

Name: _____ Date: _____

VENUS: A GUIDED TOUR PRE-LAB

Using your lecture textbook and/or any other acceptable source of information, answer each question in complete sentences. Be sure to define any relevant terms.

1. Explain the following terms related to Venus' surface features.

a. Rift Valley:

b. Shield Volcano:

c. Corona:

d. Complex Ridge Terrain/Tesserae:

2. Explain how the Magellan space probe was able to map Venus' surface in great detail in spite of the thick cloud layers that completely enshroud the planet.

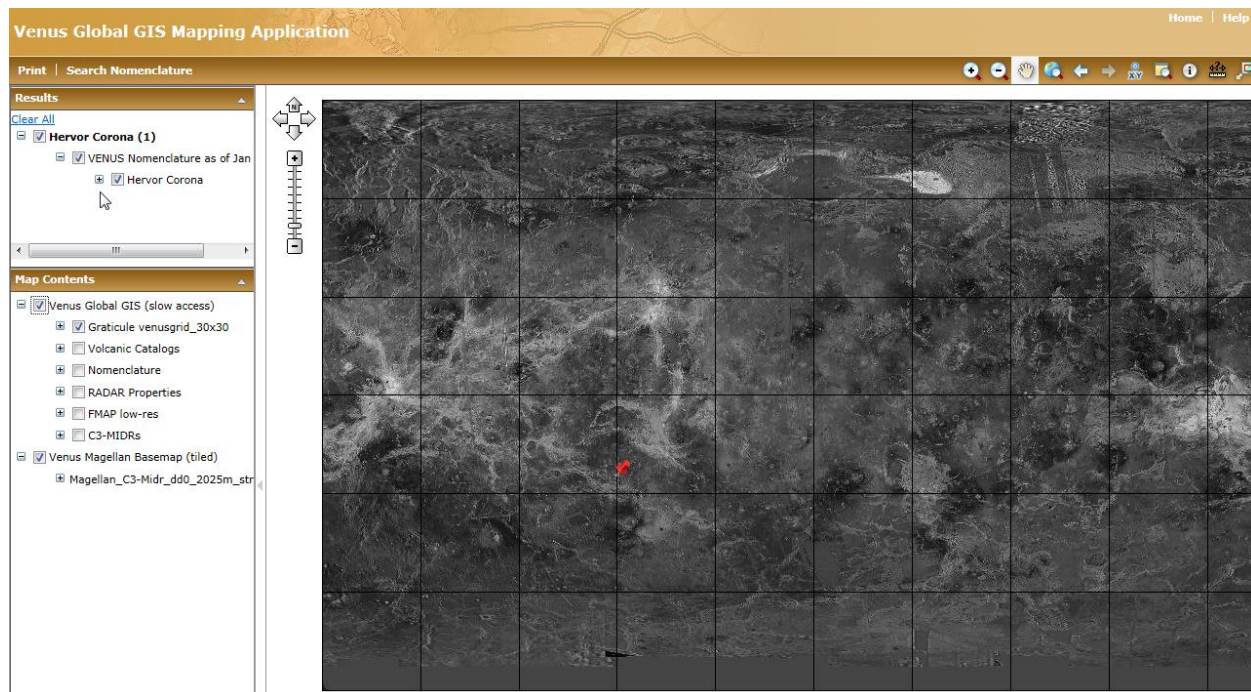
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VENUS: A GUIDED TOUR LAB EXERCISE

STARTING AND USING THE WEB SITE

The image below shows the opening screen of the USGS Venus web site.



FULL EXTENT VIEW

The website opens with the overall map of the surface of Venus. Brightness corresponds with radar reflectivity. This is a function of a number of factors, but surface roughness is the most important. Note that most of the surface of Venus is dominated by smooth (low reflectivity-and hence darker) rolling plains. Most of the bright areas are rougher highlands (In general, regions of higher elevation are more rugged.).

- Aphrodite Terra lies along the equator. This area is roughly the size of Africa and contains a collection of volcanic uplifts;
- Beta Regio, centered at about 282° W (-78°) longitude, 25° latitude is a broad crustal dome. There are two very large volcanoes found on this massif (Rhea Mons and Theia Mons).
- Phoebe Regio at about 280° W (-80°) longitude, -6° latitude. This is a region of thickened crust over a hotter than normal mantle.
- Alpha Regio at about 5° longitude, -25° latitude, is an irregular plateau, that has suffered extensive tectonic deformation creating some extremely complex terrain.

- e) Ishtar Terra at about 28 ° longitude, 70° latitude, is the second-largest and most elevated highland. It is near the polar region so unfortunately it appears very distorted when projected on this type of map (Mercator Projection).

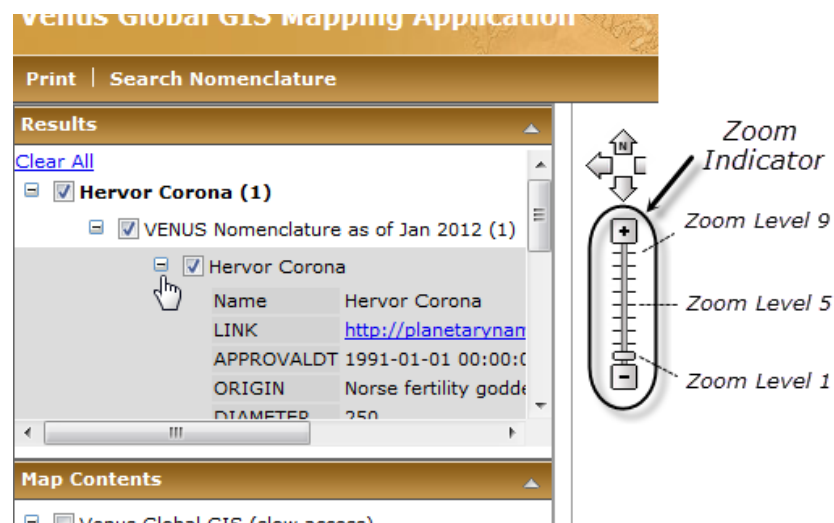
CORONAS:

Venus has an extensive history of volcanic activity and this history has left its signature over much of the surface. One type of volcanic feature found only on Venus is the **corona**. A typical corona is a plateau with a slumped interior surrounded by an annular moat and concentric faults. They are concentrated in the rolling plains of Venus and are often found in association with other volcanic features. It is believed that a corona forms when a “bubble” of hot rock (called a **diapir**) arises in the Venusian mantle. The diapir impinges on the underside of the crust, pushing the surface upward. Eventually the diapir cools and shrinks, allowing the surface to sag and fracture. Coronas are found in a number of different varieties. The basic circular coronas are called **Concentric**. We will look at some of the other types.

We will use Hervor Corona, to learn how to use the features of the website.

TWO IMPORTANT NOTES BEFORE USING THE WEBSITE:

1. The tools and features may function differently than described below depending on which web browser you are using. You may need to switch browsers to find the one that is most convenient to use.
 2. The website can “time-out” if there is a long pause in its use. You will need to close and restart the browser, then return to the website.
- Click on <Search Nomenclature> on the upper left of the screen. This will open a window where you can type in the name of a feature
 - Enter “Hervor Corona” and click <Find>
 - Under <Results> on the left side of the screen, the feature will be listed. If you click on + to the left of the name and information will be displayed.



1. Scroll down in the results window and record the following information for Hervor Corona.

Diameter: _____ km CENTER_LON: _____° CENTER_LAT: _____°

The location of Hervor Corona will appear as a red thumbtack on the global map. We can change the magnification or scale of the image to get a more detailed view.

- In the upper right of the website, there are icons to change the zoom level of the view. The icon labeled “Full Extent” will automatically set the zoom to the lowest level to view the entire surface. There is also a tool to measure locations and distance.
 - Select <Zoom In>. Now if you click on the map will zoom in by one level at the cursor’s location. Move the cursor to the thumbtack and click several times to magnify the view.
 - Using <Zoom Out> will give you a less magnified view
 - Select <Pan> to click and drag the map in any direction if you need to center an object.



Zoom In



Zoom Out



Pan

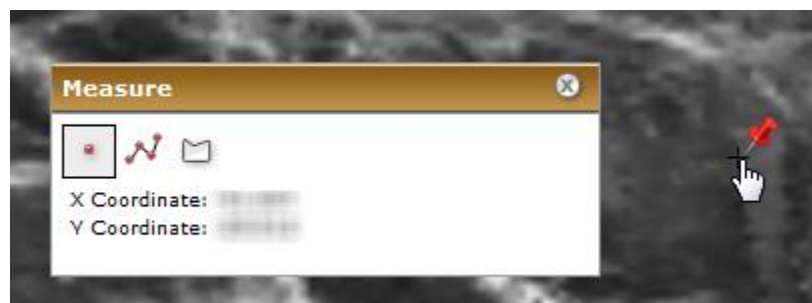


Full Extent



Measure

- Zoom in so that the Zoom Indicator is at level 8. If needed, use the <Pan> tool to get the red thumbtack near the center of the screen. Around the red thumbtack, you should see two circular rings, one inside another. This is Hervor Corona.
- Select the <Measure> tool from the upper right of the screen. A small window will appear with three icons. The left icon, “Point – Coordinates” will return the location of the cursor when we click on the map.
 - Select “Point – Coordinates”, move the cursor to the thumbtack and click. The X and Y coordinates will appear in the <Measure> window. Record the values below.

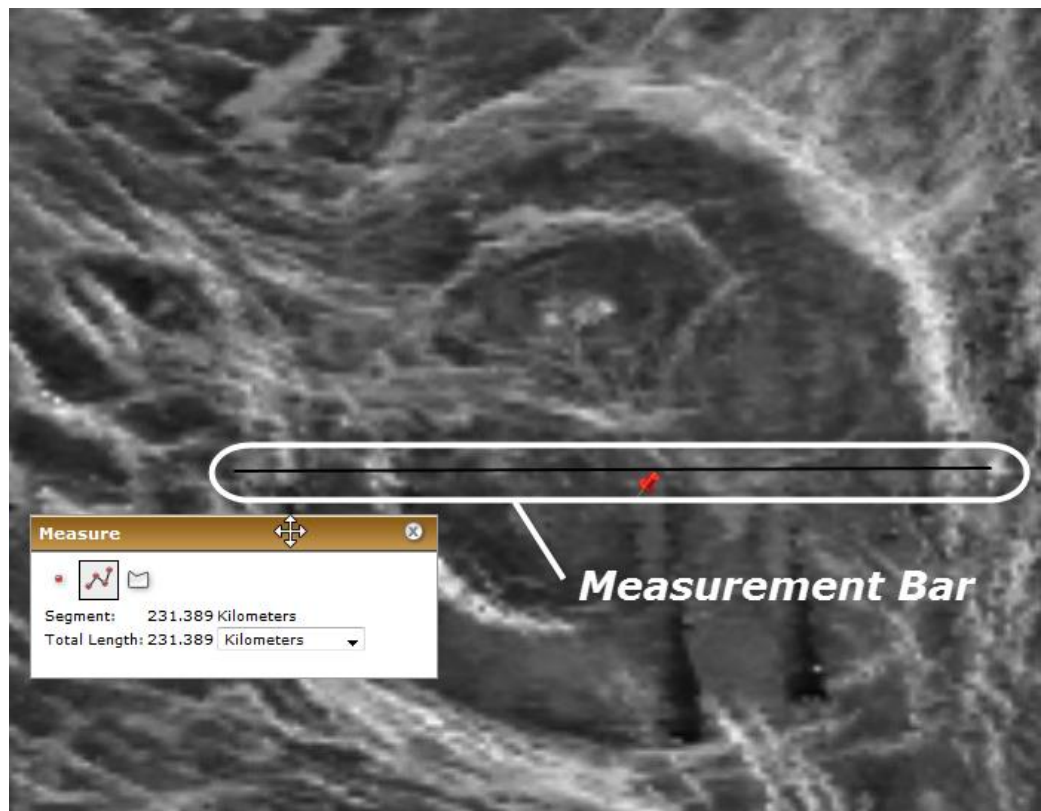


2. What are the coordinates that appear: X Coordinate: _____ Y Coordinate: _____

IMPORTANT NOTE: The Y Coordinate should correspond with the CENTER_LAT that you recorded above. However, the X Coordinate may not correspond to CENTER_LON. In the <Measure>” window, the x coordinates are positive for locations east of the map center and negative for west of center. This is **different** than the Longitude measurements in the Results window. If the X coordinate is negative, add 360°. Now it should match the value for

CENTER_LON. Verify this for yourself. If the X Coordinate is positive, no adjustment is needed; the coordinates should match.

- In the “Measure” Window, click on the center icon, “Line – Distance”, to measure distances and sizes on the screen.
 - Move the cursor to the left side of the outer ring and click to start the distance measurement.
 - Now as you move the cursor around, there is a black line that connects the cursor to that first point.
 - Move the cursor to the right side of the outer ring so that the black line is horizontal across the corona. Double-click to end the line. The length of the line will be displayed in the “Measure” window. Change the length value to kilometers. In this lab, we will use kilometers for all distances.



NOTE: The distance measurement from the “Measure” tool (in this case, 231 km) may not be identical to the diameter listed in the results window (250 km). The “Measure” tool relies on the exact placement of the cursor on the image and requires some judgment. The numbers may not be identical, but they should be similar.

3. Using the “Line-Distance”, measure the diameter in km of the inner ring of Hervor Corona.

Total Length of inner ring: _____ km

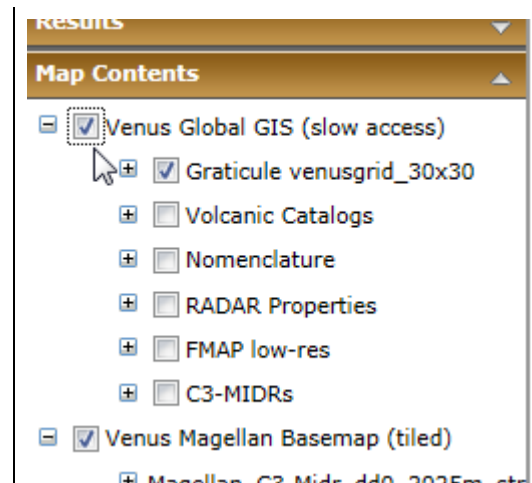
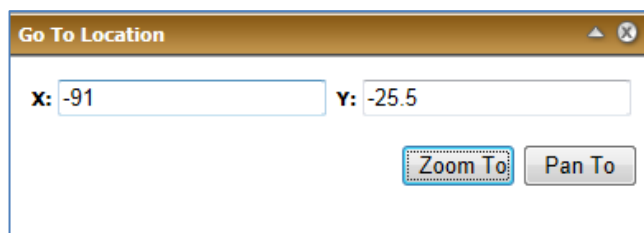
4. An example of a **Radial-Concentric** corona is Selu Corona. The radial concentric type have intense fracturing that radiates from the center of the corona along with the typical circular fracture pattern.

- Click on <Full Extent> to return to view the entire surface. Use the <Search Nomenclature> and the <Measure> tool to find the X and Y Coordinates

Selu Corona: X Coordinate _____ Y Coordinate _____

NOTE: Using <Search Nomenclature> will add the results to a growing list in the Results window and red thumbtacks to the map. This list may become too large to use easily and the red thumbtacks may clutter up the map. There is an option to “Clear All” to remove the previous search results.

To show an object at specific coordinates, click on the “<Go To Location> icon, , in the upper right. The names of features can be turned on and off by clicking the check box next to “Venus Global GIS (slow access)”, then “Nomenclature” in the menu on the left side. Depending on the zoom level, if the display gets too crowded with names, it may be more convenient to keep the names off until needed



5. Another type of corona is the **Concentric-Double** corona. These are similar to the basic type of corona, **Concentric**, but they have two distinct annular ridges and/or moats instead of one. An example of a Concentric-Double Corona, can be found at X= - 83.9 and Y = -29.9.

- Enter these coordinates in the <Go To Location> window and click <Zoom To>. Keep zooming in until the zoom level is 8. Turn on “Nomenclature” (left menu) to display the name of the corona.

Name of corona: _____

6. There are also **Multiple Coronas** where two linked coronas are surrounded by rings of fractures. You can find an example of a multiple corona, at -139.5° longitude, -20.0° latitude. Set the Zoom level to 7 to show some of the surrounding region. Record the names of the side-by-side coronas

Names: _____.

Distance in km between the centers of the two coronas: _____ km.

7. Use either <Go To Location> or <Full Extent> + <Search Nomenclature> to find and identify the type of the following coronas (Concentric, Radial-Concentric, Double-Concentric, or Multiple)

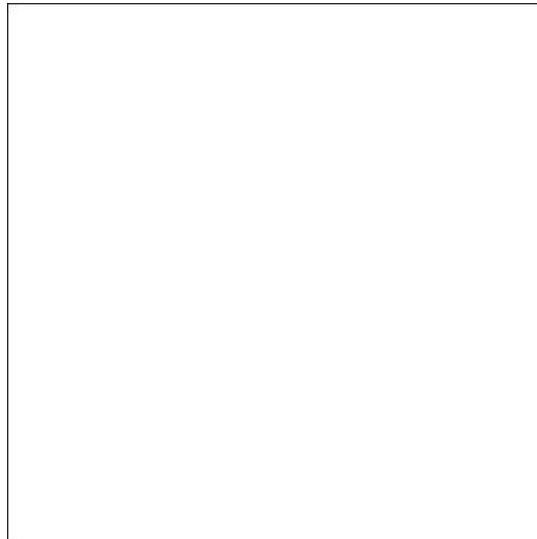
a. At X= -157, Y= 49, Name: _____ Type: _____

b. At X= 46.9, Y= -8.5, Name: _____ Type: _____

c. Otygen Corona: Location: _____ Type: _____

d. Ituana Corona: Location: _____ Type: _____

8. Click <Full Extent>, then use <Search Nomenclature> for Tamfana Corona. Magnify the view to a zoom level of 8. In the space below, sketch Tamfana corona. Make your sketch large enough that the ring structure fits in the box below.



If needed, click on “Clear All” in the Results Window.

VOLCANOES

Volcanoes are also common on Venus. Most large shield volcanoes are located neither in the lowlands, nor in the few highland regions. These volcanoes are clustered in intermediate regions possibly located over closely spaced hotspots under the crust where crustal failure was frequent. An example is Irnini Mons found near a smaller highland called Eistla Regio.

9. Click <Full Extent> and go to <Search Nomenclature>, find Irnini Mons and records its location.

Coordinates: _____.

Set Zoom to level 7 or 8 to get a detailed view. This is an example of a “**shield-type**” **volcano**. These volcanoes are much broader than their height. Seen from the side, they present an outline rather similar to that of the shield of an ancient warrior lying on the ground. Shield volcanoes are also found on the Earth. The island of Hawaii is one of them. The summit caldera of Irnini Mons is 200 km across-making it one of the largest such calderas on the planet. Note the concentric ring of fractures surrounding the caldera. Look to the southwest in the same view to see another large volcano called Anala. Note the bright volcanic flows that reach from Irnini Mons to Anala Mons.

10. Use the <Measure> tool to estimate in km how far these volcanic flows extend southward from Irnini Mons.
11. View the volcano Maat Mons, at -165.4, 0.5, with a zoom level 6. There are bright smooth lava flows to N, NW, W. How far in km does the lava flow to the west extend?
12. Similarly, look at Sif Mons, at -7.6, 22.0, and measure the length in km of the bright lava flows to the north.

For comparison, on Earth, the length of the longest lava flow from Hawaii’s Mauna Loa is 51 km. The longest lava flows found in Iceland and Australia are 150 – 160 km.

13. Click <Full Extent> and go to <Search Nomenclature> to find Theia Mons, the largest volcano on Venus. It is one of two large volcanos in Beta Regio. Record its location.

Coordinates: _____.

The lava flows from Theia Mons can extend for up to 1000 km from the volcano. You can change the zoom level to 5 or 6. At this scale we can see that Theia Mons lies at the intersection of three major rifts: one extends northeast, another to the south and a third to the southwest

14. Is it surprising to find a major volcano in the middle of a major rift zone? Explain why or why not.

Use the <Pan> tool and follow the northerly rift. The rift cuts deep though another volcano called Rhea Mons. You can turn on names with “Nomenclature” on the left menu to verify where Rhea Mons is. The volcano is the lighter shaded region that extends to both sides of the rift zone.

15. Use the principle of superposition, to determine if the volcano or the rift is the younger feature. Explain your reasoning.

Change the zoom to level 7. On the north and north-west flank of Rhea Mons, the surface has a very rough, wrinkled appearance. This is an example of a **complex, ridged terrain (CRT)** or **tesserae**. These are the oldest, most tectonically complex surfaces on Venus. The tesserae may represent blocks of thickened crust that has been stressed by deformation. This terrain contains an intricate, dense accumulation of interlocking grooves and ridges.

16. To view a different example, use the <Go to Location> tool to look at 76.8 longitude, 42.6 latitude. Turn on names with “Nomenclature” on left menu to find the name of this area.

Name: _____

17. Use the <Pan> tool to pan north to another bright CRT or Tessera. What is its name?

Name: _____

18. Click <Full Extent> and use <Search Nomenclature> to find Ozza Mons near the western edge of the global map. This is a large volcano in which a huge rift originates that runs to the northwest. It is a complex rift with many intercepting fractures. The rift lies atop Atla Regio - a huge series of broad crustal rises. Record the location.

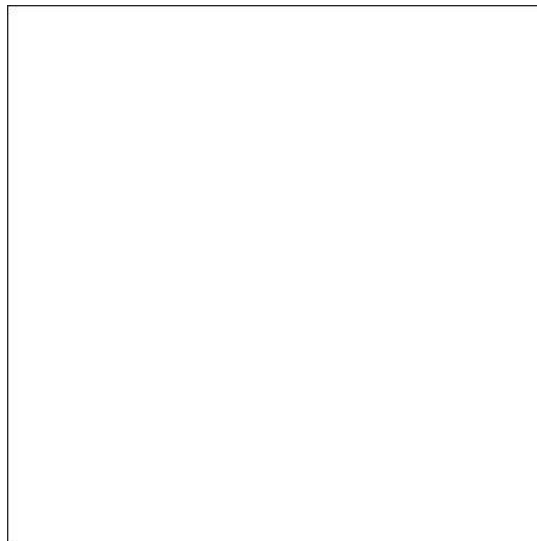
Coordinates: _____.

19. Set the zoom to level 4. You can see how far the northwest rift extends from the mountain. Use the <Measure> tool to determine the approximate length and width in km of the rift that originate at Ozza Mons.

Length: _____ km

Width: _____ km

20. Go to -159.1° longitude, -9.5° latitude to find a small, “**anemone-type**” volcano. Zoom all the way to level 9. Note the petal-like lava flows from this volcano. Sketch this volcano in the space below.



21. Use the <Measure> tool to estimate the diameter in km of this volcano.

If needed, click on “Clear All” in the Results Window.

CRATERS

In one respect, the surface of Venus is similar to Earth’s surface in that there are very few impact craters, unlike what is found on the Moon or Mercury. The dense Venusian atmosphere influences the size of craters. The atmosphere “burns up” small meteors, so only larger objects, producing larger craters, reach the surface. The atmosphere also has other effects on impacts. Impacting bodies are often disrupted. Shock waves associated with meteors modify craters and winds created by impacts will scatter debris and scour the surface.

22. Find Mead with <Full Extent> & <Search Nomenclature>. The search result may list several features and several thumbtacks will appear. In the results list (left menu), scroll down until you find “Mead”. You can click on the check box next to “Mead” repeatedly to make the thumbtack appear and reappear (flash on and off). As you zoom in, this will help you locate the crater. Alternately, while increasing the zoom, turn on names with “Nomenclature” (left menu) to identify the crater. Record its coordinates:

Coordinates: _____.

This is the largest crater on Venus. Note its double-ringed structure. Large impact features on the Moon (Mare Orientale) and Mercury (Caloris basin) show a similar multi-ring structure. Find the diameter in km of the outer ring:

Diameter: _____ km

23. Find Seymour, a medium-sized crater situated on the plains east of Beta Regio. Use the <Measure> tool to determine Seymour’s diameter. What is the diameter in km of Seymour?

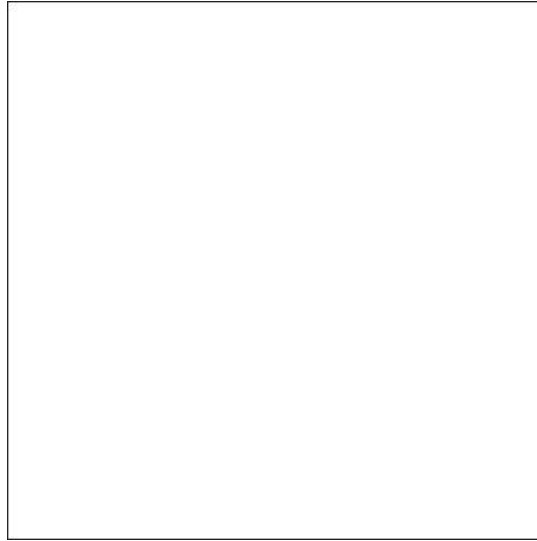
Diameter: _____ km

Note the bright lobes north and northeast of the crater. Much of this material was deposited by “recovery winds” - air rushing to fill the vacuum created as the meteor passed through the atmosphere.

Next, find the medium-sized crater Danilova. Note this crater’s **central peak**. It is similar to peaks seen in lunar craters of comparable size (~50-60 km).

24. What are the names of nearby craters? What types of craters are they? (The basic types of craters are: bowl, central peak, or flat floored)

25. Pan to the east to find Carson crater. Note the dark “parabola” of material east of the crater. This material is possibly ejecta carried by high-altitude winds. Sketch Carson and the area within approximately 100-km of the crater.



Venus has an atmosphere with ambient winds that can affect the terrain around craters and other elevated features over long periods of time.

26. Find the crater Adivar. This crater shows a prominent wind streak - material in the turbulent airflow downstream from an elevated feature. What direction are the prevailing winds in this region? Explain your reasoning.
27. Find the crater Balch and zoom in. This crater has been cut by a rift valley (near Rhea Mons). Use the principle of superposition with the crater and rift valley to determine which is the older feature and which is the younger feature. Explain your reasoning.

SUMMMARY

28. How is the volcanic and tectonic activity on Venus different from Earth?
29. Give some reasons why.