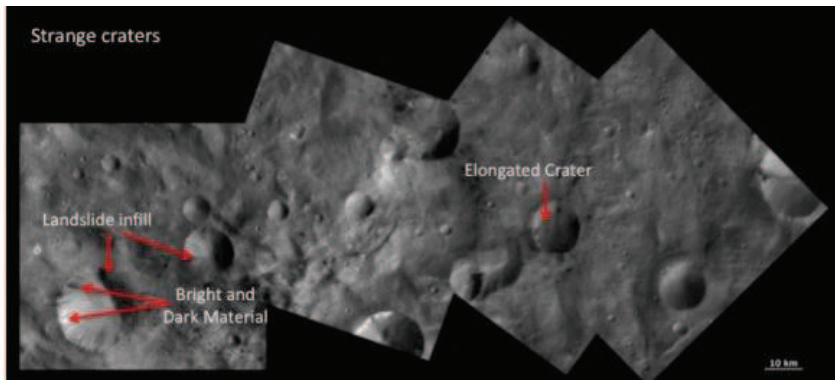


7. “Turn Markings Off” will make your markings go invisible so you can see the underlying image again. This is useful if you think there may be a feature under something you’ve already marked. When clicked, this will change to “Turn Markings On” to return to the previous state.
8. These are extra options that we ask you to choose before clicking the “Done Working” button for that image. Check “Odd Features” if there is something odd in the field that you have not already marked. Check the “Bad Image” box if the image is grainy, black, distorted, or has some other problem with it. That way we can remove it.
9. Once you’re done marking everything in the image, click this button to save your work and move on to the next one!



[http://cosmoquest.org/projects/vesta\\_mappers/](http://cosmoquest.org/projects/vesta_mappers/)

## Asteroid Science

### Meet Vesta

There are many asteroids, small rocky bodies that orbit the Sun, in our Solar System. Roughly the length of the state of Arizona, Vesta is one of the largest! The age of Vesta’s surface is really important to know, because it was probably one of the very first objects to fully form in the solar system. Vesta finished forming before the bigger planets so it’s probably recorded more history than any of these bodies. Vesta is located in the asteroid belt between Mars and Jupiter.

### Figuring Out Vesta’s Surface History

Why do we care about craters? Craters can tell us a lot about what’s happening on a planetary surface. One of the main uses of craters is to tell ages. On the moon, we have a chronology that tells us that a surface that has a certain number of craters of a certain size will be a specific age. The basic idea is that if a surface has been around longer (it’s older), it will have accumulated more craters.

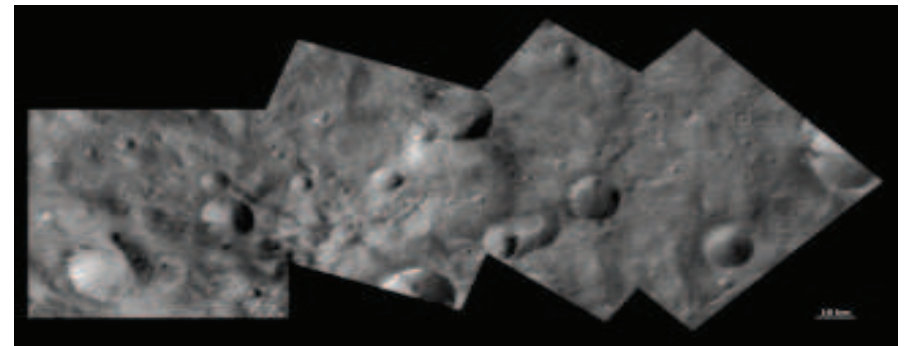
As it turns out, it’s not only the age of a planetary surface but also where you are in the solar system that can affect how many craters you accumulate. For a very long time, we only had the Earth and the Moon to look at to get information about what the early solar system looked like, but that was for our own cosmic neighborhood. The asteroid belt was a very different place, with more objects of varying sizes, so Vesta may have a totally different cratering history from other planets.

### Vesta’s Geology

We all expected to find craters on Vesta, and in particular the giant south polar impact basin, now called Rheasilvia, that was initially detected by Hubble Space Telescope data. But it turns out Vesta had a few things up her sleeve (See image right).



Vesta has a really thick “regolith”—the upper layer of its crust—probably from being pulverized in the asteroid belt for 4.5 billion years. All of that regolith is basically layer upon layer of impact ejecta, and there are places where these layers can be seen, and where their existence changes how the surface behaves. It’s been surprising to find so many features that show evidence for “mass wasting,” essentially land slides and other evidence for materials moving across the surface probably due to shaking by impacts and gravity (See image below).



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### Asteroid Science (continued)

Few people expected to see tectonics—all those ridges and fractures criss-crossing and encircling Vesta. Vesta doesn't have plate tectonics like Earth, Vesta's tectonic features are almost certainly associated with the giant impact events. While Vesta is much like the planets in many ways, for example that it differentiated to form a core, mantle and crust, its tectonic history is one of those places where Vesta acts like an asteroid (See image, bottom left).

Vesta has pit chains on its surface that look very similar to crater chains, but these are actually places where the thick regolith layer has been laid down over tectonic features, and then fallen in! (See image, bottom right).



How and when all these features formed on Vesta is difficult to understand without a lot of context... *that's where mapping comes in!* In a geologic map, scientists essentially trace out the different features, so that it's easier to tell which one lay on top of or below other features. Then, we can determine the stratigraphy, essentially the layered history of the surface, and reconstruct Vesta's past.

Thanks to the Dawn Mission (launched in 2007), a suite of instruments sent to gather data from various space objects, The Asteroid Mappers project can now use the visible light images to research the surface of Vesta. With so much data collected, scientists will need years to process the information. This is where you, our citizen scientists, come in!

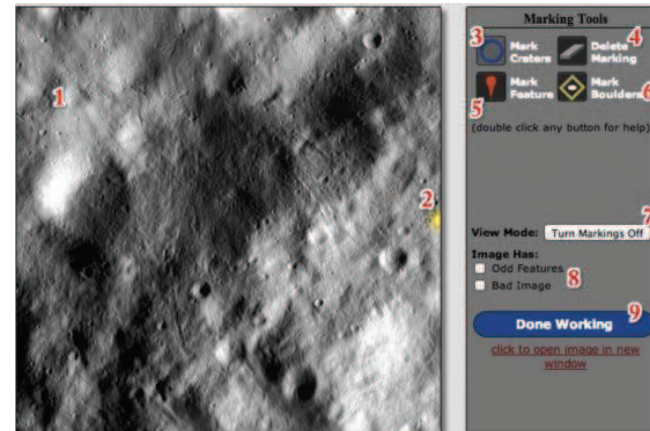
In the coming months, new tools and projects will be added to teach you how to become a geologic mapper (well, a simplified version of the real deal, since actually, it's an art form) and to give scientists an idea of where to go with future citizen science. We are looking forward to figuring out just how good you are!

[http://cosmoquest.org/projects/vesta\\_mappers/](http://cosmoquest.org/projects/vesta_mappers/)

### Asteroid Mappers Tutorial

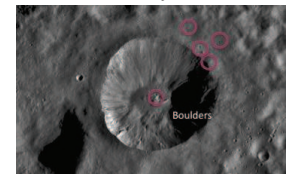
Directions:

1. Once on the 'Asteroid Mappers' page, [http://cosmoquest.org/projects/vesta\\_mappers/](http://cosmoquest.org/projects/vesta_mappers/), click 'Get Started!' in the 'Simply Craters' box.
2. Type in the following information:  
**Username: FredThePenguin**      **Password: ilovecraters**
3. Using the tools on the left hand side of the screen, mark craters and flag interesting images for followup to map the history of Vesta!
4. Once you have marked all that you can, click 'Done Working.' This will save your data and will give you a new picture of Vesta to analyze!



The previous image is what you will be presented with during the main tasks for Vesta Mappers. The numbers below refer to the numbers in the image.

1. This is an image taken of the surface of Vesta. It is what we want you to map out for us. Some images have a black edge, as shown here, and that is okay.
2. This yellow marker indicates the direction from which sunlight is coming.
3. This is probably the tool you'll use the most because it lets you mark craters. When this screen grab was taken, that was the tool that was selected, indicated by the light background. To use the Mark Craters tool, select it, and then draw on the image. Start at the center of a crater you want to mark, hold the mouse button down, and drag until you reach the edge of the crater. If the crater is smaller than our minimum size, the crater you draw will remain red and will disappear when you release the mouse button. If it's big enough to be counted, it will turn green.
4. "Delete Marking" does what it sounds like — if you have this tool selected, move your mouse over the feature you have marked, click, and you will erase it.
5. Mark Feature lets you put down a flag on the image in the location of a feature that you think is particularly interesting and allows you to choose from a menu of possibilities.
6. Mark Boulders allows you to mark large rocks or boulders on the surface. See the image below for an example, pointed out with a yellow arrow. You can tell a boulder from a crater by the orientation of the shadows as they are reversed from those of the craters. (The light/dark are left/right for craters in this image, whereas boulders and other raised surfaces are right/left.



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