Interview: Doug Griffith

Radar imaging our 'sister planet' Venus

Carl Osgood interviewed Magellan's Mission Director Doug Griffith on Dec. 27.

EIR: Could you describe the mission director's job?

Griffith: I'm in charge of all the work from the standpoint of monitoring the health and well-being of the spacecraft, seeing that it's got proper sequences to keep it operating, and taping data. That's quite an operation on Magellan to tape radar data, it turns out, and then there's an equally big job when the data come back to the ground. It's not like normal planetary missions which have had imaging-type cameras. The radar data go through three processing steps before you see any kind of an image at all. At that point, it's very long strip images that are later mosaiced into bigger images. We take enormous strips of data. We take strips of data that are about 20 kilometers wide by about 16,000 kilometers long. Now, that's the first kind of image data we get back; those then have to be mosaiced together to make into larger images that are not so long, what we call noodles. You can imagine, those are very, very small, long strips. It takes nearly 1,800 of those to make a complete revolution of Venus for coverage.

EIR: You're working with radar data, rather than photographic imaging data; therefore, if you look at a particular feature from two different angles, it gives you more detail, doesn't it?

Griffith: Yes, it does. As a matter of fact, one of the things that happens is you get a real difference in what the feature looks like, depending on the angle that you're looking at it. If you look at a surface facing you that's a steep slope, you get a high return from the radar, a lot of reflected energy coming back. Or if it's a very rough, or a flat surface, and has a very rough nature to it, that kind of thing, in that case, will end up not having a terrific radar return. Smooth surfaces have a lot of radar return, a lot of reflectivity. Now, if the surface is sloping away from you, it turns up very dark on the radar imagery. If it's sloped towards you, you see it in a sort of broadside; it's very reflective, and you get a lot of imagery back, and you get a lot of registration.

You've probably seen some of the 3-D movies that have appeared on television. You have shots where it looks like you're flying over a very regular surface, and you see bright-looking surfaces: Those bright-looking surfaces are the surfaces that the radar is looking directly at. If it's dark-looking, it's something that's away from the view of the radar. You can come back and look at it from the other angle and see that other surface.

EIR: I've seen this in some of the articles on some volcanoes that have been imaged, where certain ones are highly reflective, and at least one is very dark.

Griffith: Well, it turns out that many, many of the high-structure volcanoes have high reflectivity around the peaks of them. That means there's some kind of chemical process going on within the atmosphere that changes the nature of the surface material to make it very reflective, after it's "weathered." Of course, the weather varies at low altitude, and it's a highly corrosive atmosphere, like sulfuric acid, and that increases what they call the dielectric constant, so you get a lot of reflectivity.

Now, there's one volcano called Maat Mons where the peak appears very dark, which would indicate that it's erupted in the fairly recent time period. Now, "recent" may be a few years or a few million years. It's hard to tell, and there is a lot of speculation as to how fast this weathering process takes place on the volcano since the last time it erupted. It's very obvious that there has been a lot of volcanic activity on the surface of Venus.

EIR: Is there any current volcanic activity?

Griffith: I don't believe that we have found any direct evidence that anything's happened in the last year, because we're just about to finish the second rotation of Venus, and one rotation takes 243 Earth days, but in that time frame, we don't yet believe we've seen anything that indicates there is something that actually changed—an eruption, a landslide or some kind of feature like that.

A few months ago, they thought they saw a feature that looked like a landslide. They're reasonably certain that it was an artifact of interpretation of the radar data, because we're looking at it at two different angles: We're comparing a right looking with a left looking, where you look at it at different directions; you get what they call a "layover effect" in the radar image, where it sort of doubles back on itself, and it gave them a false interpretation of something that looked like a real feature change on the surface. I think everybody expects to see something, but how much will you see?

The geologic processes make the changes on the order of tens of thousands of years, which is sort of a flashback in time in geologic terms. That's very recent. So, starting to look for things on a one-year basis, that's just like an instant of time, and there would have to have been some kind of very significant eruption process, like our volcanoes on Earth, for that to have happened. . . .

EIR: What about the structure of the crust?
Griffith: Oh, yes. Everybody's wondering: Are there real tectonic-type plates like we have on Earth, these plates that subduct one another, and rotate, and so forth? It's not clear whether there's much of that kind of plate structure on Venus, and that may be due to the fact that the planet's so hot and probably pliable, compared to what we think of our normal crustal surface; the surface temperature is something like 600°C. . . . There are definitely some really active zonal regions where there's more deformation, or stress activity happening, but you don't have a pattern such as in the Pacific Basin's Rim of Fire. . . . On Venus, the volcanoes seem to be fairly uniformly distributed. They don't occur in bands, like that.

EIR: So Venus doesn't have the same kind of continental structure?
Griffith: It doesn't look like it—not in the same sense that Earth does. But there are regions of highlands and lowlands that delineate what you might almost call an edge of an active region, or a crustal-type region or a plate-type region, but not quite the same thing. There's a very uniform distribution of volcanoes. There's a very uniform distribution of impact craters on Venus, from outside meteorites and asteroids that have struck the planet over the millions of years, and they're also very uniformly distributed all around. . . .

EIR: There's some speculation that renewal of the surface by volcanic activity is slower than on Earth.
Griffith: Yes, it is; it appears to be much slower. Of course, the only thing that's really renewing the surface on Venus is, by and large, volcanic activity, because there's no erosional process, such as water, even though Venus has some very fast high-altitude winds, about 200 kilometers per hour, which is quite fast.

In the surface winds, we see some very definite wind features which are starting to be of very much interest to the scientists, but they're not really highly destructive surface wind features. The winds are 2-3 kilometers per hour. They're not very fast, but we can see what you would call blowing sand, or particles, or streaks that indicate that there have been various surface winds. In addition, we've also found out that they have some of the same rotational effect that we have on Earth, where winds come down from the North and South poles toward the equator and then circulate up in the circulation cell—a Hadley cell. You see that in both the northern hemisphere and the southern hemisphere coming right up to the equator region.

EIR: What kind of effect do you think the atmospheric conditions have on the geologic processes?
Griffith: Very high winds on the surface and all that mass in the atmosphere would really move things, but the winds on the surface are so low nothing gets moved very much to any extent. Now, you do see plume effects from crater impacts, where they show an outward plume that indicates that material was thrown up into the atmosphere, and the winds in the atmosphere blow it downstream from the impact crater from a meteorite or an asteroid that hit the surface.

EIR: How does Venus compare with Earth, in other ways?
Griffith: The things that are alike on Earth and on Venus, and the things that are different, are very interesting. One thing they've found from the standpoint of gravity: You expect the gravity field to be higher in regions that have high altitudes, and where there's a lot of mass concentrated in it, and on Venus, it is; whereas, on Earth, it's just the opposite. On Earth, high mountains tend to have smaller gravity fields for some reason. The gravity field due to the distribution of mass on the planet follows your intuition more on Venus than it does on Earth. . . .

EIR: What are the plans for Magellan after the completion of the second mapping cycle on Jan. 15?
Griffith: After that, we have five more activities planned. We're in an elliptical orbit, right now, where the periapsis is about 250-270 kilometers and the apoapsis, the far point, is about 8,500 kilometers, and we're going to try to circularize the orbit with aerobraking: After cycle three, we're going to do one more cycle, where we'll concentrate on taking gravity data; late in cycle four and in the beginning of cycle five, we're going to lower the periapsis, where the spacecraft is actually dipping slightly into the upper atmosphere to get some drag, or aerobraking, That will gradually bring down the apoapsis altitude to about 300 or 400 kilometers and it'll be in a near-circular orbit. Then we can do some really detailed gravity studies of the planet. We'll also be able to get much higher-resolution data over the poles. The way our orbit goes right now, the periapsis is very close to the equator, so our highest-resolution data is around the equator and our lower-resolution data is around the North and South poles. If we can get it down to a near-circular orbit we can get higher-resolution data around the poles, as well as do some general high-resolution image studies.

One of the big payoffs is going to be in the gravity field. As we get closer to the planet, we will be getting a good gravity map of the planet. Then we're going to spend a couple of cycles getting both new gravity data and new, high-resolution imaging data, particularly over the North and South poles in the latter part of cycle five and in cycles six and seven.

So, we have a really good plan mapped out to carry us through about the summer of 1995. I think we will have accomplished most of the objectives we would like to from the scientific point of view.