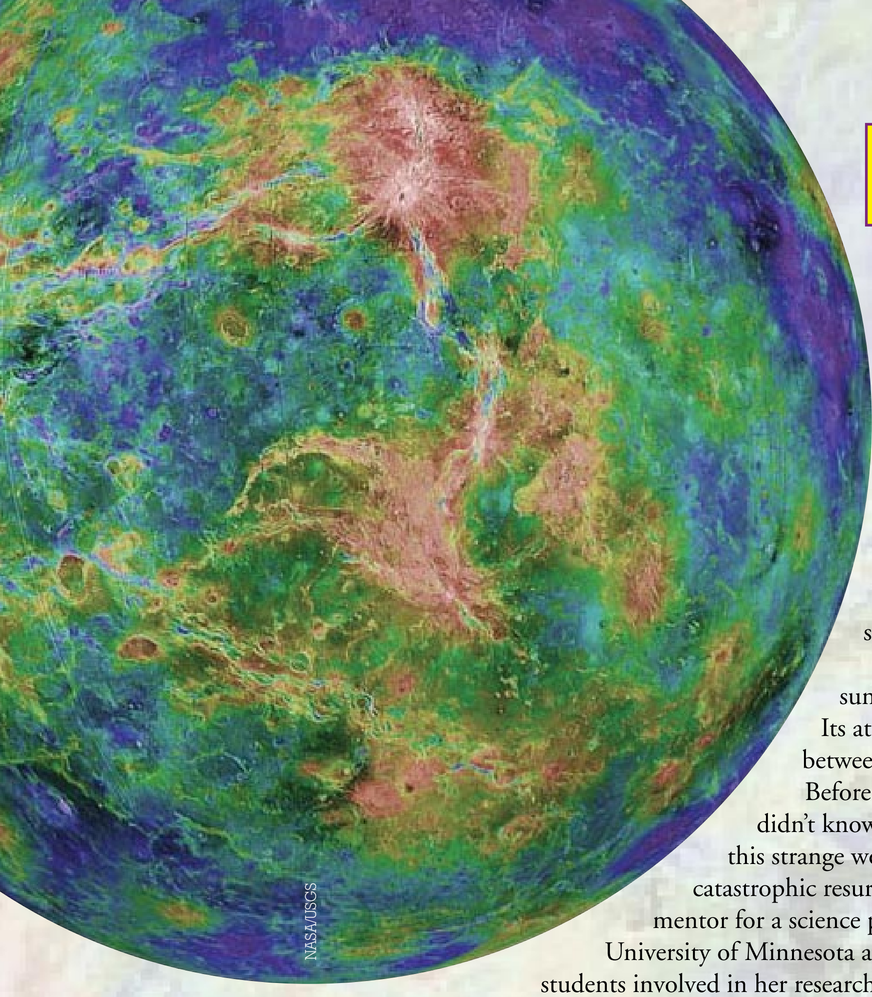

False-color composite image of Venus, coded for elevation (red high, blue low).

MAPPING VENUS

by Courtney Jackson

Venus has been called Earth's Twin. It's the planet closest to Earth not only in proximity but in size, mass, chemical composition, and distance from the sun. It was probably "born" about the same time as Earth. But that is where the similarities end.

Venus's dense atmosphere—almost pure carbon dioxide—traps the sun's energy, creating a surface temperature hot enough to melt lead. Its atmosphere holds heat so well that there is no temperature difference between day and night—even though a day on Venus lasts 243 Earth days!

Before last year, I had heard about Venus' hothouse atmosphere, but I didn't know much about the planet itself. I might never have learned about this strange world of wrinkle ridges and pancake domes, of vast lava flows and catastrophic resurfacing, if I hadn't asked my science teacher for help finding a mentor for a science project. Luckily for me, she knew a planetary scientist at the nearby University of Minnesota at Duluth, Professor Vicki Hansen, who was interested in getting students involved in her research: mapping Venus.

Mysterious Planet

Even though Venus is our nearest planetary neighbor, its thick cloud cover concealed the planet's surface from view until recently. In August 1990, the NASA probe Magellan became the first spacecraft to obtain detailed photographs of the surface of Venus. Using a special kind of radar, Magellan spent four years photographing nearly the entire surface of the planet in high resolution, revealing a surface quite different from Earth's.

There are, of course, no oceans on Venus. Any water on the planet evaporated long ago. Its surface is covered by volcanic material, with vast lava plains and thousands of volcanoes. On Earth, volcanoes and lava flows occur in organized, global-scale features (mountain ranges, deep sea ridges) that mark edges of Earth's tectonic plates. On Venus, there are thousands of volcanic structures, but there is no grand organization of these features indicating tectonic plates. Instead, the entire surface of the planet seems to be a single plate.

The planet's surface is also peppered by impact craters. Their near-random spatial distribution suggests that the entire surface of the planet is of a similar age, unlike Earth, which has distinct regions of older and younger crust (the continents and the ocean floors, respectively).

This brings us to the great, unsolved mystery of Venus. How can the entire surface of a volcanic planet be the same age? Phrases like "catastrophic resurfacing" and the planet's interior "boiling over" have been used, but how would such geological events actually occur?

Planetary scientists strive to understand "how a planet works"—the forces and processes acting within, on, and outside a planet to shape its evolution. Venus presents a fascinating challenge to planetary scientists because, despite its similarity to Earth, it clearly works differently from Earth.

By using Magellan data and planetary modeling, Professor Hansen and other planetary scientists hope to find out why.

My Own Piece of the Puzzle

Professor Hansen suggested that I analyze a small area of the planet to identify the geological structures within it and see what I could infer about its history. To do this, I would use Magellan radar and altimetry data to create a *geologic map*, which is different from a topographic map.

A topographic map displays altitude information, but it does not translate that information into geological terms.

Is a circular depression an impact crater, a dry lake bed, or a sink hole? Each of those geomorphic structures would say something different about the history of the area. It takes a trained eye to view the data and make those distinctions. A crucial step in analyzing an area's geologic history is therefore to construct a geologic map, on which someone has carefully identified and labeled the geomorphic features and the contact relationships between adjacent areas.

That is what I did on my little patch of Venus. I spent a week in Professor Hansen's lab learning the basics of using Magellan data and geologic mapping. The Magellan data can be imported for viewing with Adobe Illustrator CS2, making it fairly accessible to anyone who would like to use it. I then spent months mapping features such as fractures, impact craters, and volcanoes, as well as different terrain "textures" like tessera (areas that look like mosaic chips) and wrinkle ridges (where the crust had contracted and wrinkled). Using a computer workstation at school, I viewed the radar images on a writable monitor and used an electronic pen to mark features of interest on the image. I saved a map of each type of feature in a separate file, then used Adobe Illustrator to overlay these files to create a composite geologic map of the area.

In addition to identifying the geomorphic structures in the map area, one of my goals was to deduce the overall geologic history of the area, that is, the relative times when various features formed. For many of the features, this was possible to do; for example, where fractures or ridges cut across another feature, or where a landslide or a volcano covered over a feature, it was clear which was the younger feature. But where features did not impinge on one another or a common feature, there was not enough information to infer a relative sequence of events. With this research, I contributed a small piece to the giant puzzle of how Venus works.

Sharing the Excitement

One of the best things about doing this project was going to science fairs and talking to people about it. Many students were amazed to learn that a high school student could work with this kind of data.

My success in our regional science fair enabled me to attend the 2008 National American Indian Science & Engineering Fair in Albuquerque, which was an amazing experience. I was thrilled to win the NASA Space Exploration Award, the highest award NASA gave at that fair. I got to meet the NASA scientist who was there to give out the award. He told me how happy he was that it had been won by someone who had actually used NASA data.

In May, I attended the 2008 Intel International Science & Engineering Fair (ISEF) in Atlanta and met many more really inspiring and amazing people. The diversity of projects just within the earth science category was astonishing. I learned so much talking with the other earth science contestants, let alone the people who had done projects in other fields. At ISEF, I received awards from the Air Force and the Society of Exploration in Geophysics, but the biggest reward was just being there.

The hours I spent poring over maps of Venus taught me that planetary geology involves very careful, detailed data analysis. It also requires imagination—an ability to look at unfamiliar landscapes and open your mind to ideas about how they came to exist. Every planet and moon that planetary scientists have studied has challenged ideas about how planets work, forcing scientists to move beyond the familiar and come up with novel ideas that may at first seem outlandish, but that seem to happen on another world. As scientists continue to study planets and moons in our own solar system and discover strange planets outside our solar system, it will be thrilling to see what new challenges they pose to our imaginations. **i**

Courtney Jackson is a sophomore at Cloquet High School in Cloquet, MN. She completed this project last year, when she was a freshman. In addition to mapping planets, Courtney enjoys soccer, playing the cello, reading, and singing.

Map-a-Planet

Want to analyze your own piece of another planet? You can! NASA created Map-a-Planet Explorer, an online mapping browser that allows you to explore images of the surface of a planet or moon, access information related to the area you're exploring, and order your own tailor-made map in a wide variety of image formats.

You can just download data and play with it. Or, if you'd like to contact a research group already underway, you can use the site to find out who's in charge of creating the official geologic map for a given planetary area and contact that scientist.

www.mapaplanet.org