

On the Origins of the Main Features of the Geology of Mars

Abstract

This article will discuss the surface geology of Mars as a result of two significant events which results in many of the major surface features of Mars. The two major events are impacts on the surface of Mars. The result of these impacts create impact basins ejecta fields. The impacts also create the highest areas on Mars, the Highlands of Mars. The impacts created the volcanoes on Mars. The impacts created the fractures and flows that are seen in the southern hemisphere of Mars. In this model the southern hemisphere of Mars with the many impact craters on it, is the youngest surface on Mars the oldest surface on Mars will be the low lands in the northern hemisphere.

Introduction

The geological history of Mars is of great interest to humans since it affects the potential for life on mars. Recent exploration and mapping of mars is shedding new light on the geological history of mars. These new maps of Mars are providing new information to consider for the surface geological history of Mars. Elevation maps of Mars and surface exploration is providing new clues to the history of Mars. This paper will propose one model to explain the major surface features on Mars except for the northern low lands. The northern low lands will be the holders surface on Mars. The northern low lands will not be described in this article. The features of the southern hemisphere will be described in this article has the result of two impacts and the resulting changes they created.

Impact Model

Figure 1 shows the elevation of the surface of Mars in color-coded format. Each image in this figure is 90° apart. White is the highest elevation, followed by red yellow green and blue being the lowest elevation. The biggest impact crater on Mars is the Hellas basin. This impact crater created the lowest surface area on Mars. Obviously the Hellas basis resulted from a very serious impact. A second impact basin at Argyre Planitia is another significant impact. A third significant impact site is located north of Tyrhena Terra. This is third impact site is the most obscured of three.

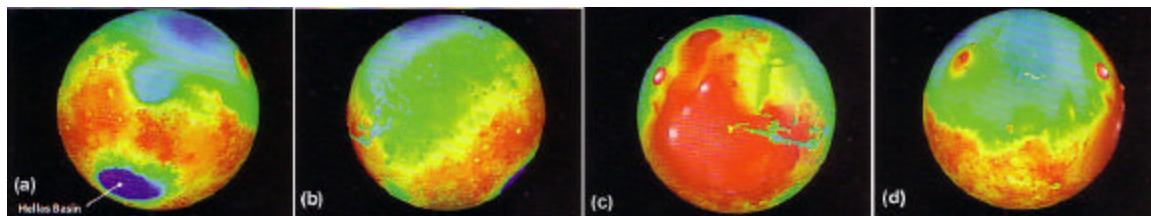


Figure 1. Elevation encoded Mars surface views. Each view is 90° apart. White followed by red are the highest elevations. Deep blue is the lowest elevation.

This model posits that the major features of the southern hemisphere are created primarily by the impact that created Hellas basin. Surrounding the Hellas basins in ring like fashion is higher elevation lands. This land also contains a ring of most of the minor impacts on the surface of Mars. Certainly we can see that this ring of higher elevation land, full of impact craters, is the rings of ejecta from the Hellas basin impact. We will see that the increase in elevation in this ring is primarily from uplift from the impact, while the impact craters are from the ejecta.

To create the lowest spot on Mars while also adding the mass of an asteroid, there has to be an increase of mass either in density or elevation.

The highest elevations on Mars are actually on the opposite side of Mars from the Hellas's impact basins. Figure 2 proposes the path that the impact asteroid could have taken to have created the highlands opposite the Hellas basins. This impact was so severe that created not only the lowest elevation on Mars, but also the highest. This impact penetrated so deeply into Mars that pushed on the opposite surface from the inside. This also resulted in a lopsidedness in the masses of Mars. The center of mass is off axes from the spin of Mars. This inputted such severe energy into the core of Mars that also cause series a volcanoes, the Ascraeus Mons, Pavonis Mons, Arsia Mons and Olympus Mons.

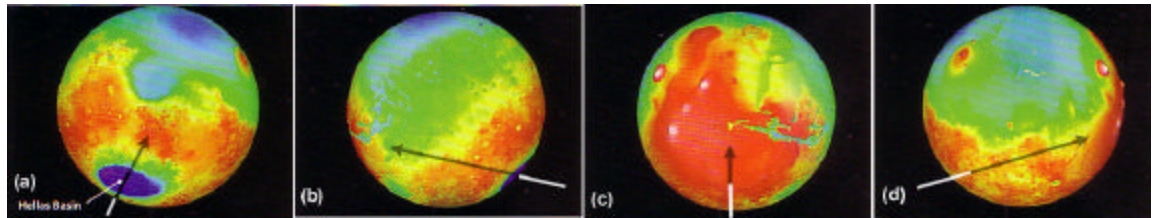


Figure 2. Proposed entry direction of the impact creating Hellas basin.

The raising of the surface of Mars opposite the Hellas basin also created the surface fracture called the Valles Marineris. The impact puts so much energy into the system with the major movement of the planetary surface and movement of ejecta and soil, that there will be tremendous surface flows with this movement and also to relax some of the elevation gains that were created. This energy also assist surface flows by helping two melts any water present and sublimate dry ice.

With the sudden change of elevation, and input of energy, there would have been flows of any fluids towards lower elevation. What types of fluids could be expected? The commonly expected or desired fluid is water. We know that water ice is present on the surface of Mars, so we should expect that some of the flows might be water from melted ice. We also know that there is dry ice on Mars, some flows might be dirt/sediment fluidized with carbon dioxide gas from sublimated dry ice. We can also have dirt fluidized just by the shaking of quakes. And with the major tectonic activity, we would have to expect lava flows for some of the fluid movement. If the impact model is correct we should see several of these fluid movements, not just water flows.

Relative Age of Mars Surface

If the impact model is correct, the northern lowlands are some of the oldest

surfaces on Mars. This is a reversal of the traditional views. The traditional view is that the surfaces with the most craters are the oldest surfaces, the longer a surface has been present, the more impacts it can receive from space. In this model the vast majority of impacts aren't directly from space but from the ejecta from the Hellas impact basin.

Supporting Evidence

The Meridiani Planum, which was expected to have been a shallow lake, is now reported to be a volcanic region. [Thomas McCollom, *Nature*, 2005] There is evidence of water formerly present in the region based on the sulfate rocks and hematite present, which form in the presence of water on earth. The region is also full of basaltic dust, typically formed from volcanic activity. Also erosional remnants are not observed in the area [L.A. Soderblom, et. al.; *Science* 3, December 2004, Vol. 306, no. 5702, pp. 1723-1726].

Surface hematite is found in Meridiani Planum, Valles Marinaris, and Aram Chaos.