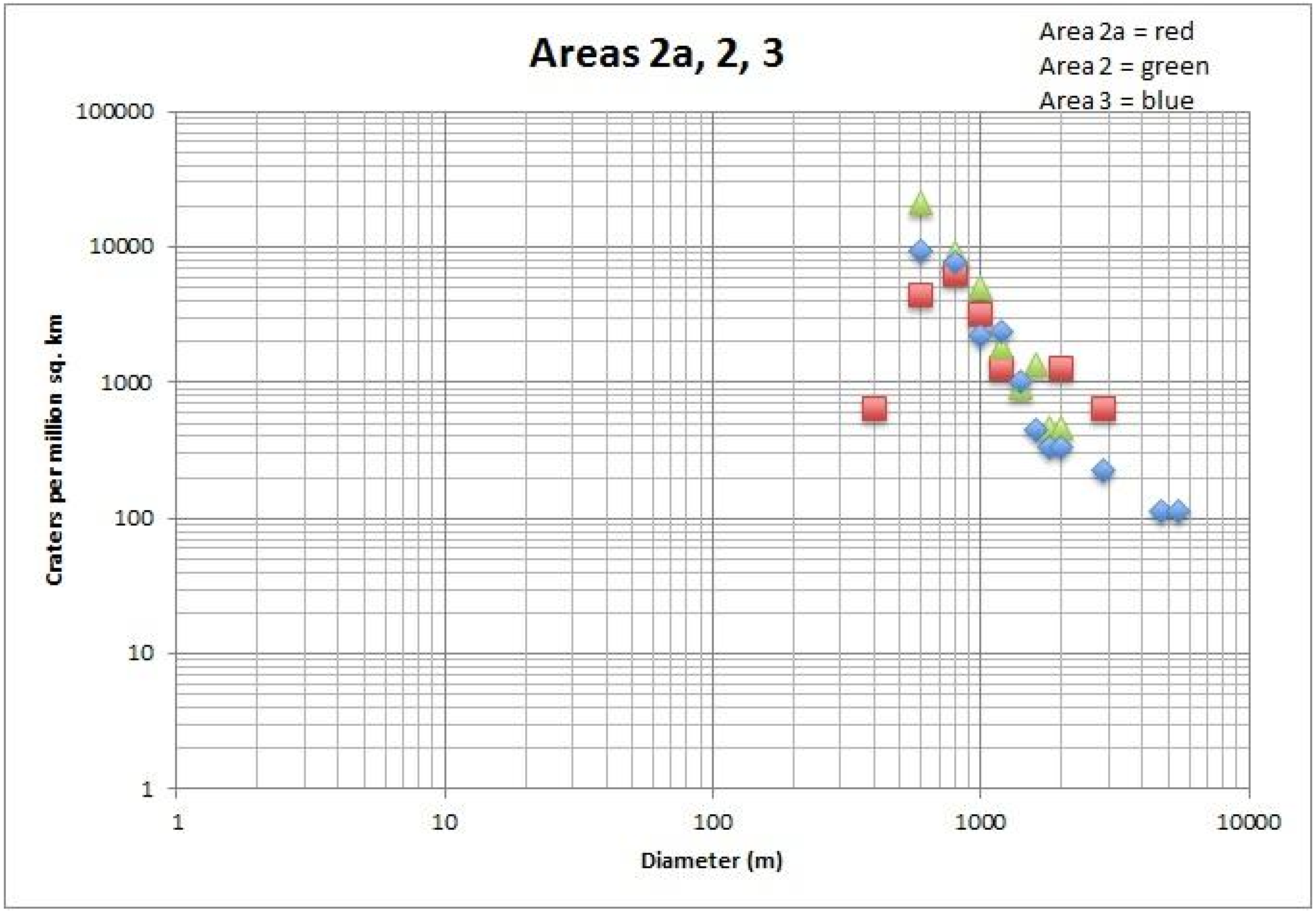


Another example with all 3 team members.

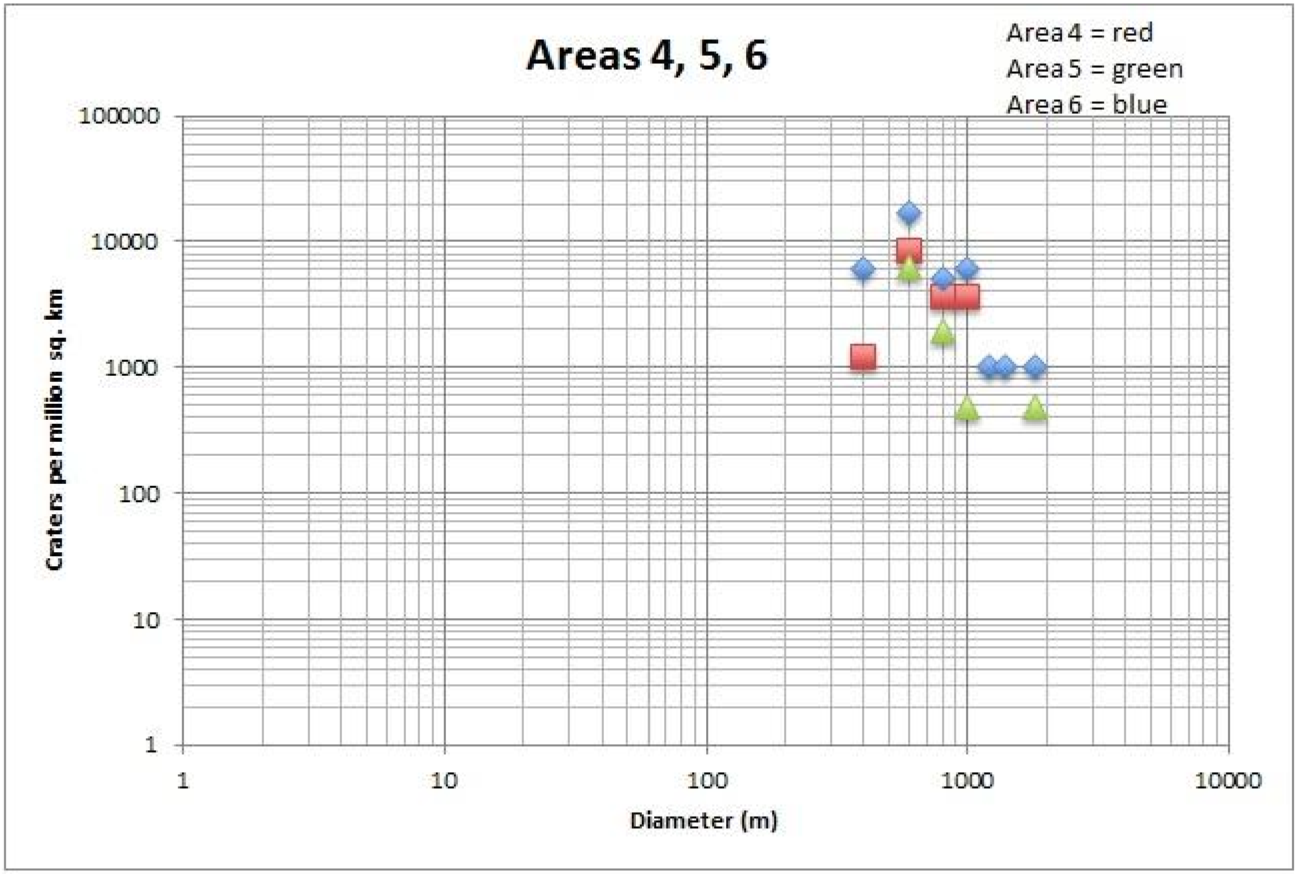
Mare Orientale

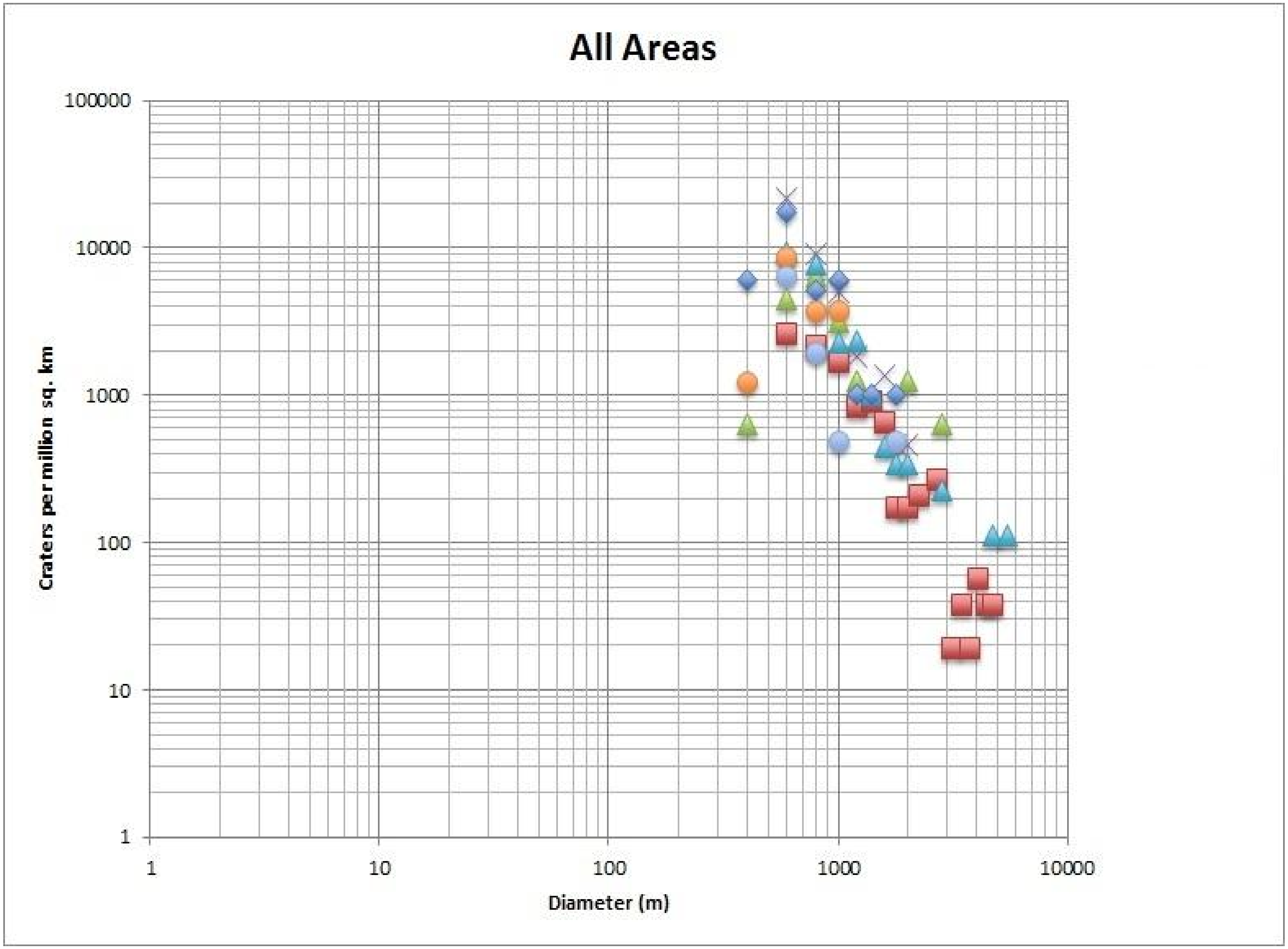


Lacus Veris


Areas 2a, 2, 3
Area 2a = red
Area 2 = green
Area 3 = blue
Craters per million sq. km
100000
10000
1000
100
10
1
1
10
100
1000
10000
Diameter (m)

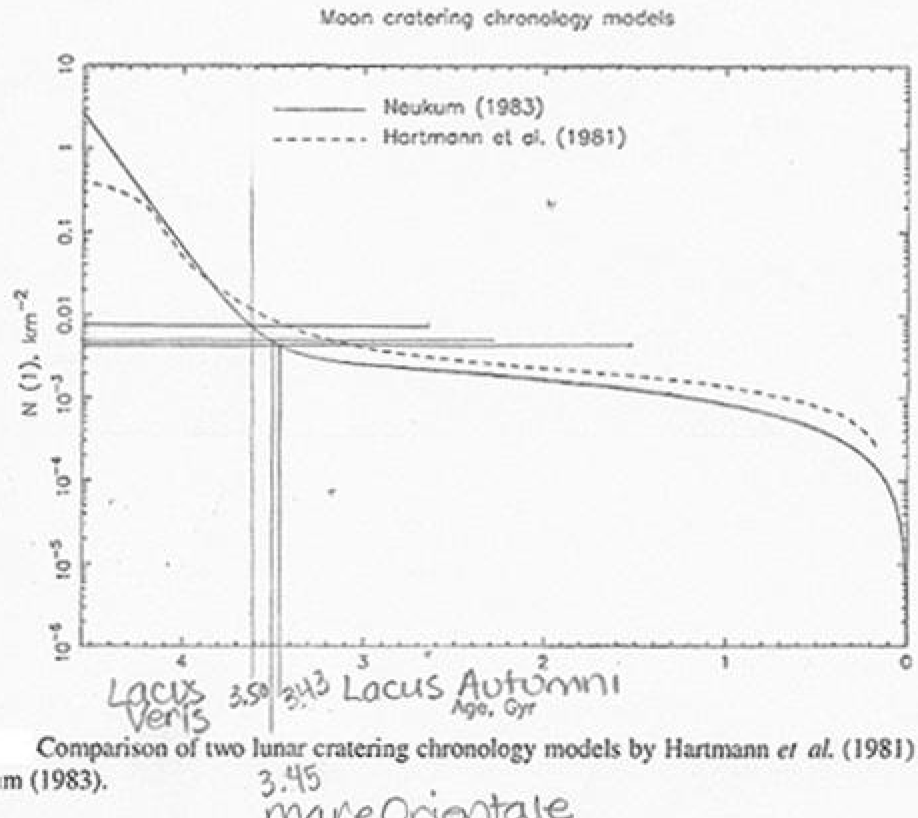
Lacus Autumni





Area 1 = red square
Area 3 = blue triangle
Area 2a =green triangle
Area 4 = orange circle
Area 6 = blue diamond
Area 2 = x
Area 5 = blue circle

Hand graphing the data



Comparison of two lunar cratering chronology models by Hartmann *et al.* (1981) and by Neukum (1983).

Absolute Ages

- Calculated using Neukum et al. formula
- Programmed into a TI-84 calculator

- Mare Orientale (Area 1) = 3.52 Gyr
- Lacus Veris
  - Area 2a = 3.58 Gyr
  - Area 2 = 3.69 Gyr
  - Area 3 = 3.62 Gyr
  - Average= 3.63 Gyr
- Lacus Autumni
  - Area 4 = 3.62 Gyr
  - Area 5 = 1.16 Gyr
  - Area 6 = 3.67 Gyr
  - Average= 3.47 Gyr

CONCLUSION

- Results were very close to Whitten et. al. paper
- Due to time constraints, did not have time to analyze other basins
- We plan to continue to look at the other basins

CITATIONS

Ivanov, B A., G Neukum, W F. Bottke Jr., and W K. Hartmann. *The Comparison of Size-Frequency Distributions of Impact Carters and Asteroids and the Planetary Cratering Rate*. Tucson: U of AZ Press and Lunar & Planetary Institute, 2002. 89-101. Lunar and Planetary Institute.

Michael, G G., and G Neukum. "Planetary surface dating from crater size-frequency distribution measurements: Partial resurfacing events and statistical age uncertainty." *Earth and Planetary Science Letters* 294.3-4 June (2010): 223-29. Lunar and Planetary Institute.

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Whitten, J., J. W. Head, M. Staid, C. M. Pieters, J. Mustard, R. Clark, J. Nettles, R.L. Klima, and L. Taylor (2011), *Lunar mare deposits associated with the Orientale impact basin: New insights into mineralogy, history, mode of emplacement, and relation to Orientale Basin evolution from Moon Mineralogy Mapper (M3) data from Chandrayaan-1, J. Geophys. Res.*, 116.


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