A NEW MODEL OF MARS AS A FORMER CAPTURED SATELLITE: BI-MODAL DISTRIBUTION OF KEY FEATURES DUE TO ANCIENT TIDAL STRESS?

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ABSTRACT

Conventional models of Mars, based on measurements by initial Mariner unmanned spacecraft, found an arid, apparently ancient environment without current liquid water. This prompted subsequent, highly negative assessments regarding Mars' history, and the difficulty for the origin and/or evolution of higher forms of life. Later, the unmanned Viking missions (as well as the 1997 Pathfinder Lander) seemed to confirm this barren model. Complex, sometimes contradictory geologic theories to explain this desolate Mars environment have been proposed, based on a wide variety of observed surface phenomena and features. A new model that reconciles major puzzling contradictions among past models is now put forth, using new observations from MGS high-resolution images of Mars and a reevaluation of certain Viking era experiments. Small-scale surface features are identified which, it is proposed, are the direct product of wide spread ancient and recent bursts of subsurface *liquid* water. These water "stains" are shown to cluster (beyond statistical chance) in an unmistakable tidally-determined, bi-modal distribution on the planet: centered near the Tharsis and antipodal Arabia "bulges." A revaluation of Mars ancient history is therefore proposed, suggesting that Mars (well after solar system formation) was captured into synchronous orbital lock with a larger planetary companion ("Planet V"), accounting for the clustering of present day water bursts around the former beds of two bi-modally distributed "Mars ancient oceans" as a direct result. The current Tharsis and Arabia mantle uplifts are shown to be an inevitable additional fossil signature of such former tidal stresses, induced by a close gravitational relationship with Planet V. Other heretofore inexplicable Martian surface features are shown to be consistent with such a simple "tidal model": Valles Marineris (as an eroded ancient tidal bore, formed immediately post-capture); the presence of the extremely flat terrain covering the northern hemisphere (via deposited sediments from the once tidally supported oceans, when released); and the current trench or "moat" around the Tharsis bulge (from relaxation of Tharsis back into the mantle, after tidal lock was broken). The long-mysterious "Line of Dichotomy" is explained as a remnant of a "blast wave" of debris from this sudden severing of the former orbital lock relationship with Planet V, due to either a catastrophic collision or explosion. Chemical signatures of this extraordinary destruction event on Mars are shown to be consistent with the model; including the distribution of olivine preferentially below the line of dichotomy; the presence of primitive mantle and core materials such as iron and sulfur in unusual abundance on Mars surface; and the concentration of proposed "water stains" in areas bereft of olivine. Mars unusual magnetic field "striping" is now shown to be another unique southern hemisphere signature of this destruction event, caused by standing P and S waves reverberating through the planet's crust as a result of the massive simultaneous impacts from Planet V debris. Recently published research showing unprecedented outflow channels from the Tharsis and Arabia bulges are shown to be consistent with the sudden relaxation of the two tidal oceans, as is the sculpting of huge amounts of material by fluvial processes north of the Arabia bulge. Two possible mechanisms for the destruction of Planet V and the breaking of this tidal lock are outlined. Finally, a new timeline for Mars geologic evolution is proposed that is consistent with these observations, placing these events between capture ~500 MYA and the destruction of Planet V at 65 MYA.

Introduction: Man's fascination with Mars has led to many fanciful and romantic notions about the planet's genesis. Early popular (and even some scientific) speculations focused on a planet populated by exotic creatures if not warring advanced civilizations; these were based in large part on Lowell's turn-of-the-Century model of a harsh and frigid Mars, one that was still habitable, though dying. It was not until the 1964 Mariner 4 mission that the general public and the scientific community got their first close-up view of the real Mars -- as Mariner 4 flew by at a distance of 6,118 miles. The 21 images telemetered back to JPL surprisingly revealed a cratered terrain more akin to the lifeless lunar surface than anything on Earth. With these first insitu spacecraft Mars data, hopes for finding anything approaching another "Earth" elsewhere in this solar system were permanently dashed. Subsequent missions confirmed that the Martian atmosphere was much too thin and the temperatures too low to allow for the presence of surface liquid water, eliminating almost any remaining hope of finding current life.

Eleven years later, biology experiments conducted in 1976 by the Viking Landers (including one termed the Labeled Release Experiment, or LRE), produced positive results for life bearing organisms in the samples.[1] However, these findings were directly contradicted by other instruments' results, which indicated that the biology data were "false positives," generated by a non-biological chemical reaction with the Martian soil.[2] Among the principal reasons cited for consensus against the LRE was the absence of available liquid water on the Martian surface – a key prerequisite for life. This general dismissal of the LRE results was immediately challenged by the LRE's Principal Investigator, Gilbert Levin. Levin[3] showed that liquid water could flow on the present day Martian surface, if the available water was restricted to the lower 1-3 km of atmosphere, rather than being evenly distributed throughout its depth. Meteorological data from Mars Pathfinder later confirmed the Levin model for atmospheric water distribution.[4]

One remarkable development in this regard has been the rediscovery of 25-year-old "lost" NASA data from Levin's own experiment. Joseph Miller, a neurobiologist at the University of Southern California, recently presented evidence that the radioactive C02 release that was the heart of Levin's experiment exhibited a clear 24.66-hour *Martian* diurnal cycle – precisely the circadian rhythm to be expected of *living* Martian microbes in the soil.[5] If confirmed, this would strongly indicate current microbial organisms on Mars – despite a quarter-century of disclaimers and the apparent dearth of liquid water.

In striking contrast to the current apparent aridity of Mars, analysis of images from Mariner 9 and Viking's later Orbiters did reveal evidence of large and catastrophic *ancient* water flows on Mars. They also revealed evidence of a violent geological past -- with huge volcanoes, extensive cratering in the southern hemisphere, and a massive canyon system (Valles Marineris) stretching almost one-quarter of the way around the planet.

Despite evidence of wide-spread water flows on Mars, the general scientific consensus now is that any liquid water on the planet has been confined to the very distant past (circa 3 plus billion years -- GYA), when a much denser atmosphere allowed it to flow freely across the surface. The presence of large numbers of eroded craters in the south is cited as proof that the planet has been geologically dead for at least 3 billion years -- the time since the last "heavy bombardment" of the inner solar system.[6]

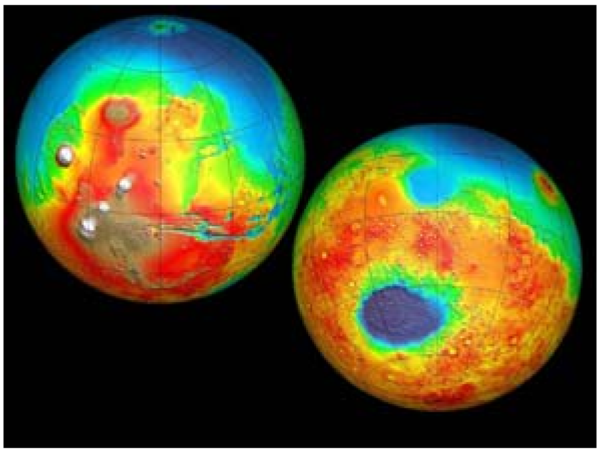

Figure 1 - MOLA colorized image of Mars showing the heavily cratered southern highlands (yellow and orange) and the smooth, sparsely cratered northern lowlands (blue and green).

Other surface features present more difficult problems for geologists. There are vast differences in crater densities between the northern and southern planetary hemispheres. In the North, medium-sized craters are rarely seen, with significant distances between them. This is in distinct contrast with the South, where craters are so numerous that they overlap each other, making it difficult to distinguish between individual impacts. This stark difference is mysteriously emphasized by a "Line of Dichotomy": a separation line running around the circumference of the planet at about a 35-degree angle to the Equator. The southern, heavily cratered side of the line, is also (mysteriously) nearly 30 kilometers (on average) higher than the northern sparsely cratered lowlands.

Somewhat limited by existing theories of solar system formation, planetary geologists have tried to explain these major discrepancies on Mars in terms of familiar models. Since the northern hemisphere accounts for 50% of the land mass but only 7% of the craters, the latest idea is that Mars must have lost its "primordial crust" in the northern hemisphere to an ancient period of "vigorous convection and high heat flow"[7] early in Martian history, at a time well after the last heavy bombardment period. However, the lack of smaller craters on the northern plains (based on relative dating of similar cratering statistics from the Moon) paradoxically implies a relatively recent date for this proposed "event."

An Alternative Model of Solar System Evolution -- In 1978, Naval Observatory astronomer and celestial mechanics expert, Thomas Van Flandern, put forth the idea (based on an original model by Olbers) that a relatively recent "exploded planet" in the asteroid belt between Mars and Jupiter was responsible for the origins of most comets and asteroids in the solar system.[8] This notion, called the Exploded Planet Hypothesis (EPH)[9], has found little support in the planetary science community, but its lines of evidence since its initial publication over twenty years ago have become increasingly compelling. Part and parcel to this hypothesis is the idea that half Mars visible surface was devastated by this proposed explosion event, neatly accounting for the cratering dichotomy between the northern and southern hemispheres, and the loss of a once dense and possibly life sustaining atmosphere.

More recently, writer Graham Hancock has popularized an alternative catastrophic theory, which supports the conventional view that the north was stripped of several layers of primordial crust.[10] Hancock argues that a large comet or planetoid somehow wandered into the Roche limit zone of Mars and was drawn into the planet in the Hellas basin, effectively tearing away the older surface of the northern hemisphere via secondary bombardment, and depositing the remnants of its shattered bulk into the southern highlands. Hancock's idea is based on Donald W. Patten and Samuel L. Windsor's research,[11] who surmise that this object was in fact a "rogue planet" they call "Astra," described in their book "The Scars of Mars." There are however numerous problems with the "Astra" concept – for instance, it cannot account for the presence of the asteroid belt, while the EPH does so intrinsically. The authors of this paper believe that the EPH is the much stronger hypothesis (if appropriately modified), and that it has already demonstrated a capacity to survive serious falsification efforts, qualities not shared by "Astra."

Extension of the EPH – Recently, Van Flandern has extended the EPH to include the notion that several "planets" (Pluto, Mercury, and Mars) are actually former moons of current or destroyed planets. Evidence to support this hypothesis is extensive, but for our purposes we will focus exclusively on the evidence for Mars. Of these lines of evidence, we will address here only a few as relevant to our proposal. A more complete analysis will be left to a follow–on paper. Some of the evidence, as compiled by Van Flandern:

- Mars is much less massive than any planet not itself suspected of being a former moon
- The orbit of Mars is more elliptical than any other major planet (Pluto notwithstanding)
- Its spin is slower than larger planets, except where a massive moon has intervened
- It possesses a large offset of center of figure from the center of mass
- The shape is not in equilibrium with its current spin
- The "crustal dichotomy" boundary is nearly a great circle
- The northern hemisphere has a smooth, 1-km[sic]-thick crust; the southern crust is over 20-km thick
- Crustal thickness in the south decreases gradually toward the crustal dichotomy boundary
- Lobate scarps occur at the boundary divide, compressed perpendicular to the boundary
- Huge volcanoes arose where uplift pressure from mass redistribution is maximal
- A sudden geographic pole shift of order 90° occurred
- Much of the original atmosphere has been lost
- A sudden, massive flood with no obvious source occurred
- Xe^{129}, a product of nuclear fission, has an excess abundance on Mars

Previous to this, Dorman & Woolfson (1977), writing in the Philosophical Transactions of the Royal Society of London, resented a model called "the Capture Theory of Planetary Formation." They proposed that Mars was once an original (not captured) moon of one of two colliding "protoplanets" in the early accretion solar system phase.[12] They even provided one specific piece of evidence to support their idea that Mars began as such a satellite: Mars density is much closer to that of some of the Galilean satellites than it is to Venus, the least dense inner planet. This implies a genesis more in common with

Io, Europa and Earth's Moon than with the terrestrial planets.

To quote Woolfson (1984): "As part of the [Capture Theory] scenario, it has been suggested that *Mars was originally a satellite of one of the colliding planets.* The densities of the terrestrial bodies and some larger satellites are shown in support of this suggestion (Figure 2). Connell & Woolfson (1983) have ascribed the hemispherical asymmetry of Mars, like that of the Moon, to abrasion by high-speed ejecta from the planetary collision of that face of the satellite turned toward its primary. This will give rise to a thinning of the crust and for Mars such features as the centre-of-mass centre of figure offset are well explained by this. If Mars as a satellite was in synchronous rotation about its primary then this mechanism would suggest that its spin axis should be contained in the plane of asymmetry, but it is actually 55 degrees [the 35 degree line of dichotomy, minus 90 degrees] to that plane [emphasis added]."

Van Flandern's EPH Model proposes that there were formerly two massive planetary bodies in the current orbits of Mars and the Asteroid Belt, respectively. Both exploded. The first (Planet K) detonated in the orbit of the current Belt "several hundred million years ago." The second (Planet V) exploded near the present day orbit of Mars, some 65 million years ago (MYA). In Van Flandern's theory, additional impact damage was done to Mars when a much smaller *second* former moon of Planet V exploded in Mars vicinity 3.2 MYA. In our modification of the EPH, we will show that it is not necessary to invoke a literal planetary "explosion" to produce all the subsequent effects Van Flandern has proposed, including the formation of asteroids and comets, and the escape of most of the remaining mass from solar influence. In doing so, we will draw upon new data not available when Van Flandern originally formulated his EPH ideas, specifically, observations of certain Extra Solar planets that follow orbits similar to what we are proposing led to Mars initial capture as a satellite, and then the destruction of its "foster parent," Planet V.

The relevance of water – If Mars, prior to its capture (in our model) formerly had a denser atmosphere that provided for liquid water on the surface, it is likely that this water – dependent on the amount -- was distributed in lakes or oceans, much as it is here on Earth. If this was the case, there should still be pockets of this water trapped beneath those former lake or ocean beds, relatively close to the surface, dependent on how long ago the water actually flowed. If extensive "fields" of this frozen or (sometimes) liquid water were discovered near the surface, this would strongly imply such former "lakes" or "oceans" were the source.

Besides Levin's atmospheric model, the best evidence for current liquid water near the surface of Mars (until recently) was provided by Dr. Leonard Martin of the Lowell Observatory. Martin, in 1980, compared two images of Mars taken from the Viking Orbiters that clearly showed an erupting water spout.[13] This implied active geothermal heating of a source of water not too far below the current Martian surface.

In June 2000, Michael Malin and Ken Edgett of MSSS published a paper in Science[14], proposing that grooved features on cliffs and gullies on Mars were fossil evidence of prior erosive runoff from liquid water. They placed the events as recently as 1 MYA, but conceded the bursts could also include present day occurrences.

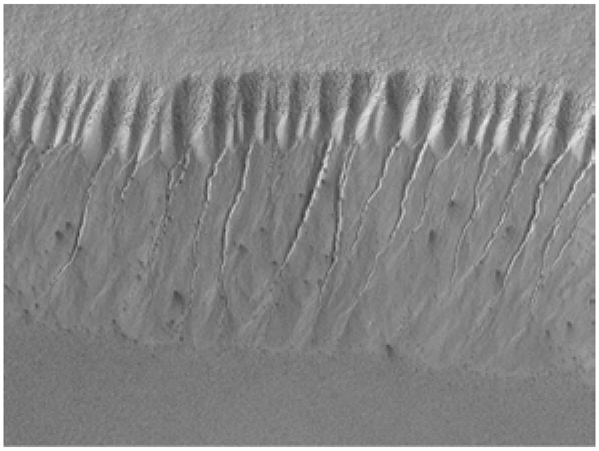

Figure 3 – Proposed fossilized water runoff channels. (MSSS/NASA)

In 1998, one of a growing number of "independent researchers," Byran Butcher, noticed and published on the Internet a curious "dark area." He casually suggested it might be "a coffee stain, water, or a shadow."[15] In July 2000, the authors published a much more specific model, based on an MOC image of an unusually dark, highly elongated "stain" emanating from an exterior point source on a crater wall, proposing that it was a current water flow consistent with the model Malin and Edgett had put forth a few days earlier.[16] They quickly found numerous additional examples.

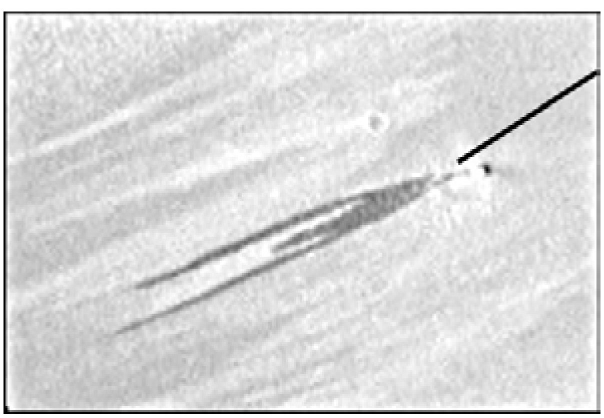

Figure 4 – Proposed point source liquid water burst image from MO4-00072 (MSSS/NASA)

Subsequent to this, Palermo, England and Moore also found that surface "stains" were inconsistent with aeolian features, mass wasting or other non-fluvial processes.[17] At the suggestion of one of the authors (Hoagland), Palermo et-al then proceeded to systematically map the locations of these "seep" images relative to Mars surface coordinates, to see if there was a global pattern to their distribution. As a control, they also mapped randomly-selected "non-stain" images until a representative and statistically valid sampling had been completed.

Immediately, two striking global patterns emerged: both pointing to present day liquid water as a source of the "stains" or "seepages." In the first pattern, the map showed that seepage images seem to appear preferentially near equatorial latitudes, mostly between 30 degrees North and South; none were found above 40 degrees North and South. This implies that the phenomenon is restricted to warmer areas of Mars, which would be expected if these were truly water flows. An equatorial pattern is also inconsistent with the "dust avalanche" model put forth by Malin and NASA as an explanation for these features.[18]

The second, more important pattern discovered was that the water flows seemed to cluster preferentially around two pronounced geological features on the Martian surface: the Tharsis and Arabia mantle uplifts ("bulges" -- Figure 5). The theoretical factors behind this second (and very pronounced) bimodal "stain" distribution pattern are the primary subjects of this paper.

Mars as a Tidal Locked Moon of a Companion Body – The authors are proposing in this paper that Mars, at some point earlier in solar system history, was captured by one of two larger planetary bodies orbiting near the present day orbit of Mars. This scenario is an extension of the Capture Theory model of solar system formation put forth by Dorman & Woolfson (1977), as well as Van Flandern's Exploded Planet Hypothesis (1978). It is also based on current observations of significantly elliptical orbits for many newly-discovered Extra Solar planets around nearby stars, as reported by Butler, et-al.[19]

One relevant example is the Jupiter-massed planet orbiting the nearby K-type star, Epsilon Eridani. With an orbital period of 6.9 years, an orbital eccentricity of 0.6, and an average distance from its star of 3.4 astronomical units (AU), this planet's orbit would take it as far out as Jupiter and as close as Mars if it orbited in our own solar system.[20]

It is our proposal that two previous planets in the vast "gap" between the current orbits of Jupiter and Mars, with orbital eccentricities far less than the Epsilon Eridani planet, after several billion years were gradually perturbed into a series of close encounters. This eventually resulted in the low-probability but possible "three-body capture" of a third object, the formerly freely orbiting Mars, and millions of years later, the actual collision of the two larger planets. As noted, such theoretical former solar system members have been referred to as "Planet K" and "Planet V" in Van Flandern's original EPH model, the latter estimated to possess approximately 4-5 Earth masses.

We propose that, like theoretical models invoked now to explain some Extra Solar System observations of formerly interacting planets,[21] a rare multi-planet encounter occurred late in solar system history between two planets formerly occupying the current gap between Jupiter and Mars: two massive terrestrial planets termed "K" and "V." As a result, Mars was robbed of a critical portion of its solar angular momentum, allowing capture in an extreme elliptical orbit as a new satellite of Planet V.

An alternative scenario involves only one former solar system member – Planet V.

Given the parameters of existing solar system members -- distance, density, and mass, especially Mars' low density compared to the other terrestrial planets (Figure 2) -- it seems reasonable to assume that if two additional Earth-massed planets had formed between Jupiter and Mars, they would have incorporated significantly more water than did Earth. And, given the increased likelihood of multiple glancing collisions in the early planetesimal phase for this region of the solar system,[22] they probably possessed multiple natural satellites as well. An encounter of Mars with such a system, billions of years after its formation (as we are proposing), would thus have a reasonable probability of encountering a satellite as well. This type of encounter has a much higher probability of happening than the previous scenario presented (the three-body interaction of Planet K, Planet V, and Mars). But, this second type of encounter could also result in Mars being captured by Planet V – via the ejection of one of Planet V's *own moons*. Calculations examining similar scenarios have been performed in connection with the anomalous Neptune system – which consists now of a major planet-sized satellite (Triton) in retrograde orbit, and a smaller moon (Nereid) in a highly elliptical one. This has been viewed for years as prima-facie evidence for a highly unusual Neptune encounter earlier in solar system history with an outside object in heliocentric orbit, which reversed Triton's orbit and ejected a previous moon from the system entirely. That "escaped satellite" is now known as "Pluto."[23]

Regardless of the precise methodology of capture, the subsequent, strong tidal relationship between Mars and the more massive Planet V (Figure 6) would have resulted in a further, rapid loss of Mars spin angular momentum, from a "free" rotation period in solar orbit on the order of ~12 hours down to the presently observed ~24. This estimate is based on models of Earth's primordial rotation slowed by early lunar tides (Figure 7). [24] In the model, inevitable tidal evolution not only ultimately circularized Mars orbit around Planet V, it resulted in Mars finally rotating/revolving around Planet V synchronously, in approximately 24 hours -- with one side always facing Planet V, as Earth's Moon does today.

It is the authors' central proposal in this paper that it was this verifiable "Mars tidal lock relationship" with Planet V that accounts for a host of previously inexplicable and even contradictory Martian surface features, that otherwise will remain perpetually mysterious.

This begins with the otherwise baffling present-day Tharsis and Arabia antipodal uplifts on the planet, which are located precisely 180 degrees opposite (Figures 8 and 9). In this tidal model, the Tharsis "bulge" -- a huge upwelling in the mantle and crust of Mars, unique in the solar system – is explained as a combination of the extended gravitational tidal influence of the larger Planet V acting for a significant period of time on that hemisphere, in concert with pre-existing internal mantle upwellings. As would be expected from such a tidal situation, a smaller but still significant "anti-bulge" would inevitably be raised at the antipodal location to Tharsis -- which accounts for the Arabia uplift precisely 180 degrees around the planet.

All formerly fluid or partially fluid bodies in the solar system, including the inner moons of Jupiter and Saturn, show signs of such tidal evolution (Figure 10). Io, in particular, has significant bi-modal tidal bulges, similar to the model we are proposing now for Mars.[25] We additionally postulate that other heretofore inexplicable geologic features, such as Valles Marineris and the Elysium Mons, were also an extended result of this former tidal mechanism. The authors also propose that, when this tidal lock relationship was severed -- by the events directly leading to the destruction of Planet V -- Mars rotational polar axis obliquity, relative to the plane of its satellite orbit, dramatically shifted. This sudden obliquity shift, as part of this rapidly timed sequence of events, is responsible in the model for the apparent discrepancy of the "Line of Dichotomy" blast wave being inclined about 55 degrees to that rotational axis -- instead of being focused on the Tharsis region itself (see details, below).

Original capture model and consequences – After capture, as this close orbital relationship between Mars and Planet V evolved and the orbit circularized over hundreds of thousands or even millions of years, any surface water of oceanic volume would have "sloshed" back and forth across the surface of Mars twice every Martian "day," just as lunar tides do here on Earth. We assert, based on this intrinsic tidal process, that Mars at the time of capture had to have been a "warm, wet world" with both a denser atmosphere and a copious supply of flowing liquid water, otherwise it would not evidence the major surface signatures of tidal movement we will demonstrate.

But first: as an intrinsic aspect of this model, we begin by proposing that the puzzling "mantle uplift" of Tharsis began long before this dynamic capture sequence culminated. Once Mars was captured and oriented with the pre-capture "heavy side" (Tharsis) pointed "down" (toward Planet V), the uplift process was then further and extensively augmented by the "stretching" gravitational forces of Planet V close by. Further, we suggest that this process resulted in the relatively brittle crust of Mars weakening at the eastern base of the now stretched Tharsis rise, resulting in a series of radial fissures opening up – one of which was then radically enlarged to become the Valles Marineris canyon system.

In the model, this original tension crack was inevitably expanded by the erosive effects of a massive volume of directed tidal waters – termed a "tidal bore"[26] (Figure 11) -- rushing back and forth (at several hundred kilometers per hour!) the entire ~ 1600 kilometer plus length of the original fissure, twice each Martian day, in direct response to the original spin rate of Mars and the massive gravitational tides caused by Planet V. Before Mars' tidal lock with the larger planet was achieved, this enormous surge would have flowed, always westward, around the circumference of Mars in the direction *opposite* Mars spin, until it piled up against the immobile eastern side of the pre-capture Tharsis bulge. At that point, when "high tide" passed, the released waters would have rushed (under Mars gravity) back down the canyon system toward the east, scouring the floor once more, until the next "high tide." This almost unimaginable force of rushing water, through an expanding canyon system of parallel fissures eventually opened up by the fluvial erosion, would have recurred *twice* each Martian "day," possibly for several million years -- until Mars' rotation was finally stationary relative to Planet V.

Figure 12 – Valles Marineris, a heretofore inexplicable trough extending one quarter of the circumference of Mars, is the largest canyon in the Solar System. The authors submit that this a fluvial trench generated by tidal bore action during Mars' "captured satellite" phase.

It is our proposal that this "scrubbing action" eventually resulted in a radical deepening of the original narrow cleft to form the present day ~7-km-deep, ~4000-km-long canyon system known as "Valles Marineris" – a system (Figure 12) now stretching one quarter of the way around the planet Mars.

This assumes that Mars, like the other planets of the solar system, prior to its capture had a prograde spin. Thus, the tides induced by Planet V forced the rising and falling waters to always assault the *eastern* side of Tharsis – which is precisely where Valles Marineris formed.

The newly-found bi-modal clustering of "stains" (current water flows) exclusively in the Tharsis and Arabia regions of the planet by Palermo (2001), 180 degrees apart, is an additional major indicator that this model is correct. This accounts not only for tidal bi-modal crustal deformation of the planet, as predicted by the satellite model, but also implies that major quantities of unevenly distributed fluid (water) once also existed on the surface. Presumably, this water primarily resided after "tidal lock" in two opposing "tidal ocean bulges" – with possible dry land between -- because of the inevitable bi-lobed tidal forces experienced by Mars as an ultimately *synchronously rotating* satellite of Planet V.

Long Term Stasis – The evidence argues that, once Mars lost its remaining spin momentum and established this stable synchronous orbital relationship, this was not broken or adjusted significantly until the catastrophic destruction of Planet V. The constant tidal tugging on the two opposing hemispheres of Mars from this synchronous orientation now resulted in a continual uplift of the Tharsis region, and to a lesser extent Arabia, antipodal to the Tharsis rise. The formerly racing tides would also then have stabilized, and the tidal erosion of Valles Marineris would have totally subsided. At this point, the only additional fluvial erosion processes likely on the planet would have been wind-induced wave action and severe storms. Evidence of the former should still present itself on some key surface features not altered by the subsequent Planet V destruction.

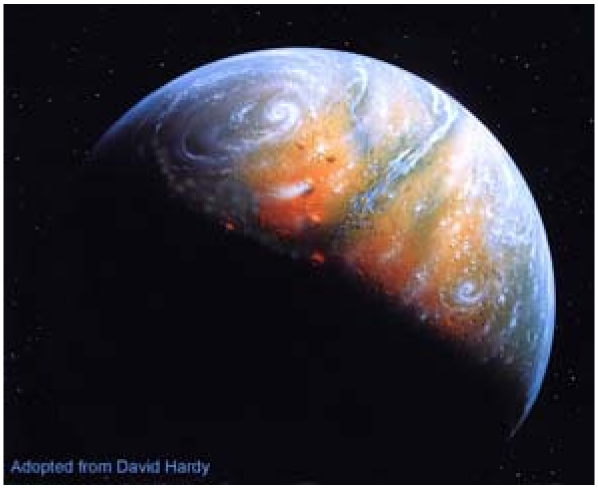

Figure 13 – Artists conception of Mars as it might have appeared during its "Garden of Eden" period, after capture by Planet V.

One potential candidate for such erosive signatures is Olympus Mons itself. Olympus Mons rises some 24 kilometers high and measures 550 km in diameter, making it the largest shield volcano in the solar system. According to our model, a significant portion of this volcano most likely stood above the water-line of this ancient "Tharsis Ocean," and should still display signs of aeolian wave action.

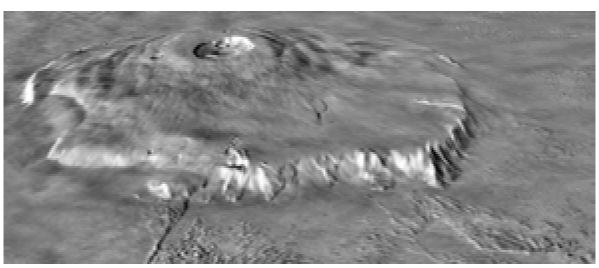

Figure 14 – Olympus Mons 3D perspective image showing prominent vertical scarp at the base of the lower flanks (NASA).

Remarkably, Olympus Mons is almost completely encircled by a very steep, nearly vertical escarpment. This scarp ranges from between 2-10 km high,[27] indicating that it was carved out over time as the volcano was pulled/pushed upward by the continuing tidal force of Planet V aiding internal planetary uplift. The vertical walls of the scarp suggest that it was created by this proposed aeolian wave action, as it bears a strong resemblance to similarly vertical, wind/wave action features on Earth. Ironically, this idea was first proposed in a somewhat modified form in 1973, by University of Pennsylvania geologist, the late Henry Faul. Titled romantically "The Cliff of Nix Olympica" (the pre-Viking name for Olympus Mons), the paper was never accepted for publication "because of the paucity of data."[28] The Viking and MGS missions have now remedied that situation, and we hope that Henry Faul's remarkable idea is finally given its appropriate hearing.

The "White Cliffs of Dover" (Figure 15) are a prime terrestrial example of such features. These lime-rock vertical cliffs are created by the action of the waters of the English Channel. High winds in the Channel create a constant bashing action on the shore rocks, eventually beating the rocks to a vertical face. Similar features are seen across the Channel on the coast of France.

Figure 15 – The White Cliffs of Dover, a vertical, aeolian wave action feature on Earth.

Further evidence that the Olympus Mons scarp feature is due to the wind-driven action of an ocean can be found in the fact that it envelops the entire mountain (Figure 16); if a hypothetical ocean surrounded such a rising tectonic feature, the wind/ocean patterns would be expected to erode a mostly uniform scarp such as the one we see.

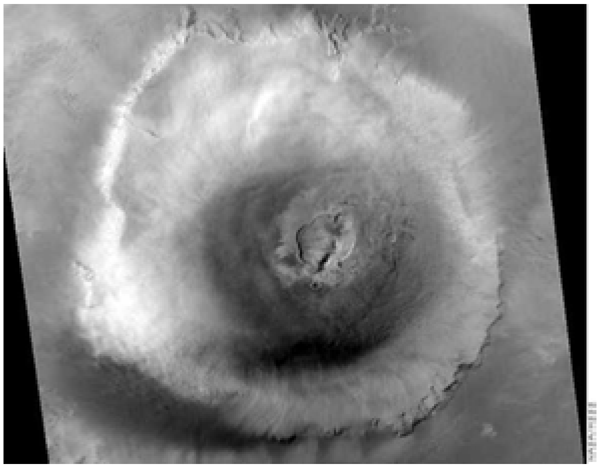

Figure 16 – Overhead view of Olympus Mons from Mars Global Surveyor. Prominent vertical scarp nearly encircles the base (NASA/MSSS).

It is also likely the scarp was formed after Mars assumed synchronous tidal lock around Planet V, since it does not appear to be a result of directional tidal forces. If the scarp was tidal, it is likely the cliffs on its circumference would be significantly more pronounced on the eastern side. Intriguingly, Arthur Clarke several years ago created a computer-generated image (Figure 17) depicting precisely such an "Olympus Ocean." Although projected to a time when humans have terraformed the planet Mars, his depiction – especially the waters swirling around the 22,000 foot-high cliff around the mountain – are eerily accurate to our own model of a former "tidal Mars."[29]

Figure 17 – Arthur C. Clarke's projection of an "Olympus Ocean" lapping at the 22,000 foot-high-cliffs surround Olympus Mons

Stain Distribution - A major, long-term consequence of this eventual Mars synchronous rotation around Planet V is the present bi-modal distribution of subsurface water stains. The tidal forces from Planet V would have pushed water into sub-crustal fissures and cavities at right angles to the exerted tidal stress between Mars and Planet V (Figure 18). Over time, this would have driven additional Martian water in between the two "tidal oceans" deep underground and toward one of the two "water poles" at either end of the line connecting Mars with Planet V.

This important theoretical detail is neatly confirmed by the crucial observation that the stain flow images are clustered *only* in the Tharsis region and Arabia, exactly 180 degrees opposite. Any water apparently residing in between these two locations seems to have been driven underground by the proposed tidal stresses on the planet. So deep, in fact, that it is now unable to leave any surface indications between these two former tidal "poles."

Another observation consistent with the idea that the stains reflect current water reservoirs just below the surface, relates to the "line of dichotomy" itself. Stains observed on Tharsis seem only to occur north of this line of demarcation. This implies that the smoother hemisphere to the north is the older geologically, as on Tharsis it possesses the majority of the subsurface water/surface stains now remaining from one of the two tidally separated oceans. If the material making up the more heavily cratered southern hemisphere is due to superimposed material on the smoother, more eroded original crust (Figure 19), then we would likely not now find much water near the surface in those regions – even under the former Tharsis tidal ocean.

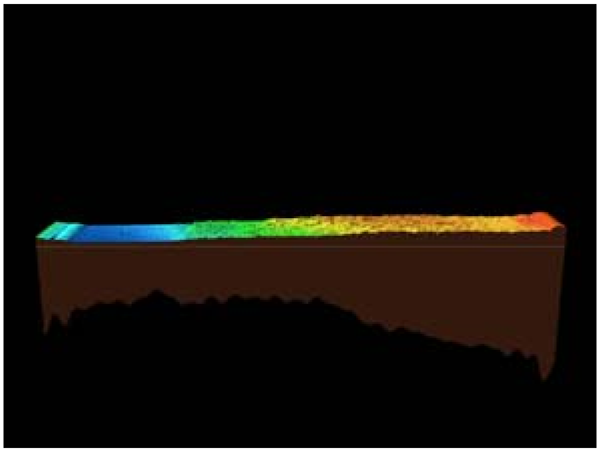

Figure 19 – MOLA generated 3D topography strip showing the dramatic difference in crustal elevation between the heavily cratered southern highlands and the smoother northern lowlands. Possible water stain images appear only above the crustal "line of dichotomy."

The exception to this pattern would appear to be the location of the opposite "tidal ocean" – the Arabia Terra plateau, which is heavily cratered as if from the Planet V event, but possesses the second highest number of current water stain images (see Figure 5). Recent scans from MOLA have shown that the crust is significantly thinner in Arabia than it is in most of the cratered southern hemisphere,[30] accounting for the presence of relatively shallow water seepages beneath this former ocean. Additionally, researchers Brian Hynek and Roger Phillips from Washington University in St. Louis, interpreting this new altimeter evidence from Mars Observer, conclude that an enormous amount of surface material was somehow excavated from the planet's western Arabia Terra region.[31]

"We argue that this entire region has been massively eroded," said Hynek. "The region used to look like the rest of the [southern] highlands, but a vertical kilometer of material — enough to fill the Gulf of Mexico — has been relocated downslope and spread out into the northern plains." According to Hynek, the most likely erosional force of this magnitude is flowing water. "Lots of things can erode planets. Wind is very effective on long timescales. Volcanoes, ice, and glaciers can all erode features," he said. "But on this large of a scale these are unlikely explanations."

Their puzzling observations are neatly explained by the sudden collapse of a former "tidal ocean" previously maintained by Planet V. When Planet V "exploded," a massive wall of water would have been released in a few hours, rushing northward – taking a good deal of Arabia Terra with it in the process – exactly as Hynek and Phillips now conclude. This, of course, also explains the current surface presence of stain images in this region – they are the exhumed underground remains of the subsurface waters from this former "Arabia Ocean."

The Destruction of Planet V – We have freely used the phrase in this paper "when Planet V exploded" to describe the eventual disappearance of Planet V and the release of Mars back into a heliocentric (solar) orbit.

In Van Flandern's original model, Planet K and Planet V disintegrated via literal *explosions,* leaving only a residue of smaller fragments (the asteroids and comets); most of the material from these (and previous) planetary explosions, according to Van Flandern, was completely ejected from the system by the highly energetic nature of the events themselves or subsequent encounters with Jupiter. In terms of the actual mechanism, some previously unknown "physics process" Van Flandern has argued, is responsible for destroying single planets well after their formation. This insistence on a heretofore unmodeled, "mysterious energy release" mechanism has played a major role in Van Flandern's less than enthusiastic reception by the planetary science community, in spite of the many other recent confirmations of his model. Since the evidence Van Flandern has marshaled for the after effects of this Event is far more important here than the precise destruction mechanism he's proposed, we believe a shift of emphasis could retain the best features in this instance, while avoiding the non-testable aspects of Van Flandern's original EPH model

It is our opinion that the eventual destruction of Planet V was occasioned by a simple and direct (if not long overdue) collision with the other proposed major planetary object in Van Flandern's celestial mechanics' reconstruction: "Planet K." Post Apollo models for the origin of the Moon have embraced a similar concept. As the three leading pre-lunar landing theories for lunar origin were tested on the returning Apollo samples and found to not fit the evidence, a radical new theory was proposed. In 1975, Drs. William K. Hartmann and Donald R. Davis, writing in ICARUS, suggested that the Moon was formed as a side effect of a catastrophic "glancing collision" of the Earth with another major planetary object. Their idea was that "a Mars-sized planetisimal" collided with the early Earth, spalling off enough lightweight crustal material to recondense to form the Moon. In 1984, the first planetary conference to specifically consider all aspects of this revolutionary theory was convened, titled "Origin of the Moon."[32] It is our proposal that a similar event, simply delayed by a quirk of celestial mechanics until very late in solar system history, precipitated the destruction of two planets in the current Asteroid Belt ~65MYA. This event, we suggest, thus liberated Mars from its temporary synchronous orbit of Planet V to once again pursue a solitary – if significantly more elliptical than any other inner planet -- solar orbit.

Remarkably, at a June, 2001 Earth Systems Processes Global Meeting in Edinburgh, Scotland, astrobiologist Bruce Runnegar of the University of California in Los Angeles presented some striking independent evidence that "something" major happened in the solar system ~65 million years ago. Runnegar and his colleagues had previously identified evidence of a 400,000-year cycle in ancient ocean sediments, indicating changes in Earth's climate corresponding to natural fluctuations in its orbit. To probe this cycle's influence on Earth's climate over the past 100 million years, Runnegar's team constructed computer models based on known variations in planetary orbits, their proximity to the Sun and their interactive perturbations. In running the models, they found that the known fluctuations of the solar system's dynamics remained constant going back to 65 million years ago. Then, to their surprise, the frequency of perturbations to the orbits of the inner planets *suddenly changed.*[33]

"If the orbits of Mercury, Earth and Mars were being shaken up at this time, maybe asteroids were being shaken up too," says Runnegard.

Or, maybe they were being *formed* – in a gargantuan collision.

Aspects of this model echo another source of surprising information about the solar system: cuneiform records from the earliest "high" civilization, the Sumerian. Zecharia Sitchin has written extensively about the Sumerian's uncanny "knowledge" of possible collisional events from this earliest period of solar system history.[34] With the latest discoveries of radically different extra solar planetary systems and current theoretical efforts to understand these systems in terms of *potentially interacting planetary orbits*, the relevance of Sitchin's Sumerian translations should take on new meaning.

In our Mars tidal model, the result of such an unimaginable collision of two massive planetary objects (remember, at least 4-5 Earth masses each) would be almost indistinguishable from a literal planetary explosion. The effects of the collisional destruction of Planet V and K on a nearby captured Mars, orbiting less than 100,000 kilometers away, would have been almost inconceivable. In addition to the discovery of suddenly "shaky planetary orbits" at ~65 MYA, such an Event should have left a number of predictable surface features on Mars itself – other unmistakable signatures of vast destruction.

Signatures of a Catastrophe -- Assuming that only the top 1% of Planet V and K's lithospheres survived this disruptive Event -- as accelerated chunks of various- sized crustal debris moving outward from the site of the collision -- large amounts of much smaller materials from the exposed high temperature mantles and cores of the respective planets would have been ejected at high speed directly towards Mars in this Event. In looking for resulting evidence of their impacts on Mars, we should expect to see signatures of rapid surface heating and then freezing; catastrophic water and associated mudflows; a major loss of atmosphere along with huge quantities of water; and finally – hemispherical cratering on Mars from a vast amount of blast debris from Planet V.

Mars shows all these signatures and more.

The strongest direct evidence of a debris-filled "explosion Event" occurring close to Mars, is the mysterious "line of dichotomy" separating the northern and southern hemispheres at that angle of 35 degrees. Logically, if Mars was in synchronous orbital lock with Planet V when the "explosion" came, then evidence of a wave of impacts from the destruction of the Planet should be plastered all over Mars' one "side," *at right angles* to the incoming debris. It is not. Instead, the line of dichotomy is aligned (~60 degrees) to the current Mars spin axis. And the authors acknowledge that this presents some serious problems for this entire model.

Without the narrow orientation constraints now imposed by the Mars tidal model presented in this paper, some previous workers have attempted to explain away this serious geometric discrepancy by proposing a completely different pole position for the "pre-explosion" Mars: an original rotational axis almost 90 degrees to the current orientation. Such a situation is termed "polar wander," and involves the long-term mechanical re-alignment of a planet's spin axis (relative to surface features) after a new mass distribution is imposed – either internally (long-term convective flow) or externally (material accreted from major impacts).[35] This "wander" continues until a new rotational equilibrium is established under the influence of the new mass distribution, with a new resulting pole position.

The nature of this "new mass redistribution," which subsequently forced Mars to assume its current pole position, was assumed in this case to be the sudden addition of significant crustal mass from the disintegrating Planet V. If Mars' "pre-explosion" spin axis had been perpendicular to this incoming wave of blast debris, so this theory proposed, the momentum of the impacts coupled with the unbalanced additional mass piled on the planet's "side," would have initiated a "polar wander scenario" – until Mars "toppled over" to reach its current position of new rotational equilibrium, relative to its current surface features.

Our tidal model, and the evidence supporting it presented here, emphatically *forbids* such an "easy" dynamical solution to this major problem. The alignment of Mars prior to Planet V's destruction is now firmly determined: it *must* have been with the Tharsis/Arabia line aimed directly *toward* Planet V (Figure 6). The spin poles would then have been at right angles to this immovable alignment. So, the debris from the "explosion" should have smashed into the planet at right angles to the *current* Mars Equator – which the line of dichotomy shows it clearly did not.

It has been argued that some major debris – huge ejected "pieces" of Planet V's disintegrating crust -- reached Mars first. That these planet-busting impacts, which left the major scars known as the "Argyre" and "Hellas" basins, literally "rolled Mars over on its side" *before* the blast wave of smaller (but more numerous) debris arrived. This however, is not at all likely. The smaller pieces would have been accelerated *fastest,* and would have arrived *first* … followed by the largest pieces *last*. Simple Newton's Laws:

F = MA.

So, what is our solution?

We propose that as it was approaching Planet V toward its ultimate collision, Planet K passed close by Mars in its orbit around Planet V (Figure 20). This close encounter gravitationally interfered with the tidal lock between Mars with Planet V. In fact, it began a radical, gravitationally induced reorientation of the entire Mars' spin axis relative to Planet V. This was NOT internal "polar wander" relative to surface features, but an entire change of the obliquity of Mars (spin axis tilt) relative to Planet V.

After initiating this first major change in Mars' orientation in perhaps several hundred million years, Planet K continued inward toward it's catastrophic rendezvous with Planet V. This impact initiated an almost inconceivable release of energy – the equivalent of Van Flandern's EPH explosion – and the shattered fragments of the crust of both worlds, accelerated by the enormous blast, began their spherical, outward journey through the solar system. Some of them, a tiny fraction of the total mass of both exploding planets, in the space of a few hours eventually reached Mars. But, by the time the first major wave of fragments had arrived, Mars had tipped over by some ~60 degrees, presenting almost the entire southern hemisphere to the "explosion." That's why the "line of dichotomy" is tilted by that ~60 degrees, relative to Mars spin axis. In fact, as Mars continued to heel over and larger, slower fragments continued to arrive, this was when the material which partially covered Arabia Terra reached the planet. Shortly after that, the largest, continent-sized fragment -- which created the 2300 kilometer wide, 5 kilometer deep Hellas basin, the largest on the planet Mars – impacted south of Arabia Terra (Figure 21).[36]

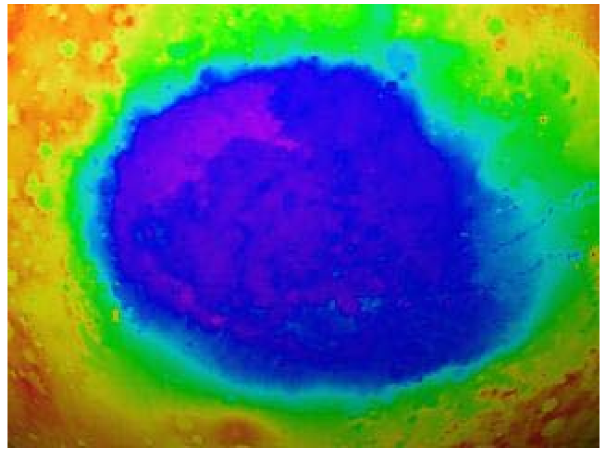

Figure 21 – Hellas' 2300 km impact basin

Approximately 12 hours since the collision of Planet's K and V had now elapsed.

The effects on Mars of such an unimaginable collision/explosion "right next door" would not be limited to massive, visible impacts on the surface. The effects of countless megatons of smaller, accelerated mantle and core material from Planet's K and V, entering the Martian atmosphere at hypersonic speeds, would literally superheat that atmosphere and then blow a major fraction of it into space. Any surface waters would literally boil from the shockwaves and radiant heating of incoming high-velocity debris, and a major fraction of that water would then join the atmosphere in its escape. With the immediate loss of a significant percentage of the atmosphere, temperatures on the surface would plummet, resulting in any remaining liquid water quickly freezing. Shallow underground reservoirs would remain liquid for a longer interval, before also becoming ice.

It is a "snapshot" of these bi-modal, formerly flash frozen water concentrations at the moment of catastrophe – the locations of the two former Martian tidal oceans -- that the current "stain images" now seem to be confirming.

Chemical Signatures of a Collision Event - Several current geochemical puzzles regarding Mars are solved with the introduction of this "Martian satellite model." When Viking carried out the first insitu surface composition measurements in 1976, one of the puzzling results was an unusually high percentage of sulfur in the soil. Compared to an average surface abundance on Earth of 0.07%, Viking reported a Mars sulfur abundance of over 3% -- *43 times* more. Similarly, iron on the surface of the Earth is 3.8%, while on the surface of Mars it measures over 15%.[37]

Models for planetary formation generally agree that iron and a host of other "heavy elements" sink to the centers of newly forming worlds to form high-temperature cores.[38] Another generally agreed upon core constituent, present to approximately 10%, is sulfur – as FeS. In the awesome collision of two such massive planetary bodies, it is inevitable that copious amounts of these high-temperature materials would be ejected directly into space. It is our proposal in this paper that not only did this occur, but that Mars swept up precisely these abundant core materials; which is why they now exhibit such unusual and misleading abundances in the *surface* materials mantling the planet.

Recent Surveyor composition data from the Thermal Emission Spectrometer (TES) has revealed that this anomalous sulfur is in the form of sulfates, as opposed to iron sulfide – the form of the original FeS we are proposing. It is obvious, in our model, that the original FeS falling out of space became oxidized, turning into sulfates. A similar fate seems to have befallen the anomalous iron that also rained on Mars from this catastrophe.

For Mars presents us with a greater paradox than sulfur. We must ask a far more basic question: why is it so *red*? Mars redness, we now know from TES data,[39] results from the extensive drifts of *iron oxide* strewn across the surface. A fundamental question then becomes: if the original iron source was *metallic* iron, from the exploding/colliding planets' cores, where did the *free* oxygen come from to eventually oxidize that iron down on Mars? Even primordial free oxygen, capable of oxidizing iron in geological strata termed "banded-iron formations" and "red beds" on Earth, it is agreed, derived from one main source: growing *biological* activity.[40]

In the iron-rich, rusted sands of Mars, are we seeing striking evidence of similar biological activity? Did the "rain of iron" falling from the sky from the destruction of Planet V encounter an atmosphere containing copious *free oxygen* – bringing to a tragic end a *biological* "Garden of Eden" era for the captured Mars?

Mars Global Surveyor surface composition data indicates another major surface anomaly on Mars that supports this tidal model. Using the information from TES, Robert N. Clarke and Todd M. Hoefen, of the U.S. Geological Survey, have reported the identification of widespread abundances of *olivine* [(Mg, Fe)2 SiO4] on the Martian surface (Figure 22).[41] As olivine (an iron-magnesium silicate) quickly weathers into other minerals in the presence of liquid water, its surprising abundance according to all conventional Mars models would indicate that the planet has been "cold and dry" for the last several billion years. It's widespread presence, according to Clark, seems to effectively preclude former models of a "warmer, wetter Mars."

Our interpretation is quite different: that the source of Mars' olivine (like its anomalous iron and sulfur) is totally *external* -- also coming from the destruction of Planet V, rather than from conventional internal ancient volcanism.

Because olivine is thought to be a major component of the mantles of the inner "rocky" planets, its dispersion into space in a major planetary collision would be inevitable. Like the anomalous presence of iron and sulfur in the Martian surface soils (in our model, from the collisionally-exposed planetary cores), we now propose that the unexpected global abundance of olivine is also precisely in accord with the hypothesis presented here: that a collision/explosion of two major Earth-type planets released enormous quantities of mantle material directly into space. And that Mars inevitably swept up a significant amount of this rapidly condensed material. Because Mars' climate radically changed immediately after this Event, and its remaining water froze, the presence of large quantities of unweathered olivine on Mars can only be another striking signature of. Mars' former existence as a satellite of Planet V -- which (the olivine confirms) was then catastrophically destroyed.

If our model is correct, there should be two additional observations strongly supporting this assertion. First, the olivine that TES detected should be primarily concentrated in the areas defined as being from the blast wave pattern of Planet V's destruction. Second, the current water "stains" should cluster in areas with *low* current olivine detection.

Point number one: examination of the global olivine distribution map from TES (Figure 22), shows that over 90% of this important mineral is concentrated in areas *south* of the "line of dichotomy" on Mars – where impact debris from Planet V is also concentrated. Again, olivine in this amount would normally be found in unweathered volcanic fields newly erupted from the planetary mantle. Since the standard model for explaining Mars' heavily cratered southern hemisphere assumes a very ancient surface, this presents a fundamental problem. On a planet otherwise exhibiting abundant evidence of extensive water flows and its attendant weathering of olivine, how can the current surface distribution of this mineral support an *ancient* southern hemisphere? The answer is: it can't. Thus, we take this wide-spread olivine as strong confirmation that a) the source of this material is *new*, and b) is *external* to Mars' underlying landscape; more precisely, that it's simply accreted mantle material from the disintegration of Planet's K& V.

Point number two: by overlaying Palermo's "stain global distribution" with the USGS TES mineral map from Clark and Hoefen, we can easily assess the second correlation. As one can see (Figure 23), the "water stain" image clusters occupy – almost exclusively – areas with little or no olivine. This is also entirely consistent with the model we've proposed, that these stains are evidence of current, extensive, ground-based *liquid* water.

Further corroborating evidence for this dramatic sequence of events comes from additional TES data. As reported in SCIENCE,[42] two distinct surface spectral signatures have now been identified on Mars from low-albedo regions of the planet. Comparisons with spectra of terrestrial rock samples indicate that the two compositions are a basaltic mix dominated by plagioclase feldspar and clinopyroxene, and an andesitic (silicic) composition dominated by plagioclase feldspar and volcanic glass. The distribution of these two distinct mineral compositions is, again, split roughly *along the planetary dichotomy line.* The basaltic composition is confined to the heavily cratered terrain in the south, and the more silicic composition is concentrated in the northern plains.

This separation of Mars into two distinct mineralogical regimes, composed now of two very different surface materials – one considered "primitive" (because the chemistry is simple), and the other "complex" (because its formed by extensive weathering of lighter, differentiated crust materials) – is in fact another remarkable confirmation of the tidal model. In the conventional geological history of Mars, the discovery of a basaltic ("primitive") volcanic rock composition of the (below the "line of dichotomy") southern hemisphere, indicates as we have noted that this part of Mars is considerably *older* than the rest of the planet. The theory is that it in fact dates back to the earliest history of Mars, when the first massive basaltic volcanism was forming surface crust. In this view, the (presumed) remnants of the last heavy meteor bombardment are also represented on this "primitive" southern hemisphere, by the extensive cratering below the "line of dichotomy." This overwhelmingly crater-covered landscape, in this theory, simply confirms the idea that this is truly ancient "3+GYA" original Martian crust.

The tidal model, and its associated "Planet V destruction," takes the same data and presents a radically different reconstruction.

In our view, this "bi-modal" surface composition is actually another major confirmation of the tidal model. The massive cratering and basaltic ("primitive") composition of the southern hemisphere stems directly from the same *external* source that left the mysterious olivine, iron and sulfur strewn across the planet: the primitive, infalling mass of basaltic *mantle and core* materials which have covered Mars to a depth of almost 30 kilometers from the "exploding" Planets K & V. The more weathered northern plains, according to TES data, also confirm – contrary to all the conventional Mars models -- that it is in fact the *older* hemisphere of Mars, and was long exposed to the erosive and weathering effects of *liquid* water … if not perhaps free oxygen.

The last major signature of Mars' former existence as a tidally locked satellite of Planet V, and the sudden catastrophic change in that condition, comes from a close examination of the Tharsis "bulge" itself. Roger J. Phillips of Washington University in St. Louis and several colleagues recently published an extensive new study of this massive Martian feature. Phillips reports that the Tharsis rise is the result of 300 hundred million cubic kilometers of lava -- enough to cover Mars 2 kilometers deep, if spread evenly across the planet -- that somehow became concentrated in *one* place on Mars. This calculation is far greater than previous estimates from past studies.[43]

Around much of the Tharsis rise is a puzzling, low-lying area called the Tharsis trough (Figure 24). Phillips says, "Imagine that Mars is a beach ball and that the Tharsis mass load is your fist. As your fist pushes into the beach ball, there is a bulge created on the opposite side of the ball (the Arabia bulge), and a depression or trough surrounds your fist (the Tharsis trough)."

The authors – in light of the tidal model presented in this paper -- have a very different interpretation of these associated features.

As noted earlier, it is endemic to the tidal model that both the Tharsis bulge and it's 180-degree smaller counterpart, Arabia, are classic signatures of *tidally distended fluids*. The enormous bulk of Tharsis cited by Phillips' in this recent study merely demonstrates how effective the tidal forces from Planet V truly were, in allowing such an enormous mass of mantle material to rise above the Mars mean datum against Mars gravity – some 10 km above the surrounding terrain. This condition is termed "hydrostatic equilibrium."

It is intrinsic to this model that when Planet V's partially supporting tidal forces were suddenly removed, this enormous Tharsis mass was suddenly dependent for its continued elevation solely on existing internal forces within Mars. The result was simple:

over millions of years, Tharsis began to slowly sink back toward the center of Mars, seeking to establish a new state of hydrostatic equilibrium. The "Tharsis trough" around this massive concentration of material is merely the result of an inevitable *depression in the Martian crust* around this ponderous mass (Figure 24), as that crust has broken and sunk under the enormous (now unsupported) weight of Tharsis, attempting to come to a new equilibrium condition.

As for the Arabia bulge on the planet's other side, contrary to Phillip's assertions, its uplift had *nothing* to do with this partial relaxation of Tharsis back into the mantle. To the contrary, as previously noted Arabia's original uplift was a separate tidal signature of Mars previous close association with Planet V. After its destruction, Arabia experienced it's own partial readjustment toward Mars center, also in direct response to the removal of the previously partially supporting tidal forces from Planet V.

One side effect of this inevitable "sinking process," of bringing Tharsis and (to a lesser extent) Arabia into a new condition of hydrostatic equilibrium with Mars, was the late creation of a whole new volcanic "rise" at 90 degrees to both these former uplifts. In looking at the map (see Figures 8 and 9), it is obvious that the Elysium uplift is the direct result of the release of compressional forces in Mars' mantle, the slow sinking of the two former tidal masses on both "sides" of Mars seeking a new equilibrium. Over time, the enormous potential energy released within the mantle from the partial downward readjustment of Tharsis and Arabia caused a "pulse" of major heating inside Mars where the internal forces balanced. The result, 90 degrees in between, was the creation of a much later, much smaller volcanic uplift -- Elysium Mons.

Magnetic Confirmation of Catastrophe? -- For many years the question has remained: does Mars (like all the other planets measured) possess an intrinsic magnetic field? This question is important to geologists and biologists alike. For, if Mars has (or *had*) a sizable magnetic field, then the evolution of the planet would have been far more benign for the development of life. Mars Surveyor, beginning in 1997, finally gave an answer to this question: no. The core mechanism which would support an active Martian magnetic field generation process, like in the Earth or Jupiter, has died -- leaving only a *remnant* surface field from an ancient dynamo to be detected.

But what MGS did detect of this ancient Martian field is quite bizarre: a remarkable series of "magnetic bands," stretching across a huge swath of the southern hemisphere, a quarter of the way around the planet (see Figure 25). These irregular east/west stripes measure about 100 kilometers wide and are up to 2000 kilometers in length. The stripes represent areas of Mars' ancient "frozen field," recorded in magnetized "strips" of Martian crust, alternating in polarity – North/South – until they reach the "line of dichotomy," where they then mysteriously dissipate.[44] Two important additional facts: the bands do *not* extend into the northern plains; and, they also mysteriously stop at the locations of the huge Argyre and Hellas impact basins.

When planetologists were initially confronted with this data, they likened the magnetic striping to an analog of magnetic banding seen in sea floor spreading here on Earth, a strong signature of plate tectonics. This view was reinforced by the location of the Mars' magnetic banding: exclusively in the heavily cratered *southern hemisphere* (Figure 25). These workers immediately equated the banding (in their model) with the process being "very ancient' -- dating back to the original formation of Mars' basaltic crust. The main problem with this model: the Mars' banding is far larger than the suggested parallels on Earth, and there seems to be no “point of symmetry” from which the upwelling lava spread out in both directions, unlike undersea ridges here on Earth which are creating new seafloor in this process.[45]

We suggest a completely different origin.

When the initial wave of blast debris from K and V reached Mars, it proceeded to leave a vast sea of molten rock across the southern hemisphere from the millions of essentially simultaneous impacts. The seismic effects in Mars from such an inconceivable event can only be expressed in terms of the well-known Richter scale. Calculations have been done expressing the conversion of the expected impact energy of a colliding object into seismic shaking.[46]

These calculations demonstrate that even the fall of a one kilometer object on Earth can locally create the equivalent of a 9.5 Richter scale earthquake, the largest ever measured. Imagine a rain of objects a million times greater -- ranging from a few hundred meters to several kilometers across – all hitting Mars *simultaneously*. Even allowing for the lesser gravitational acceleration of Mars, and the lower initial velocity of debris from the nearby K & V collision when compared to Earth events, this wave of impacting debris would amount to an input of seismic energy roughly equivalent to a Richter Scale 15 Event – across the entire planet!

The closest recorded approximation of the physics of such an event may be found during the Apollo lunar missions. In 1969, after the Apollo 12 astronauts emplaced a seismic experiment on the lunar surface, the ascent stage from their discarded lunar model was deliberately impacted back on the Moon to calibrate the experiment. According to the official NASA mission documents and press reports, the Moon “rang like a like a bell for over an hour after impact …”[47] One explanation was that the dry, upper layers of the Moon efficiently transmitted the impact energy (equivalent to 1600 lbs of TNT) of the impacting LM, as a set of standing waves around the Moon, first increasing and then decreasing in intensity as the energy was reflected between two upper layers of the lunar crust. We propose a similar phenomenon – but at an incalculably greater intensity – occurred on Mars as a direct result of the barrage of impacts that blanketed the southern hemisphere from the destruction of Planet V.

We suggest that the input of this much seismic energy, simultaneously across the entire southern hemisphere of Mars, created a set of unprecedented *standing P and S waves* within the crust, reverberating back and forth between the Martian poles. In this hemisphere, literally melted from the multiple, overlapping impacts, these resonant harmonics cooled the banded sections first (in the rarefactions between the standing waves) -- resulting in the existing background global magnetic field of Mars being “frozen in” -- as a series of alternating bands of polarity within the heavily iron-enriched rocks (Figure 25). (This well-known threshold, whereby magnetic materials cooled below a certain temperature will retain a background magnetic field, is termed the “Curie point.”[48]) As a further confirmation of our model, we point to the “anomaly” of Argyre and Hellas. The MGS magnetic survey discovered that the “banding” stops at the site of these two major impact basins. We propose a simple and elegant explanation for this important observation: in keeping with basic Newtonian physics, which constrains these largest fragments of Planets K&V to arrive *last,* it is consistent with this model that when these massive, slowly-moving impactors arrived and excavated their respective basins, their colossal collisional energy destroyed the delicate “standing wave” conditions for preserving the magnetic banding from the previous debris. They also raised the local material above their Curie point again, literally melting any cooling bands which had previously formed in these locations. In this way, the absence of magnetic signatures around these two major impact sites confirms that they had to have arrived *last*.

We therefore propose that the puzzling magnetic banding of alternate polarity on Mars arose, not from any type of ancient "Martian plate tectonics," but as a direct result of the enormous seismic energy transferred to the southern hemisphere by the countless massive impacts from the "recent" (~65 MYA) destruction of Planet V. We further submit that the complete absence of any similar phenomenon elsewhere on Mars – north of the impact "line of dichotomy" -- is compelling evidence for this hypothesis. And finally, this key indication of Mars' former active magnetic field, inferred from the strength of the "frozen field" magnetic bands -- approximately 1/400th Earth's current surface field – is more than sufficient to have encouraged a viable Martian biological environment … in *recent* times.

Another Moon? -- In Van Flandern's original celestial mechanics model for the EPH, his analysis of the orbits of long-period comets strongly implied *another*, far more recent "explosion event" than the one we've been discussing here.[49] Van Flandern proposed a *second* satellite of Planet V as the cause of these new comets, which was destroyed in a similar manner to Planet V, but after several million years. Calculations showed that after Planet V was shattered and its determining gravitational field disappeared, Mars and this second satellite could have gone into an orbit *around each* other. According to Van Flandern, such a second orbital capture had "about a fifty/fifty chance," of taking place.[50]

That such a "late" destructive event took place is well-supported by the comet orbit data Van Flandern's analyzed. Whether this event took place with this second moon orbiting *as a satellite of Mars* is much more problematic. It is our proposal in this paper that the logical mechanism of destruction of such a second hypothetical satellite would have been another world-shattering collision. Because of later interactions with Jupiter, the primary debris of the original collision would have been diverted into orbits which eventually crossed the orbits of all the other planets in the solar system. This (according to Van Flandern) is why there are so many recent impact craters on solar system objects; they stem from the debris of this 65 MYA Event, "mopped up" by subsequent collisions throughout the solar system.

As an extension of this process, the most massive remaining fragment(s) of Planet V would have remained near the new orbits of Mars and any second "wandering moon, " but in a somewhat eccentric orbit. In our reconstruction, consistent with the comet data indicating a second "fragmentation event," the inevitable collision of such a Planet K/V fragment with this second moon likely took place 62 million years after the destruction of Planets K & V. But, unlike Van Flandern's reconstruction, we do not believe that such an event necessarily took place in the immediate vicinity of Mars. Van Flandern believes that Mars and the "second moon" had to have been orbiting each other, primarily because the massive evidence of "late" water flows on Mars and a presumed high water content for the composition of this "second moon." In our model, because of the tidal release of vast reservoirs of Martian water after Planet V was gone (water not known to Van Flandern when he first proposed his model), we believe the fluvial signatures he ascribes to the destruction of this second, "Europa-type" moon were all created 62 million years *earlier*, in the immediate aftermath of the Planet V destruction at 65 MYA.

Effects Beyond Mars – The catastrophic destruction of a moon or major planet – either through collision or explosion – could not take place without leaving major signatures far beyond its immediate vicinity. One potential signature -- the peculiar orbits of the long-period comets – was the data that initially awakened Van Flandern's interest in this subject. But there are other indicators that now amply support the model of a former "tidal Mars," and the catastrophic destruction of its foster parent.

These include the striking hemispherical dichotomies seen on several other solar system objects, in particularly Iapetus, one of Saturn's icy moons (Figure 26). Iapetus orbits Saturn in 79.33 days. As the initial blast wave of high temperature, carbon-rich debris from the destruction of Planets K&V spread out across the solar system, it eventually swept past Iapetus. Because of the satellite's slow, almost 80-day tidally locked rotation/revolution around Saturn, the debris – passing Iapetus in only a few hours -- impacted essentially on the facing side of Iapetus – resulting in one of the most asymmetrical objects in the solar system.[51]

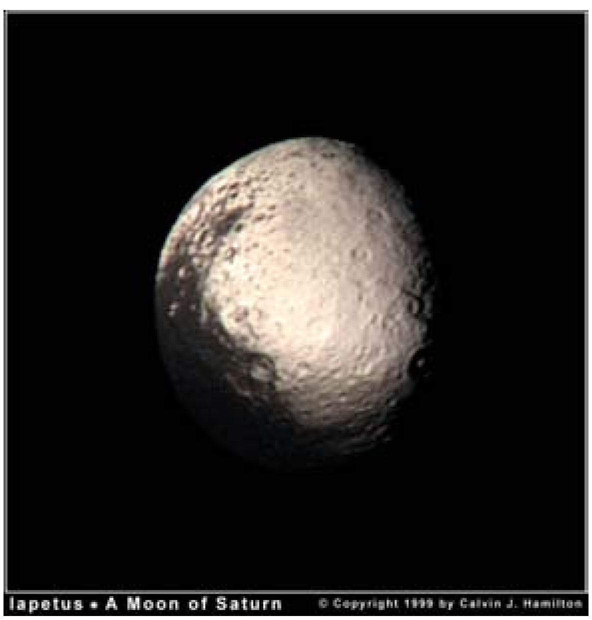

Figure 25 – Saturn's moon Iapetus, pitch black on one side as if from a blast wave.

The extraordinary events occurring at the end of the Cretaceous Period (~65MYA) on Earth is also on this list. From the sudden extinction of the dinosaurs and 50% of all other species, to the world-wide layers of iridium and soot that are now evidence of an extraterrestrial impact of unimaginable global scope, the destruction of Planet V obviously also left its tragic mark as far away as Earth.[52] It is now apparent that the object which struck this planet ~65 MYA and triggered a wave of catastrophic mass extinctions, most likely occurred as a direct result of the impact of a large (~10 km) fragment from Planets K&V. But what of later impacts?

Several years after the Viking missions returned the first Martian atmospheric and surface composition data, workers began using this list of elements and isotopes to compare with meteorites found on Earth.[53] In 1985, the first identification of a rare form of meteorite (one of only 13 currently known, called "SNCs") as specifically coming from the planet Mars was published.[54] This identification was based on a claim of a "perfect match" between trapped gasses in the SNCs with the Martian atmospheric composition measured by the Viking Landers. But this theory is not without its critics, among them Tom Van Flandern.

"This highly misleading paper ["Meteorites: Evidence of Martian origins"] is the original source of the assertion [that there are meteorites on Earth from Mars], quoted often in the media of late … Non-meteorite-experts may be forgiven for not considering what was not shown.

- The log-log plot [of the gasses compared to Viking's findings] hid the size of the discrepancies for individual gases.
- Gases were selectively plotted only for cases of relative agreement.
- No comparison plots to show how well the same data fit gas compositions for *other* source bodies, or solar

system averages in general, was presented.

"... carbon dioxide (CO_2) is the most abundant gas on Mars by far. Yet its relative abundance in the meteorites is but a *tiny fraction* of its abundance on Mars … The case for a Martian origin [of SNC meteorites] is really a case based on *a lack of a suitable alternative* [emphasis added]."[55]

In other words, without the model of colliding/exploding Planets K& V, the *only* possible origin for such "anomalous meteorites" -- in the minds of most researchers -- is the planet Mars. With the substantive evidence for other, destroyed planetary bodies in this region of the solar system – now implicit in the Mars tidal model we've presented – serious alternatives for the origin of currently identified "Martian meteorites" present themselves.

The recent discovery of trapped *salt water,* as small inclusions in some meteorites[56] is an obvious (if astonishing to mainstream planetologists) confirmation of a) the Mars tidal model presented here, and b) the catastrophic destruction of its former "parent" planet. If current meteorites derive from the "recent" collision/explosion of multiple Earth-massed planets in the solar system and/or escaped moons, the water from such bodies could easily be *ocean water* [as on Earth, and as also projected by one of the authors (Hoagland) to currently exist on Jupiter's moon Europa].[57] This water, trapped within some rare meteorite structures, would be expected to contain salt (sodium chloride) from run-off minerals dissolved from potential continental portions of the former planet(s). "The existence of a water-soluble salt in this meteorite is astonishing," wrote R.N. Clayton of the University of Chicago.[58] For all conventional (primordial) high-temperature models of asteroid formation, this discovery truly is impossible. Only the trapping of Mars as a former satellite, and its release with the disintegration of Planets K&V, contains this specific discovery as an *implicit* aspect of the model.

In a further note, Carleton Moore of Arizona State University reported in the July 2000 issue of "Meteoritics & Planetary Science" the discovery of anomalously high chlorine levels (one half of the "sodium chloride" of ordinary salt) in the "Martian" meteorites (the SNCs) in ASU's collection, as opposed to normal levels in the "asteroidal" ones. The anomalous presence of water-derived salts has also been reported in NASA's most controversial "Martian meteorite" – ALH84001 – center of the reported discovery of fossil bacteria in 1996. Moore and his team, in re-analyzing their meteorites, concluded the excess chlorine could easily have resulted from saltwater leaking in. Moore sees these elements as potential tracers of "an early Martian ocean," infused with salt compounds much like Earth's own.[59] This elevated presence of salts and salt compounds in the SNCs, as compared with other meteorites, in our model simply comes from *another* ocean – one on Planets K or V. Thus, the elevated presence of water-soluble *salts* in SNCs is also remarkably consistent with the model we've presented.

In the same vein, when the bright comet Hale-Bopp made its brief but spectacular visit to the inner solar system in 1997, an unusual new cometary signature was observed (although a previous bright comet, in 1957, had also exhibited this feature.[60] In addition to the usual twin tails exhibited by comets – an ion tail of molecular fragments dissociated by the sun, and a dust tail of small particles emanating from the coma --- Hale-Bopp displayed a remarkably third tail – comprised entirely of *neutral sodium.*[61] The discoverers were at a loss to explain this unique feature, simply saying in their announcement " … there is no obvious explanation at this moment of how the observed sodium tail is formed." One of the authors (Hoagland) immediately realized that this signature, while extremely puzzling to most astronomers and planetologists, was totally consistent with the EPH hypothesis, and could easily be explained by an unseen parent molecule within the new tail: sodium chloride. In other words, if Hale-Bopp was another fragment of the disrupted planet/moon that Van Flandern initially pointed out over twenty years ago, then the discovery of sodium strongly implied that this comet parent body also had *an ocean* – and Hale-Bopp was simply another fragment of that planet. He promptly informed Van Flandern of his hypothesis.[62]

A New Mars Timeline – One of the serendipitous features of this model is that it now allows an independent assessment of the relative ages of various features and phenomenon on Mars. All previous efforts to date surface features have had to rely on relative ages, based on crater counts, normalized to cratering statistics and radiometric ages from the Moon.[63] The tidal model provides the first truly independent means of calibrating, from a radically different perspective, the geological history of Mars, if not other bodies in the solar system (see below).

Thus, a new Mars chronology can now be tentatively proposed. It is divided into three main periods: the time from solar system formation to Mars' capture by Planet V; the period of Mars' existence as a tidally-locked satellite of Planet V; and the interval post-Planet V's destruction to the Present.

Period I -- The earliest era of Mars' history – Period I in our proposed new timescale -- remains the most uncertain and ambiguous. In terms of the model presented in this paper, one key reason is the presence of widespread cratering due to the nearby explosion/collision of Planets K and V. This pattern of hemispherically devastating impacts, coupled with the massive fluvial changes to the northern plains that immediately followed, have all but eliminated records of earlier Mars' features from which reliable reconstruction of its history prior to capture would be possible. The nature of the collisional/explosive "Planets K&V Event" also effectively destroyed the ability to use relative cratering as any reliable estimate of age, on Mars (and many other satellites and planets). As previously noted, debris from this incalculable planetary catastrophe would not only have bombarded Mars, but also would have spread throughout the solar system, irrevocably changing cratering statistics and any crater-based age determinations on a host of other worlds.

Despite this major obstacle, there do seem to be some remaining clues to dating ancient Martian surface features. Recent publication of MGS evidence of deep and widespread sedimentary layering indicates a long period of "warm, wet" climate.[64] The presence in some areas of over 1000 evenly spaced rock layers (presumably from standing water deposition) also implies that these sedimentary deposits were controlled by cyclic climatological events. And this, in one model, then implies some kind of ancient, regular, polar obliquity shifts and resulting periodic increases in atmospheric density, from changing solar insolation of the Martian poles.[65]

Since this kind of cyclic obliquity shifting would be prohibited *afte*r Mars' capture as a tidally locked satellite, it is proposed here that these conditions only could have occurred when Mars was freely orbiting the sun as an isolated world. This implies that Mars enjoyed a considerable period of "warm, wet" climate *early* in solar system history, *before* its capture by Planet V, and before the internal radioactive energy sources of Mars died. In this new chronology, Mars long primordial period of isolated, heliocentric existence -- Period I – ended with the multi-body capture of Mars by Planet V.

Period II -- In this chronology, Period II dates from the "capture event" itself, to the destruction of Planet V. Surface evidence of this major phase of Mars' geological evolution includes the beginnings of radial crustal fracturing around the Tharsis uplift; the beginnings of and rapid tidal enlargement of Valles Marineris from one of these equatorial rifts; the despinning of the planet until a tidal lock of ~24 hours was achieved; the beginnings of the lesser 180-degree Arabia Terra uplift, opposite Tharsis, as a direct consequence of the establishment of tidal lock; and the eruption of vast quantities of N02, CO2 and H2O into the Martian atmosphere as a direct result of the accelerated uplift of the tidally-distended Tharsis. A significant increase in water availability, warming temperatures occasioned by an increased greenhouse process, and bi-modal pooling of this water into two stable "east/west" oceans, would have marked what might be termed this "Garden of Eden " phase of Martian evolution.

If Planet V possessed one or more additional moons, as Van Flandern has proposed, their location in the same system as the tidally captured Mars, would have occasioned an internal Martian heating similar (though less intense) to that currently seen in the Io/Europa situation.[66] Thus, for as long as Mars was a satellite of Planet V, internal energy from a tidally disturbed orbital condition, in addition to its own dying reserves of radioactive elements, would have kept its core alive, its magnetic field at full strength, and its atmosphere constantly replenished. This "idyllic" planetary situation – Period II -- would have ended abruptly some 65 MYA, in the collision of Planets K &V.

Period III – The last phase of Martian history would have begun with the destruction of Planet V and the release of Mars back into a solar orbit. With the sudden relaxation of its previous tidal lock from Planet V, all the waters collected in Mars' two bi-modal oceans would have rushed toward the lowest areas again – mainly the northern plains. This unprecedented tsunami situation not only would have scoured vast portions of the planet's crust from Tharsis and Arabia and relocated

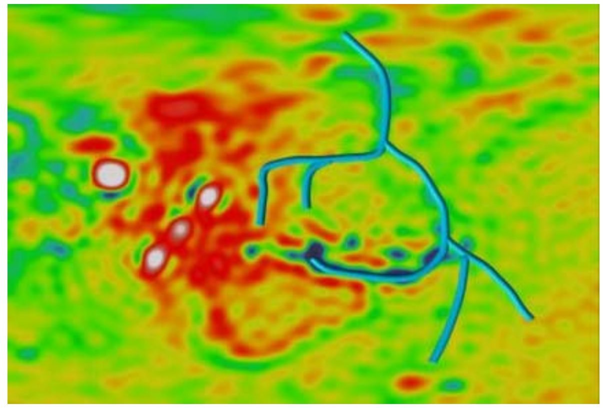

Figure 27 – Outflow water channels beneath and north of Valles Marineris (MOLA)

these previous sedimentary layers as vast mudflows across the north, the rush of waters would have carved enormous new "outflow channels" in that crust away from Tharsis and Arabia – exactly as we see. As they plunged down the Valles Marineris system and headed north, some of these now catastrophically released waters would have buried older "outflow channels," from the earlier phases of Valles Marineris' creation (Figure 27), under kilometers of additional sediments -- also confirmed by the new MOLA observations.[67]

Recent MGS observations have uncovered additional striking evidence supporting this "catastrophic collapse" of the former "Tharsis ocean," this time northwest of Arsia Mons. Writing in the June 2001 issue of the *Journal of Geophysical Research,*[68] University of Arizona researcher James Dohm has billed his team's new findings as "the largest flood channels in the solar system," caused by "catastrophic floods of enormous magnitude" – some 50,000 times the flow rate of the Amazon. Located southwest of Olympus Mons (Figure 28), the newly-discovered channels are 10 times the size of Kasei Valles, the largest previously known outflow channel system on Mars. Measuring as wide as 200 kilometers, in our view only the catastrophic collapse of the former "Tharsis tidal ocean" and the scouring effect of trillions of tons of newly-released water rushing north can now account for their existence – exactly as the tidal model would predict.

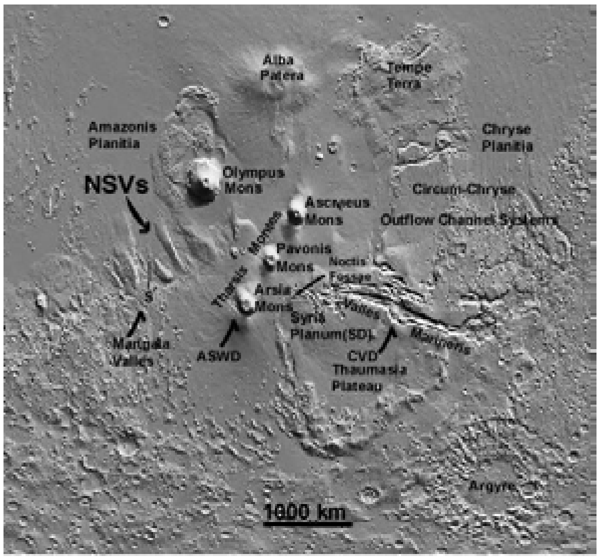

Figure 28 – New flood channels on Tharsis (NVS) -- 10 times larger than any previously discovered, draining north-west.

Strikingly consistent with this model is the bi-modal distribution of *all* the Martian "outflow channels." If the oceans we've projected were bi-modally distributed, as we now state categorically, then the outflow channels emptying those oceans when the tidal lock collapsed would also be expected to have a bi-modal distribution in the geologic record. Again, this is exactly what we see. Examination of the channel distribution maps from MGS (Figure 29) reveals that catastrophic outflow channels draining the two potential tidal oceans are unquestionably also bi-modally distributed -- around the *periphery* of both the Tharsis and Arabia regions, exactly as the tidal model would predict.

Apart from the immediate (and catastrophic) relocation of Mars' oceans, the slow geological relaxation of Tharsis (and to a lesser extent Arabia) back into the mantle after their partial tidal support was suddenly removed, would have begun in Period III as well. This would have created over the following millennia an inevitable downward warpage of the crust around this massive, now unsupported uplift, called the "Tharsis trough" (Figure 24). This inevitable settling would have also triggered additional volcanic activity both in those regions, and at 90 degrees. The latter we have now identified with the late creation of Elysium Mons.

The catastrophic arrival on Mars, a few hours after the Planets K&V collision, of the first debris wave, is marked by the peculiar "line of dichotomy" of "shoulder-to-shoulder" impact cratering that has so puzzled planetary geologists since 1971. These first impacts would have begun a long period of Mars continually "mopping up" material left from the catastrophe near its resultant solar orbit; estimates for this interval depend on how rapidly the huge quantity of dust and larger crustal fragments would have either collided with Jupiter (or other solar system planets), or would have been completely ejected from the solar system by encounters with these bodies. Those estimates range from "a few million" to perhaps 100 million years.[69]

Because of this vast orbital reservoir of condensed core and mantle materials from the Planets K&V collision, Mars would have continuously "swept up" new supplies of olivine and iron-rich sulfur compounds from space for millions of years. This process would have continually replaced previously fallen materials weathered from surface exposure to liquid water stemming from irregular periods of Martian volcanism, triggered by the continuing slow collapse of Tharsis and Arabia. In this way, Mars surface history after the collision ~ 65 MYA – the beginning of Period III -- would have been a complex tale of episodic "warm, wet" periods in which these "primitive" materials could be destroyed, followed by cold and arid intervals in which they could once again accumulate. This episodic environment likely has extended to the Present, triggered by this residual internal volcanism from the continued settling of Tharsis, as well as major obliquity shifts and their periodic warming and release of current polar reservoirs of C02 and H2O.

In our model, one direct consequence of this accreted, sulfur-rich surface environment is the mysterious "stains" themselves. Appearing initially as extremely dark, flow-like features on sloped surfaces, it is our proposal that "stains" are created in Period III by underground liquid water, "wetting" surface *sulfur-rich* materials. On the current sands of Mars, composed of iron oxides and trace sulfur compounds, this would initially produce *sulfuric acid*. The acid would then reduce the iron-sulfur mixtures to an extremely stable, dark black compound -- ferrous sulfide (FeS) -- which would remain visible for years after this initial "wetting."[70] Eventually, this black "iron sulfide" stain would be converted back to reddish iron oxides, via the simple process of oxidation (Figure 30). This would come from the trace amounts of free oxygen continuously liberated from Mars' predominantly carbon dioxide atmosphere by solar ultraviolet radiation.

Figure 30 – Dark (fresh) flows alongside lighter faded (older, oxidized) flows (USGS).

Another validation of the tidal model may lie in the recently published work of Kuzmin R.O. and E.V. Zabalueva Vernadsky. In June, 2000 the two geochemists from the Institute of Geochemistry and Analytical Chemistry, Russian Academy of Sciences, presented a paper at NASA's 31st Lunar and Planetary Science Conference on the possibility of liquid water on the current Martian surface. They proposed that the presence of water-soluble salts in the Martian regolith should influence the melting temperature of any ice currently trapped in the upper layers of this icy, porous soil. In the presently observed climate of Mars, such "icy soil" conditions (they contend) would be expected only above 40-45 degrees North and South (the ice, in this model, long having evaporated closer to the Equator, in the billions-of-years history of Mars). In the Russians' calculations, the salts' presence even in this high-latitude ice-containing-soil could produce a liquid water phase (seasonally) in a broad range of negative temperatures.[71]

In the tidal model, the last major source of liquid water flowed across Mars only 65MYA -- not "billions." Therefore, groundwater would not have had sufficient time to sublimate from the current Martian soil in regions close to the Equator. In these equatorial regions, according to our model, now lie the 180-degree seabeds of two former tidally-locked oceans, whose underlying sediments would be expected to contain a very high percentage of exactly these essential water-soluble *salts* needed to keep subsurface water liquid under current Martian temperatures.

Thus, the equatorial location of the "stains" (30 degrees plus or minus), and their clear bi-modal 180-degree distribution, also strongly suggest – supported by the Russians' calculations -- that "stains" do in fact represent current aquifers of liquid, *briny* water from those former "twin" Mars' oceans.

Implications for Martian Life – It is now undisputed that the catastrophic events which brought the Cretaceous to a close ~65 million years ago, and resulted in the elimination of the dinosaurs, also made it possible for mammals to eventually overrun the Earth. And, some 62 million years later – at the time of the postulated collision/explosion of the 2nd moon of Planet V, which (according to Van Flandern) resulted in comets like Hale-Bopp -- one of those lines of mammals was just beginning to assume eventual domination of the Earth – the primates that would one day lead to us.

These events, we now believe, were inexorably set in motion by the destruction of Planets K&V.

But what of Mars itself? How long did Mars spend as a satellite of Planet V – in Period II -- before the latter was destroyed? Was there time enough for life to actually originate upon the planet, and if so, when – in Period I, *before* its capture -- or in Period II, sometime *after*? If life did evolve on Mars, what can the tidal theory tell us now about its subsequent development? Are there any clues contained in the Martian tidal model which could reveal if and when a "biological capture clock" for Mars was ever started?

As stated earlier, we now know from MGS of the existence of massive, regular sedimentary layers across major sections of the planet. From these we can logically infer that Mars experienced a protracted period of systematic climatological change, most likely in response to cyclic alterations in its spin axis obliquity – which laid down sediments in response to these repeating environmental cycles.[72] Clearly, this period refers to Mars orbiting the sun as *a single planet* -- as such significant obliquity excursions, according to the work of Lasker et al. (1993) strongly indicate that major obliquity excursions would have become impossible during Mars' tenure as a tidally captured satellite.[73]

Calculations of Mars current isolated obliquity shifts by Wisdom et al. (1995)[74] reveal chaotic excursions up to 60 degrees, and periods on the order of 3-5 million years. These would inevitably result in drastic changes in Martian atmospheric density and temperature, as polar ices melted and refroze – thus easily producing the extensive sedimentary deposition layers MGS has now discovered.[75] Taking one MGS observation "of a thousand individual layers," and multiplying by the amount of time in each potential long-term cycle (~3-5 million years), we arrive at one estimate of the span of time represented by this pre-capture phase of Martian evolution: several *billion years*. This, in effect, is equal to the ~ 5 billion years since the formation of the solar system.[76] From this we can now estimate that the time Mars spent as an isolated planet, *before* capture – in other words, the length of Period I -- was probably *most* of solar system history.

So, when did Mars' capture occur?

Based on extensive new calculations published in recent years, it appears that "chaotic instability" of the solar system orbital dynamics can set in even after *several billion years*.[77] These calculations, however, have been performed without consideration of two former "missing" planets (this model). It is therefore likely that our solar system's stability would be even more chaotic with their addition to the model – particularly, if (as we and Van Flandern propose) they once inhabited the current region between Jupiter and Mars. This is due to Jupiter's disproportionate effect (from its excessive mass) on all long-term stability considerations.

If basic solar system physics is now questionable, even after billions of years of apparent "orbital stability," then it is also theoretically possible for the "rare" planetary event we've proposed in this paper to have occurred: the close encounter of Planet V with Mars, with the subsequent ejection of another satellite -- required to remove sufficient energy for capture. Which again raises the crucial question: *when did this occur?*

The capture of Mars by Planet V -- through the mechanism of the ejection of another satellite -- presents a possible independent means of dating this seminal event. Such an ejected satellite initially would have assumed its own moderately eccentric orbit of the sun – resulting in relatively rapid resonance encounters with either Jupiter or Earth. These close approaches, especially with Jupiter, would have radically altered its initial heliocentric orbit, resulting either in eventual complete ejection from the solar system or eventual catastrophic impact with another planet.

It is our tentative proposal here that such an impact *did* occur -- with Venus as the target. Because these two events are linked – the "Mars exchange" of a satellite with Planet V and its eventual Venus impact – this sequence of events may in fact allow a *date* as to when the capture of the planet Mars by Planet V occurred.

Venus is a unique planet. Although often described (because of size and composition) as a "sister planet to the Earth," in fact the two planets could not be more different. From its atmospheric composition (~ 97% CO2) to its impenetrable clouds of *sulfuric acid* (more anomalous surface sulfur …), to its surface temperature (~900 degrees F.), to the pressure at the base of the atmosphere itself (92 times the Earth's), Venus' current environment is as opposite from the environments of Earth and Mars as one could possible imagine. And, unlike the rotational periods of Earth and Mars and their direction of rotation, Venus spins in the *opposite direction* – and takes 243.7 days to make one complete rotation.[78]

Magellan spacecraft radar data from its 1990-1994 survey of the planet revealed a surprising geological discovery: some catastrophic event appeared to have *completely erased* the normal range of impact craters expected from Venus' earliest eons. The planet appeared, instead, to have been *completely resurfaced* in a geologically brief period via a violent paroxysm of planet-wide volcanism. The provisional dating of this event: ~500 MYA.[79]

It is our proposal in this paper that these *three* phenomena – the cataclysmic global melting of Venus; the reversal and slowing of its spin; and the capture of Mars by Planet V -- are the result of the *same* causal sequence of events: the ejection of a Planet V satellite at the same time Mars was captured, and the ultimate collision a few million years later of that massive moon with the second planet from the sun. This collision not only *radically changed the orientation of Venus' spin axis to its current retrograde rotation,* but the energy of the event essentially *melted the entire Venusian surface*. The extremely puzzling anomalous sulfur abundance seen on Venus (as well as equally disturbing quantities of argon-40, and even chlorine in the atmosphere – perhaps a signature of a former Venusian *ocean*?)[80] is thus a direct result, in this model, of the impact of a major *silicate* satellite from planet V -- propelled into Venus a few million years after the exchange of Mars at the inner edge of the (eventual) location of the Asteroid Belt.

This "causal chain," if we are right, thus dates Mars capture to ~500 MYA.

Remarkably, *the* major biological event of terrestrial evolution was occurring *coincident* with these phenomena: the sudden appearance (in less than ~40 million years) of *all* the current advanced life forms on this planet, called the "Cambrian Explosion."[81] This was followed by ~500 million years of subsequent evolution of those life forms, ultimately resulting in the human species.

If this reconstructed timeline is correct, then the extent of Period II on Mars – a “warm, wet” capture interval, fed by volcanic activity stimulated by Mars tidal situation as a satellite of Planet V -- was essentially *the same* as that for the appearance and development of advanced life on Earth. This timeline now has profound implications for the independent evolution of intrinsic Martian life.

From the evidence we have assembled, we now know that that large oceans existed during Period II on Mars (otherwise, there would be no vast flow channels when their tidal lock was suddenly released); that an atmosphere dense enough to permit a greenhouse effect to keep that water liquid also had to exist (otherwise, there would have been no “liquid water” in such vast amounts); and that such an atmosphere had to have contained (at least toward the end) abundant amounts of *free oxygen* (otherwise, the iron currently dispersed across the Martian surface would *not* be in its highly oxidized condition). These observations all parallel the simultaneous development of an equivalent environment suitable for the evolution of advanced life forms on Earth: time, temperature, liquid oceans, and an oxygen-rich atmosphere.

It is thus our tentative conclusion, based on the model presented here, that the tidal epoch of Mars – Period II -- may have led directly to a separate, spectacular evolution of *indigenous Martian organisms.* In fact, there is nothing in this data to preclude the ultimate appearance of *intelligence itself.*

We only have to be willing to seriously look.

Predictions – The “Mars tidal model” we’ve presented offers a host of future, short and long-term observations by which to judge the full potential of the theory.

In October, 2001, NASA’s next unmanned Mars mission – 2001: Mars Odyssey – arrives. By December, it will have been aerobraked into its final, polar orbit and begun a set of unprecedented surface observations.[82] Some of these will be directly related to the viability of the Martian tidal model we’ve presented.

Odyssey carries three new scientific instruments to Mars: THEMIS, a combined visual/infrared camera; GRS, a gamma ray spectrometer; and MARIE, the Mars Radiation Environment Experiment.[83] GRS is an instrument designed to detect gamma ray emission and neutrons via cosmic ray-excited stimulation from 20 primary elements – including silicon, oxygen, iron, magnesium, potassium, aluminum, calcium, sulfur, and carbon.

It is this GRS instrument which will furnish the first definitive test of the Mars tidal model presented in this paper.

One of the elements GRS will detect is hydrogen. Hydrogen makes up two thirds of every water molecule. Thus, Odyssey will map for the first time (to a depth of approximately one meter) the global distribution of hydrogen on Mars, from which a global distribution of all subsurface ice and/or liquid water will be inferred.[84]

The Mars tidal model specifically predicts, based on the currently observed bi-modal stain distribution in the MOC images, that Odyssey’s GRS will confirm a *superimposed* bi-modal distribution of subsurface hydrogen over Tharsis and Arabia on Mars. From this, a similar bi-modal distribution of ice and water on the planet will be inferred. Only the tidal model can properly account for this unexpected (to all other Mars models) expected global distribution.

But, the Odyssey observations have the potential to confirm a good deal more.

That Planet V had to be destroyed, thus releasing Mars from its previous tidal lock configuration, is a given of this model. But, if the destruction of Planet V and the release of Mars was *not* via a collision of the two major planetary bodies (K&V), then the only viable alternative is a genuine *explosion*.

One critical test of this hypothesis will present itself via additional impending Mars Odyssey/GRS observations of Mars. If a major new energy source exists, based on a revolutionary physics capable of literally destroying worlds, then one side effect of this should have been the creation of a series of highly radioactive short-lived elements in the wake of the Planet V Event. It is strongly implied, based on the calculated energies required to "explode" a planet that such a source would of necessity involve *nuclear* level effects – in which case the associated isotopes might well mimic those found in similar catastrophic stellar detonations.[85] Because of the relatively recent time frame for the proposed destruction of Planet V (~65 MYA), several elements and isotopes from such a massive, anomalous nucleosynthesis in the vicinity of Mars – if it took place -- should still exist. These may include the isotopes aluminum 26, lead 107, iodine 129, plutonium 244 and samarium 146.

With half-lives ranging from a few hundred thousand to 150 million years, Odyssey's GRS should be able to detect gamma ray emission direct from some of these primary "anomalous" isotopes, if they are present on Mars in significant amounts. Other direct decay signatures would include neutrons, as well as electrons and high-energy helium nuclei. The second Odyssey radiation instrument -- MARIE – should be extremely valuable in corroborating the latter anomalous "high-energy phenomenon" currently emanating from Mars' surface, if they are in fact present.

The global distribution of such radioactive isotopes (or their daughter products) should also, in the model, conform to the observed TES data on anomalous mineralogical distributions: divided again by the "line of dichotomy." If present, most radioactives (or their products) from the "Planet V Event" should still be found covering the southern hemisphere – consistent with an explosion, in this variation of our model. Measurement of the remaining isotopic distribution, compared to daughter products, should also unequivocally determine the *date* of this Event.

Positive detection of such short-lived radioactive elements on Mars would raise the stakes enormously. For, not only would the specific tidal model detailed here be resoundingly confirmed, but a clarification of precisely *how* Mars former "parent" planet was destroyed – via a "new physics," with all its attendant implications -- would finally be forthcoming.[86]

Verification of longer term predictions of this model depend on more aggressive manned and unmanned Mars missions. Example: insitu measurement of the still occurring slow collapse of Tharsis back into the mantle, from a network of seismic stations placed at strategic points across the surface, should confirm the "recent" date of this event -- ~65 MYA.

The tidal model also contains a cautionary tale for future missions and investigations. In the current search for Mars' elusive water reservoirs, already some investigators (Malin et al. – 1999) – based on a few high-resolution MGS imaging of very selected regions of the northern plains[87] have rejected the idea of "ancient oceans." The absence of wide-spread, long-term oceanic features along the margins of the northern plains – for instance, fluvial-eroded scarps -- argues in their presentations that Mars never supported long-term, liquid, wind agitated waters on those plains. And, in the current Martian models, if Mars ever had significant amounts of standing water ("oceans"), they would have *had* to occupy those currently-observed (from MOLA), low-lying northern plains.

But this is precisely opposite what the tidal model argues: that Mars' long-term oceans were *not* centered around these current low-lying northern areas -- but around Tharsis and Arabia, with a vast gap of dry land (including portions of the northern plains) between. Only when the tidal lock with Planet V was broken, do we contend that a vast amount of water rushed toward these low lying northern Martian regions. But, such waters would also have quickly evaporated and/or frozen – leaving *no time* to etch classic "oceanic signatures" across those plains.

The warning is quite clear: without the correct Mars' model, future missions and investigations run the serious risk of looking in the wrong locations for the wrong surface features to test the wrong geologic models.

Likewise, an aggressive effort to locate fossils and/or evidence of former intelligence on Mars must focus on the *correct* regions in this model. Such investigations, if properly conducted, should ultimately lead to a confirmation of our now ~500 MYA timeline for Mars' parallel biological development with Earth – the discovery of a variety of truly advanced indigenous fossils (some of them quite large), and/or even *artifacts* -- only possible if the tidal model is substantially correct.

Conclusions – Richard Feynman was once quoted as saying "You know you're on the right track with a new idea, if you put in fifteen cents and get two dollars back."

The Mars tidal satellite model we've presented here is just such a "two dollar" idea. It for the first time accounts for a number of baffling, enduring mysteries about the Red Planet, while at the same time remaining consistent with each new observation -- such as the recent equatorially constrained, bi-polar "dark stain phenomena," and MGS observations of "recent" (<100,000 year) ice deposits near the Martian surface.[88]

Previously enigmatic Martian surface features are now elegantly and simply explained by the significant tidal forces to be experienced in such a captured orbit. These include a unique tidal erosion mechanism for the largest canyon in the solar system – Valles Marineris; the presence of two antipodal "bulges" in the mantle and crust of Mars – Tharsis and Arabia – raised by these major tidal forces over time; and the otherwise inexplicable bi-modal distribution of current fluvial signatures known as "stains," as the fossil remnants of two former "bi-modal tidal oceans."

The Mars tidal model also accounts for the presence of vast surface and deep, ancient water channels flowing northward from Valles Marineris, and now Tharsis; the vertical scarp encircling Olympus Mons; the otherwise inexplicable height and volume of the Tharsis volcanic uplift itself; the location of the Arabia and Elysium uplifts (at 180 and 90 degrees, respectively), from Tharsis; the formation of the Tharsis "trench"; the extreme difference in crustal thickness between the hemisphere's above and below the "line of dichotomy"; the dramatic difference in cratering patterns between these same two hemisphere's; and the sudden fluvial excavation of massive amounts of material from the Arabia Terra rise.

It also accounts for the otherwise inexplicable presence of high levels of iron, iron oxides, sulfur and olivine on Mars – all major signatures of some kind of *external* "collision/explosion event" recently in solar system history.

The authors fully acknowledge that certain secondary aspects of the tidal model may not be testable as yet. For instance, it may not be possible to precisely determine what precipitated the destruction of Planet V. Two possibilities have been suggested here: either, a devastating collision with another major object also formed in this general location of the early solar system; or, the outright explosion, via a literal "new physics," of Planet V. Either mechanism results in the return of Mars to a free orbit of the sun circa 65MYA, as mandated by this model, and leaves vital surface clues (for follow-on missions, such as Mars Odyssey) as to this crucial sequence of events.

However, there is sufficient evidence now consistent with this model to strongly infer the prior existence of a "Planet V." This is based on the clear signatures of its effects now visible in the topography and geology of Mars, as well as other bodies in the solar system. The lack of a currently verifiable mechanism for Planet V's destruction in no way diminishes the wide-ranging implications of the striking evidence of its demise, nor the quiet surface testimony of its profound effect upon the body we call "Mars."

Finally, there is significant evidence that Mars' environment -- as a tidally locked satellite for ~500 million years -- created conditions astonishingly favorable to the evolution of advanced biology upon the planet. Recent rediscovery of decades-old Viking data, indicating the presence of microbes in the soil exhibiting a 24.66-hour Martian circadian rhythm, leave wide upon the possibility of much higher evolution not yet officially discovered. This includes the now distinct possibility, based on the eerie parallel of Mars reconstructed 500 MYA of evolution with the Earth's, of even former *intelligent* inhabitants.

It is the opinion of the authors that the evidence of Mars as a tidal locked satellite is now sufficiently compelling to begin a major reassessment of our current view of Mars.

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Figures

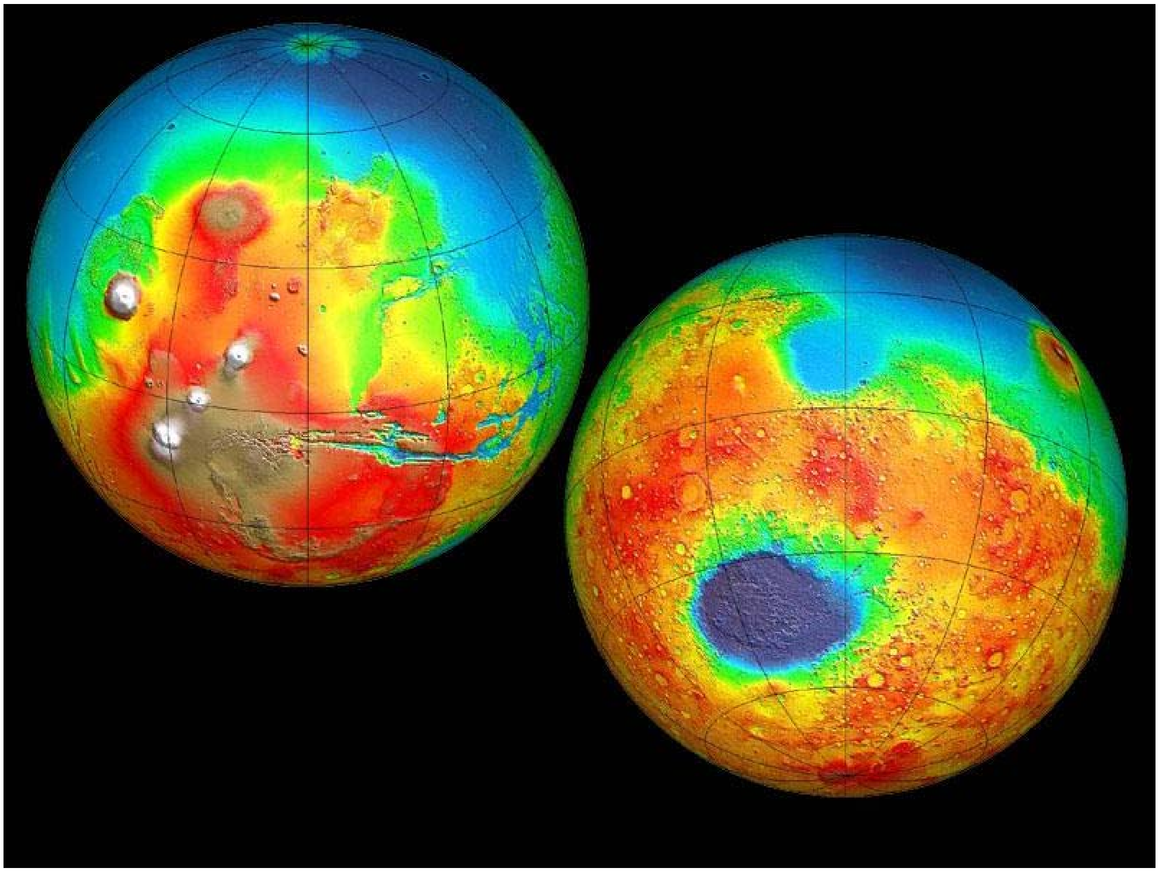
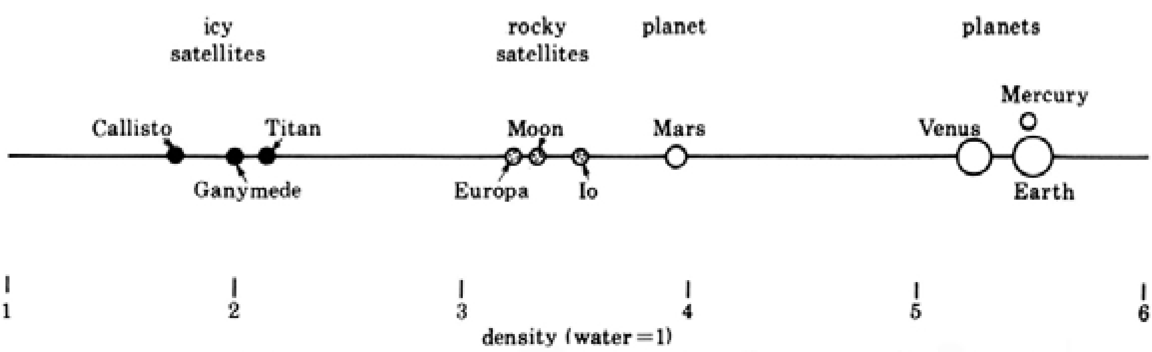


Figure 1 – Fig.1 - MOLA colorized image of Mars showing the heavily cratered southern highlands (yellow and orange) and the smooth, sparsely cratered Northern lowlands (blue and green).



Terrestrial planets and some larger satellites strung out according to density.

Adopted from Woolfson (1984)

Figure 2 - Terrestrial planets and larger satellites listed according to density. Mars is much closer to Earth's Moon, Io, and Europa in density than it is to Venus, the first major terrestrial planet listed.

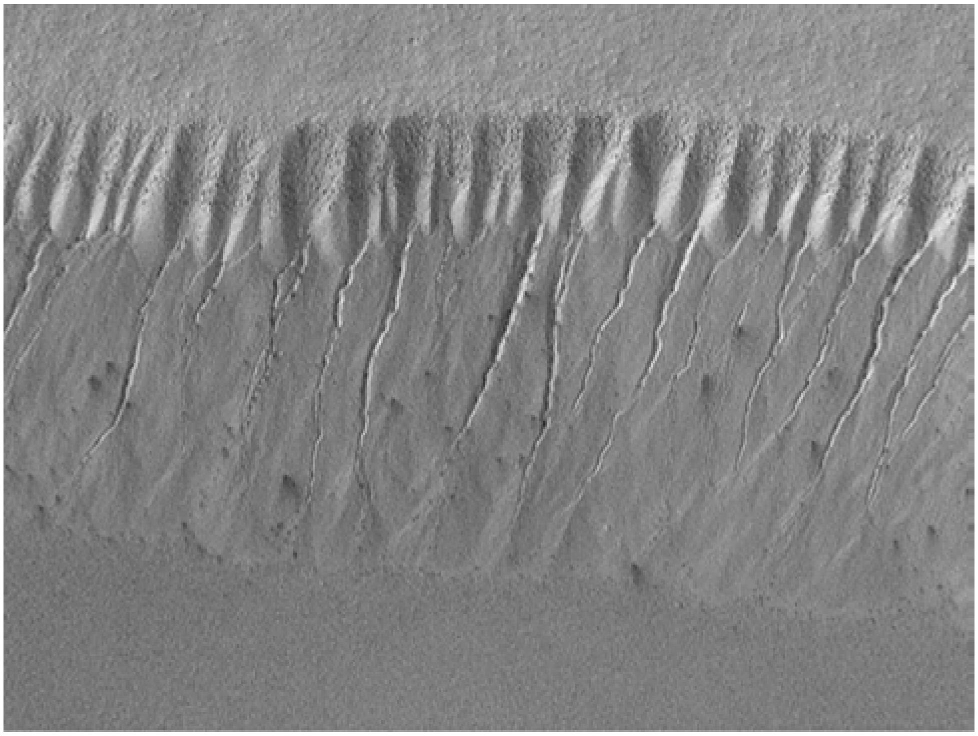


Figure 3 – Proposed fossilized water runoff channels. (MSSS/NASA)

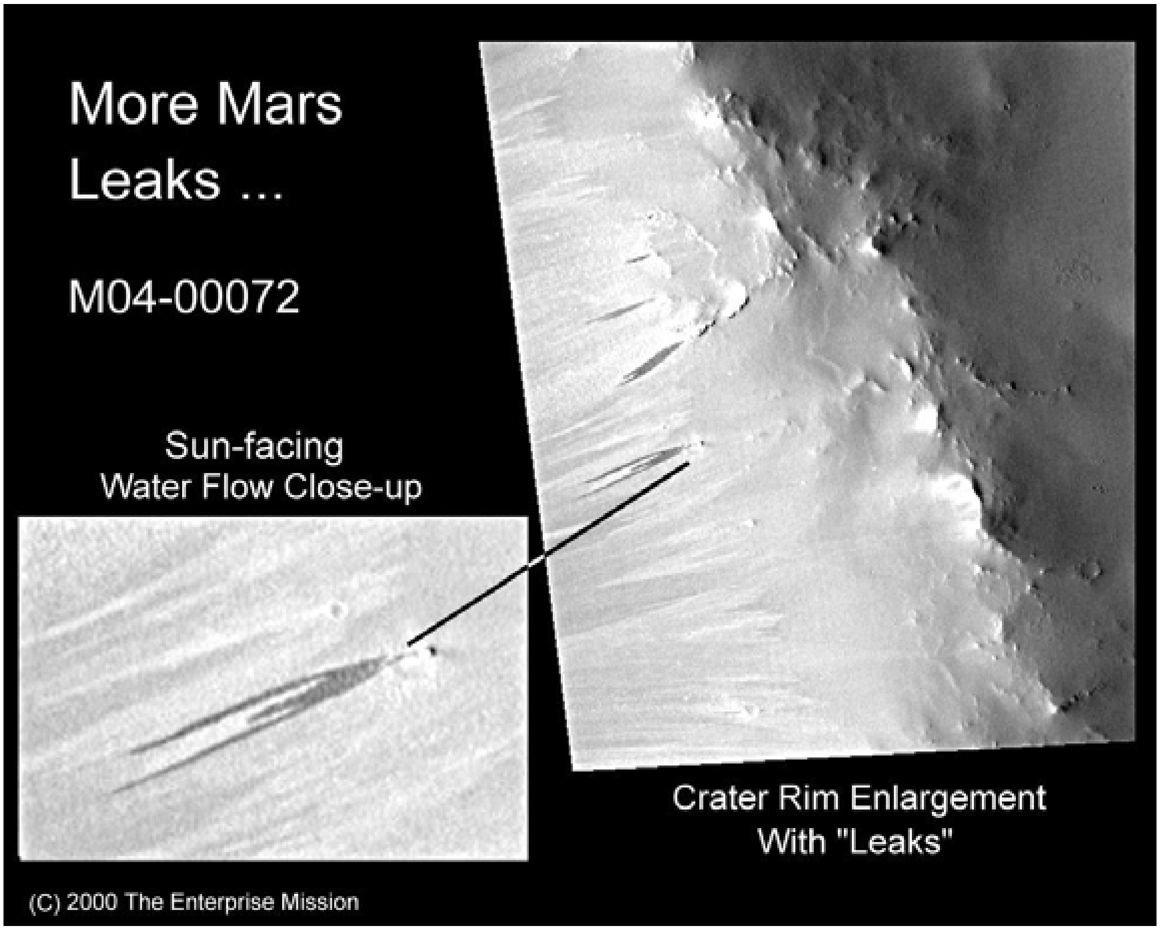


Figure 4 – Proposed point source liquid water burst image from MO4-00072 (MSSS/NASA)

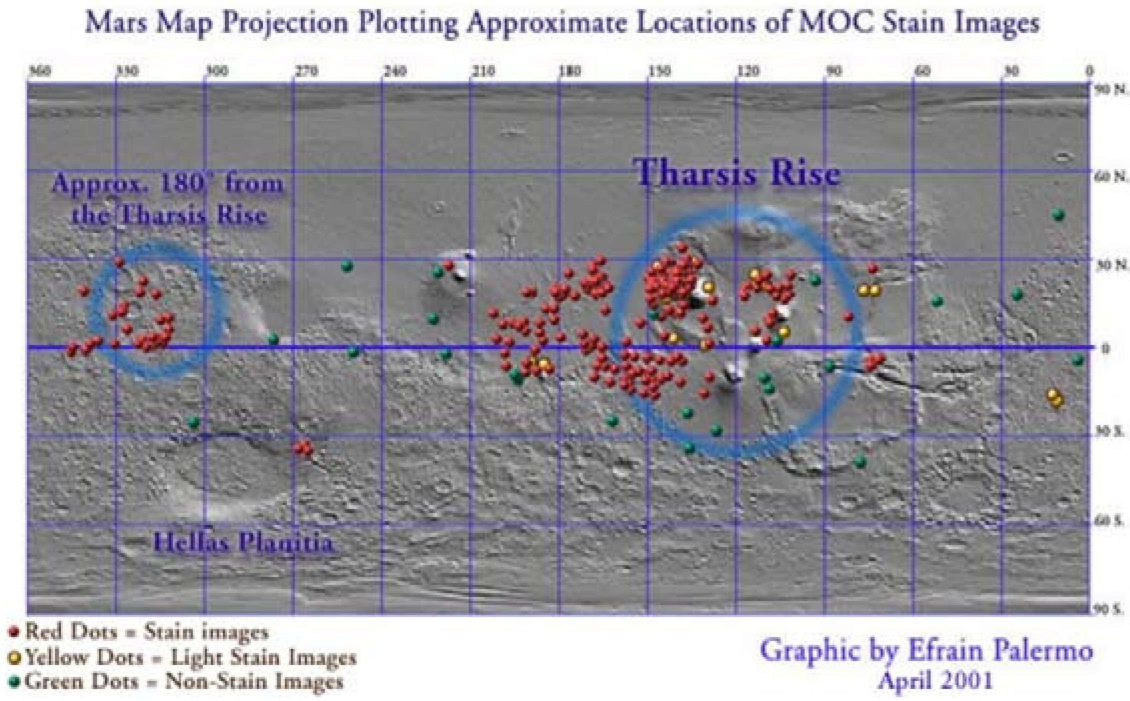


Figure 5 – Map showing flow image distribution.

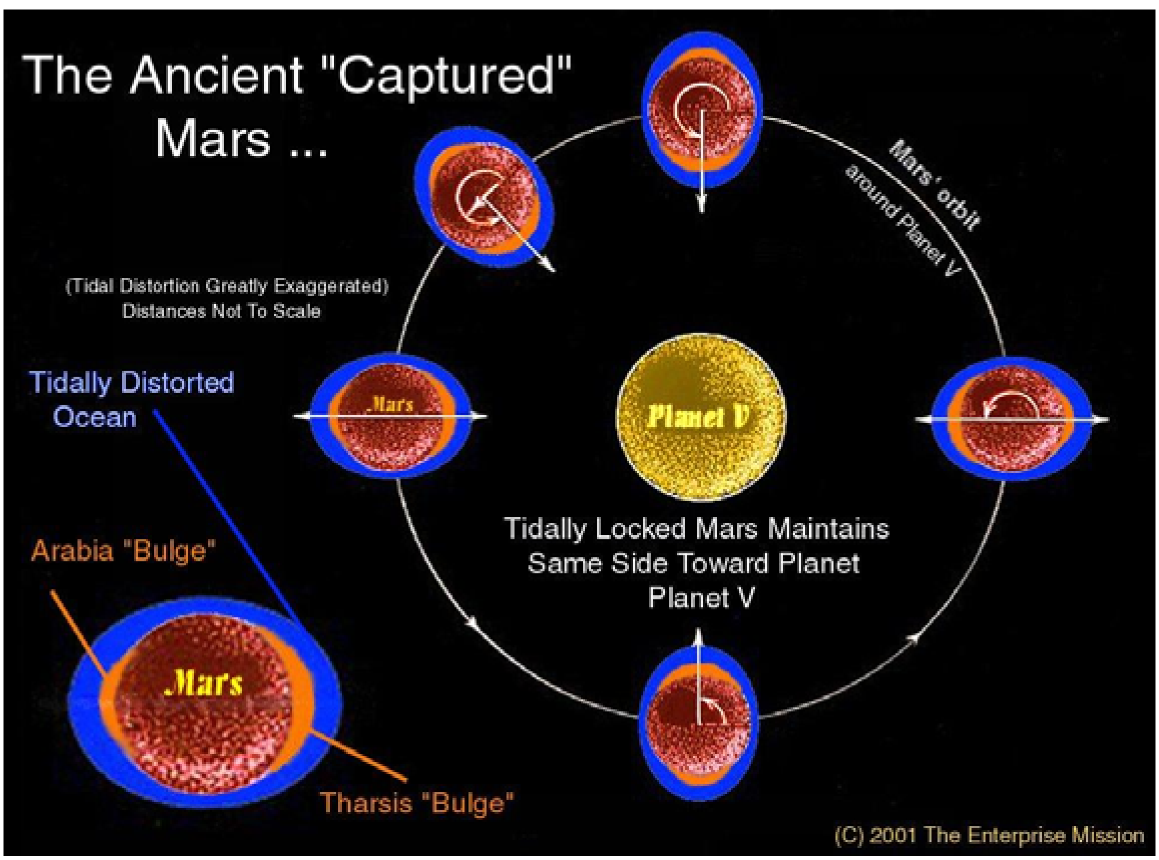


Figure 6 – Mars captured by the larger Planet V and brought into a tidal lock relationship, with gravitational bulges developing on opposite sides of Mars, 90 degrees to the spin

axis of Planet V. Bulges precisely correspond to the Tharsis and Arabia bulges, 180 degrees apart.

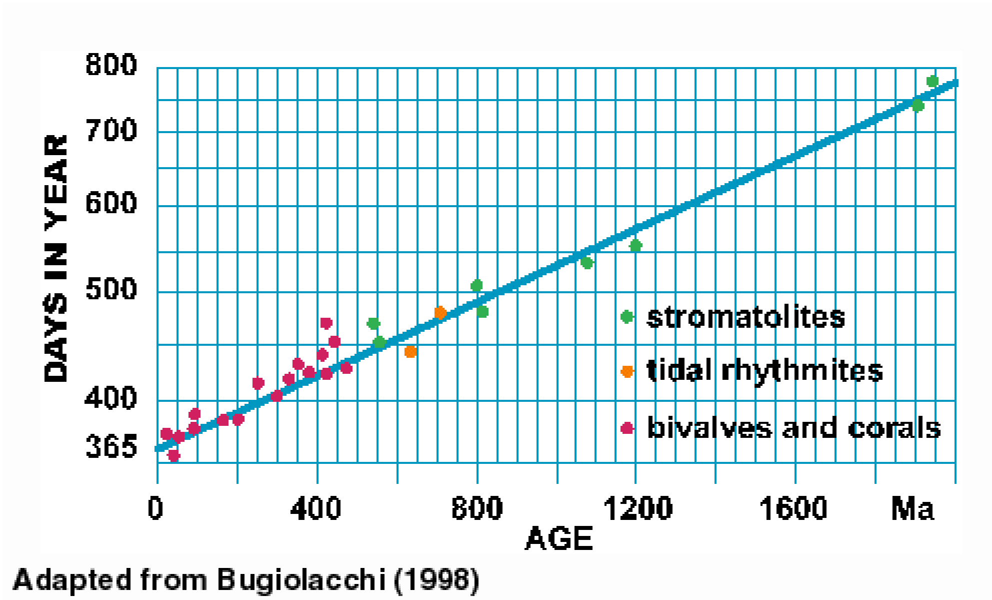


Figure 7 - Growth increments of fossils and tidal sediments on Earth record a significantly shorter day as one moves further back in time.

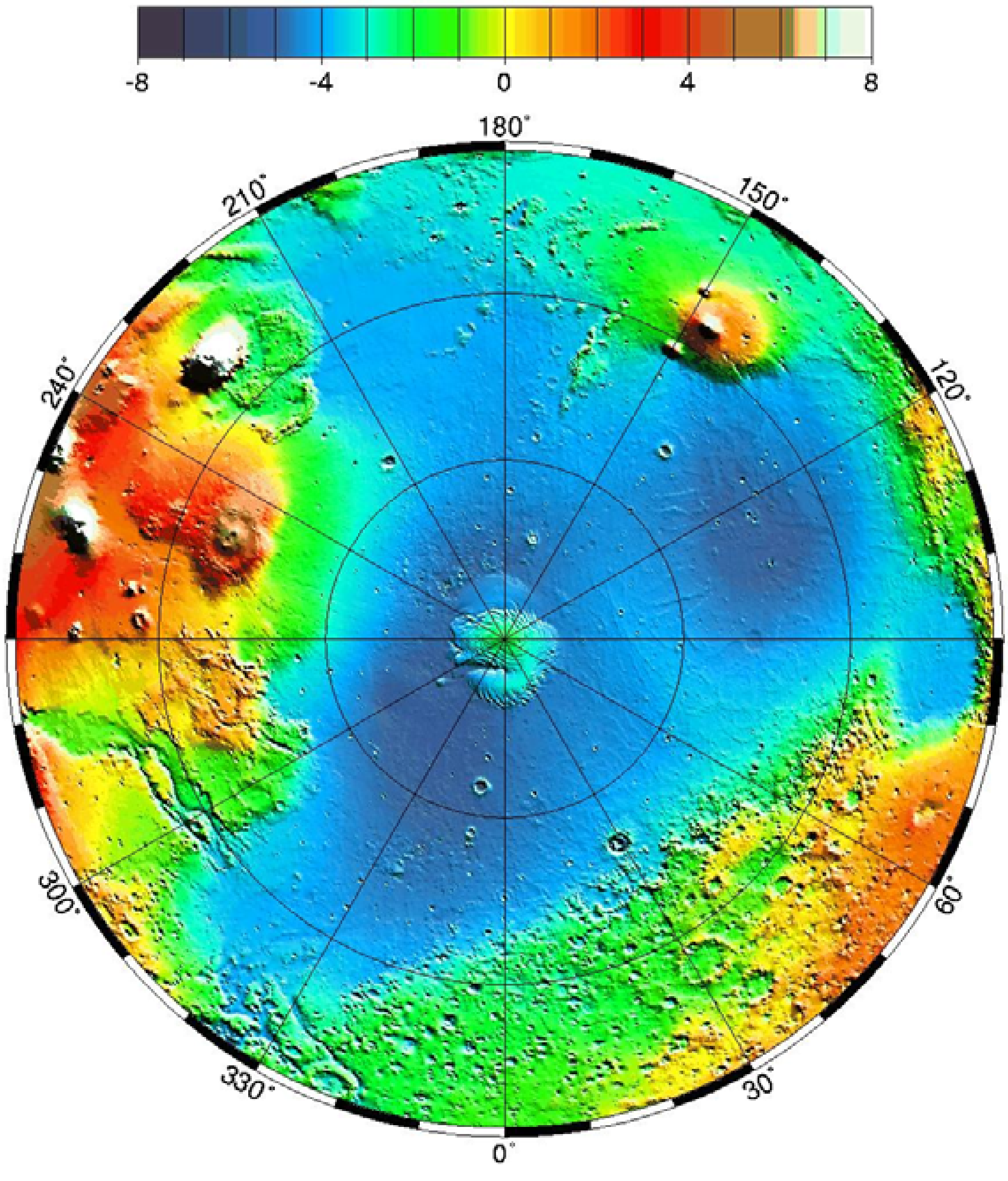


Figure 8 - Colorized polar MOLA image (NASA) showing location of Tharsis (~240°) and Arabia (~60°) bulges on Mars, 180 degrees apart around the longitudinal circumference of the planet. Note also Elysium Bulge, roughly 90 degrees from the tidal axis between Tharsis and Arabia.

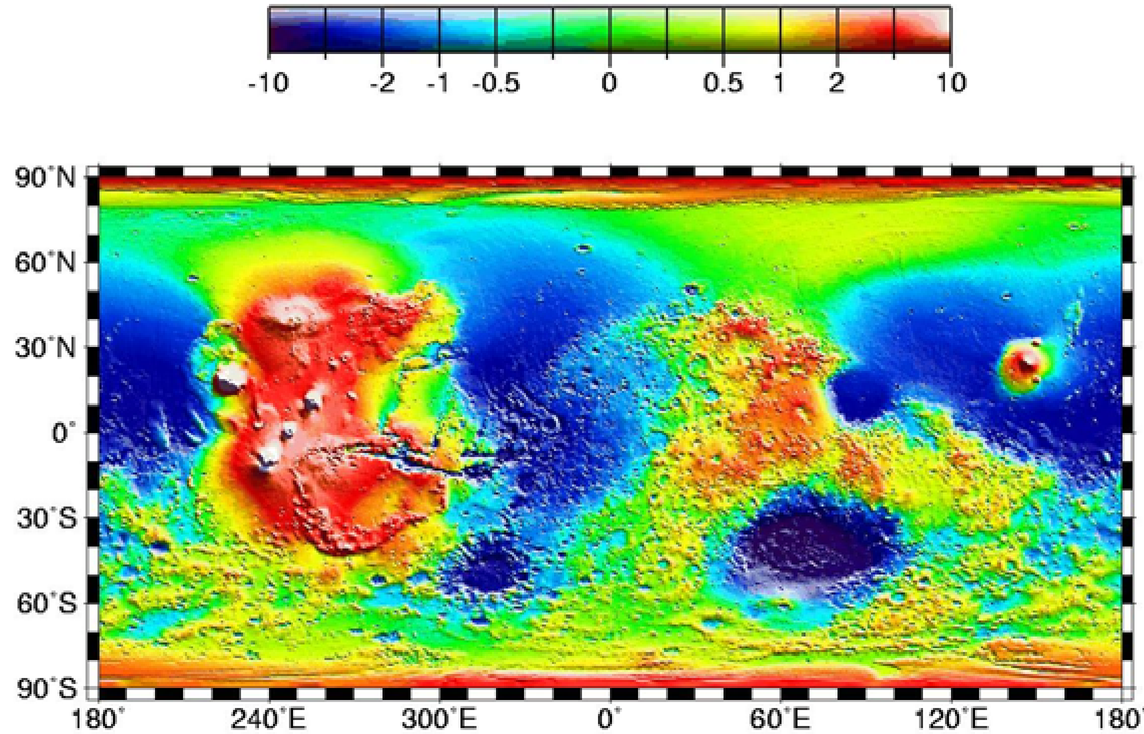


Figure 9 – Colorized Mercator projection of MOLA data (NASA) showing the locations and elevations of Tharsis, Arabia, and Elysium bulges (red is the highest elevation).

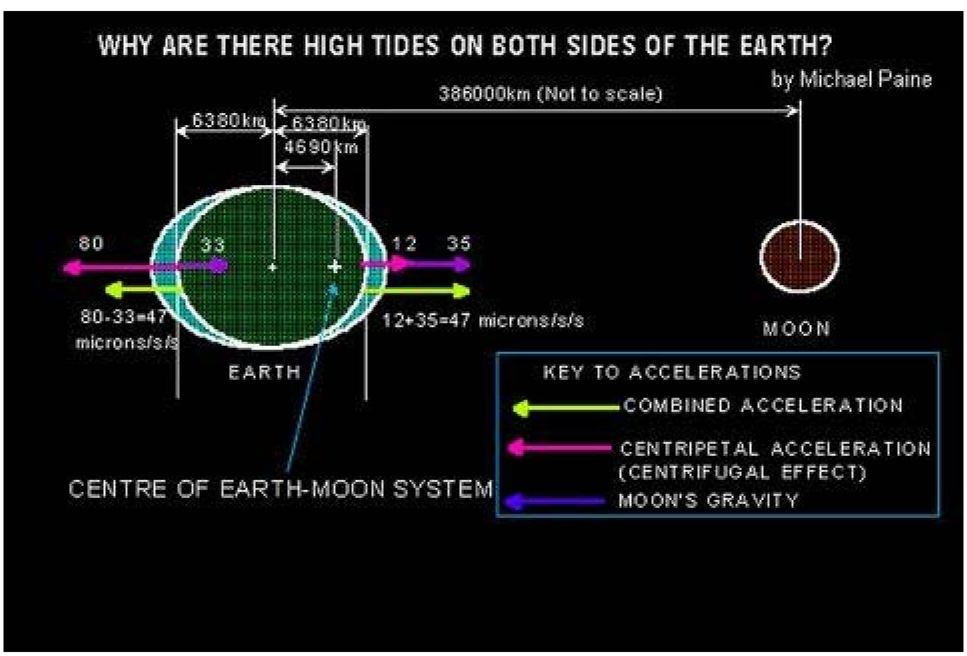


Figure 10 - Example of typical anti-podal tidal bulge on Earth


Figure 11 – A typical terrestrial tidal bore wave making its way up a river basin.

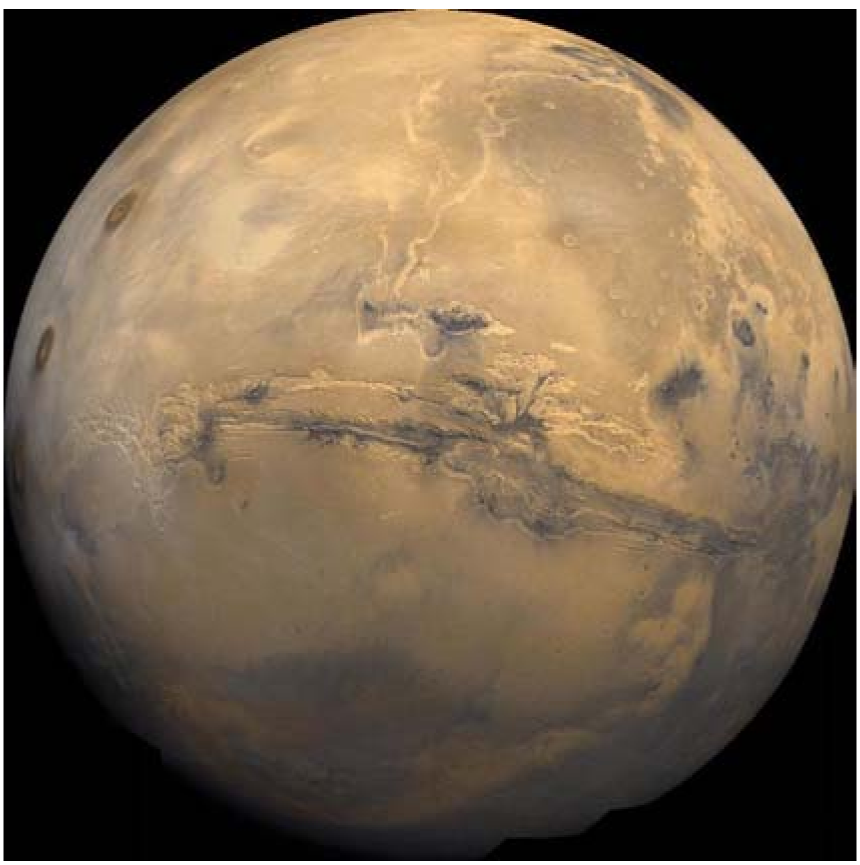


Figure 12 – Valles Marineris, a heretofore inexplicable trough extending one quarter of the circumference of Mars is the largest canyon in the Solar System. The authors submit that this a fluvial trench generated by tidal bore action.

Figure 13 – Artists conception of Mars as it might have appeared during its "Garden of Eden" period after capture by Planet V.

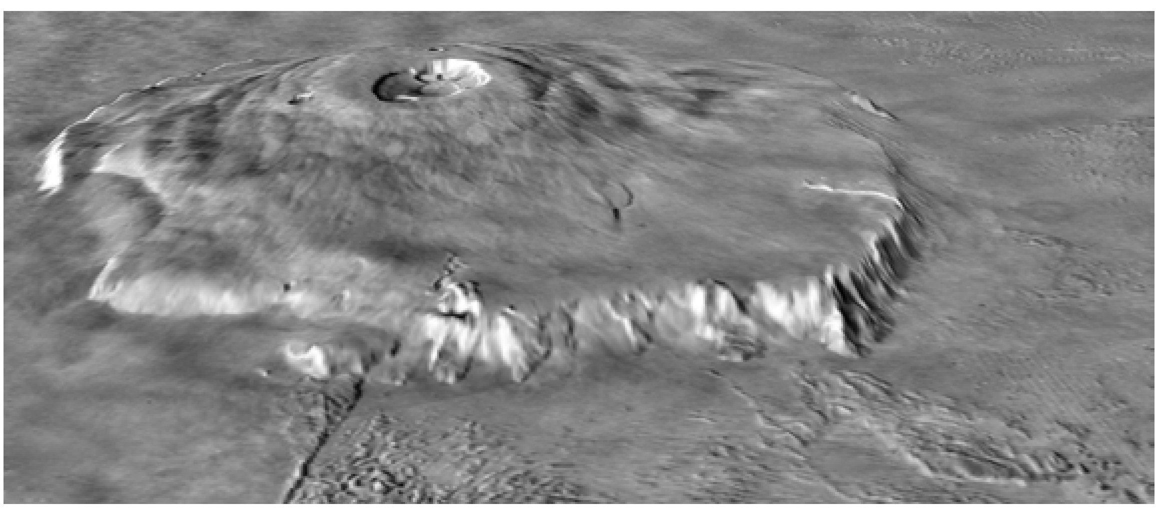


Figure 14 – Olympus Mons 3D perspective image showing prominent vertical scarp at the base of the lower flanks (NASA).

Figure 15 – The White Cliffs of Dover, a vertical, aeolian wave action terrestrial feature.

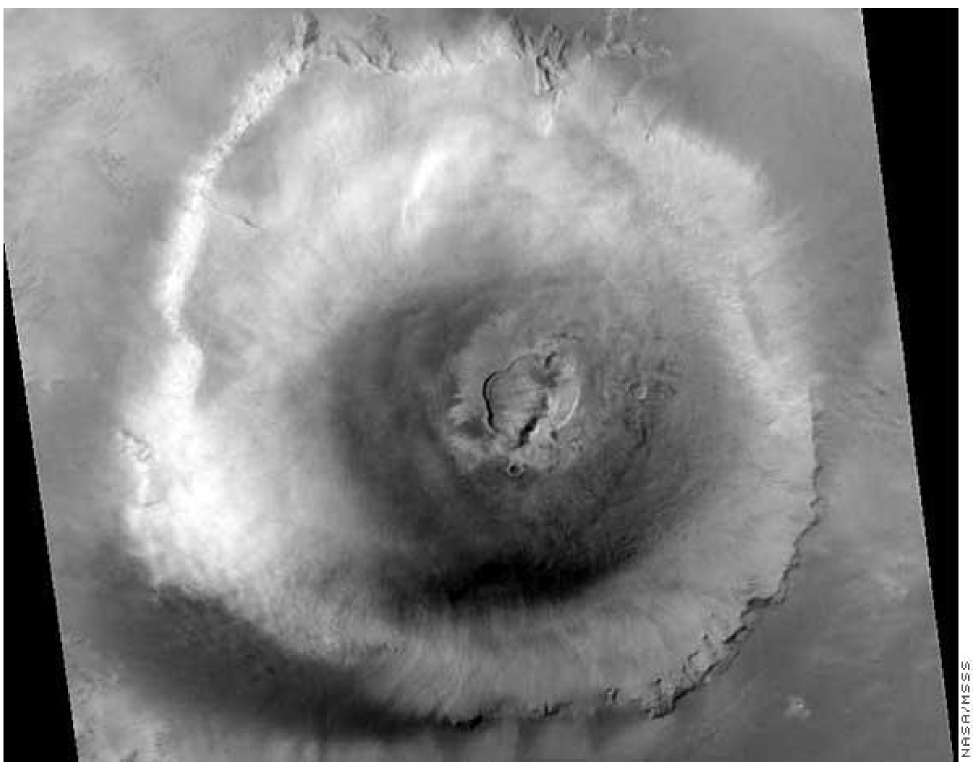


Figure 16 – Overhead view of Olympus Mons from Mars Global Surveyor. Prominent vertical scarp nearly encircles the base (NASA/MSSS).

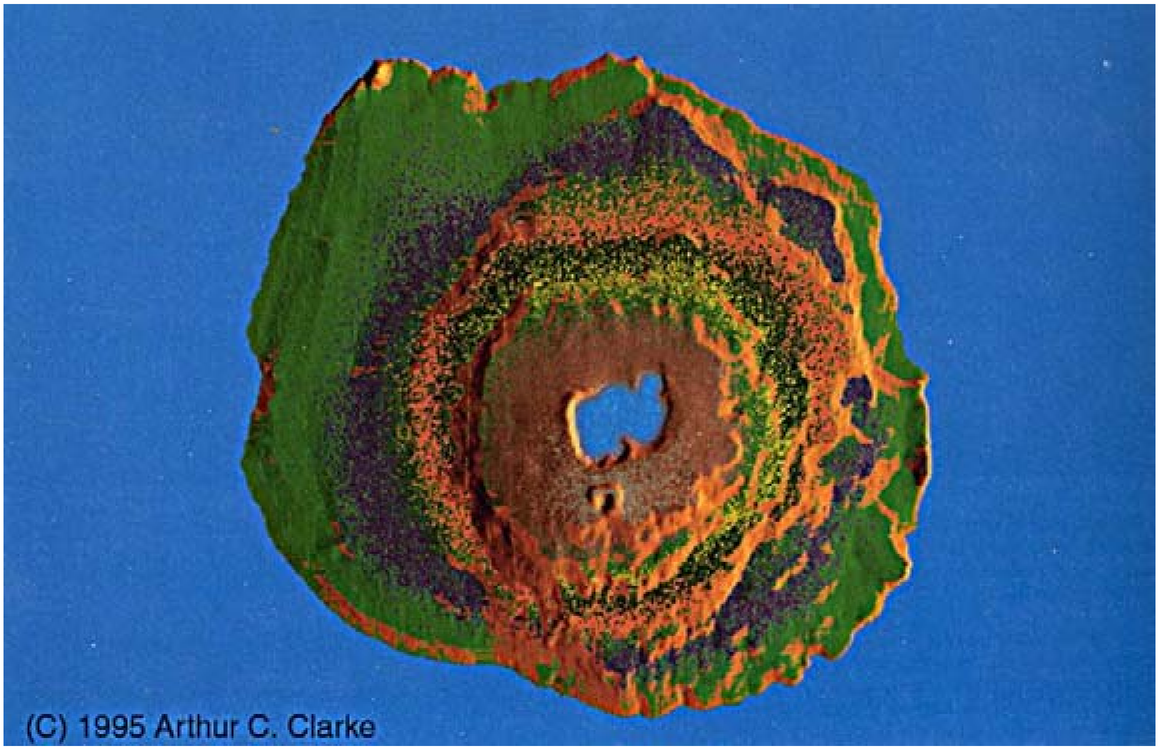


Figure 17 - Arthur C. Clarke's projection of an "Olympus Ocean" lapping at the 22,000 foot-high-cliffs surrounding Olympus Mons.

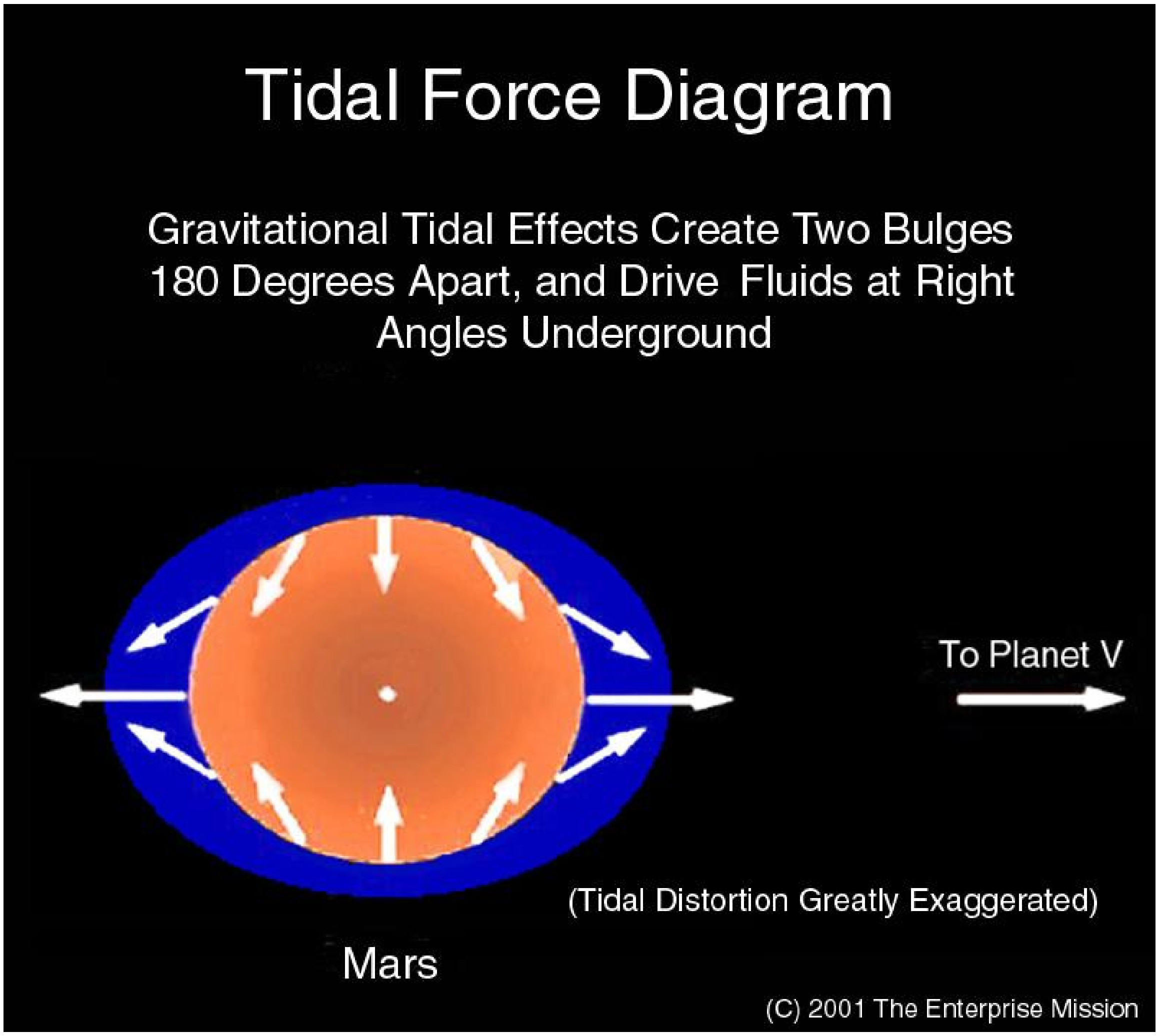


Figure 18 – Water is forced into sub-crustal cavities in the ocean beds by the tidal forces exerted by Planet V at right angles to the lines of force.

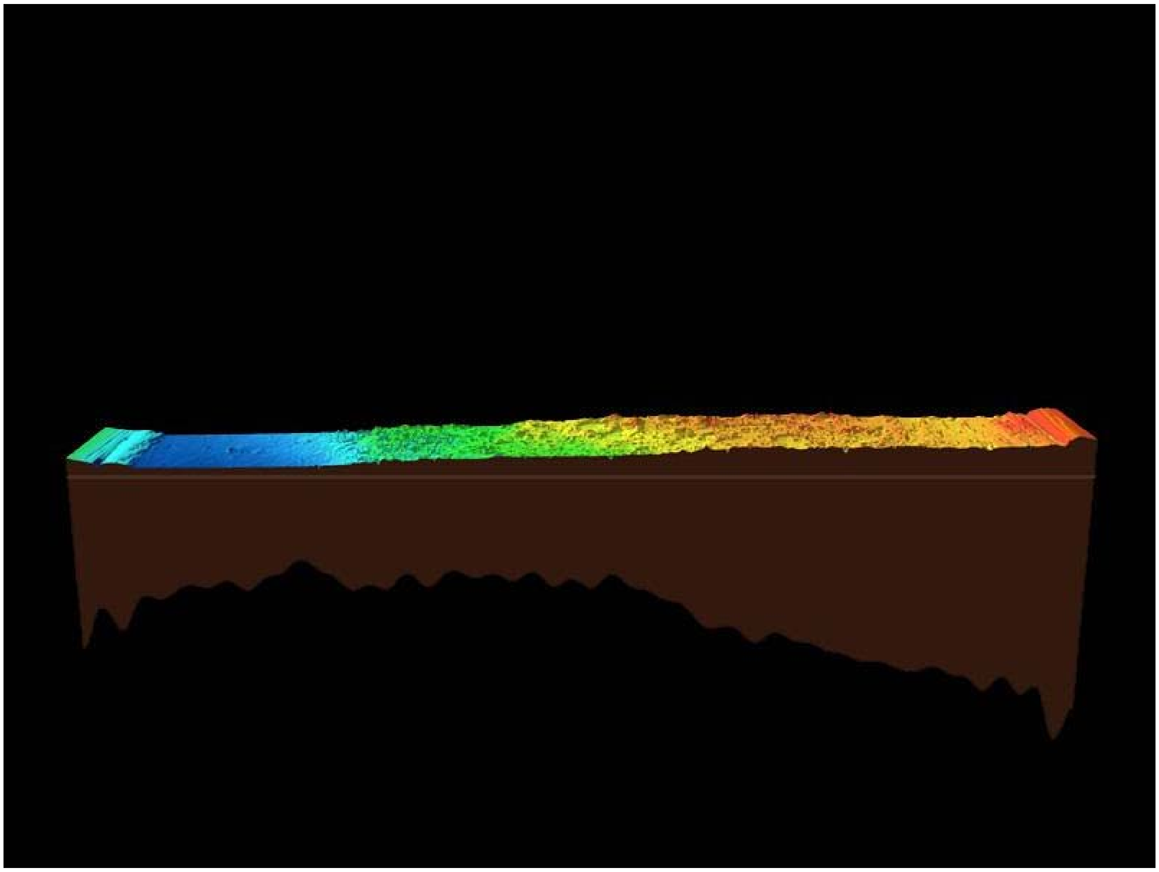


Figure 19 – MOLA generated 3D topography strip showing the dramatic difference in crustal elevation between the heavily cratered southern highlands and the smoother northern lowlands. Possible water stain images appear only above the crustal “line of dichotomy.”

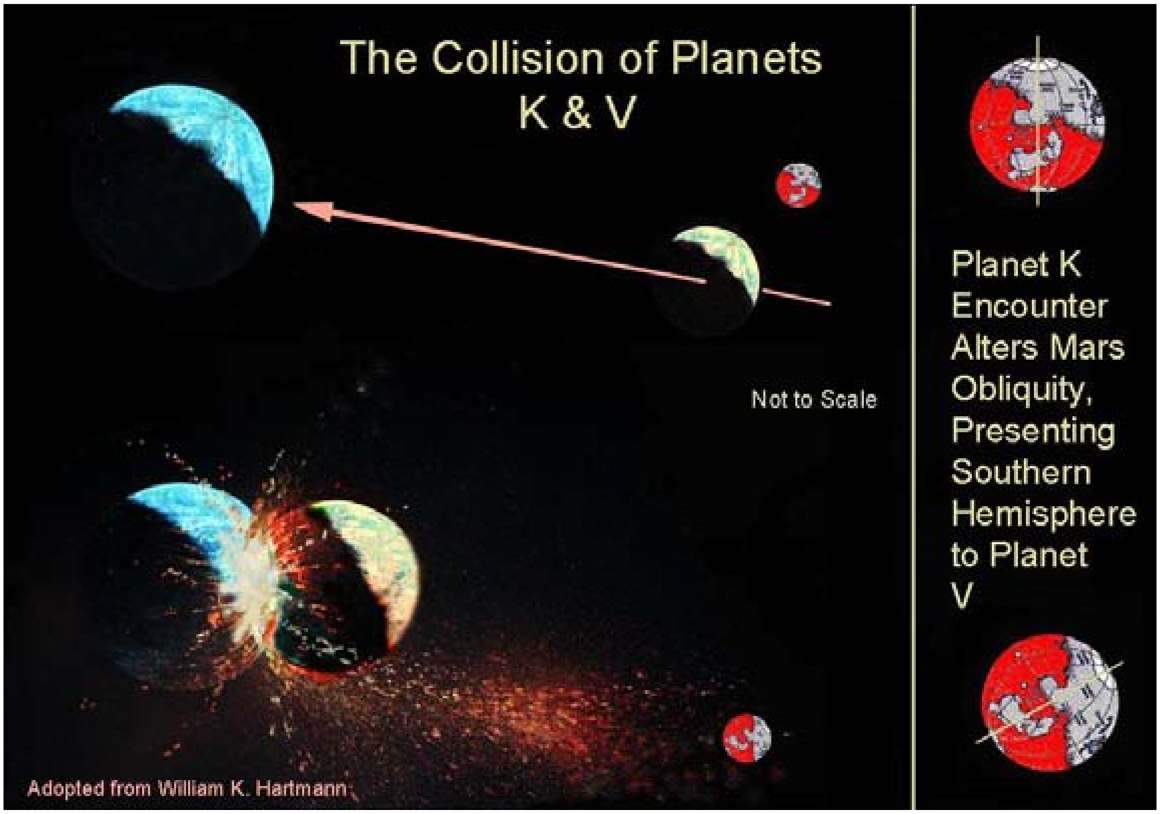


Figure 20 – Proposed collision event of planets V and K. Close approach of planet K alters Mars obliquity, resulting in a debris splatter pattern 60 degrees to previous (and current) spin axis.

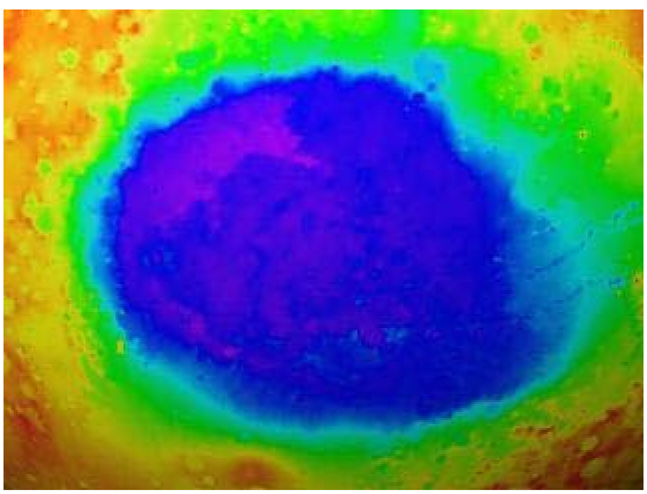


Figure 21 – Hellas impact basin.

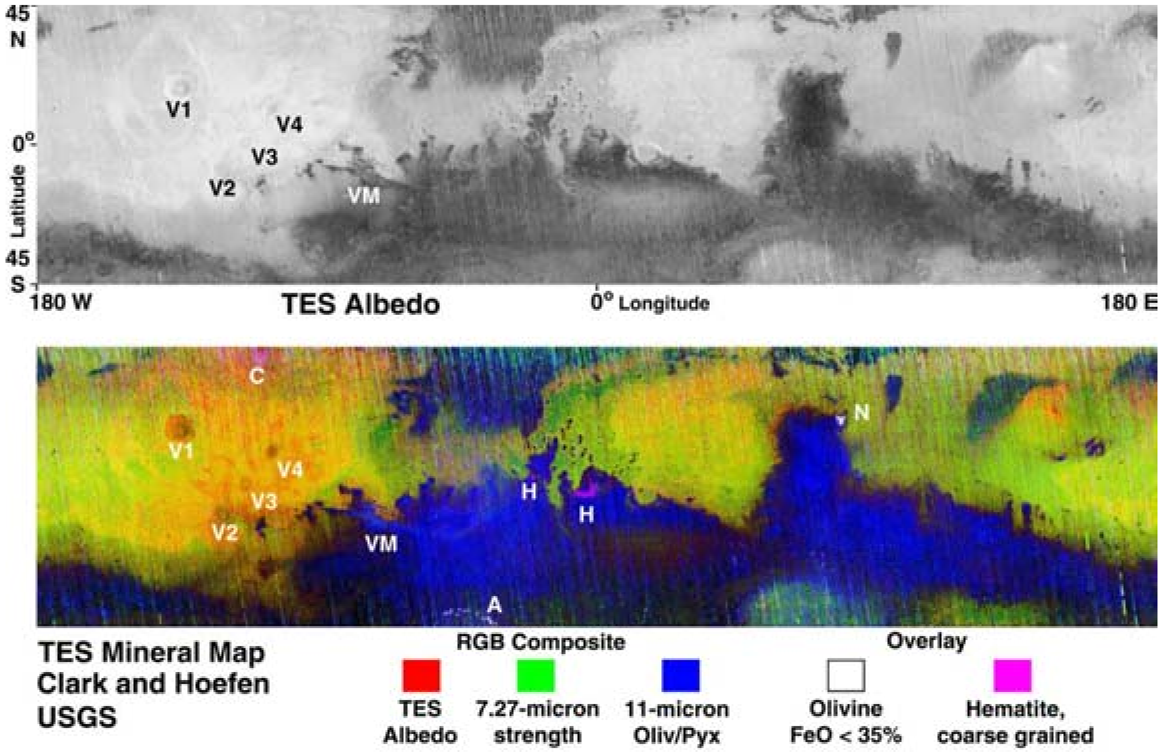


Figure 22 - Mars global Olivine distribution (Blue) (USGS).

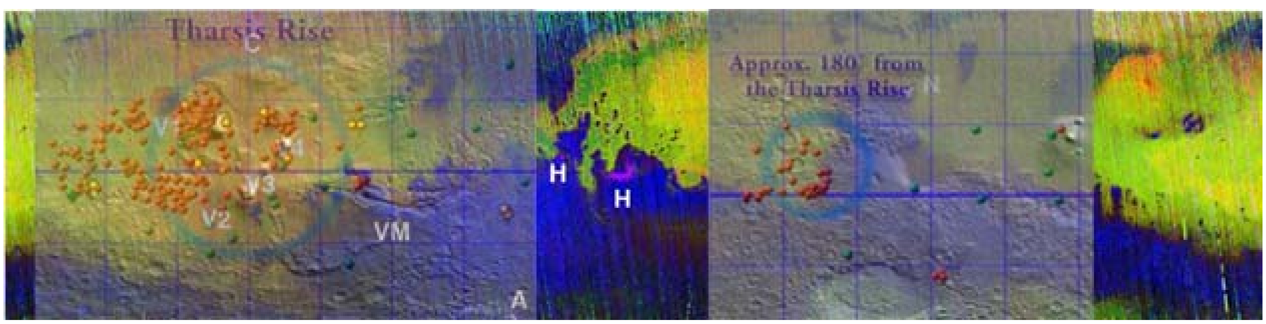


Figure 23 – Water stain map superimposed over Olivine distribution map.

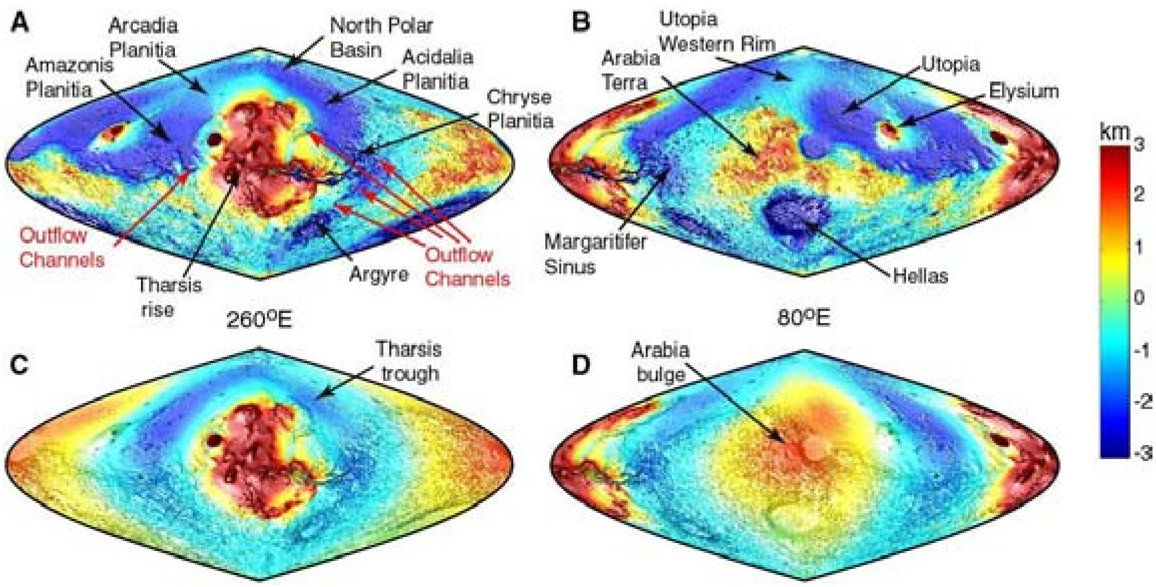


Figure 24 – The "Tharsis Trough" (MOLA).

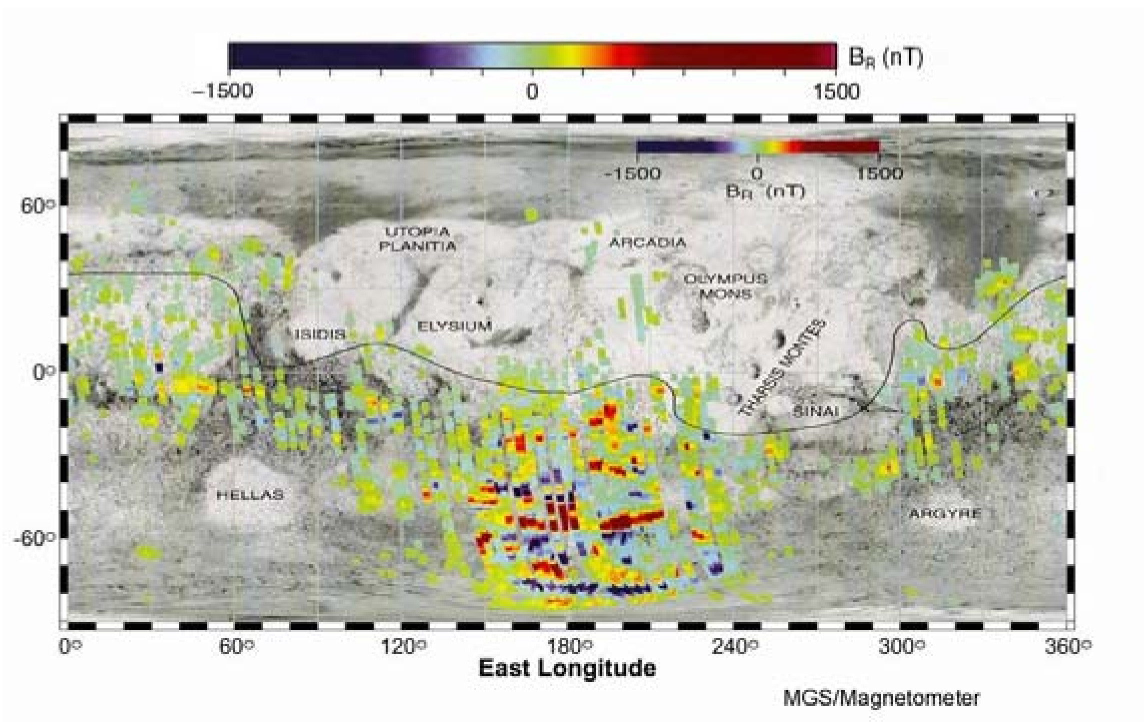


Figure 25 – Mars magnetic field striping distribution. (NASA/MSSS)

Figure 26 – Color image of Saturn’s moon Iapetus, pitch black on one side as if from a blast wave

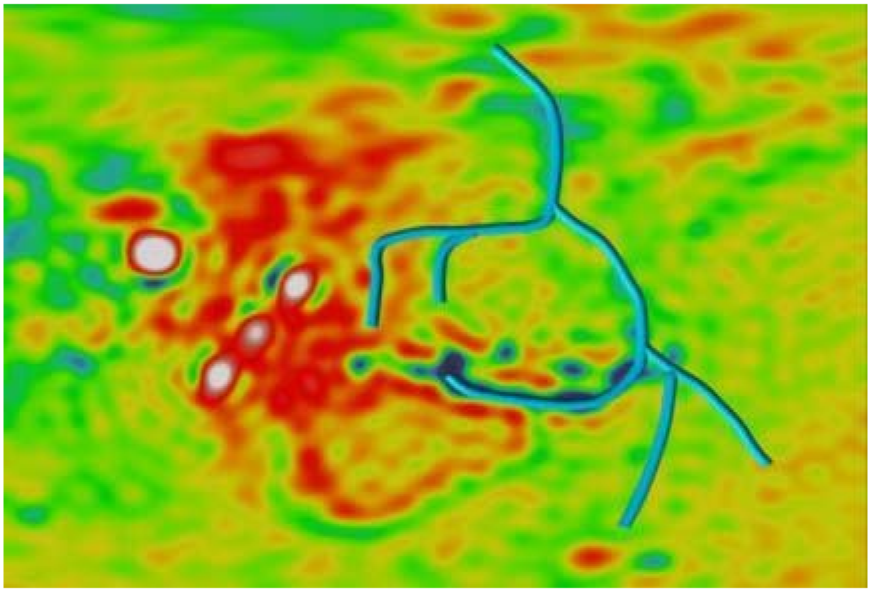


Figure 27 – Outflow water channels beneath Valles Marineris (MOLA)

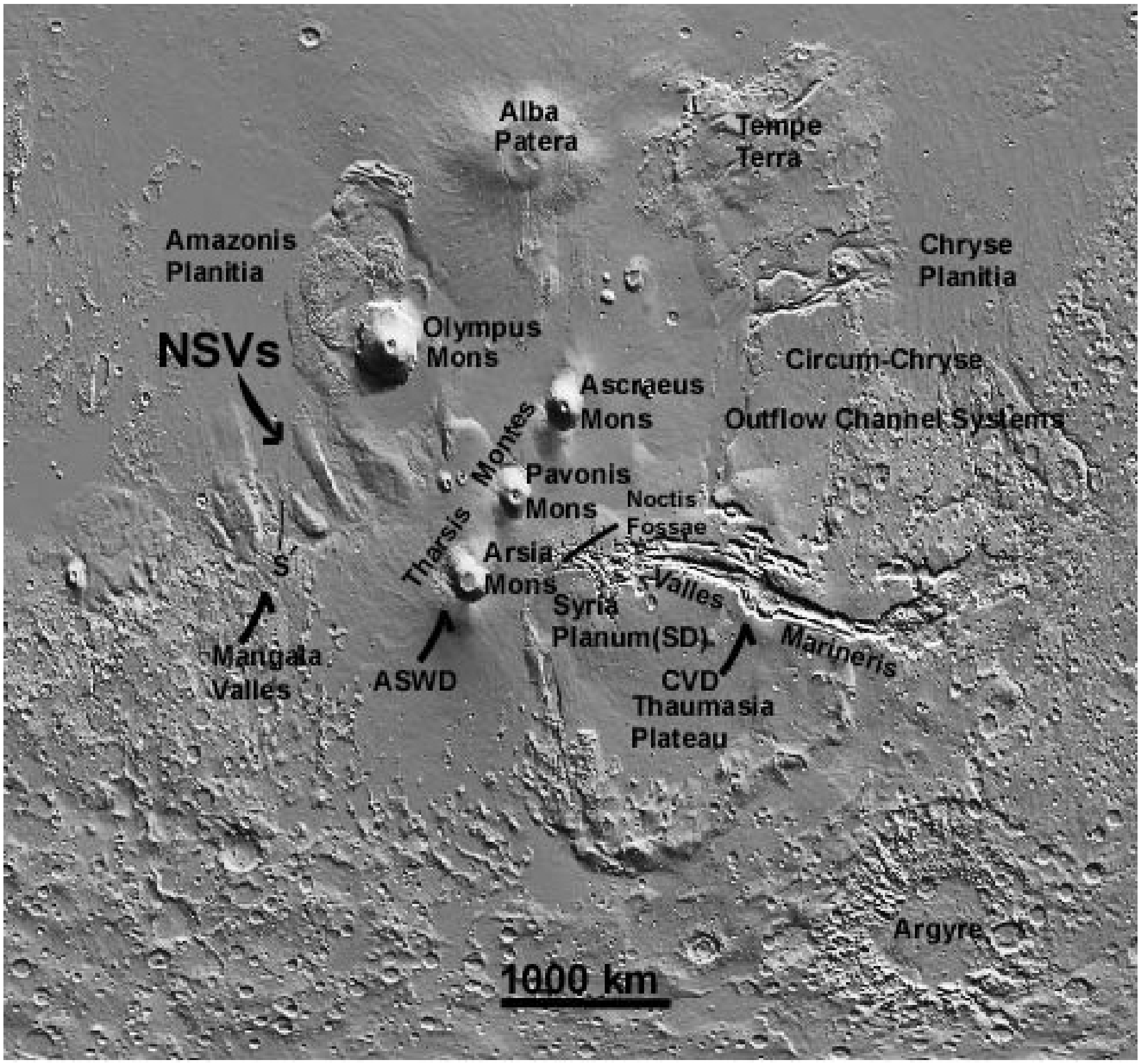


Figure 28 - New flood channels on Tharsis (NVS) -- 10 times larger than any previously discovered, draining northwest.

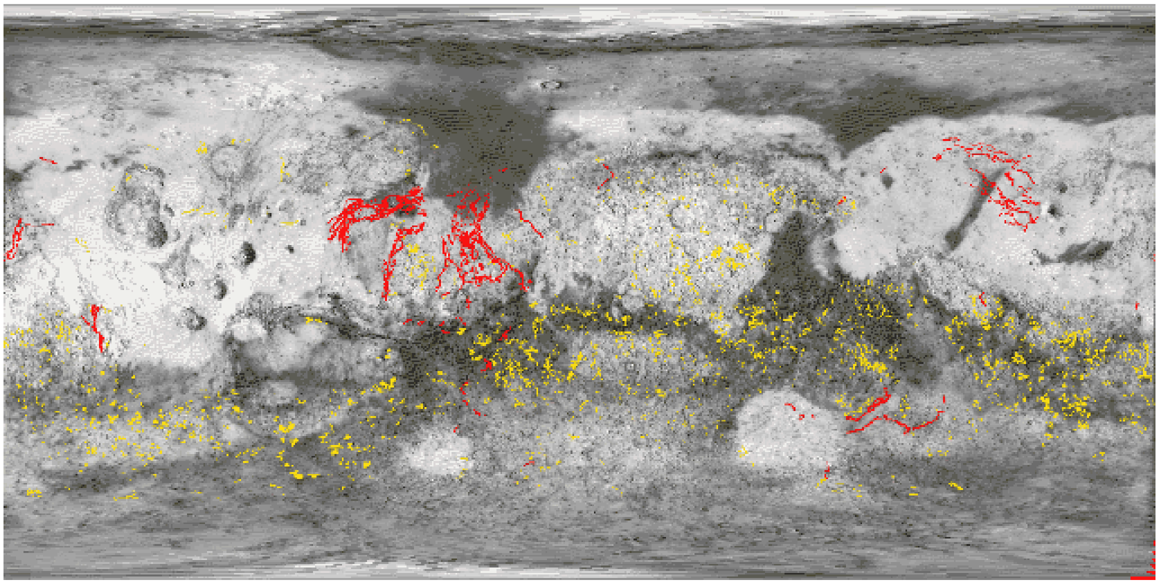


Figure 29 – Image map showing bi-modal outflow channel distribution from Tharsis and Arabia ocean beds.

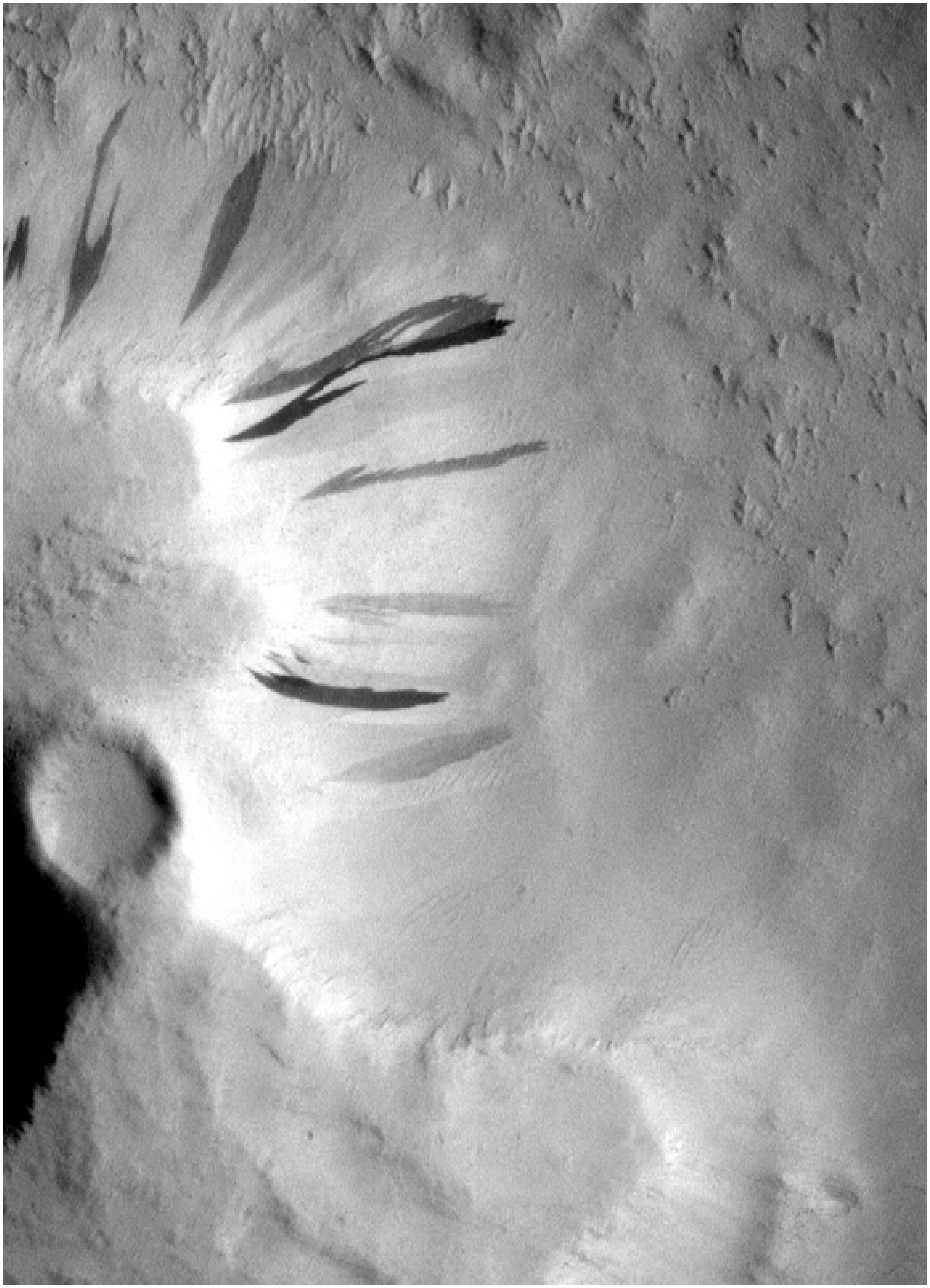


Figure 30 – Dark (fresh) flows alongside lighter faded (older, oxidized) flows (USGS).