

Southwest Arizona's Painted Rock Mountains

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ABSTRACT

The Painted Rock Mountains are located at the eastern edge of the Sentinel Peak Volcanic Field. They are a late Cretaceous/early Tertiary andesitic extrusive volcanic deposit. They are completely unrelated to the Sentinel Peak volcanism. Painted Rock Mountains debris forms distinctively colored alluvial fans as a result of chemical weathering on the rocks' exterior. Stream channels on those fans show up light in color. The extensive Native American rock art here was created taking advantage of this light/dark inside/outside dichotomy.

Subject headings: Painted Rock Mountains – alluvial fans – Titan connection – Native American art

1. INTRODUCTION

At the Space Cadet location marked (I think?) as 'gullies' in the southeast of the map (but north of the 8), orbital imagery shows light-colored water runoff channels in darker surrounding terrain. You can also see strange light-colored circles between the channels.

The entire area is located within the **Painted Rock Mountains**, a volcanic range totally unrelated to the Sentinel Peak volcanism. The dark color of the background rocks in the area is caused by **desert varnish**, a process by which the exterior layers of rocks darken with time. The gullies are located on rocky debris washed out of the mountains known as **alluvial fans**, a feature that Ralph thinks he sees in Cassini RADAR images of Titan. By selectively scraping desert varnish off of rocks, intelligent beings have left their mark on this area as **rock art**.

2. PAINTED ROCK MOUNTAINS

The Painted Rock Mountains are a relatively low (1511 ft max) and small mountain range extending north of the 8 on the eastern edge of the Sentinel Peak Volcanic Field centered at about 32.927°N113.0335°W. In LandSAT visible color images (Figure 1), this mountain range is distinct in color, different from the black neutrally colored lava flows of the Sentinel Peak Field.

The rocks that make up the Painted Rock Mountain range are andesitic in composition. Extrusive lavas behave very differently depending on how much silica (SiO₂) they contain, with viscosity rising with silica content. Basalts are very silica-poor. When extruded, they flow easily. Rhyolites are basically extruded granites; they're very silica-rich and extraordinarily viscous. Andesite is between the two.

The Painted Rock Mountain's andesites were erupted

about 70 million years ago, late in the Cretaceous to early in the Tertiary. I don't know if any K/T boundaries are preserved here, but I doubt it – the environment was likely erosional except for the lava deposition. The timing of the eruptions leads me to think that the Painted Rock volcanoes were part of the wave of volcanism that has swept west to east and back throughout the southwestern US since the Laramide Orogeny (Rocky Mountain building episode starting maybe 80 Myr ago).

The present location and extent of the Painted Rock range appears to me to be the result of basin and range extension. We're not still seeing the original mountains built up 70 million years ago, we're seeing rocks that were initially buried but have been brought up by basin and range and are now eroding. I'm guessing at a lot of this based on two sentences that I found in Roadside Geology of Arizona, so please correct me if you know better.

3. DESERT VARNISH

The rocks making up these mountains are naturally light in color. Not yet understood processes convert the outer few millimeters of the rock into a metal-rich dark coating known as desert varnish. The process could be either chemical or biological, or maybe a combination of the two. It seems to require both water in the form of rainfall and high evaporation rates (hence it is confined to deserts). Areas under overhangs on cliffs that don't receive water don't get desert varnished, or don't get converted as quickly.

Many species of bacteria and fungus are present on desert varnishes, or at least lots of things grow when you take a cotton swab, rub it on desert varnish, and then rub it into a petri dish. The varnishes themselves do contain biological proteins (they're the same handedness as those produced by Earth life). However, it's not yet clear whether

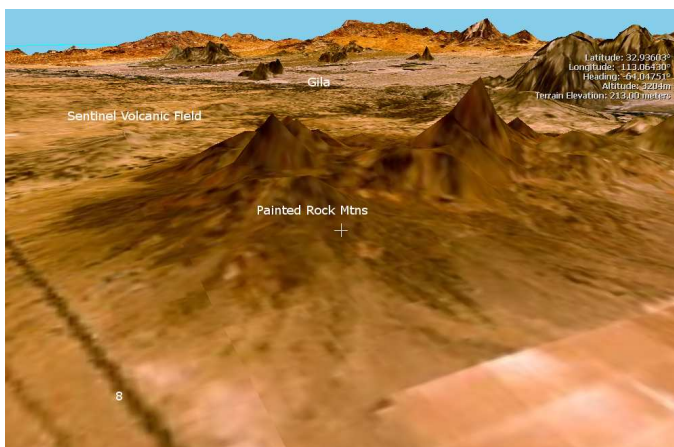


Fig. 1.— Painted Rock Mountains, looking west from a point above the agricultural fields. 7x vertical exaggeration.



Fig. 2.— Painted Rock from the Painted Rock Mountains. The desert varnish coating is only a few mm thick.

those proteins are incorporated into the varnish accidentally or whether the single-celled organisms living on the rocks actually help to form the varnish.

Some rocks at the Mars Pathfinder landing site show evidence of "desert varnish-like coatings" (Murchie et al. 2004 LPSC abstract). Murchie et al. conclude that these must have formed during Mars' wetter past, and are now being eroded away to different degrees by aeolian processes (dustblasting).

See Perry & Kolb scientific article "Biological and Organic Constituents of Desert Varnish: Review and New Hypotheses" for more details.

4. ALLUVIAL FANS

During the monsoon season, the dark rocks of the Painted Rock Mountains get washed into mountain gullies and washes. When these washes exit the edge of the mountains, the water they carry slows down and dumps out rocks from the mountains into the surrounding terrain. Over time this process results in lobate, sloped, rocky areas of quite large extent that now surround the mountains. The Space Cadets' gullies exist within these alluvial fans.

Alluvial fans have developed a surprising new planetary connection. Cassini RADAR images (Figure 3) show what may be rocky (light in the radar image) areas that seem to have been deposited by a possible stream. Until VIMS and ISS get to look at this same area its difficult to be sure, but this might indicate bulk transport of material from the light colored highlands into the darker lowlands by fluvial processes.

5. ROCK ART

Striking and improbable erosion patterns on some rocks in this area have led some to speculate that the markings might be artificial in origin. They have invoked a species of intelligent beings inhabiting the area we are now in.

If there were such beings, they almost certainly have died out by now. As anyone following the news can tell you, there are no reliable signs of intelligent life on Earth.



Fig. 3.— Possible alluvial fan on Titan. From RADAR, so be careful in interpreting.

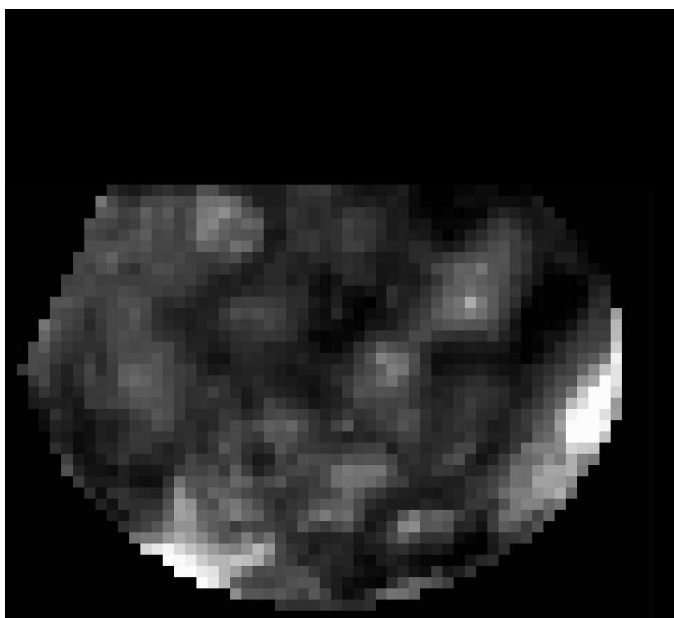


Fig. 4.— Orthographically projected view of Pioneer Venus altimetry data for Venus, same geometry as IR view below. Pretty unrelated, but I think that it is the planetary connection for some of the Space Cadets' weather data.

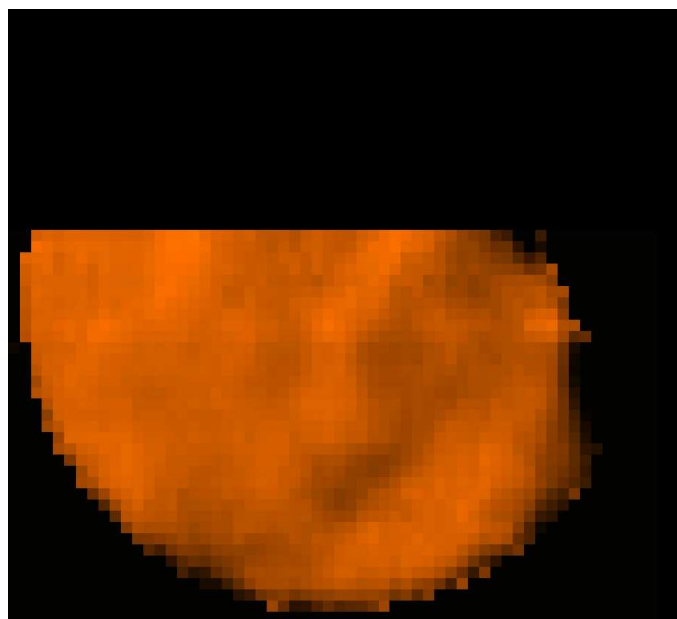


Fig. 5.— Near IR ($1.18\mu\text{m}$) view of Venus' nightside taken April 28, 1993 at the AAT 4m near Coonabarabran, Australia by my former boss at JPL, Vikki Meadows. The cloud contribution has been subtracted off by hand (by an undergrad with the time for such manual image processing: me). High areas are cold, and therefore dark in the IR view. You can see the tentacles of Aphrodite Terra peeking over the limb at bottom left, and Maxwell Montes lost in crescent-subtracted light at the bottom right.