Josephine Brozny

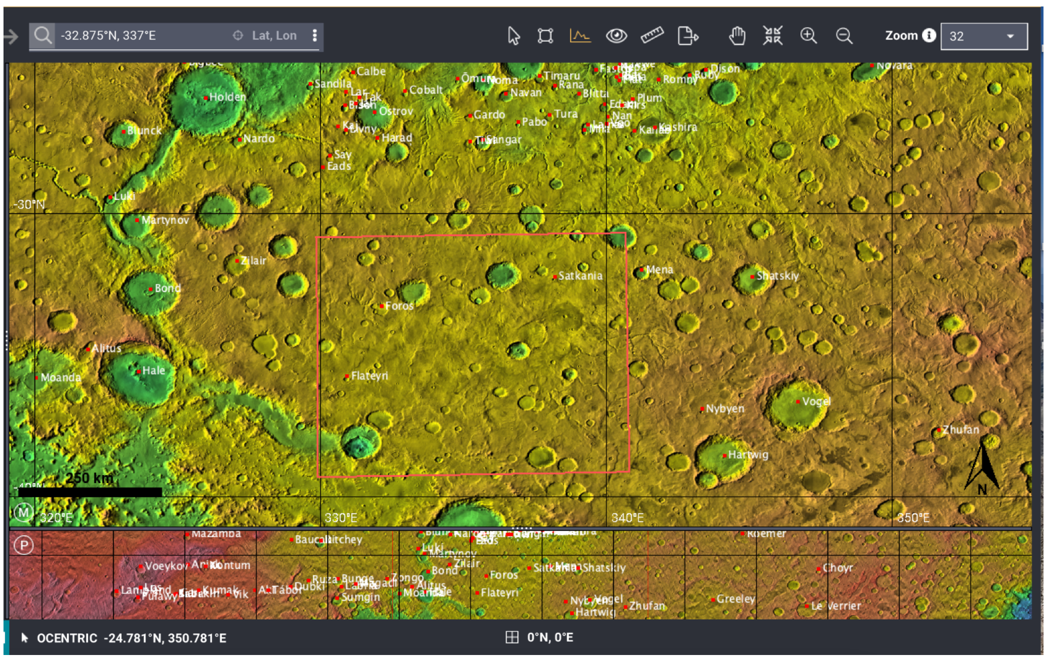
Kate Drobnich

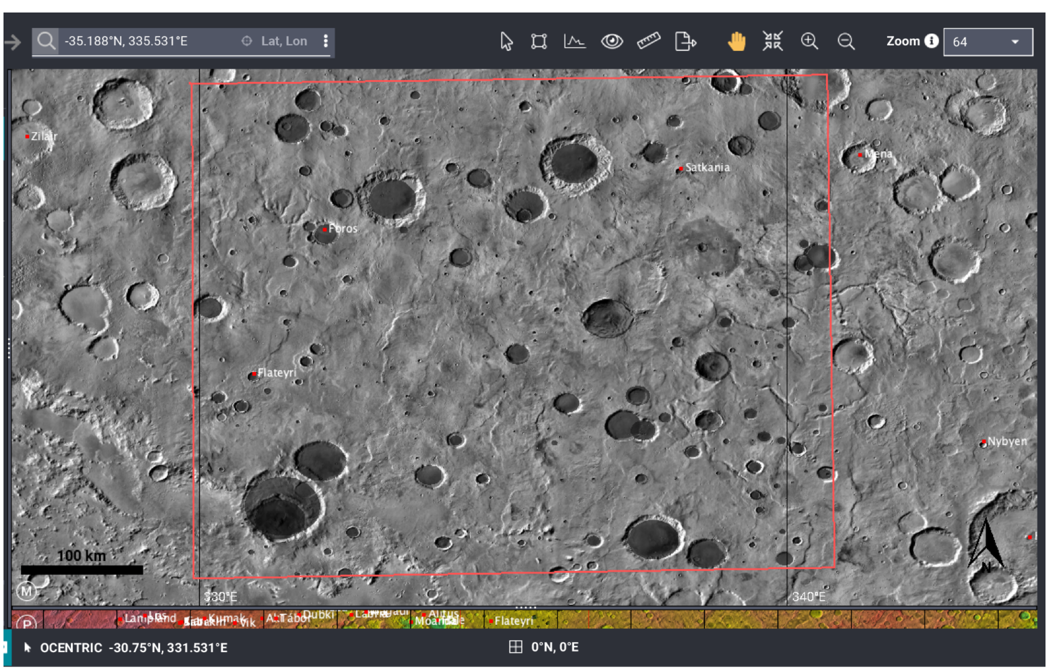
Analyzing Observed Crater Sizing on Mars

1. Size Frequency Distribution

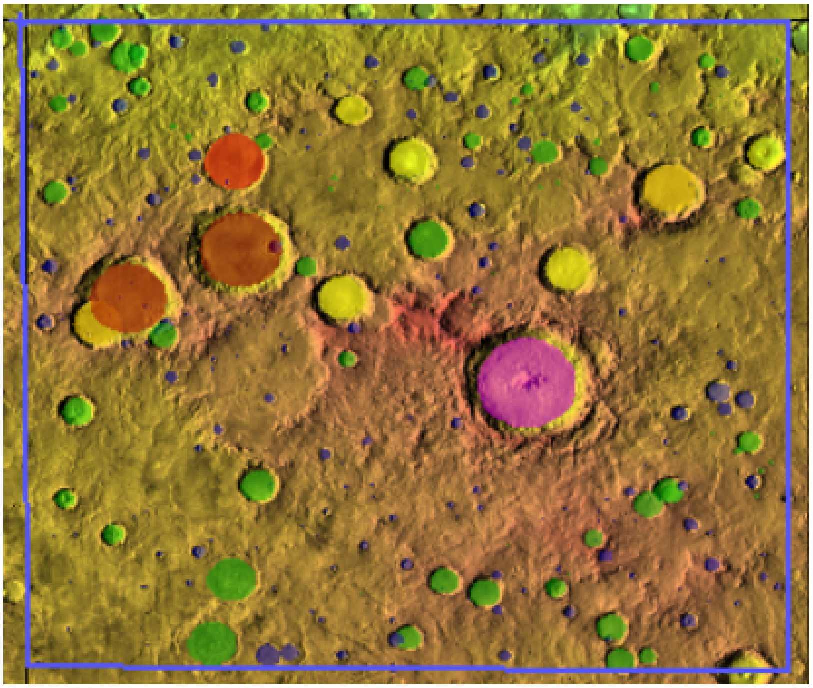
a)

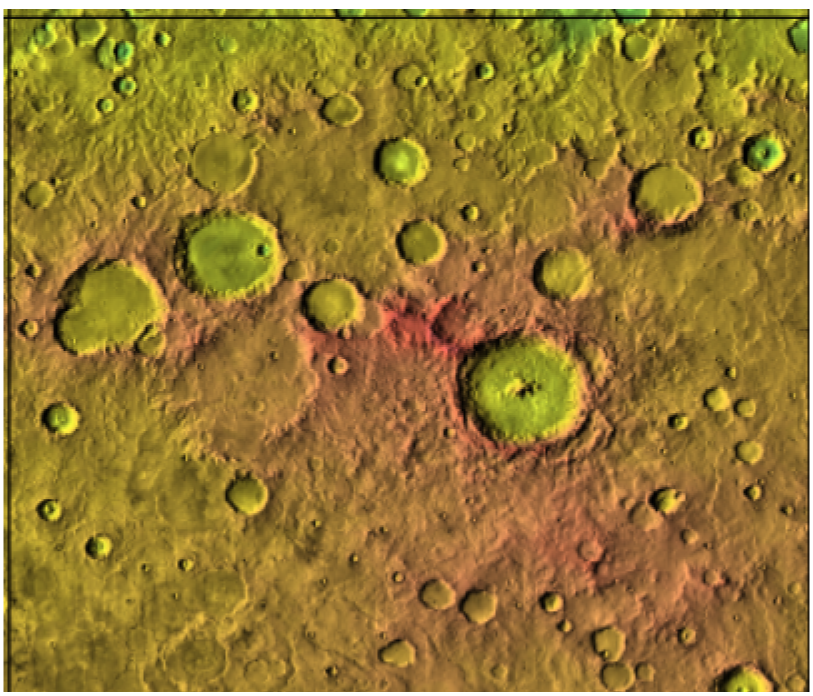
Region 1:





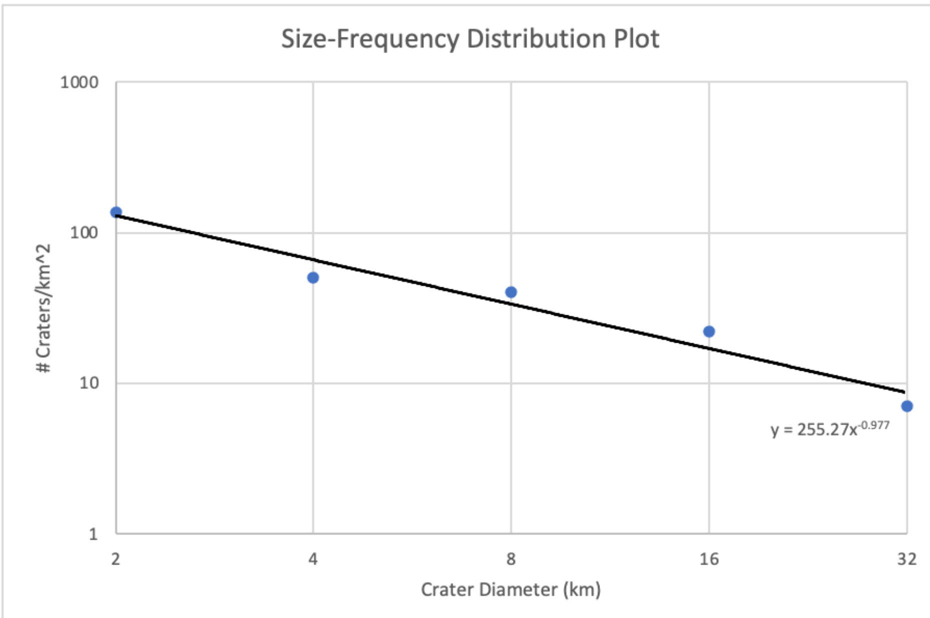
Region 2:



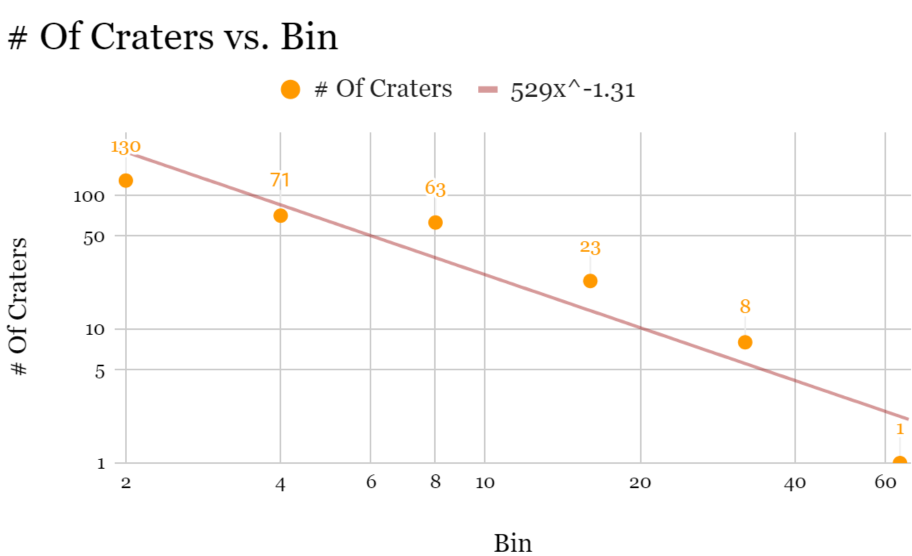


b)

Region 1:



Region 2:



c)

Region 1: b= 0.977

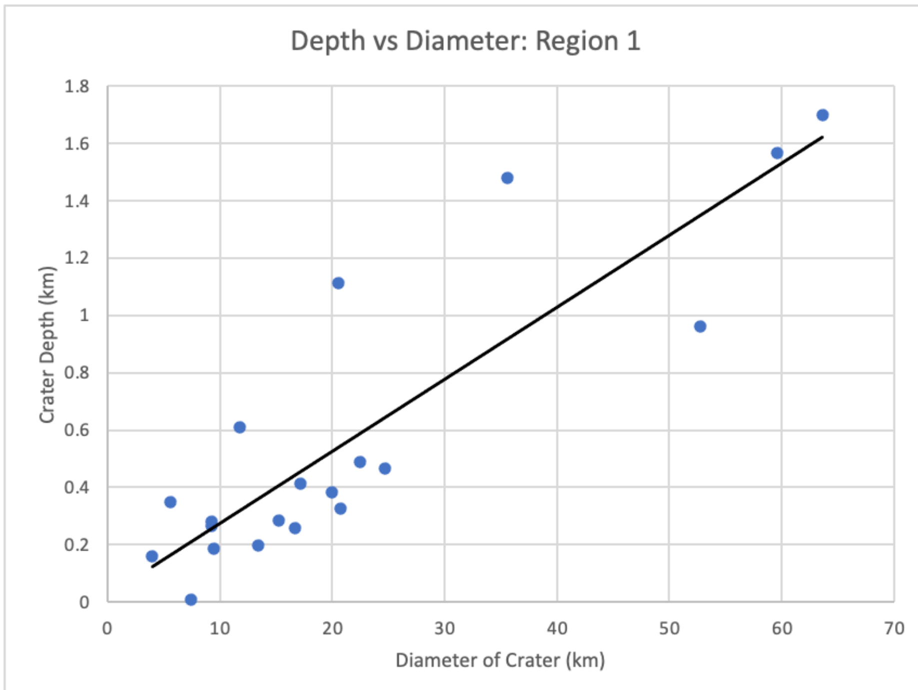
Region 2: b=1.31

d) Beginning our visual analysis, we can see that region one (younger) has less craters than region two (older - billions of years old). We assume in this case that some process has eliminated the presence of distinct craters like in region 2, most probably being because of erosion by water, wind, and or lava. Because we see a lack of craters of all size ranges in some areas, it is our best guess that it is not water erosion which is the dominant process here and actually potential lava fields. Due to the quality we cannot tell for sure, but this is our best judgment. In addition, just by looking at each region we can recognize that there are more small craters than large ones. This is confirmed by our size frequency distribution plots where our b values are close to 1 for both plots. We see a slightly steeper slope for region 2 due to the fact that it contains more data of larger craters than region one. This data shows a very low frequency of large craters, and an even higher distribution of smaller craters, causing the b value to be larger. Nevertheless both regions show that smaller craters are more common than larger ones. However, this relationship is not as strong as we expect. Looking at other planets such as the moon, the b value is closer to 2 because smaller craters are more abundant. Thus, knowing Mars once held an atmosphere and carried water, we hypothesize for our findings that many of the small craters were eroded and filled in by mostly rain but also wind. Looking at region 2 in particular - it is obvious that billions of years of erosion have taken place as there are many geological figures that look to be old craters, but not clear enough to tell for sure. This was part of the challenge identifying craters in this region and may affect our results. Again for region 1 this may be true, but especially because we see a lot of craters wiped out from assumed lava plains.

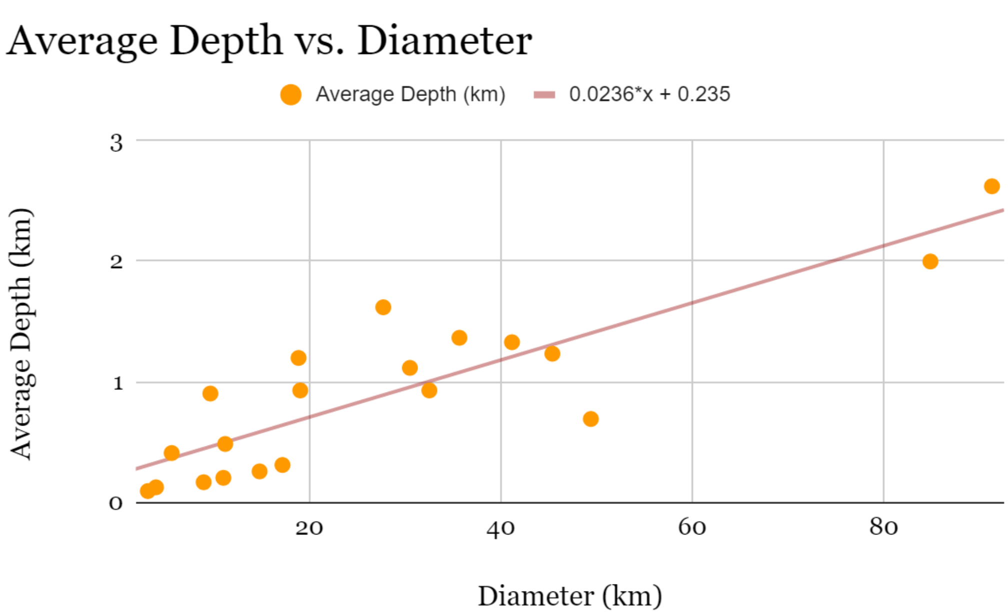
2. Depth-Diameter Ratios

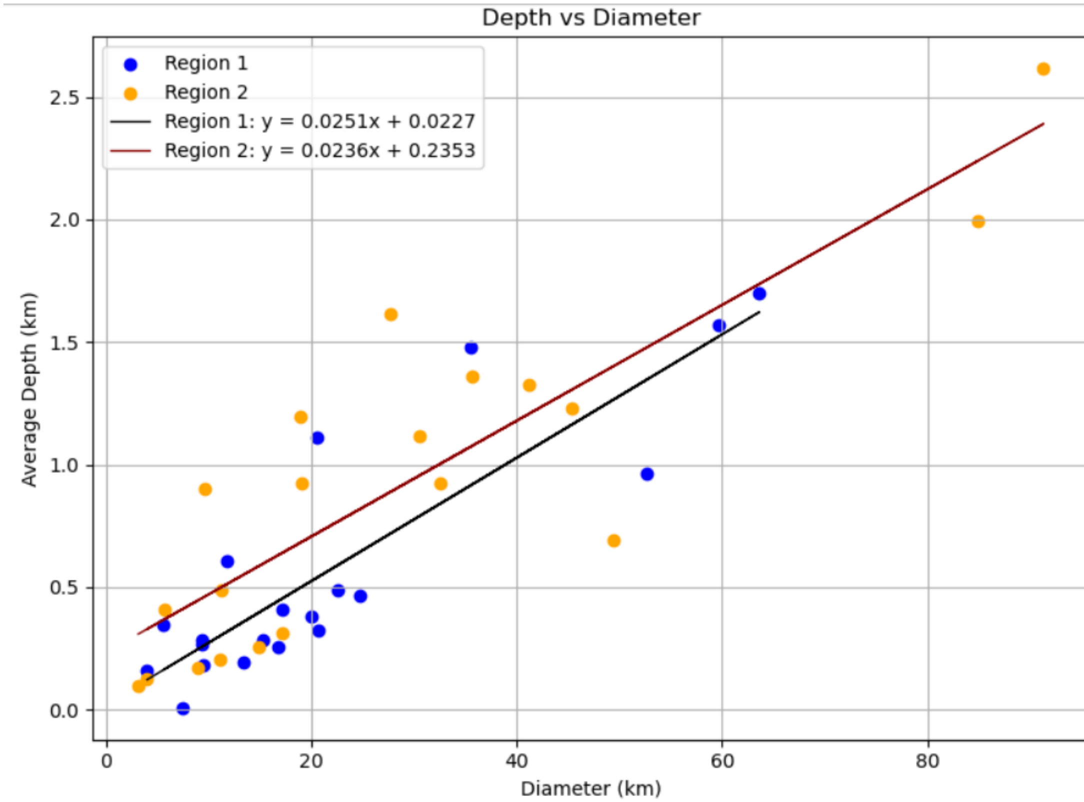
a)

Region 1:



Region 2:





b) Our regions did not yield the results we were quite expecting. We expect to see a depth:diameter ratio of 1:5 for most craters and for small bowl shaped craters we expect to see a ratio closer to 1:10. However, looking at our graphs, this proves to not be the case. Starting with region 1 we can see that there are a few less large craters to analyze because that region simply lacks these craters. But looking at the 60 km crater we see a ratio of roughly 1:38, a 36 km crater as 1:24, one of the 20km craters is 1:50, and a 10km crater as 1:50. For region 2 we see a ratio of roughly 1:36 for the 91 km crater, a ratio of about 1:30 for a 40 km crater, and about 1:50 for a few craters around 10 km. For both regions we see a lower ratio for larger craters and a higher ratio for smaller craters. This is consistent with what we want to see, although they are not the exact ratios we expect. Looking at the data of region 1 and 2 on the same plot we can clearly see a similar trend between the two. We believe that the ratios are off from their expected values due to the fact that erosion has occurred and filled in these craters. Over time, water and wind have altered the topology of the surface, extending and collapsing the crater walls and filling in the craters with sediment. This makes them much more shallow than we expect. It is also easier for smaller craters to be filled in, which confirms the ratio being higher than the large craters. In terms of the large craters, central peaks are more to blame for their shallow nature because of the vast amount of energy compared to smaller craters. Will go more in depth on the why in part 3. Lastly, it is important to note that the location of the profile line will affect our depth plot. We found that the profile lines that extend past the ejecta blanket gave the most accurate elevation to calculate crater depth with.

We do not want to use heightened material near the rim or ejecta blanket of the craters because it does not represent the elevation of the surface at time of impact, essential to calculating the accurate depth of the crater. The rim and ejecta blanket are higher and would result in a larger depth value for the crater than is actually valid.

3. <u>Central Peaks</u>

a) In Region 1, there are 6 identifiable central peaks. Their diameters are roughly; 20 km, 24 km, 35 km, 22 km, 27 km and 41 km. Region 2 has 12 identifiable central peaks whose diameters are roughly; 16 km, 11 km, 20 km, 24 km, 16 km, 16 km, 11 km, 13 km, 14 km, 83 km, 18 km, and 30 km. For only the craters that were profiled - we found 2. The 83 km crater and the 24 km crater. In Region 1, looking at only the craters that were profiled, there is only 1 with a central peak and it has a diameter of 40 km. Looking at the data

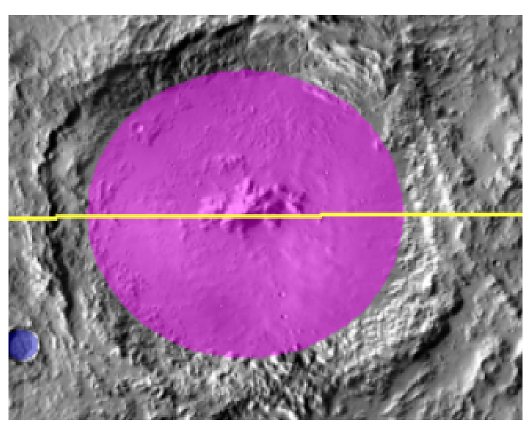
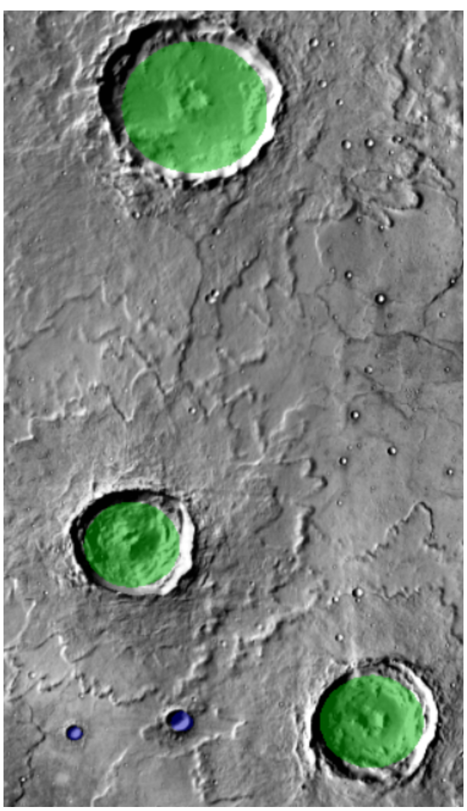


Photo of 83 km crater central peak from region 2 from both profiled regions, a diameter of around 49 km appears to be the most typical crater size to possess a central peak with a range of 24 - 83 km. Looking at the entire region gives us a better understanding of the range of diameters with central peaks however we are supposed to be focusing on the profiles. We must note that with limited data on very large craters, we cannot have a complete understanding of this phenomenon for all sizes. Central peaks form due to the strong force that is experienced upon impact. A larger impact results in a larger crater which will cause unstable walls that cave into the crater center. In order to "make up for" the shock that was experienced, there is an uplift that takes place that helps the crater reach equilibrium. This is what creates the central peak. In other words, central peaks form because when asteroids that large hit the ground it essentially blasts the rock at such high energy it behaves like a liquid, and rises as a rebound to the force of the rock compressing in the ground and solidifies as a peak.



This happens instantaneously. Just like water splashes back up when something drops into it. We noted that typical craters that have a diameter smaller than 10 km do not usually have a central peak. This makes sense because their impact would not contain enough energy to cause the amount of deformation that a larger impact would and therefore equilibrium is not far off. On the other side of the spectrum, we don't always see a central peak in large craters due to different factors. Some have multiple other craters inside affecting their structure, have been eroded by volatiles, or filled in by water/sediment. Region 1's central peaks follow a more typical idea of their structure.

However, in region 2 we see quite a few more craters which look to have a central peak but isn't quite right. Instead, these craters look like they have another impact directly in their center. The craters pictured range from a diameter of 15 to 20 km. We learned that in fact region 2 is located in the permafrost on Mars and thus the surface is behaving uniquely. Instead of peaks these craters have central pits. This is because the material is acting much more like a liquid, and we can see this behavior in the interesting formation of the ejecta blankets as well. It almost looks like mud. These photos are totally consistent with the ones we saw in lecture and explain why these craters look different to those with central peaks.