# *Team Nu*

# Introduction

- ***Question:*** Can a relationship in sub surface ice be determined using rootless cone occurrence around rampart craters in Isidis Planitia?

# Importance

- ***Importance/Interest:*** We chose this topic to find out how rootless cones and rampart craters can effect sub surface ice on Mars.

# Hypotheses

- ***Main Hypothesis:*** As the distance from rampart craters increases, the amount of rootless cones increases.

- **Alternate Hypothesis:** As the distance from rampart craters increases, the amount of rootless cones is not affected.

# Background

***Rootless Cones-***

Raised features near volcanoes. The formation of rootless cones is when lava flows on top of underground frozen water, heating it till the steam has to rise and explodes causing a raised feature.

***Rampart Craters-***

Rampart craters are a specific type of Martian impact crater which are accompanied by distinctive fluidized ejecta features.

***Isidis Planitia-***

A plain located inside a giant impact basin on Mars. It is the third biggest impact structure on the planet after the Hellas and Argyre basins – it is about 1500 km in diameter

# Background

***Lobate Ejecta-***

Ice melts underneath the surface as the impact crater hits, causing the formation of lobate ejecta.

***CTX Image-***

The CTX camera will obtain grayscale images of the Martian surface. A typical CTX image maybe as wide as 30 kilometers and as long as 160 kilometers, or more.

***THEMIS Image-***

An instrument on board the Mars Odyssey spacecraft. It combines a 5-wavelength visual imaging system with a 9-wavelength infrared imaging system.

http://isis.astrogeology.usgs.gov
http://themis.asu.edu/about
http://en.wikipedia.org/wiki/Isidis_Planitia

# Camera/Spacecraft

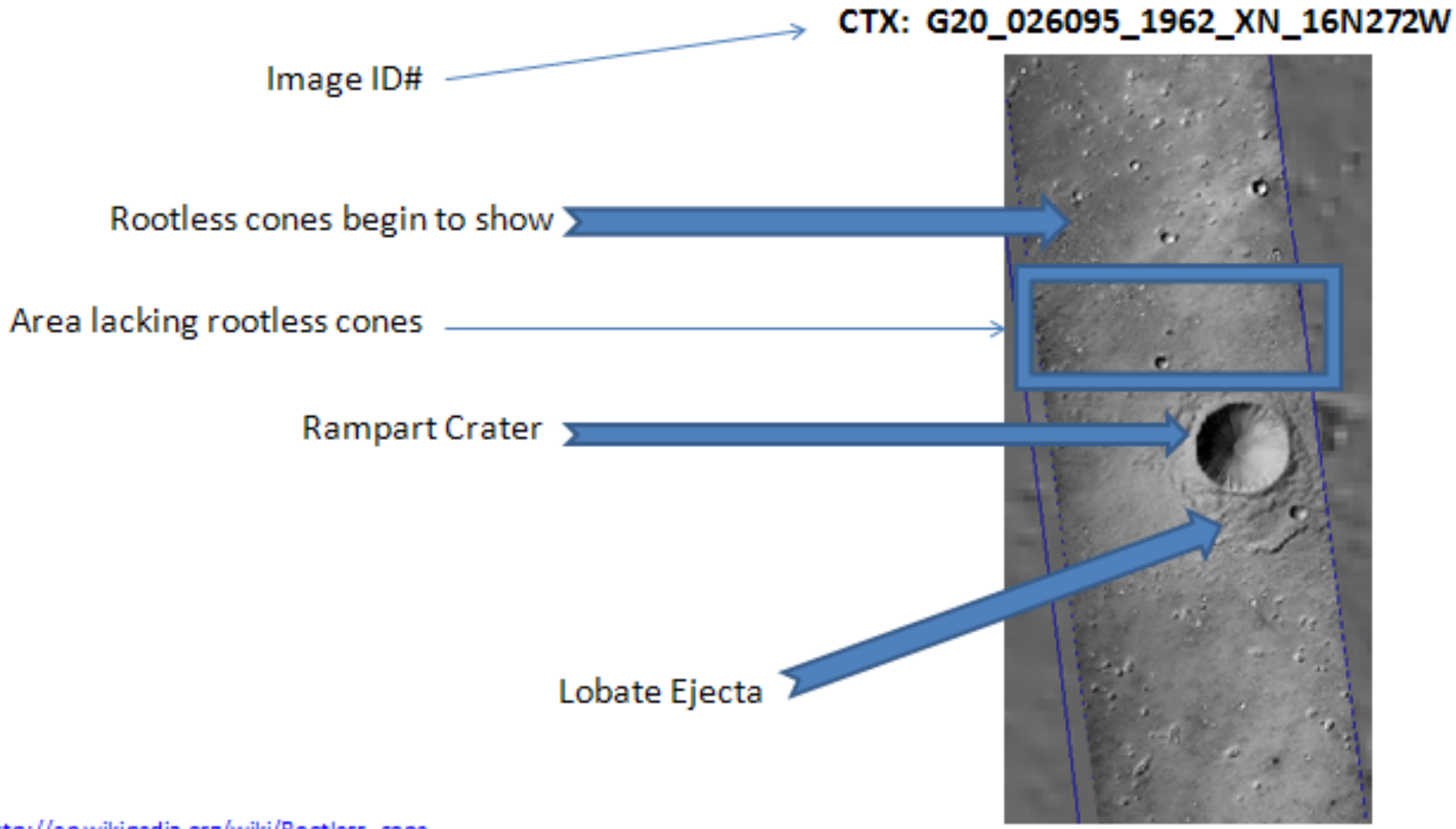
Camera- THEMIS (Thermal Emission Imaging System)

Spacecraft- Mars Odyssey

Camera- CTX (Context Imager)

Spacecraft- Mars Reconnaissance Orbiter

# Control Image (Rootless Cones)




http://en.wikipedia.org/wiki/Rootless_cone

# Background

## ***How rootless cones form***

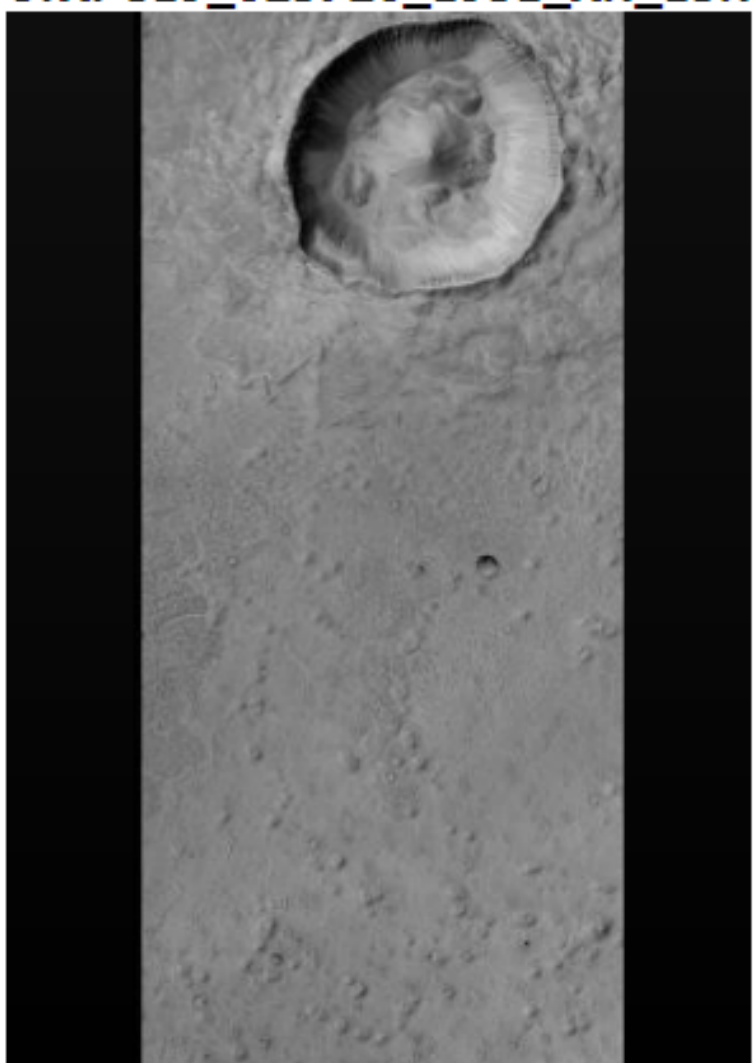
**Resulting from the explosive interaction of lava and water or ice underneath the surface. Ice underneath the surface is heated and explodes  up out of the surface, causing a cone to form.**

**A rampart crater creates a certain form of ejecta called lobate ejecta. This ejecta deposit is believed to form when an impacting object rapidly melts ice in the subsurface. The presence of liquid water in the ejected material allows it to flow along the surface, giving the ejecta blanket its characteristic, fluidized appearance.**

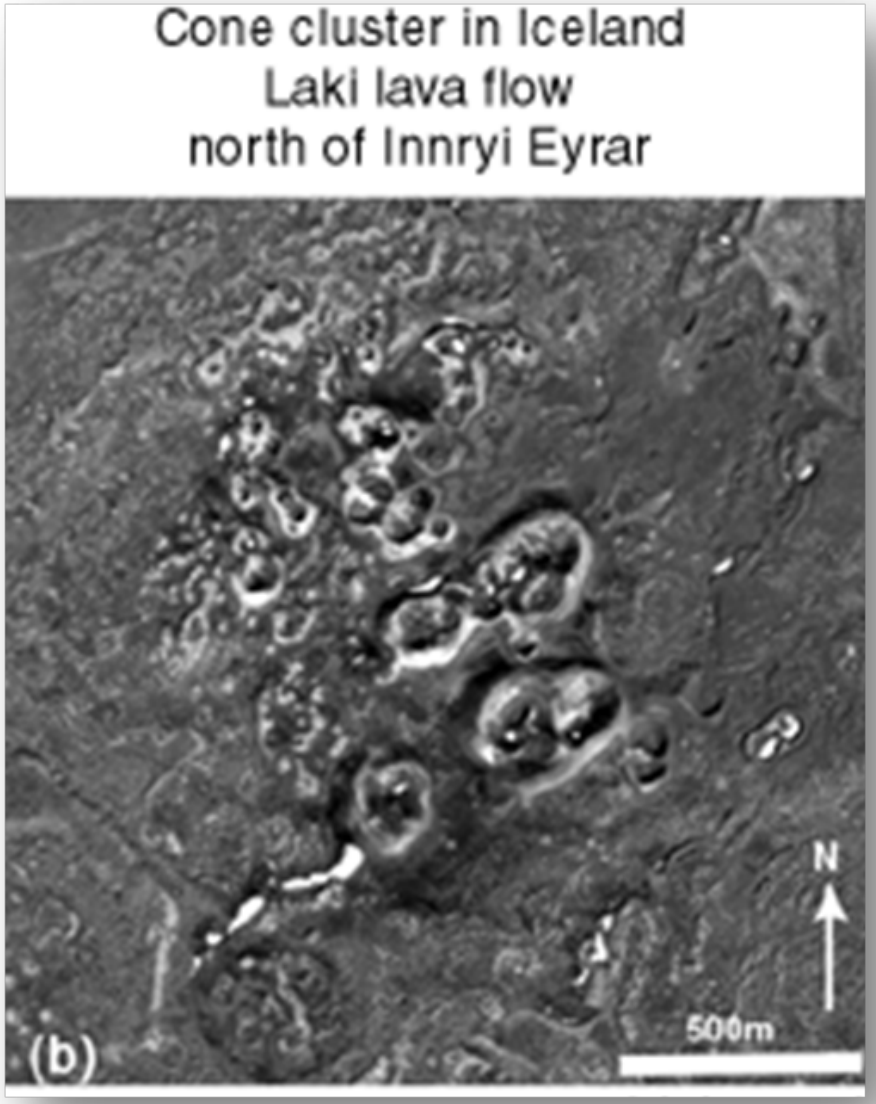
# Analog

## MARS

CTX: G19_025726_1951_XN_15N



## EARTH



# Research

***Research Done By***: *B. C. Bruno, S. A. Fagents, C. W. Hamilton, D. M. Burr, S. M. Baloga*

- Their research was to find and distribute rootless cones and determine if there are ice mounds.

**Source:** JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 111, E06017, 16 PP., 2006
doi:10.1029/2005JE002510

**Citation:** Bruno, B. C., S. A. Fagents, C. W. Hamilton, D. M. Burr, and S. M. Baloga (2006), Identification of volcanic rootless cones, ice mounds, and impact craters on Earth and Mars: Using spatial distribution as a remote sensing tool, *J. Geophys. Res.*, 111, E06017, doi: 10.1029/2005JE002510.

# Science Research

- **Rootless volcanic cones are an important diagnostic of ice distribution in the near-surface regolith.** [Greeley and Fagents, 2001; Lanagan et al., 2001; Fagents et al., 2002; Fagents and Thordarson, 2006].

- **They were first identified in Viking Orbiter imagery.** [Allen, 1979a; Frey et al., 1979; Frey and Jarosewich, 1982]**, and more recently from data acquired by both the Thermal Emission Imaging System (THEMIS) on Mars Odyssey and the high-resolution (Nar-row-Angle) Mars Orbiter Camera (MOC-NA) aboard Mars Global Surveyor.**

http://web.eps.utk.edu/faculty/burr/pubs/06Bruno_etal_JGR.pdf

# Science Research

- **On Mars, potential rootless volcanic cones have been identified in the northern lowland plains including Acidalia, Amazonis, Isidis, and Elysium Planitia.** [Allen, 1979a; Frey and Jarosewich, 1982; Greeley and Fagents, 2001; Lanagan et al., 2001; Fagents et al., 2002].

http://web.eps.utk.edu/faculty/burr/pubs/06Bruno_etal_JGR.pdf

# Set-up of Data Table

| | | | Number of rotless cones | | |
|---|---|---|---|---|---|
| Image ID # | Central Longitude | Central Latitude | 0-5km from crater | 5-10km from crater | 10-15km from crater |
| B18_016812_1983_XN_18N275W | | | | | |
| G06_020425_1962_XN_16N275W | | | | | |
| P03_002334_1970_XN_17N275W | | | | | |
| V27155032 | | | | | |
| V26868027 | 85 | 17 | | | |
| G05_020359_1952_XN_15N272W | | | | | |
| G20_026095_1962_XN_16N272W | | | | | |
| B17_016390_1954_XN_15N273W | | | | | |
| P13_006237_1952_XN_15N272W | | | | | |
| G18_025317_1957_XN_15N273W | 87.3 | 14.5 | | | |
| G20_025963_1938_XN_13N278W | | | | | |
| G03_019238_1930_XN_13N268W | | | | | |
| B16_015968_1931_XN_13N269W | | | | | |
| B20_017537_1951_XN_15N268W | | | | | |
| V20054002 | 91.2 | 14.3 | | | |
| P21_009256_1916_XN_11N267W | | | | | |
| G02_019027_1912_XN_11N267W | | | | | |
| B21_017682_1938_XN_13N267W | | | | | |
| G14_023774_1904_XN_10N267W | | | | | |
| B02_010601_1923_XN_12N267W | 92.9 | 11.5 | | | |
| GO3_019581_1919_XN_11N272W | | | | | |
| B18_016535_1908_XN_10N271W | | | | | |
| B18_016601_1902_XN_10N273W | | | | | |
| V09359003 | | | | | |
| V15187007 | 87.9 | 11.3 | | | |
| B05_011643_1887_XN_08N275W | | | | | |
| B05_011432_1887_XN_08N274W | | | | | |
| G19_025594_1877_XN_07N275W | | | | | |
| B17_016311_1903_XN_10N276W | | | | | |
| P15_007015_1858_XN_05N273W | 85 | 7.9 | | | |
| P13_006224_1929_XN_12N276W | | | | | |
| B20_017300_1927_XN_12N277W | | | | | |
| B21_018012_1928_XN_12N276W | | | | | |

# **Procedures:**

# Using Layers

Sentences Marked with an Asterisk (*) is the limitation.

**We used layers, including but no limited to:**

1. **Crater Counting-** For Specifying where to look, and to count the Rootless Cones.

   **You need to click all of the features so it can count it.*

2. **CTX Stamps-** use them to measure the features.

   **There may not be the stamps in a certain spot.*

3. **MOLA (colorized elevation)-** to see where we need to look, and how high the elevation is. (looks better than the gray one)

   **Pixilation occurs when you zoom in a lot.*

4. **128ppd Elevation-** to measure the distance between the ejecta and outwards, the craters diameter, and ejecta length.

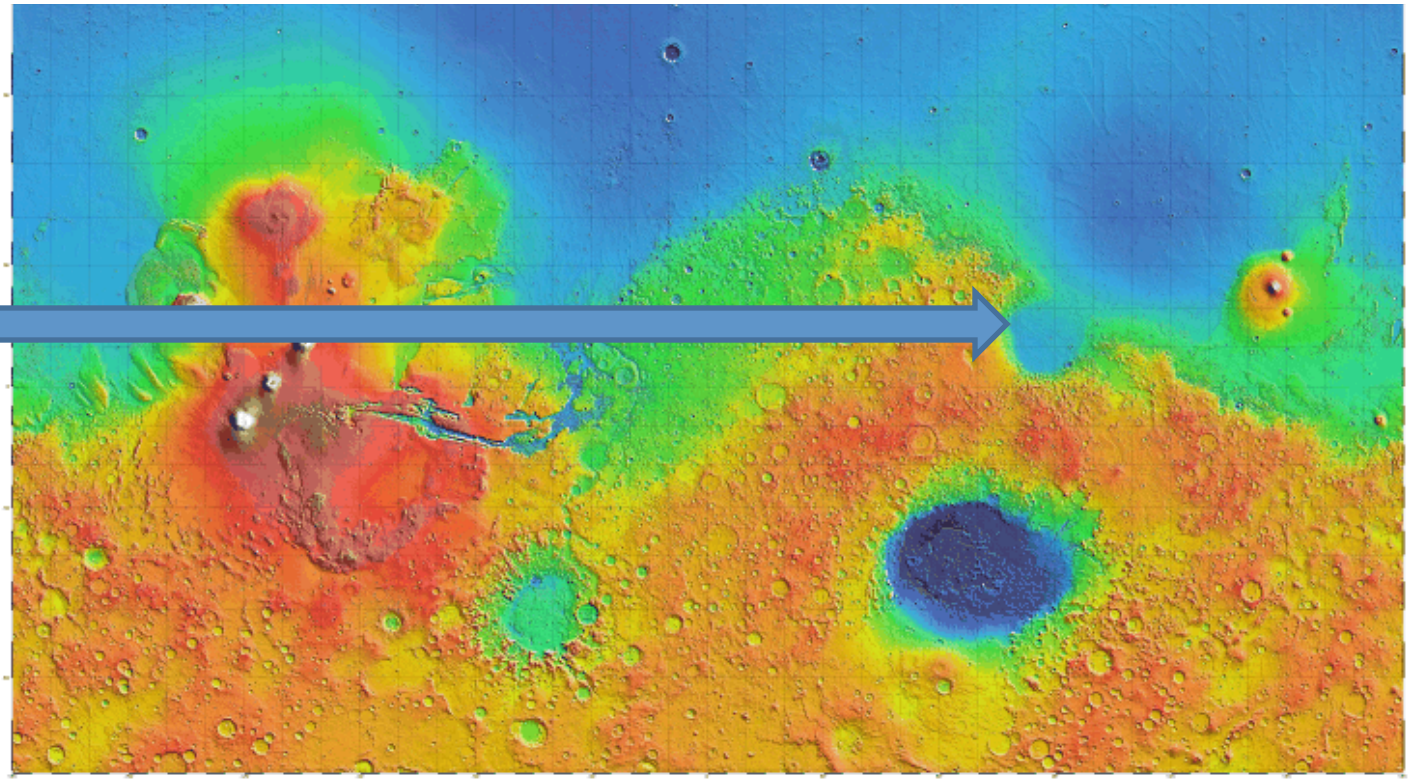
   **When you move the mouse, the measurement goes away. It doesn't stay.*

# **Procedures:** Using Layers *(cont.)*

5. **THEMIS Stamps-** use them to measure the features.
   **There may not be the stamps in a certain spot.*
6. **HIRISE Stamps-** use them to measure the features.
   **There may not be the stamps in a certain spot.*
7. **THEMIS Day IR-** To see better
   **zoomed out, cant see anything.*
8. **THEMIS Night IR-**to see better
   **zoomed out, cant see anything.*
9. **Nomenclature-** to find any volcanoes near Insidis Planitia.
   **only marks Large features and landmarks.*
10. **MOLA Shaded Relief-** To see and know where we are.
    **Zoomed in a lot, pixilation occurs.*

# **Procedure:** Finding Location

- We will be looking in Isidis Planitia, which is 80-95 degrees longitude, and 5-20 degrees latitude.



**Isidis Planitia**

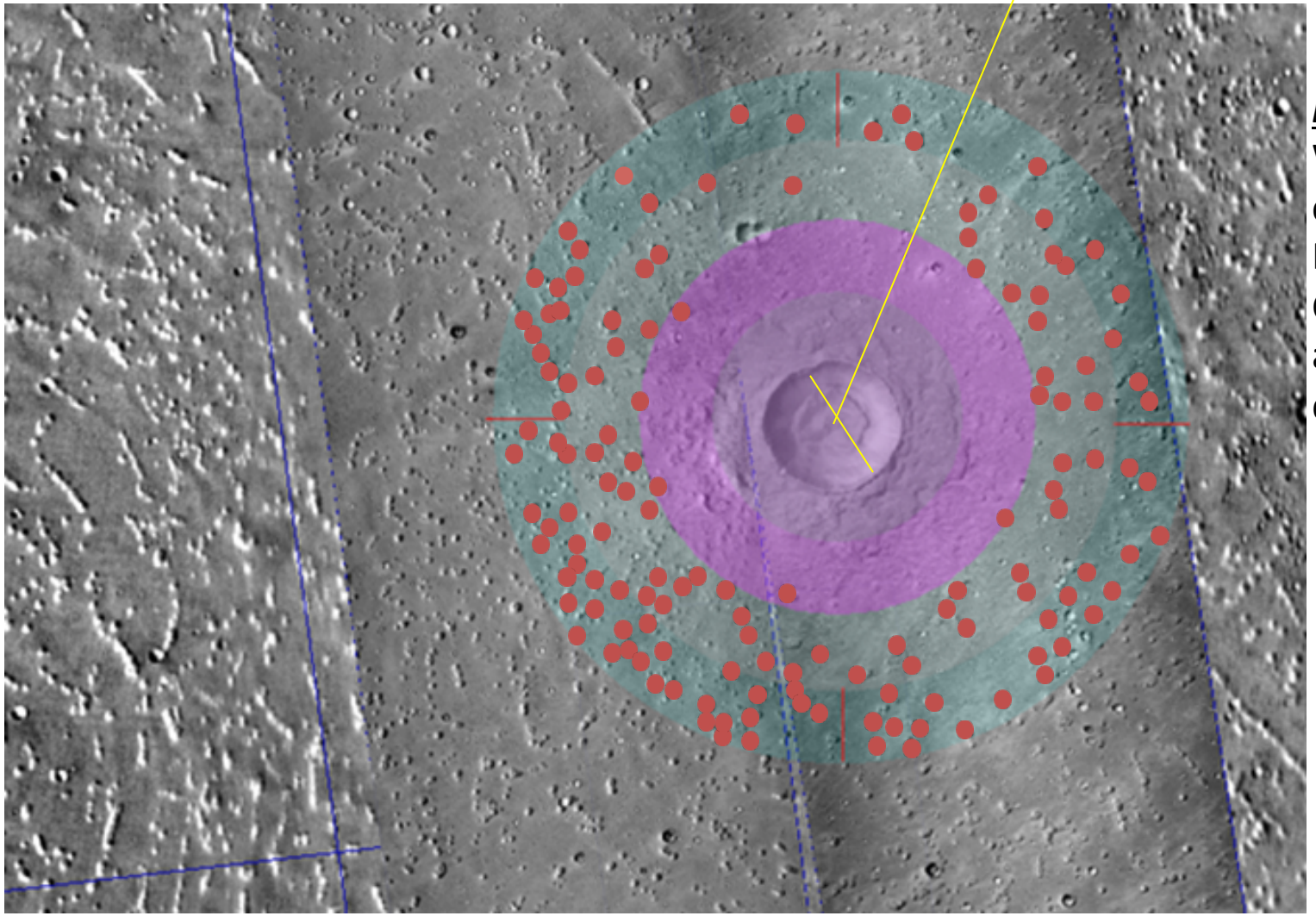
http://www.astro.wisc.edu/

# **Procedures:** Finding Location/Getting Data

1. Download JMARS
2. Got to “add new layer”. Put up colorized elevation
3. Find Isidis Planitia, which is 80-95 degrees longitude, and 5-20 degrees latitude.
4. Got to Crater Counting, go to a 1,000k, and plot Isidis Planitia.
5. Then, plot three different regions, size 400k, inside Isidis Planitia. Then, we will be looking in three more regions, size 160k, in each of the first three regions.
6. To measure our feature, we find a Rampart Crater, within the third crater counting layer, and plot that crater, with the diameter is between 10-20 kilometers, with a fourth crater counting.
7. We then measure out to the ejecta with a crater counting.
8. We go out every 5 kilometers for three times and count the rootless cones with Crater Counting.
9. Repeat steps 6-8 for each crater.

# Example:

**Red Dots=** Rootless Cones
**Each Ring=** 5km outwards




***Note:***
We are counting the Rootless Cones, which are the red dots.

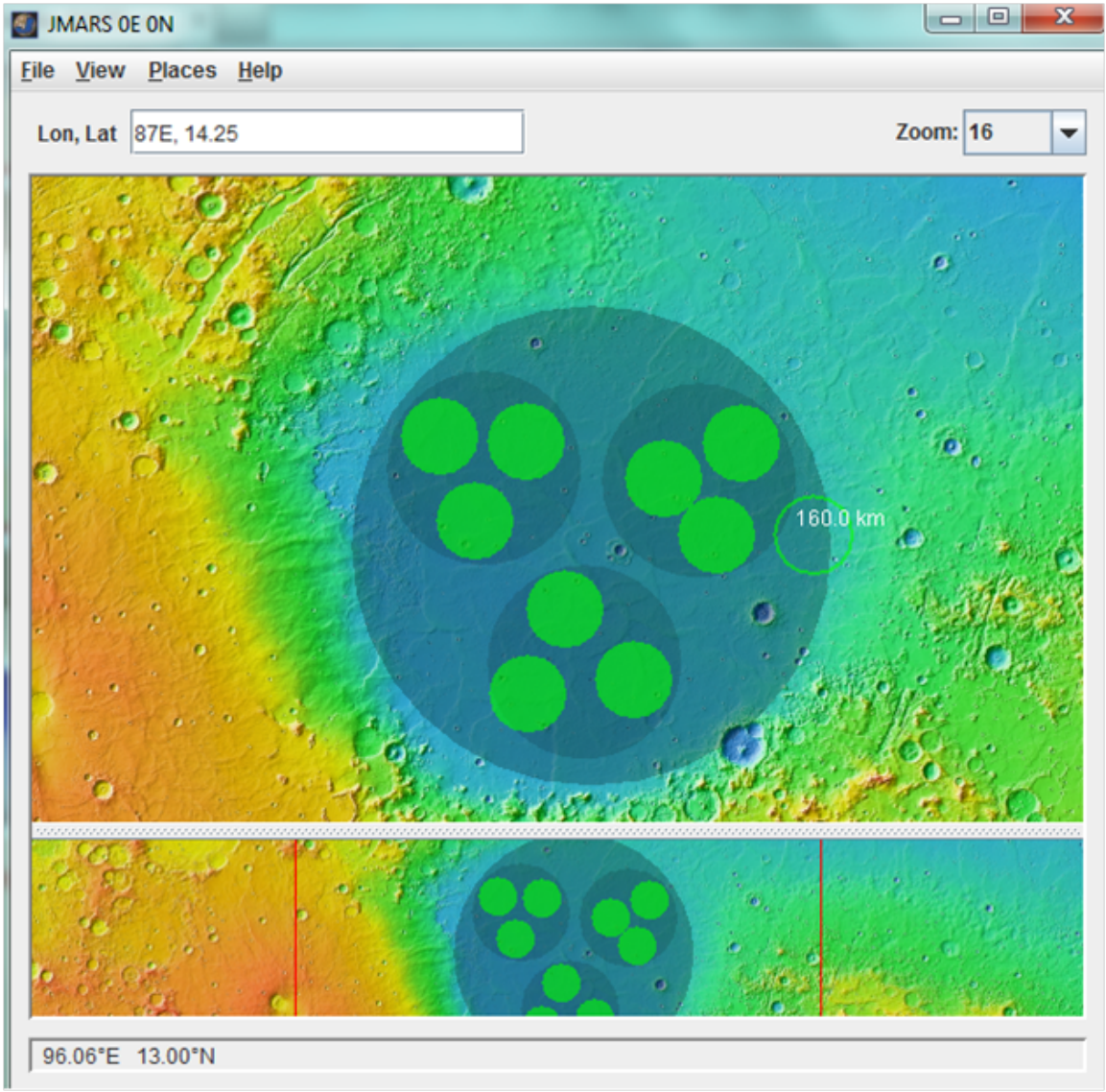
# Bias Reduction

***We reduced bias by:***

- Using three circles within Isidis Planitia.
- Using two craters for each of the three circles.
- Using five images for each crater used.
- Using five km for each counting of rootless cones.
- Keeping each of the craters used in between 10-20 km.

# Reducing Bias

***This is what it looked like.***



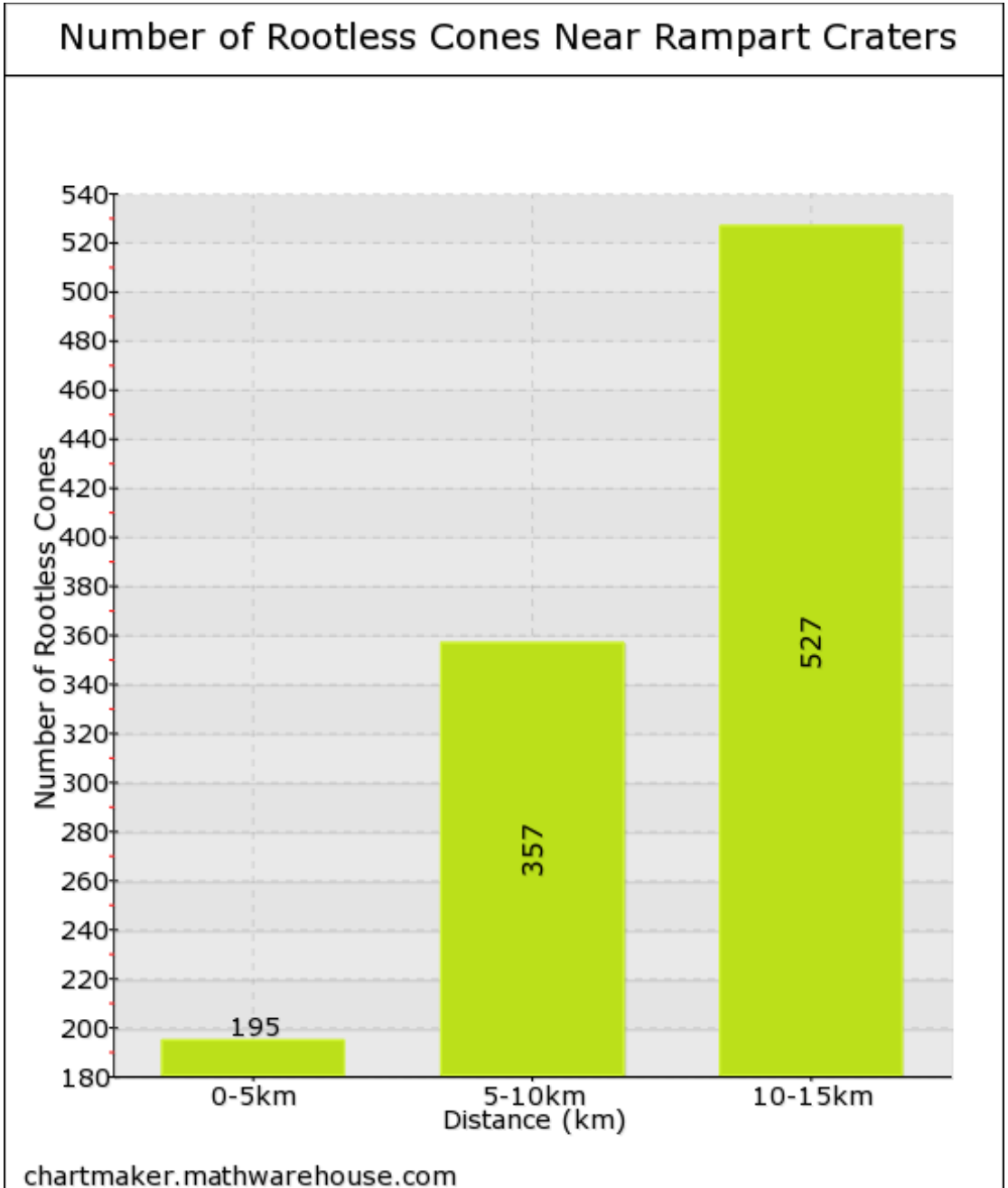
# Data Table

| Image ID # | Central Longitude | Central Latitude | Number of rootless cones | | |
|---|---|---|---|---|---|
| | | | 0-5km from crater | 5-10km from crater | 10-15km from crater |
| B18_016812_1983_XN_18N275W | 85 | 17 | 24 | 52 | 79 |
| G06_020425_1962_XN_16N275W | | | | | |
| P03_002334_1970_XN_17N275W | | | | | |
| V27155032 | | | | | |
| V26868027 | | | | | |
| G05_020359_1952_XN_15N272W | 87.3 | 14.5 | 19 | 36 | 58 |
| G20_026095_1962_XN_16N272W | | | | | |
| B17_016390_1954_XN_15N273W | | | | | |
| P13_006237_1952_XN_15N272W | | | | | |
| G18_025317_1957_XN_15N273W | | | | | |
| G20_025963_1938_XN_13N278W | 91.2 | 14.3 | 16 | 38 | 47 |
| G03_019238_1930_XN_13N268W | | | | | |
| B16_015968_1931_XN_13N269W | | | | | |
| B20_017537_1951_XN_15N268W | | | | | |
| V20054002 | | | | | |
| P21_009256_1916_XN_11N267W | 92.9 | 11.5 | 13 | 29 | 51 |
| G02_019027_1912_XN_11N267W | | | | | |
| B21_017682_1938_XN_13N267W | | | | | |
| G14_023774_1904_XN_10N267W | | | | | |
| B02_010601_1923_XN_12N267W | | | | | |

# Data Table Continued

| | | | | | |
|---|---|---|---|---|---|
| GO3_019581_1919_XN_11N272W | 87.9 | 11.3 | 29 | 51 | 84 |
| B18_016535_1908_XN_10N271W | | | | | |
| B18_016601_1902_XN_10N273W | | | | | |
| V09359003 | | | | | |
| V15187007 | | | | | |
| B05_011643_1887_XN_08N275W | 85 | 7.9 | 22 | 34 | 55 |
| B05_011432_1887_XN_08N274W | | | | | |
| G19_025594_1877_XN_07N275W | | | | | |
| B17_016311_1903_XN_10N276W | | | | | |
| P15_007015_1858_XN_05N273W | | | | | |
| P13_006224_1929_XN_12N276W | 83 | 13.3 | 33 | 56 | 71 |
| B20_017300_1927_XN_12N277W | | | | | |
| B21_018012_1928_XN_12N276W | | | | | |
| B17_016166_1927_XN_12N277W | | | | | |
| B17_016311_1903_XN_10N276W | | | | | |
| G19_025726_1951_XN_15N278W | 81.3 | 15.1 | 39 | 61 | 82 |
| B17_016377_1927_XN_12N278W | | | | | |
| B19_017155_1969_XN_16N279W | | | | | |
| G05_019990_1968_XN_16N278W | | | | | |
| B17_0161666_1927_XN_12N277W | | | | | |

# Analysis Plan-Graph

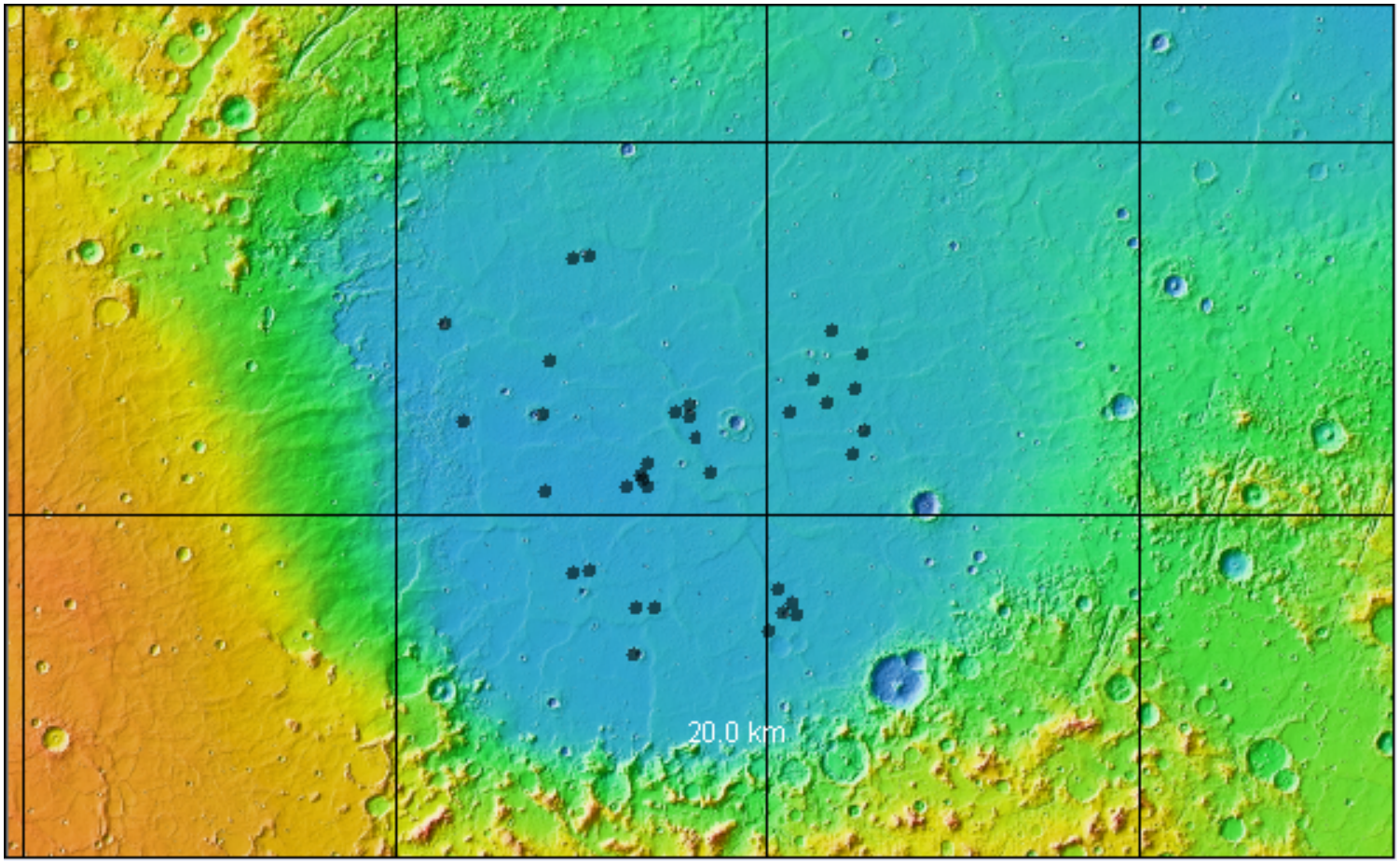


# Analysis Plan

# MOLA Points

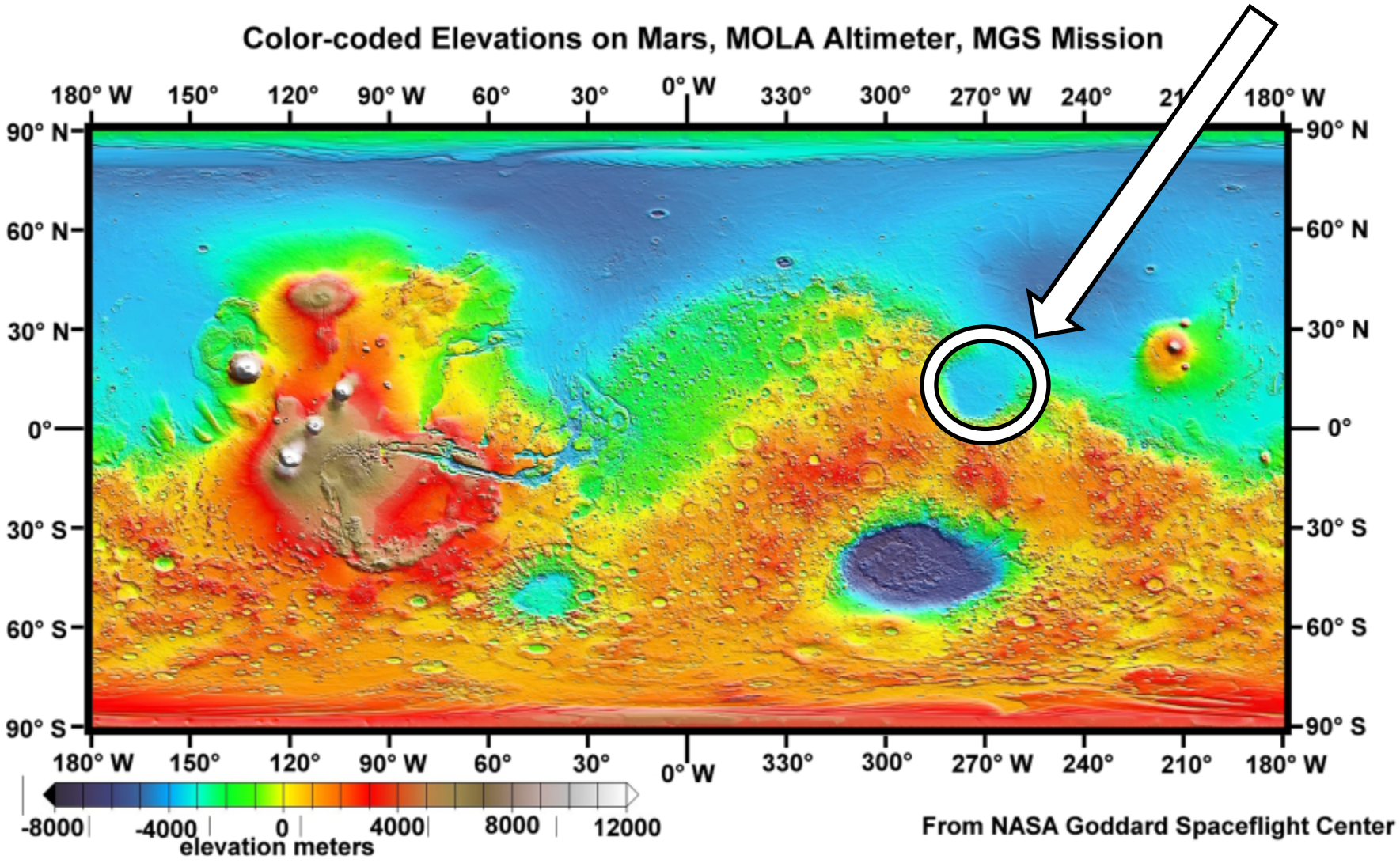
***Region:*** Isidis Planitia

- Dots are where we found the images.



# Analysis Plan

***Region:*** Isidis Planitia



# Conclusion

- ***Science Question-*** Can a relationship in sub surface ice be determined using rootless cone occurrence around rampart craters in Isidis Planitia?

# Conclusion

- ***Hypothesis-*** As the distance from rampart craters increases, the amount of rootless cones increases. According to the data, our hypothesis was supported.

# Additional Research

- If we could expand our research we would study the process of re-charge in subsurface ice in Isidis Planitia.
- We would compare the rootless cones in Isidis Planitia with other areas containing rootless cones (Elysium Planitia and Chryse Planitia)
- We would research the past climate changes in Isidis Planitia.

# References/Citation


***Images Used:***

- CTX:G19_025726_1951_XN_15N
- Christensen, P.R., B.M. Jakosky, H.H. Kieffer, M.C. Malin, H.Y. McSween, Jr., K. Nealson, G.L. Mehall, S.H. Silverman, S. Ferry, M. Caplinger, and M. Ravine, The Thermal Emission Imaging System (THEMIS) for the Mars 2001 Odyssey Mission, *Space Science Reviews*, *110*, 85-130, 2004. (THEMIS Camera)
- http://www.psrd.hawaii.edu/June01/lavaIceMars.html (Iceland image)
- http://jmars.asu.edu/ JMARS 0E 0N
- http://viewer.mars.asu.edu (To view images on the web browser. )
- NASA/JPL-Caltech/Arizona State University. (images created through JMARS)
- http://www.lpi.usra.edu/science/treiman/greatdesert/workshop/marsmaps1/ (MOLA Map)
- Christensen, P.R., N.S. Gorelick, G.L. Mehall, and K.C. Murray, *THEMIS Public Data Releases*, Planetary Data System node, Arizona State University, <http://themis-data.asu.edu>. (THEMIS Image in data table)

***Research:***

- **Source:** JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 111, E06017, 16 PP., 2006 doi:10.1029/2005JE002510
- **Citation:** Bruno, B. C., S. A. Fagents, C. W. Hamilton, D. M. Burr, and S. M. Baloga (2006), Identification of volcanic rootless cones, ice mounds, and impact craters on Earth and Mars: Using spatial distribution as a remote sensing tool, *J. Geophys. Res.*, 111, E06017, doi: 10.1029/2005JE002510.

***JMARS Citation***

- Christensen, P.R.; Engle, E.; Anwar, S.; Dickenshied, S.; Noss, D.; Gorelick, N.; Weiss-Malik, M.; *JMARS – A Planetary GIS*, http://adsabs.harvard.edu/abs/2009AGUFMIN22A..06C

# References/Citation


- Christensen, P.R., N.S. Gorelick, G.L. Mehall, and K.C. Murray, *THEMIS Public Data Releases*, Planetary Data System node, Arizona State University, <http://themis-data.asu.edu>.

- Taylor, G. Jeffrey (Oct. 1996) Life on Mars? The Evidence and the Debate. *Planetary Science Research Discoveries*. http://www.psrd.hawaii.edu/Oct96/LifeonMars.html (30 Jan. 2012).