Journal of Cosmology, 2014, Volume 24, Number 13, pages 12229-12280.
Release Date, November 20, 2014

Evidence of a Massive Thermonuclear Explosion on Mars in the Past, The Cydonian Hypothesis, and Fermi's Paradox

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Abstract

The Fermi Paradox is the unexpected silence of the cosmos under the Assumption of Mediocrity, in a cosmos known to have abundant planets and life precursor chemicals. On Mars, the nearest Earthlike planet in the cosmos, the concentration of ^{129}Xe in the Martian atmosphere, the evidence from ^{80}Kr abundance of intense $10^{14}/cm^2$ flux over the Northern young part of Mars, and the detected pattern of excess abundance of Uranium and Thorium on Mars surface, relative to Mars meteorites, can be explained as due to two large thermonuclear explosions on Mars in the past. Based on the pattern of thorium and radioactive potassium gamma radiation, the explosions were centered in the Northern plains in Mare Acidalium at approximately 50N, 30W, near Cydonia Mensa and in Utopia Planum at approximately 50N 120W near Galaxias Chaos, both locations of possible archeological artifacts. The xenon isotope mass spectrum of the Mars atmosphere matches that from open air nuclear testing on Earth and is characteristic of fast neutron fission rather than that produced by a moderated nuclear reactor. The high abundance of ^{40}Ar cannot be explained by mass fractionation during atmospheric loss, and must be the result of neutron capture on ^{39}K, also requiring an intense neutron flux on the Mars surface as is the high abundance of ^{17}N and deuterium. Modeling the ^{129}Xe component in the Mars atmosphere as due to fast neutron fission and the ^{80}Kr as due to delayed neutrons from a planet-wide debris layer, and assuming an explosive disassembly of uranium-thorium casing into a planet wide debris layer with 10% residue, all three estimates arrive at approximately 10^{25} J, or a yield of 10^{10} Megatons. This is similar to the Chicxulub event on Earth and would be large enough to create a global catastrophe and change Mars global climate. The absence of craters at the site suggests centers of the explosions were above the ground. The explosions appear due to very large fusion-fission devices of similar design as seen on Earth, and the Acidalia device, the largest, being approximately 80 meter radius. The explosions appear correlated with two sites of possible archeology, sites which formed the basis for the Cydonian Hypothesis. The Cydonian Hypothesis is therefore reconsidered in the light of new imaging and geochemical data. A model of Earthlike eroded archeology is adopted for comparison with Mars artifacts using the pyramids at Giza and the Sphinx and Olmec heads as analogs under the Principle of Mediocrity with attention to details. The new images of the Face at Cydonia Mensa confirm eyes, nose, mouth, helmet structure with additional detail of nostrils and helmet ornaments being clearly seen in new images with details at approximately 1/10 scale of the face. New imagery confirms the pyramid structure seen in Viking images of the the D&M pyramid and new high resolution images show evidence of collapsed brickwork. New images of a face found at Galaxias Chaos (the Utopia site) confirms facial structure with eyes, nose, mouth and helmet. High resolution imagery shows symmetric brickwork around the nose region. The civilization appears to have been primitive and indigenous to Mars. Taken together, the evidence suggests that Mars was the locale of a planetary nuclear massacre. The answer to Fermi's Paradox may thus lie on Mars. It is recommended that a mission for human occupation of Mars be immediately initiated to maximize knowledge of what transpired there.

Key Words: Mars, Fermi's Paradox, Fission, Fusion, Fast Neutrons, Cydonia Mensa, Galaxias Chaos, Cydonian Hypothesis, Airburst, Xenon Isotopes

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1. Introduction: Earth, Mars, and Fermi's Paradox

We now confront a cosmos we know to be awash in both the chemical precursors of life and planetary systems on which that life can flourish. We now know that life began very early on Earth and strong evidence also points to life on very Early Mars, Mckay et al. 1996) suggesting life is highly probable in the cosmos. Moreover, there are increasingly cogent arguments for the thesis that bacteria and viruses responsible for the evolution of all life are distributed widely throughout the observable universe (Wickramasinghe, 2014, and Hoyle, 1983).

Assuming Mediocrity (Sagan and Shklovskii 1966), the concept that Earth and humanity are typical of life bearing planets and intelligent life in the cosmos, we would expect a radio-noisy universe full of civilizations such as ourselves. However, we also confront a universe that is as silent as a ghost town. Enrico Fermi (Fig. 1) discovered this paradox (Jones 1985) in 1950 at Los Alamos in New Mexico. He had been having lunch with Edward Teller and some other scientists, and their conversations had turned to extraterrestrial life and space travel.

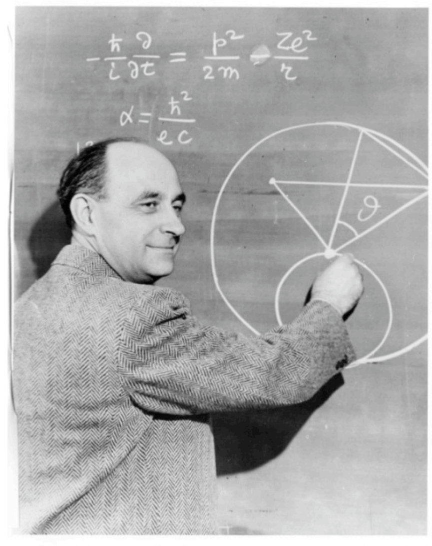

Figure 1. Enrico Fermi

Fermi analyzed the problem of the universe where intelligent life was both possible and noisy. He also knew the Universe was very old compared to humanity. There was plenty of time for other species to develop and make radio and TV broadcasts and spread throughout the universe to all habitable planets. Logically, we should be confronting a universe full of life and noisy cultures like ourselves.

"Where the hell are they?" asked Fermi. Is some force present that enforces silence on civilizations in the cosmos?

Mars is the nearest Earthlike planet that we can explore in the cosmos. Mars shows evidence of being far more Earthlike in the past and of having biology (Mckay et al. 1996).

NASA, from its inception, expected that 'artifacts' of past intelligent activity might be found in the Solar System:

"Though intelligent or semi-intelligent life conceivably exists elsewhere in our solar system, if intelligent extra-terrestrial life is discovered in the next twenty years, it will very probably be by radio telescope from other solar systems. Evidence of its existence might also be found in artifacts left on the moon or other planets."

(Brookings Report to NASA, 1961). When Mariner 9 orbited Mars and revealed past Earth-like conditions there, searches for signs of past intelligent activity were conducted (Sagan and Wallace 1971).

Overview

Mars shows, based on new data, evidence that during this period of Earthlike climate, biological evolution produced, at length, a humanoid civilization leaving ruins at several sites, Cydonia Mensa and Galaxias Chaos being two sites most intensively investigated. Data from these sites formed the basis for the Cydonian Hypothesis (Brandenburg , DiPietro and Molenaar, 1991) of an ancient, indigenous, approximately Bronze Age civilization on Mars.

Isotopic and gamma ray data form Mars has now revealed evidence that a massive mixed fusion-fission explosion happened on Mars near Cydonia Mensa. Evidence of a smaller explosion is also found near Galaxias Chaos. Taken together this assemblage of data suggests a possible planetary nuclear massacre occurred on Mars in the distant past. Therefore, the answer to Fermi's Paradox may lie on Mars: that intelligent technological forces are loose in the universe that wipe out more primitive species. In this article we will discuss the salient features of the Mars nuclear data and its interpretation, we will compare new imaging data from Mars with the predictions of the Cydonian Hypothesis, and we will discuss where this leaves us in the context of Fermi's Paradox. In the author's opinion, this will leave us no options but send an international landing team to Mars as soon as possible to maximize knowledge of what occurred there.

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2. Evidence for Large Thermonuclear Explosions in Mars Past

The study of noble gas abundances has always been useful in planetary science. These gases, which remain nearly free of chemical reactions with the environment and whose original relative abundances are thought to be fixed by primordial nucleo-synthesis predating the formation of the solar system, provide clues to the processes which have shaped contemporary planetary atmospheres. A signature feature of Mars atmosphere is the predominance of two noble gas isotopes: ^{129}Xe and ^{40}Ar over their other isotopes (Mahaffey et al. 2013) (Fig.2) relative to Earth and other inventories (Hunten 1987). Both these gases are recognized as radiogenic, being due to nuclear reactions in a planetary environment. These isotopic features are unique to Mars, allowed the identification of Mars as the parent body of the SNC meteorites. The high concentration of ^{129}Xe in the Martian atmosphere, the evidence from ^{80}Kr abundance of intense $10^{14}/cm^2$ flux over the Northern young part of Mars, and the detected pattern of excess abundance of Uranium and Thorium on Mars surface, relative to Mars meteorites, first seen by the Russians and now confirmed by the Mars Odyssey Spacecraft Gamma Ray Spectrometer, mean that the surface of Mars was apparently the site of massive radiological events, which created large amounts of signature isotopes and covered the surface with a thin layer of radioactive debris enriched in certain elements relative to its subsurface rocks. This pattern of phenomenon can be explained as due to two large anomalous nuclear explosions on Mars in the past.

A predominance of ^{129}Xe is also present in a component of the Earth's atmosphere can be traced to fast neutron fission reactions from nuclear testing, on the Earth (Figs. 3,4). The large contribution of ^{129}Xe is due to the shift of fission product atomic isotopes to the atomic number -129 channel (Fig. 5) with higher neutron energies.(Plutonium Project, 1954 and Spence 1949). Therefore, the signature ^{129}Xe predominance of Mars can be explained as due to fast neutron fission of ^{238}U and also ^{232}Th, which shares this same fission product property in fast neutron fission. The hyper-abundance of ^{40}Ar is consistent with neutron irradiation of K^{39} over large areas of Mars surface, with transmutation to K^{40} and subsequent decay.

The Mars Noble Gas Isotopic Anomaly

The high concentration of ^{129}Xe in the Martian atmosphere is a unique feature of Mars atmosphere and differs starkly from the isotopic mass spectrum of xenon elsewhere in the solar system. This feature is found both in the isotopic spectra seen by landers and also that seen in Mars Meteorites. Additionally, in Mars Meteorites is the evidence, from ^{80}Kr abundance, of intense $10^{14}/cm^2$ flux over the Northern young part of Mars. So both Mars xenon and krypton isotopic systems are disturbed relative to terrestrial norms.

The disturbance of Mars xenon isotopic spectrum relative to earth is seen in Figure 2.

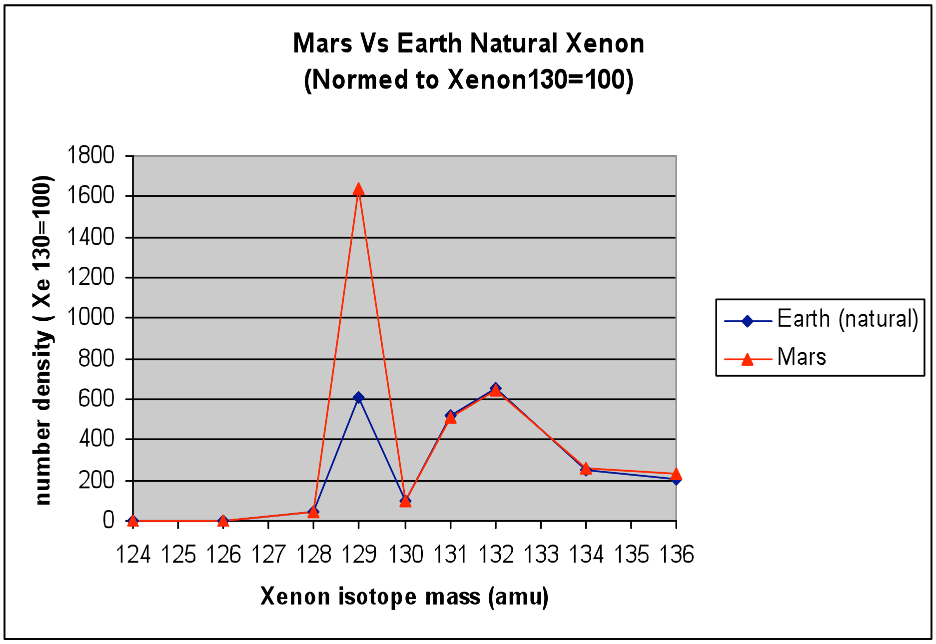

Figure 2. Mars and Earth Xenon stable isotope concentration normed to ^{130}Xe.

Mars xenon is found to match closely the component in the Earth's atmosphere produced by Earth's nuclear weapons programs, both hydrogen bomb testing and plutonium production, both of which involve large amounts of fission with fast neutrons. (see Figure 3 and Table 1). It is found that Mars xenon can be approximately by a mixture of 70% Nuclear Testing xenon, mixed with 30% natural Earth xenon, suggesting that Mars xenon was similar to Earth's before a large nuclear event altered it dramatically.

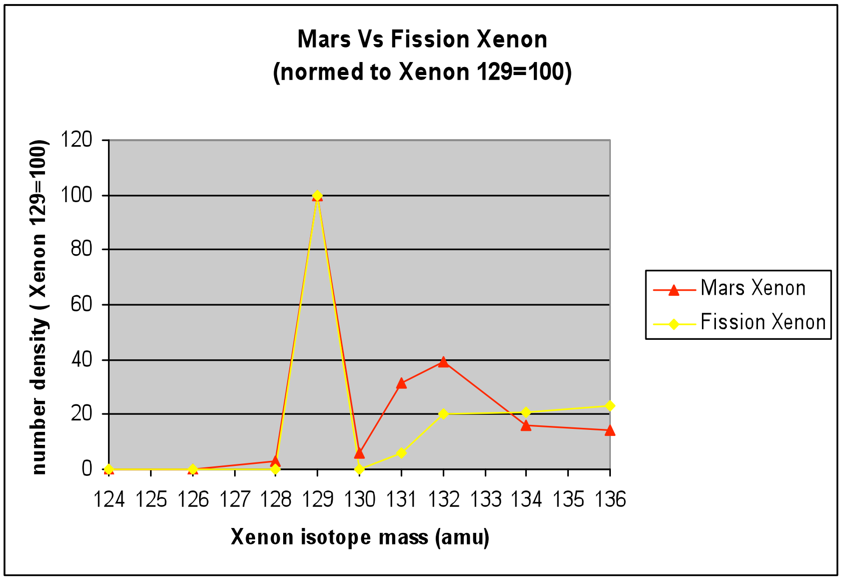

Figure 3. Mars Xenon and Earth Nuclear testing Xe normed to ^{129}Xe concentration, data taken from [6].

Xenon Isotope Abundance Normalized to ^{130} Xenon Abundance									
Inventory	^{124}Xe	^{126}Xe	^{128}Xe	^{129}Xe	^{130}Xe	^{131}Xe	^{132}Xe	^{134}Xe	^{136}Xe
Earth	2.337	2.180	47.146	649.58	≡100	521.27	660.68	256.28	217.63
Earth w/o NT	2.337	2.180	47.146	605.3	≡100	518.73	651.8	247.0	207.5
Earth Δ	0.00	0.00	0.00	44.28	0	2.54	8.88	9.28	10.13
Mars	2.45	2.12	47.67	1640.0	≡100	514.7	646.0	258.7	229.4

Table 1. Atmospheric concentrations of stable Xe isotopes normalized to ^{130}Xe, for Earth, Earth with Xe from atmospheric NT (Nuclear Testing) removed and Δ (difference in concentration) due to NT and finally Mars. Note spike in ^{129}Xe concentration in earth's atmosphere due to NT and similar spike in 129Xe in Mars atmosphere. Data taken from [6].

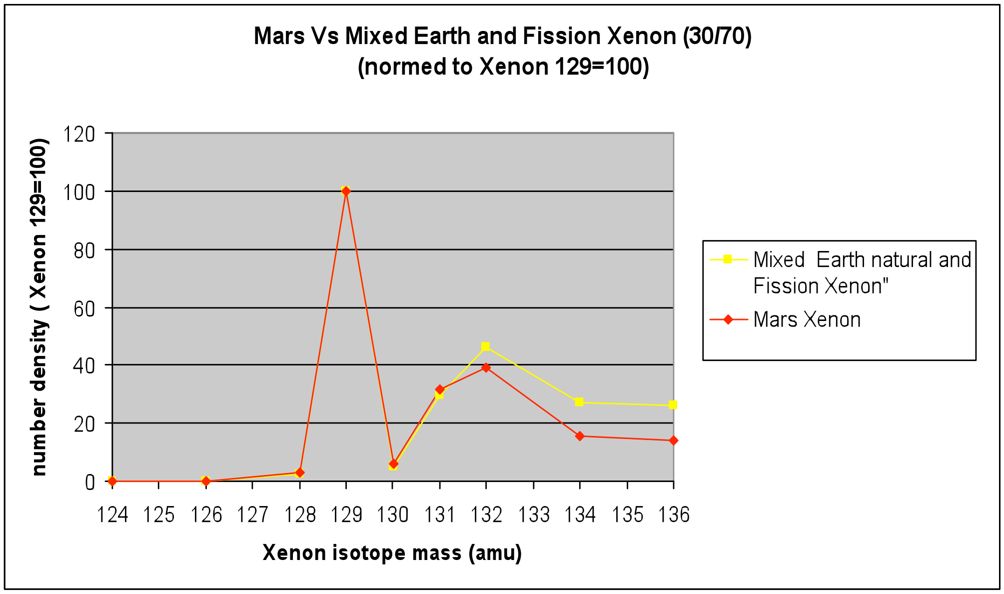

Figure 4. Mars and Earth xenon formed from 70 % nuclear testing xenon mixed with Earth natural xenon and normed to ^{129}Xe =100.

The xenon 129 superabundance in the nuclear weapons component of the earth's atmosphere is due to the change in fission product distribution that occurs with increasing neutron energy. In a normal moderated fission chain reaction, the spectrum of neutrons peaks at very low energies, in order to take advantage of the very large fission cross section of U 235 at low energies. However, in both nuclear testing and plutonium production, an un-moderated high energy spectrum of neutrons ranging in energies from low energies to 2.5 MeV is released and used to both create fission and breed plutonium from U 238. Moderated neutron induced fission produces the familiar double-peak distribution of fission products , with one peak at approximately strontium 90 and the other at approximately cesium 137, with a deep valley in between. However, for higher energy neutrons in an un-moderated fission reactor the valley between the two peaks begins to fill in, and finally for 14 MeV neutrons created by hydrogen fusion in a hydrogen bomb the valley between the two peaks of fission product masses mostly disappears. These high energy neutrons fission even fairly inert uranium 238 and thorium 229 and produce an isotopic spectrum with the valley between the double-peak filled in (Spence 1949) This change in fission products is seen in Figure 5, which compares the product spectrum of fission spectrum neutrons with that from 14 MeV neutrons. In order to boost the yield of a hydrogen bomb, the bomb casing is typically made of uranium 238 or a thorium. Accordingly, xenon 129 is produced only in small amounts by normal fission, but in a conventional hydrogen bomb explosion it is produced in large amounts.

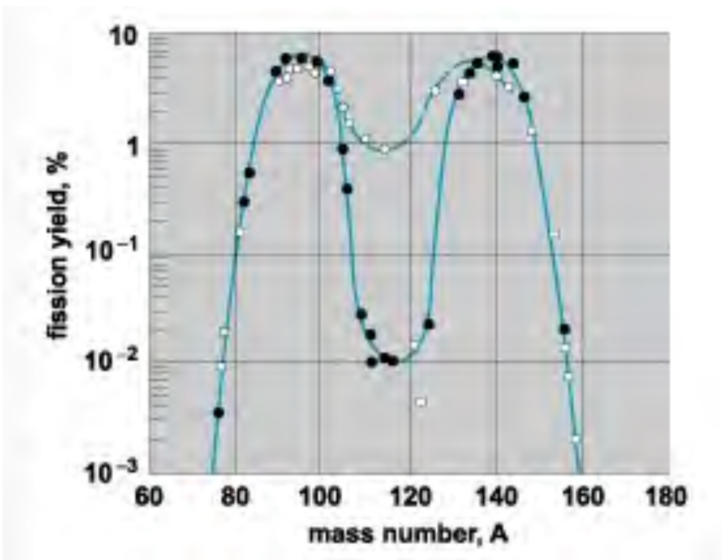

Figure 5. Mass distribution of fission fragments formed by neutron induced fission of 235U when neutrons have been moderated (solid curve) and fission by 14 MeV fusion neutrons (broken curve) (Spence 1949) showing increase in middle range isotopes for fusion neutrons.

Such a large fusion-fission explosion on Mars would also produce other effects, such as a large irradiation of the surface with neutrons, and would also produce large amounts of krypton isotopes, another fission product. If such a bomb incorporated uranium and thorium consistent with the xenon 129 production, then it would leave large residues of un-fissioned uranium and thorium on the surface of Mars. We can thus look for these other signs of a large hydrogen bomb explosion.

The ^{80}Kr abundance in Mars Shergotites are consistent with exposure to a neutron flux of $10^{14}/cm^2$-$10^{15}/cm^2$, with capture on ^{80}Br (Swindle, Caffee, and Hoehenberg 1986 and Rao et al. 2011) depending on the neutron energy spectrum. In the Shergottite EETA 79001, a composite of three distinct lithologies of approximately the same age, some lithologies show direct evidence of such irradiation . The difference in irradiation in lithologies of approximately the same age in the same meteorite suggests that this irradiation was a concentrated event in geologic time. The radiometric age of the lithology bearing evidence of irradiation is approximately 180 Myr. Other isotopic anomalies are present on Mars in heavy noble gases.

Xenon 129 is approximately 20% of the abundance of krypton 84 in the Mars atmosphere, and the krypton isotopic system is disturbed, relative to the Earth's, at about the order of 6% and is "reverse fractionated." Earth, despite the catastrophes that have occurred in its history, is believed to have retained is atmosphere mostly intact since its formation, and thus its isotopic distribution is considered a standard for primordial isotopes for large rocky planets like Mars. Various processes can erode a planet's atmosphere over time, especially if it has no strong magnetic field like the situation of Mars. These processes tend to erode the top of the planet's atmosphere, and thus erode lighter isotopes more that heavier ones. The result is that such processes of atmospheric erosion tend to fractionate, or disturb, the distribution of isotopes in a way that makes heavier isotopes relatively more abundant than lighter ones. However, on Mars, whatever process disturbed the krypton isotopes made lighter isotopes relatively more abundant that heavier ones. This requires a predominately nuclear process rather than mass fractionation.

The abundance of both Xe and Kr isotopes, both fission products, is high relative to the amounts of ^{36}Ar and ^{20}Ne, both of which can be considered primordial, though ^{36}Ar can be created by the absorption of neutrons on ^{35}Cl. On Earth, the ratio of atmospheric concentrations of these primordial isotopes is ^{36}Ar/^{20}Ne =1.85 and on Mars ^{36}Ar/^{20}Ne =2.5 and so these are comparable (Hunten 1987), especially if allowance is made for some mass fractionation or neutron irradiation of the Mars surface. Thus, we can use the abundances of these light, primordial isotopes as a metric to measure disturbances in heavier isotopes.

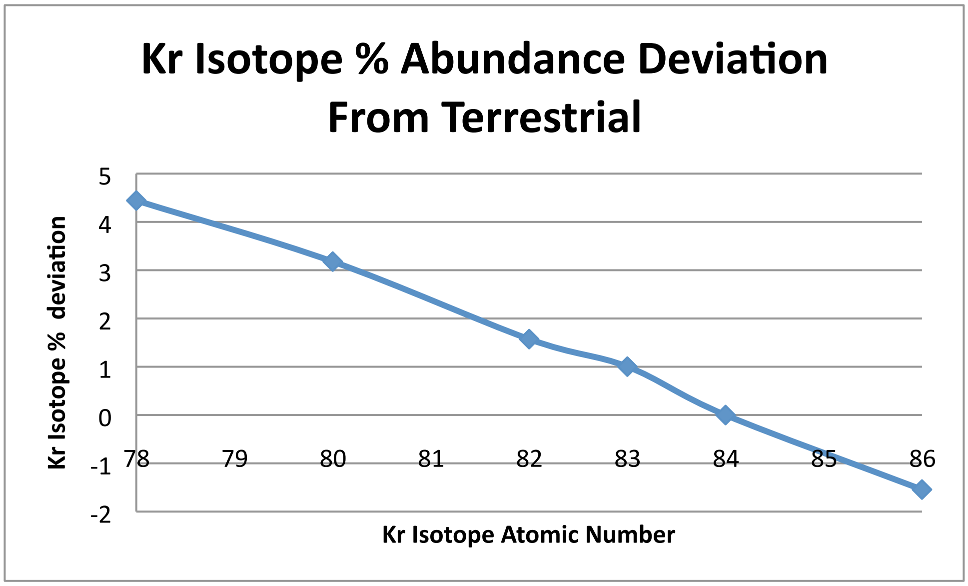

Figure 6. The percentage of of deviation of abundances of krypton isotopes relative to an Earth atmosphere reference. This graph shows that krypton isotopes are reverse-mass fractionated, favoring lighter isotopes over heavier ones and thus consistent with a nuclear process origin.

The only distribution of krypton isotopes that resembles that of Mars are those of the Sun itself, a nuclear furnace. Thus the disturbance of the krypton isotopic distribution of Mars, relative to terrestrial krypton is found to be of the same order of percentage as the xenon 129 measured relative to krypton 84. Therefore, the disturbances of both the krypton and xenon isotope systems on Mars, relative to the terrestrial standard appears to reflect a nuclear process on Mars that created almost equal amounts of krypton and xenon rather than a mass fractionation in its upper atmosphere.

Both xenon and krypton are fission products and their relative abundances and distributions among isotopes can tell us the details of the fission processes that produced them. On Earth, the relative concentration of ^{36}Ar /^{84}Kr =54, while on Mars this ratio is $^{36}Ar/^{84}Kr$ =28. Likewise on Earth the ratio of concentrations is $^{36}Ar/^{129}Xe$ = 1300 but on Mars the amount $^{36}Ar/^{129}Xe$ = 576. Thus both ^{84}Kr and ^{129}Xe, the most abundant isotopes of Kr and Xe on Mars, are doubled in abundance relative to the more primordial ^{36}Ar or ^{20}Ne. This is consistent with a large fission event on Mars that added large amounts of Kr and Xe to the atmosphere. Therefore, based on disturbances and super-abundances in both krypton and xenon, it appears a large fission event took place on Mars. Such a massive fission event would have created other effects, in particular would have irradiated parts of Mars with a neutrons. Evidence for such neutron irradiation is present, at approximately 10^{15} neutrons/cm^2, in young Martian meteorites (Swindle, Caffee, and Hoehenberg 1986 and Rao et al. 2011) in the form of a hyper-abundance of ^{80}Kr, a product of neutron capture on 79Br.

Comparison of Mars and Earth Krypton Isotope Relative Abundances						
Isotope	^{78}Kr	^{80}Kr	^{82}Kr	^{83}Kr	^{84}Kr	^{86}Kr
Mars	0.637±0.036	4.09*	20.54±0.20	20.34±0.18	=100	30.06±0.27
Earth	0.6087±0.0020	3.960±0.002	20.217±0.021	20.136±0.021	=100	30.524±0.025
Δ (Earth %)	4.65%	3.28%	1.15%	1.01%	0%	-1.52%
Δ (^{129}Xe %)	20.6%	14.58%	5.11%	4.44%	0%	-6.7%

Table 2. Abundances of stable Krypton isotopes in the Martian atmosphere and Earth.

The Mars abundance of ^{40}Ar relative to Ar^{36}, $^{40}Ar/^{36}Ar= 1.9(\pm 0.3) \times 10^3$ is 7 times that of Earth: $^{40}Ar/^{36}Ar = 2.96 \times 10^2$ This is paradoxical because ^{40}Ar is due to the decay of ^{40}K , a neutron capture product of ^{39}K and yet Earth has much more K in its soil than Mars . The abundance D (^2H) in Mars atmosphere is normally considered to be the result of photolysis of water with mass fractionation in the upper Mars atmosphere but is also consistent with an episode of intense neutron radiation of Mars surface. Thus, the hyper-abundance of ^{80}Kr, a product of irradiation of Mars rock with intense neutron flux, is also consistent with the hyper-abundance of ^{40}Ar, a product of neutron irradiation on ^{39}K in Martian rock.

The xenon anomaly together with the matching abundance and reverse fractionation of the krypton isotopes in the Martian atmosphere can only be explained by a large fission event in Mars history. Such a large amount of fission requires either a chain reaction or a large fusion event to supply the required neutrons. Only a fission chain reaction can occur in nature on Mars. Uranium 235 is the only naturally occurring isotope that can sustain a chain reaction, however, it always occurs mixed in nature with much more abundant U238. Even a billion years ago, the relative abundance of U235 at 3% allowed chain reactions in to only occur in nature in the presence of moderating groundwater which slowed the neutrons and allowed the large cross section for fission at low energies to dominate and allow a small reaction mean free path. Given the presence of impurities that absorb neutrons in nature and thus compete with fission in absorbing neutrons, a short reaction mean free path is necessary for a chain reaction to occur. A chain reaction with fast fission neutrons must also occur rapidly because fast neutrons quickly slow down by collisions. Thus a fast neutron spectrum chain reaction must occur quickly and in a compact region for it to be feasible in nature. However, the high neutron energy, such as a raw fission neutron spectrum, also requires a high density of fissionable material because of the shrinking of the cross section at high energies means that chain reaction is not possible without moderation for any natural abundance of U 235. No moderation-no chain reaction in natural uranium. Consistent with this conclusion, the only fission reactors known to operate without moderation must use highly enriched uranium , nearly weapons grade, to make up for the loss of reaction cross section that occurs at high neutron energies. Therefore, the xenon 129 super-abundance, which means that the fission event was dominated by high-energy neutrons, means that it cannot have been a natural uranium-based nuclear reactor.

Mars Actinide-Potassium Anomaly

Meteoritic samples of Mars rock, thought to be originally subsurface, are depleted in uranium and thorium relative to Earth by a factor of 10 to 3 whereas the surface rocks appear earthlike in abundance. This paradox was found in the Phobos and Mars probe data (Surpkyov et al. 1988), now confirmed by the Odyssey GRS (Gamma Ray Spectrometer) (Taylor et al. 2003), which shows enhanced levels of Uranium and Thorium, in approximately chrondritic ratio to each other, in the top layer of the Mars surface that can be measured from orbit (see Fig. 7). Hot spots of thorium in Mars Acidalium and Utopia Planitia can be seen in Fig. 8, with another concentration at the approximate antipode of the center of the hypothetical explosion. This antipode deposit, first pointed out by Dr. Edward McCullough, is consistent with an explosion sending shock waves around the planet. Consistent with the interpretation of this being due to a nuclear explosion, which would have irradiated large areas of planet's surface with neutrons and then scattered this irradiated debris all around the planet, the maps of radioactive ^{40}K shows the same features, including the antipodal feature (see Fig. 9). It therefore seems possible that a large concentrated uranium and thorium body existed on Mars and exploded, giving rise to a global surface layer of debris enriched in uranium and thorium and irradiated large areas of the planet with intense neutron radiation.

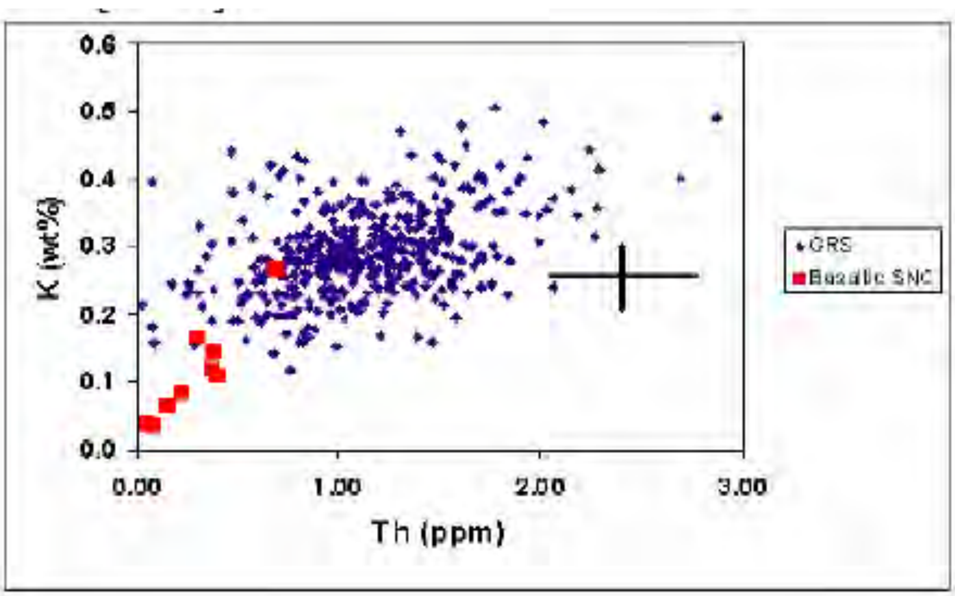

Figure 7. K, Th variations on Mars compared to Mars Meteorites. Typical Uncertainty is shown on the right. Figure taken from [12].

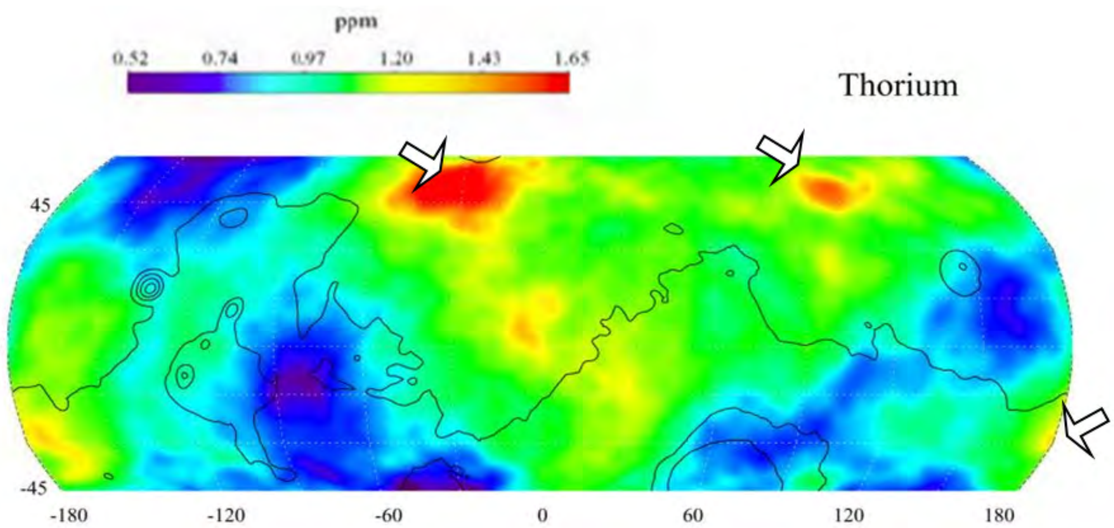

Figure 8. Map of Mars global concentrations of ^{232}Th from [12]. Arrows mark hot spots including the approximate antipode of the largest hot spot.

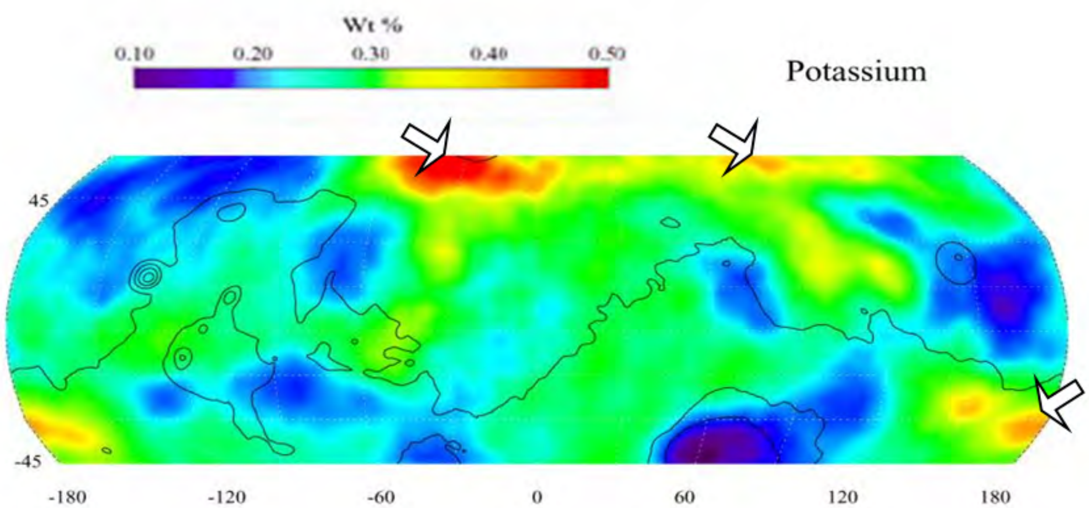

Figure 9. Map of Mars global concentrations of radioactive ^{40}K from [12]. Arrows mark hot spots including the approximate antipode of the largest hot spot.

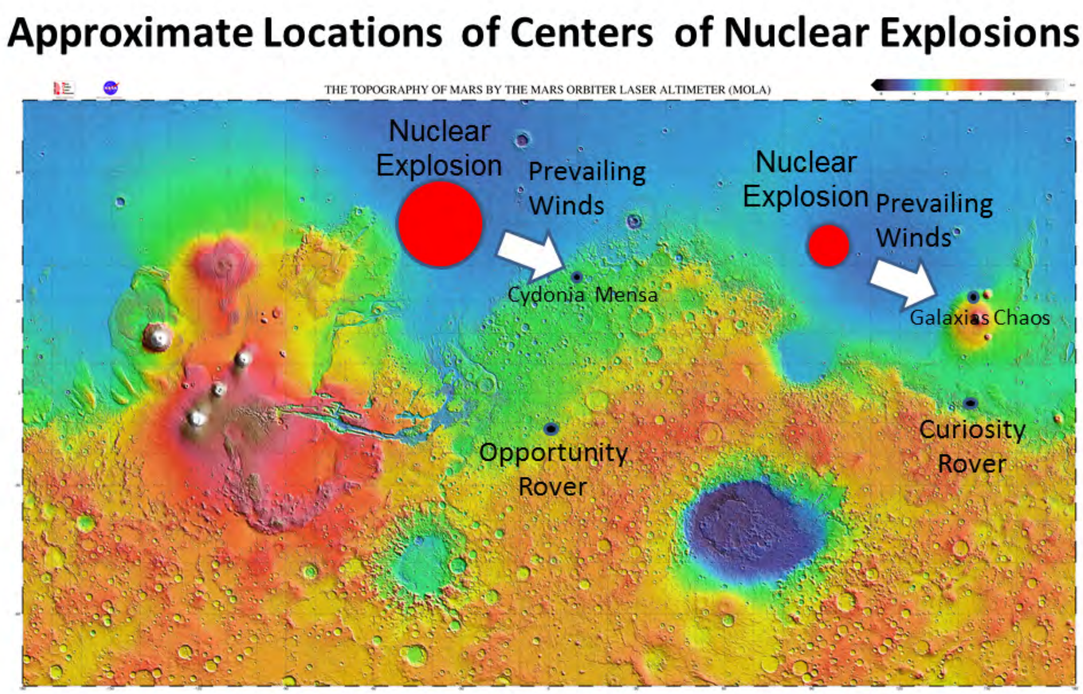

Figure 10a. The approximate Northern Martian Paleoocean shoreline (dashed line) and approximate locations of possible nuclear explosions, discussed in this article, also shown is Cydonia Mensa and Galaxias Chaos, locations of reported artifacts. Arrows indicate prevailing winds and show the path of radioactive fallout. Present Location of Mars Rovers is also marked.

No large crater is apparent at either radiation center. The amount of energy release would have to be large to produce a global debris pattern, and given its fast neutron spectrum it would have to occur rapidly. The only plausible natural explanation for such a radioactive debris pattern: natural nuclear reactors , perhaps breeding U 233 off of thorium, (Brandenburg 2011) occurring in ore bodies beneath the surface, that then explosively disassembled, would have created large craters. No large craters are found in either center of radiation. This means the fission events have to have occurred as explosions in mid-air.

Based on the fast neutron fission spectrum required to explain the xenon 129 anomaly, the large energy releases required to explain the amount of xenon and krypton and the neutron irradiation of Mars surface, and finally the lack of large craters at either site, the only known phenomena that can account for this combination of effects is thermonuclear weapons with fission boosting and exploded in mid-air.

The apparent location of the explosions in mid-air would have increased the blast shockwave overpressure over large areas due to the well-known “Mach Stem” shock wave effect. (Fig. 10b)

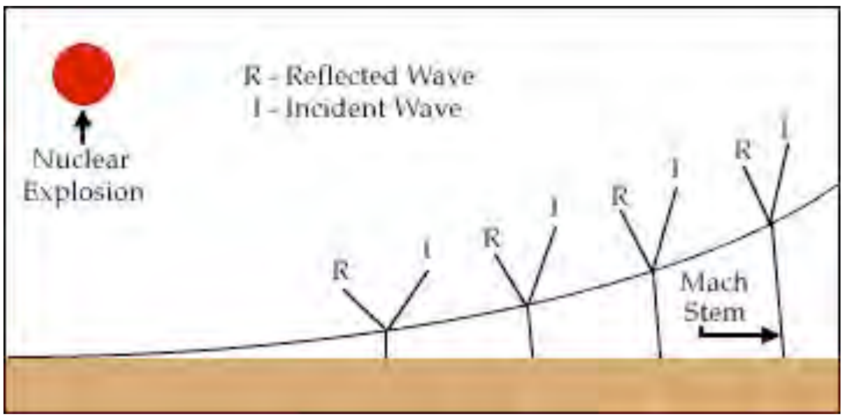

Figure 10b. The Mach Stem effect, where the incident and reflected shock waves from an airburst combine to form a much stronger shockwave some distance away from the explosion.

Fission Yield Calculations

Based on the observed abundances of Mars Xe and Kr isotopes and the observed enriched layer of U and Thorium on its surface, it is possible to estimate the number of fissions that occurred under this hypothesis and thus the energy release and approximate size of the original device fissionable casing.

Based on the abundance of ^{129}Xe in the Mars atmosphere and assuming it was all produced in the explosion at approximately a fraction mass yield F_{129} into the atomic mass 129 channel of F_{129}=3% for a fast neutron spectrum we can write for the total energy released based on ^{129}Xe:

$$W_{Xe} = W_{fission} n_{Xe129} HA / F_{129} \cong 1.5x10^{26} J \qquad (1)$$

where $W_{fission}$ is the energy released per fission of 200Mev or 3.2x 10^{-11}J, n_{Xe129} $=9x10^{10}$ cm^{-3} is the number density of ^{129}Xe in the Mars atmosphere, H =1.1 x 10^{6} cm, is the Martian atmosphere scale height-giving a columnar density of 10^{17} cm^{-2} or $3x10^{18}$ fissions per cm^2 of planetary surface- and A is the surface area of Mars of 1.4 x $10^{18}cm^2$. This is a large energy, equivalent to the impact of a 70km diameter asteroid into Mars and sufficient to produce a global ejecta layer of 4meters. 1 Megaton of energy is approximately $4x10^{15}$ J so an energy release of 10^{26}J is 10 billion megatons.

Based on the neutron fluence $F_{neutron} = 10^{15}/cm^2$ neutron fluence required to explain the irradiation of lithogies B, C of EETA79001 and account for the ^{80}Kr anomaly, and assuming this was a planet-wide occurrence from delayed neutrons of an approximate fraction $F_{delayed}$ = 0.1% that were radiated immediately after the event by fission fragments in the planet-wide ejecta layer, we can calculate and approximate number of fissions in the event as approximately 10^{18} fissions per cm^2 of planetary surface and thus have an independent estimate of the yield. We can then estimate the yield from the ^{80}Kr anomaly:

$$W_{Kr} = W_{fission} F_{neutron} A / F_{delayed} \cong 4.6x10^{25} J \qquad (2)$$

where the values of other quantities $W_{fission}$ and A are the same as in Eq. 1.

Assuming a thickness L=1 meter layer of Th and U of concentration C = 1 ppm of a total molecular number density of $n=6x10^{22}$ cm^3 covering the planet's surface, this gives a columnar density of $6x10^{16}$ cm^{-2} or $6x10^{17}$ fissions per cm^2 of planetary surface- assuming $F_{fissionable}$ = 90% casing burnup. This would represent an original amount of $9x10^{35}$ atoms of uranium/thorium or approximately 10^{12} moles at 238 g per mole. At 19g/cm^3 this represents approximately 10^{13} cm^3 or 10^7 m^3 or a cube roughly 200 meters on a side. Again we can again estimate the total energy yield:

$$W_{U-Th} = W_{fission} F_{fissionable} CnAL \cong 3x10^{24} J \qquad (3)$$

The explosion would have been a planetary scale catastrophe (Sleep and Zahle 1998). The appearance of a region of enhanced Th and radioactive K is not reflected in maps of shorter lived Fe and Si isotopes and indicates the event occurred several million years ago and probably dates to the middle or late Amazonian epochs. Irradiation of lithogies in ETA79001 indicate a possible 180 million year or earlier age for the event. Taken together, the energy released in the explosion are all approximately 10^{25} J or on the order of 1 Billion megatons of energy.

These bombs, because of their high fission content, were very “dirty,” and would have induced radiation poisoning in any life on Mars that survived the original explosions.

Thus, several lines of evidence point to a massive thermonuclear explosion on Mars. Based on the absence of craters in Acidalia Planitia or Utopia Planitia , the devices detonated in midair. This would have increased shock wave damage via the Mach-Stem effect over large areas. The location of the explosions would have, by prevailing Coriolis driven winds to the South East, have delivered most of their radioactive fallout to Cydonia Mensa and Galaxias Chaos, two locations of previously reported artifacts.

3. The Cydonian Hypothesis in the Context of New Mars Data

The Cydonian hypothesis (Brandenburg, DiPietro, and Molenaar 1991) was based on evidence of archeology on Mars at several sites , principally the Face in Cydonia and the nearby D&M Pyramid, plus evidence of a long period of Terrestrial climate on Mars. It was the simplest hypothesis that could be formulated, based on Viking data, to explain the apparent archeology on Mars since it assumed the same processes: life, evolution, and civilization, that produced the Pyramids and the Sphinx on Earth, had operated on Mars and for similar periods. The Cydonian hypothesis is thus as much a hypothesis about Mars past climate as it is about life and evolution on Mars. The hypothesis predicted that, “despite erosion” new details would be seen on the artifacts, since they would be the product of an indigenous intelligence and thus made to be seen at close range and that new evidence would be found of a geologically-long period of Terrestrial conditions on Mars. The objects would also be eroded since they were created at a time of Earthlike climate on Mars. The Cydonian Hypothesis has now been confirmed by new imaging and geochemical data.

The Cydonia region of Mars was the Prime Landing site of the Viking expedition to Mars in 1976, directed by the Jet Propulsion Laboratory. It was chosen as the Prime Viking landing site because of its geography as a place where water vapor from the North polar cap could penetrate far South, to near the equator, in the Mare Acidalium depression, making Cydonia a good place to look for life. However, Cydonia was ruled out for a soft landing as being too rocky and another site in Utopia Planum was chosen instead. Despite this, a discovery would be made in Cydonia that would change how we viewed Mars.

On July 25 1976 Dr. Tobias Owen, then a graduate student, discovered the image of the Face in Cydonia on Viking frame 35A72. The picture was taken near local sundown, in order to maximize relief. This image was publicized under the NASA descriptor “Head” at a JPL press conference, and created a sensation, however, the Viking scientists dismissed it ‘a trick of light and shadow.’ In a pattern of behavior that was to be repeated continually in the following decades, JPL announced that another image was taken a few hours later that showed nothing. This was deliberate misinformation because Cydonia would then have been in darkness and no image could be taken. In reality, JPL waited for 30 orbits (roughly 4 weeks) before reimaging the Face in Cydonia on frame 70A13, at local early-afternoon lighting, and never announced that a second image had been obtained.

Vincent Dipietro and Gregory Moelnaar, two image processing experts working at NASA's Goddard Space Flight Center, far from JPL, seized on the discovery frame of the face in Cydonia, and obtained it in electronic form and enhanced it. They also discovered the second image of the face in Cydonia on Viking frame 70A13. They also discovered a pyramid like object on three frames, within 5km of the face (Fig. 11.) When enhanced and the two images of the face compared, the results were stunning. The face in Cydonia appeared to be a symmetric carved face in a helmet (Figure 12).

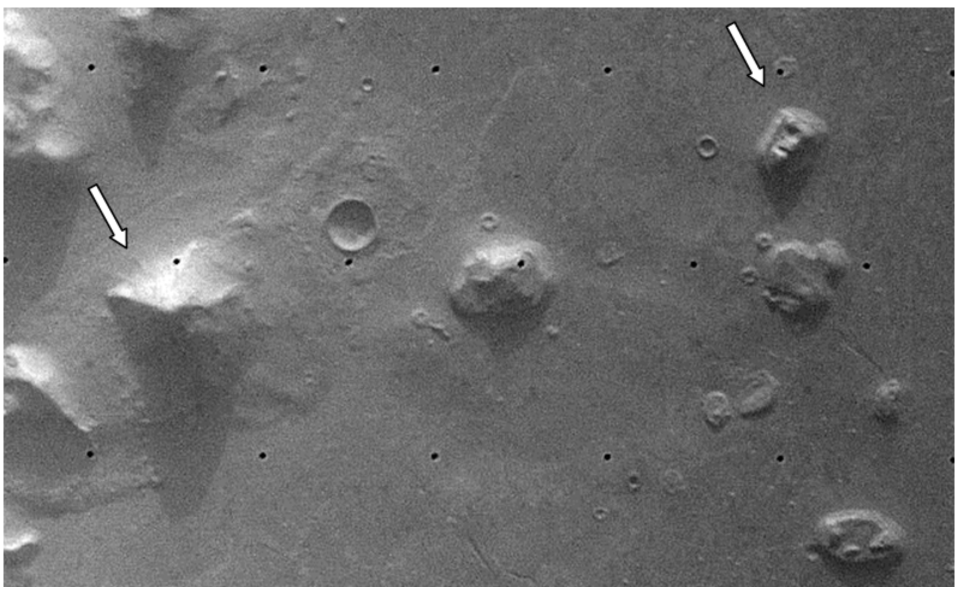

Figure 11. Viking image 35A72 showing the Face in Cydonia and the nearby D&M Pyramid indicated by arrows. Note circular crater beside face.

Inspired by The work of DiPietro and Molenaar, a group of scientist and engineers called the IMIT (Independent Mars Investigation Team), organized by a science journalist Richard Hoagland, to investigate further. In a superb bit of "guerrilla science" the IMIT team investigated Mars science in the winter and spring of 1984 and reported their findings at the seminal 1984 Case for Mars II conference in Boulder Colorado [16]. Further analysis of the two images of the face Viking images by Mark Carlotto, revealed what appeared to be "helmet ornamentation'[17] (see Fig. 12)

Figure 12. The two Viking images of the face on Mars from the discovery frame 35A72 and 70A13. Arrows point to helmet ornaments first discovered by Mark Carlotto. (Images by Carlotto)

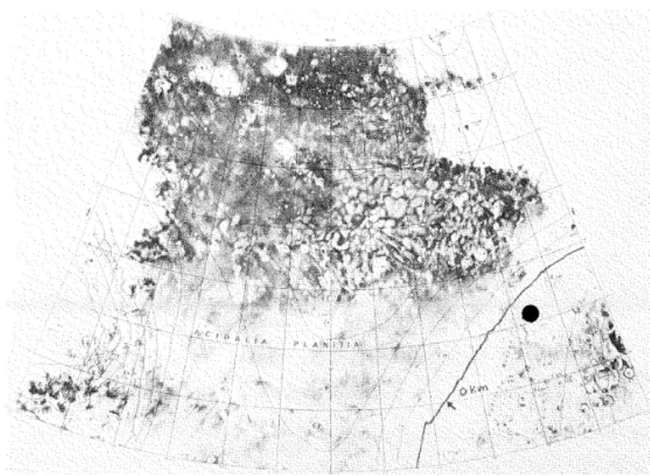

Figure 13. Map of Cydonia Mensa region showing location of Face and D&M Pyramid.

Erosion is the natural consequence of any Earthlike environment. That is: the same environment that would allow humanoid life forms to carve large artifacts also erases them in time. Thus, eroded artifacts, provided they contain enough surviving detail to be identified by artifacts, are what we would expect to find if Mars was once a Mars-Gaia and supported intelligent life before its catastrophic (that is -brief on geologic timescales) transition to its present climate.

Thus, the presence of erosion, while creating difficulties in studying details of the artifacts, also verifies the CH (Cydonian Hypothesis) because it demonstrates the climatic conditions consistent with Earth-like artifacts. Thus under the CH any artifacts must bear signs of erosion.

Figure 14. The Sphinx before partial restoration. All Earthly archeology shows some signs of erosion.

Earth Analog Archeology to Mars

We are guided in our consideration of new imaging data from Mars by Mediocrity. That is: our assumption that archeological relics found on Earth are not remarkable. That is, if Mars was like Earth in climate for geologically long period, as it seems to have been, we would expect Sphinxes and Pyramids, similar to those found in Egypt and Mexico.

Figure 15. Giza, note brickwork seen at the top of the pyramid.

Figure 16 .The Sphinx under different lighting and viewing geometry. These different conditions, coupled with erosion, can produce dramatic changes of appearance.

A close Earthly analog to the Cydonia face is provided by the Olmec heads in Mexico. Not only do they display faces enclosed by helmets, but also display ornamentation on their helmets.

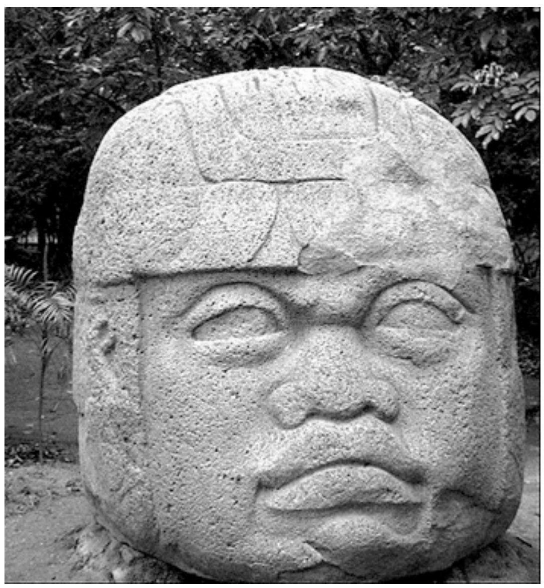

Figure 17. Olmec head with helmet ornamentation and erosion

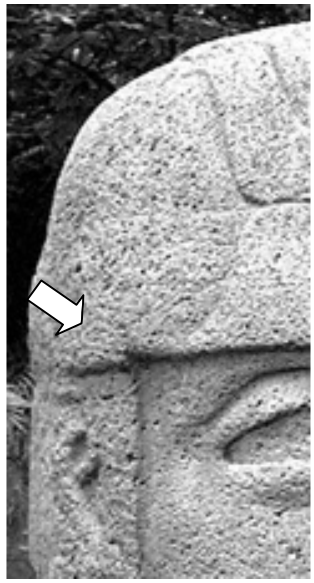

Figure 18. Detail of figure with contrast change, note “frame-corner” of face and contrasting helmet ornaments

Figure 19. Detail from Sphinx, note “frame-corner” of face-helmet juncture and helmet ornaments

In both the Sphinx and Olmec heads a common feature is noted, and is caused by the region of contact of the geometry defined by the face and the geometry of the helmet or headgear. We will term this a “frame-corner” where the line defined by the vertical side of the face or the horizontal line defined by the eyes meets the lines defined by the helmet or headgear. This frame-corner makes the transition between the geometry defined by the face region and the geometry defined by the headgear and on the Sphinx is a sharp angular structure of approximately 30 degrees, and on the Olmec heads is 90 degrees.

Thus, when the Mars Surveyor, in 1998, with is new high resolution camera, to take new images, and the Mars Odyssey in 2001 and its camera and gamma ray spectrometer to scan the surface of Mars for isotopes, both assumed orbit around Mars, many new questions had emerged that required answers.

New Imaging data from Cydonia Mensa

Mars Odyssey imaged the objects in Cydonia beginning in 2004, but at slightly better resolution than Viking and at similar lighting and viewing geometry. These images confirmed its face-in-a helmet basic structure.

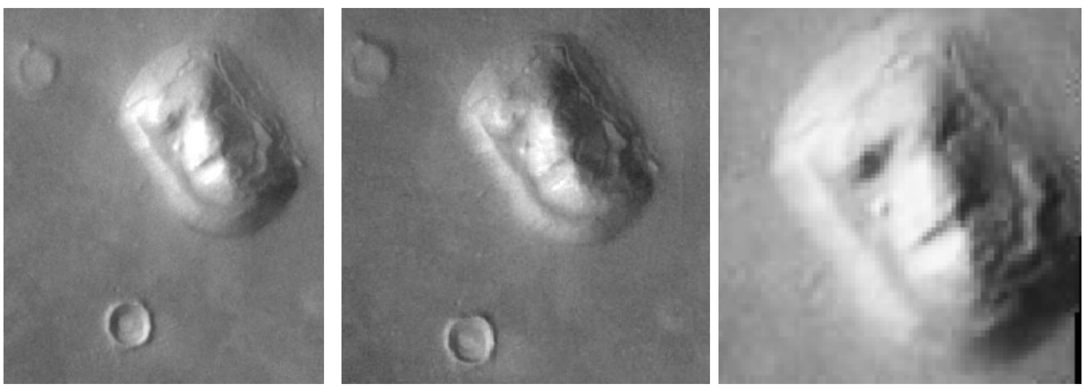

Figure 20. Mars Odyssey images V10598012 (left) V1024003 (center) and V12445004 (right) of the face in Cydonia taken under similar viewing and lighting conditions as the Viking images. Note circular crater beside the face.

However, before this, the Mars Global Surveyor, at viewing, first imaged the face at Cydonia and illumination conditions much different than the Viking images (see Fig. 21) and released without any explanation of these differences or contrast enhancement, apparently in an attempt to mislead the public and scientific community [18]. This poorly enhanced image has been termed the “cat box” image, because of its resemblance to an object in cat litter box. (see Fig. 22)

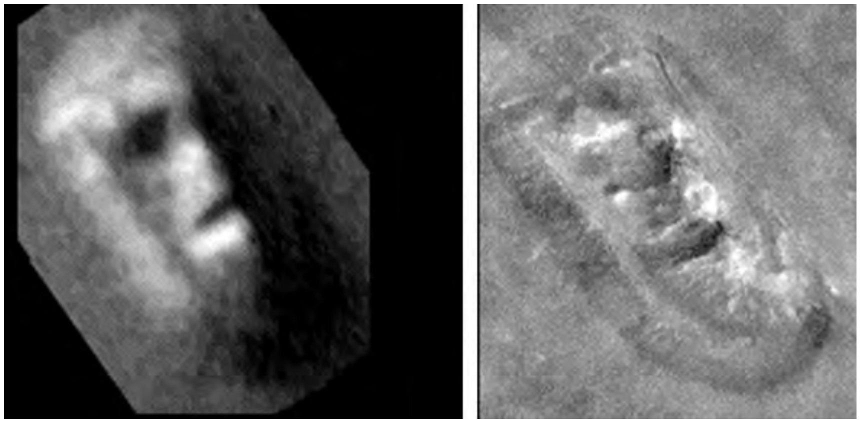

Figure 21. Carlotto shape-from-shading derived images showing expected view of the Face from Viking data (left) at MSSS image viewing angle versus (right) enhanced MSSS image (Courtesy Mark Carlotto)

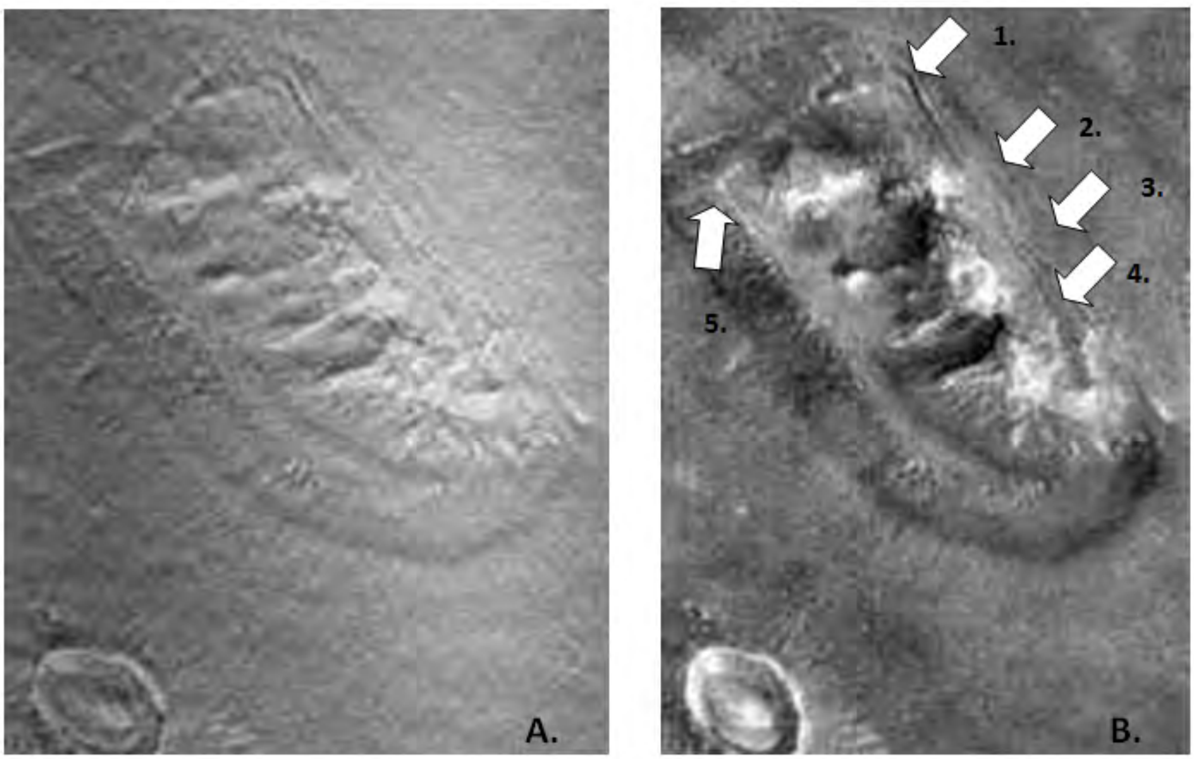

Figure 22, A and B. (A) Poorly enhanced “cat box” MSSS image (P220-03 NA image) released 5 April 1998 (B) Enhanced version by Mark Carlotto showing 1. Helmet ornaments, 2. Eyes, 3. Nostrils, 4. Mouth 5. Frame-corner. Note elliptical shape of crater beside face confirming oblique viewing angle.

Using the three dimensional shape from shape-from-shading model developed by Mark Carlotto (1998) was able to rotate the oblique image to give an approximate view of the object in the illumination it experienced, if viewed from above, as on the Viking images. The presence of helmet ornaments, also predicted by Carlotto, as well as nostrils, and the overall symmetry of the Face was confirmed. (Fig. 23 and 24).

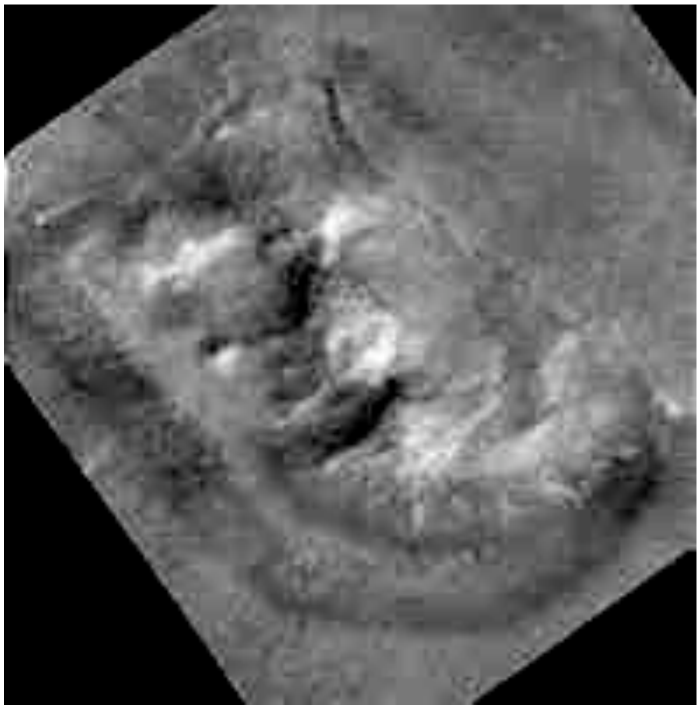

Figure 23. The face image rotated using a 3-d model of the Face from Carlotto shape-from- shading model.

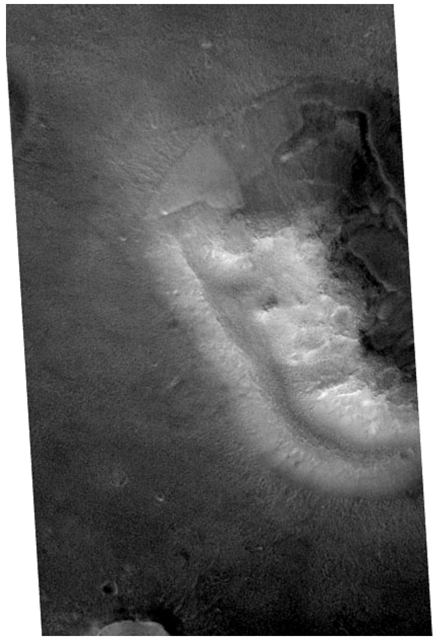

Figure 24. MOC image E10-03730 confirming nostrils, helmet ornaments, and frame-corner.

Finally full frame images of the Face were obtained under various illumination conditions, confirming both overall symmetry, anatomical completeness and the presence of nostrils and helmet ornaments. (Fig. 25 and 26)

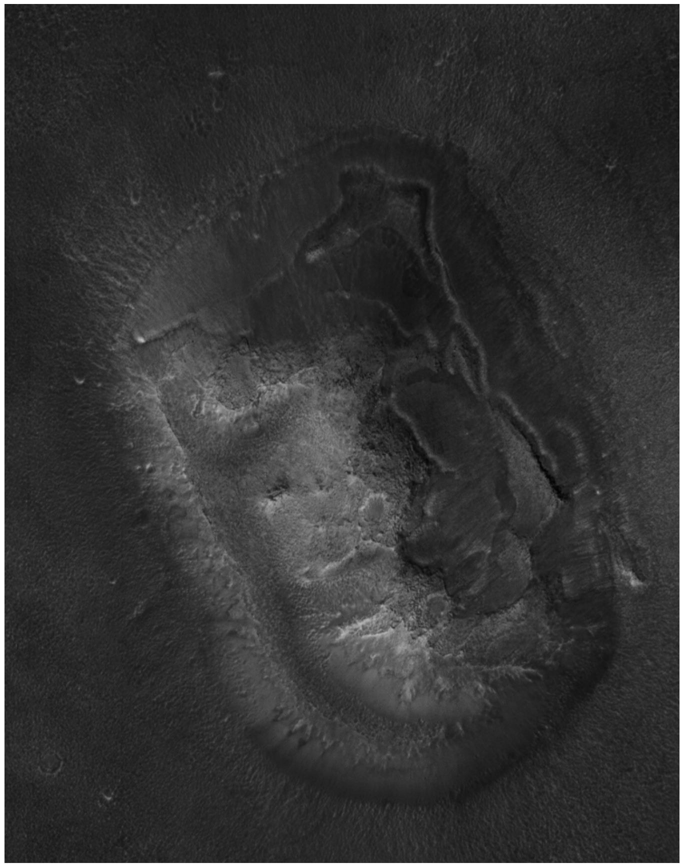

Figure 25. S1501533 with visible erosion , eyes, nostrils, mouth, and helmet sides.

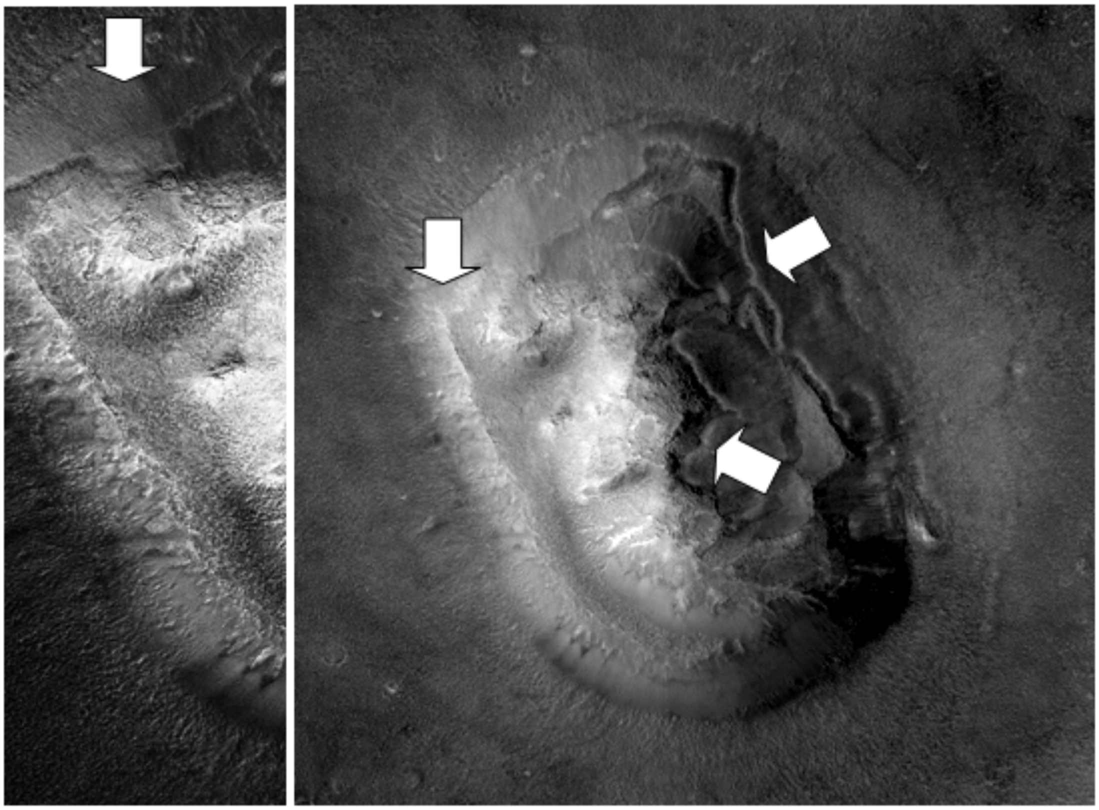

Figure 26. (left) MOC image M16-00184 showing part of the face. (right) MOC image MOC image E03-00824 showing (arrows) eyes, nostrils, frame corner, and helmet ornamentation.

Despite obvious erosion, the eyes, nose, mouth and helmet ornamentation are clearly evident.

The D&M pyramid was also imaged (Fig. 27)and appears to show a "stellation" or extension of its geometry to a nearby structure. Steallations are often seen in Earthly fortifications, such as Ft. McHenry in Baltimore (Fig. 28).

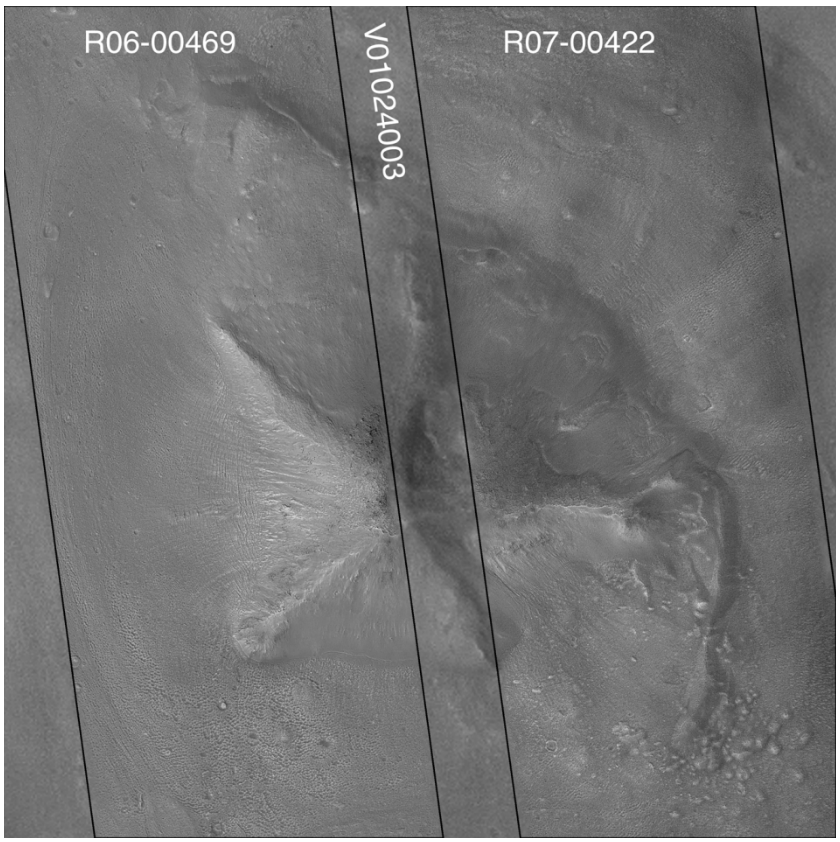

Figure 27. High resolution composite image of the D&M Pyramid with MSSS frame numbers.

Figure 28. Pentagon-shaped Fort McHenry at Baltimore showing stellation.

Not only was its overall 5 sided symmetry confirmed, but the new high resolution images revealed what appears to be a collapsed rectilinear region of brickwork, (Fig. 29, 30 and 31) where bricks were apparently used for facing the pyramid to protect it from erosion, have collapsed in one rectangular region and produced a small landslide.

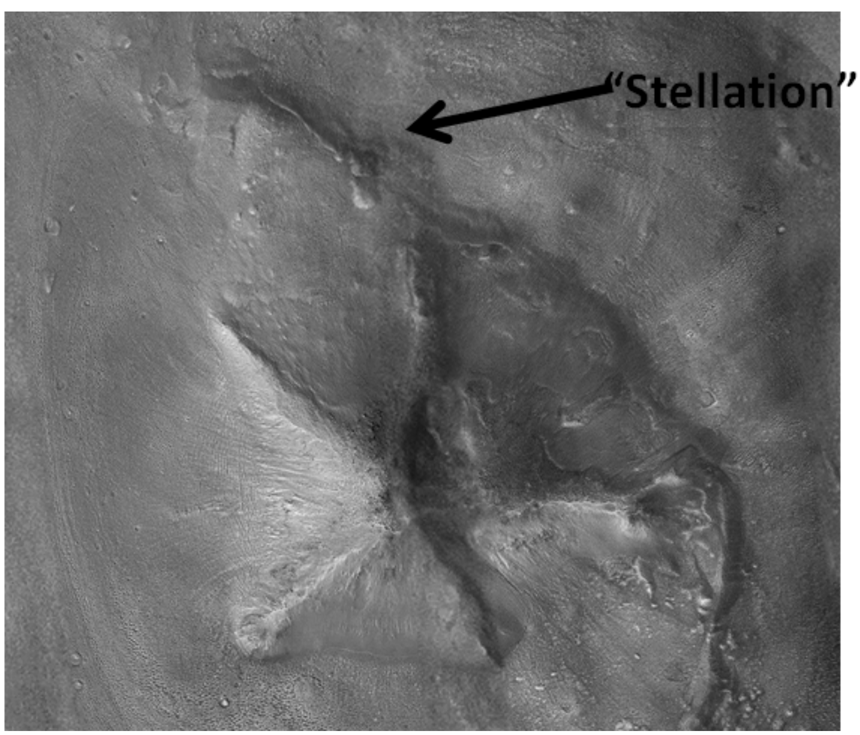

Figure 29. D&M Pyramid at Cydonia Mensa showing apparent stellation.

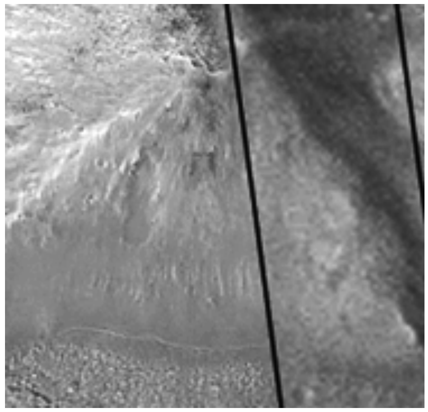

Figure 30. Enlargement of the D&M pyramid images showing dark square collapse zone in center of image.

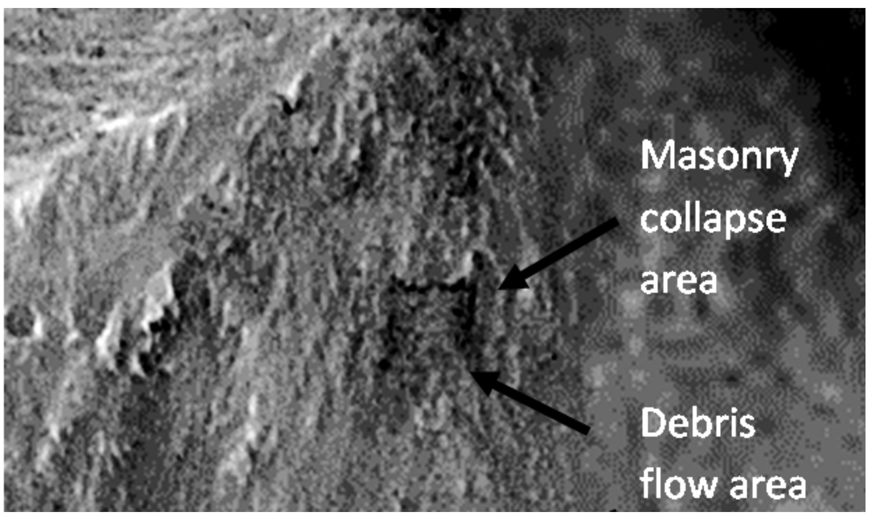

Figure 31. High resolution image portion of the D&M Pyramid showing apparent collapsed brickwork and landslide area.

With the acquisition of new images, the large scale alignments of smaller objects, particularly a set of small mounds found in Cydonia, was confirmed. As was pointed out by Horace Crater, this pattern showed a precise and repetitive mathematical symmetry (Crater and McDaniel 1999).

Figure 32 Illustrations of the pattern of small mounds found in Cydonia by Horace Crater.

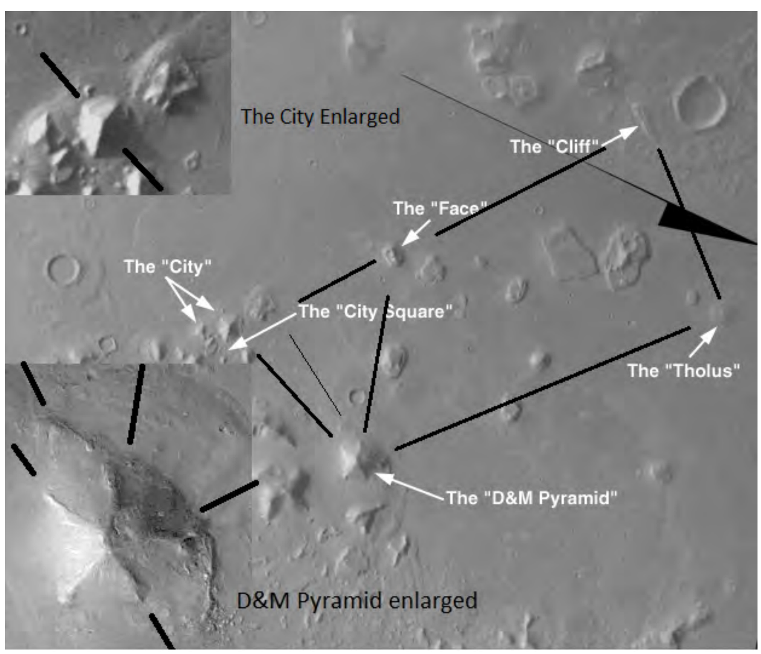

Figure 33. Face on Mars and the D&M pyramid and other objects and their apparent alignments, first proposed by Richard Hoagland and Erol Torun.

Large scale alignments of the features on the Face and D&M Pyramid were also confirmed. The most remarkable objects in Cydonia , besides the Face and D&M Pyramid, would have to be the "Wall" and the "Tholus". The Wall sits on top of the ejecta apron of a large crater. It has to have been emplaced after the crater formed because the ejecta does not "splash" around it but appears to go continuously under it. The Wall is thus geologically inexplicable and thus formed by non-geologic forces. Given its context and alignment, it appears to have been constructed to form a backdrop to the Face. This object was first discovered by Richard Hoagland (Pozos 1986)

Figure 34. The "Wall" in Cydonia Mensa, note that the ejecta apron of the crater appears continuous under the wall.

The Tholus is also geologically different from everything in the vicinity, looking like a volcanic formation, while everything around it appears to be the product of erosion.

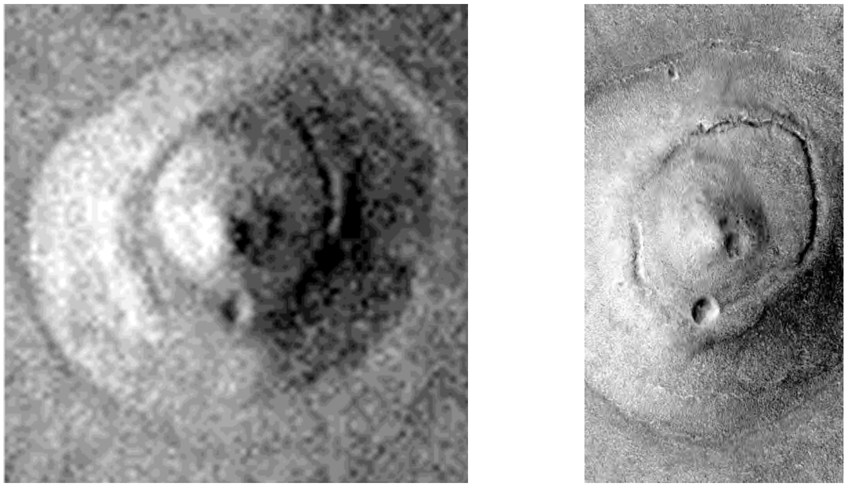

Figure 35. The Tholus from the Viking image 70A13 (left) and reimaged by Mars Surveyor, MGS image of the Tholus (M0300766) (right).

Therefore, the new images of the two most provocative objects in Cydonia Mensa, allowing for erosion that affects all Earthly archeology, strongly confirm the CH, which states that the objects would show increased anatomically and architectural details at higher resolution. The fact that it also shows erosion confirms that that were created in time when Mars had more Earthlike climate and erosion rates.

New Imaging Data in Galaxias Chaos (Utopia)

The faces (here called Galaxias and Chaos) (Fig. 37) were discovered by the author on Viking frame 86A10 (Pozos 1986) and subsequently investigated further using frames 541A453 and 243S01 and other lower resolution frames. These images confirmed the face-like structures seen in 86A10.

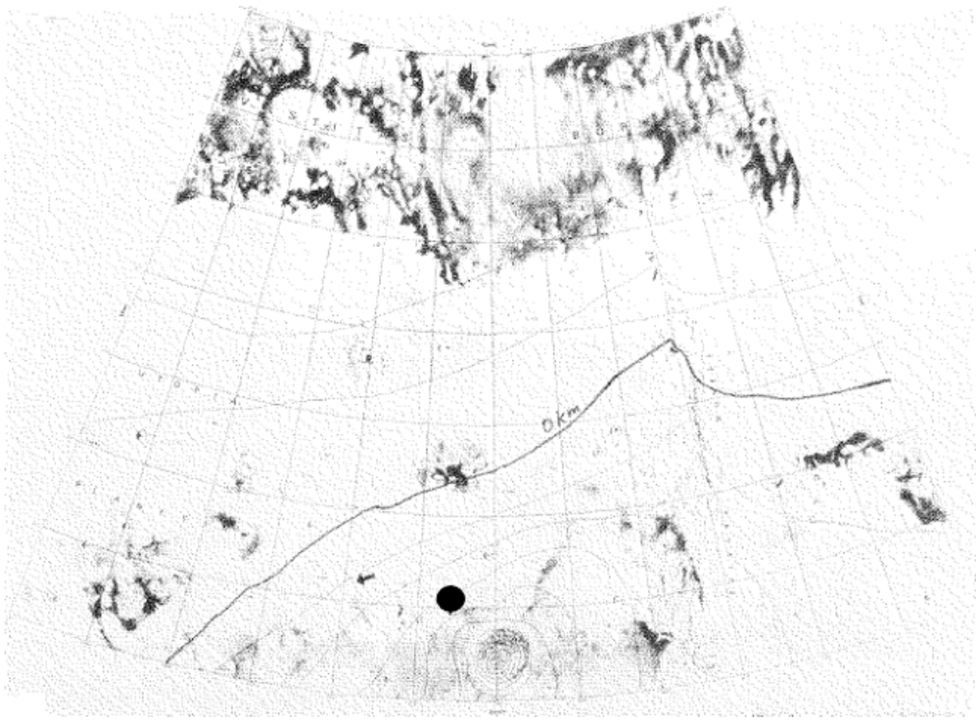

Figure 36. A map of the Utopia region showing site of Galaxias Faces

The objects were discovered by the author using an archeological site model developed at Cydonia Mensa to find a similar site. Face Galaxias resembles the face in Cydonia, though on approximately 2/3 scale. The face appeared complete, with two eyes, nose mouth and helmet like the Cydonian face. It was noted in the original publication of the Cydonian Hypothesis that the object most resembling the face

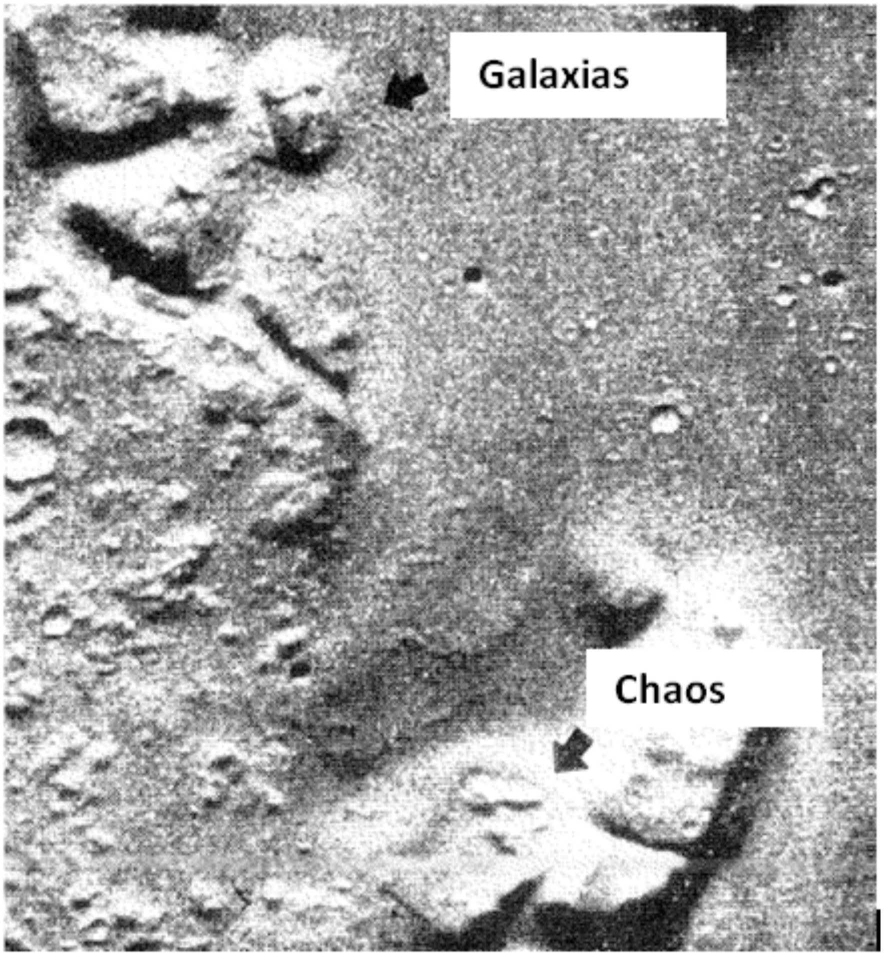

Figure 37. Galaxias Face A “Galaxas” and Galaxias Face B “Chaos” are seen in portion of 86A10.

Two new images of the Galaxias Face A have been obtained, they confirm its overall resemblance to the Face in Cydonia : face-in helmet structure, ornamental details and presence of erosion.

It can be seen that Galaxias A shares apparent ornamental details with the face in Cydonia: what appear to be marks on the cheeks and an indention over the left eye, as indicated in the original CH publication.

Figure 38. Galaxias Face A “Galaxias” and Galaxias Face B “Chaos” are seen in portion of Odyssey THEMIS Image I02816002

Three new images of the Galaxias Face A have been obtained. They confirm its overall resemblance to the Face in Cydonia: face-in helmet structure, ornamental details and presence of erosion.

It is the only object imaged at high resolution (Galaxias B was somehow excluded from both Odyssey and MRO images) It can be seen that Galaxias A shares apparent ornamental details with the face in Cydonia: what appear to be marks on the cheeks and an indention over the left eye, as indicated in the original CH publication.

The Odyssey image confirms the resemblance of the face to the face in Cydonia and the presence of shared ornamental details, such as the cheek ornaments and indentation over the left eye. Helmet ornaments also appear present.

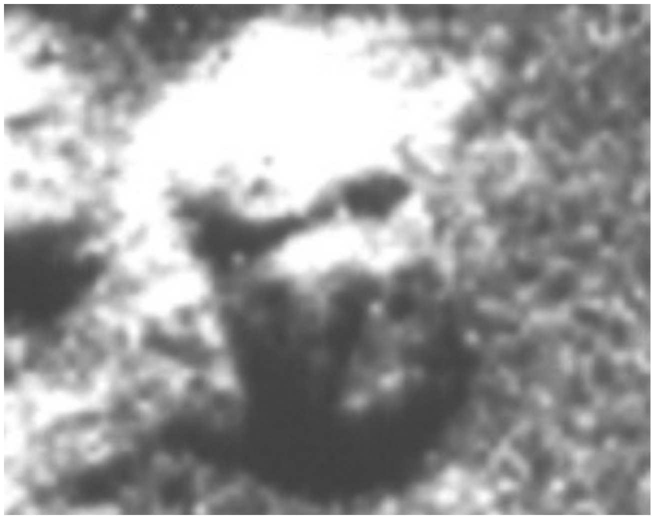

Figure 39. Galaxias Face, Viking image 86A10.

Figure 40. Galaxias Face A, 2006 MARS ODYSSEY image

V22286011 from directly above.

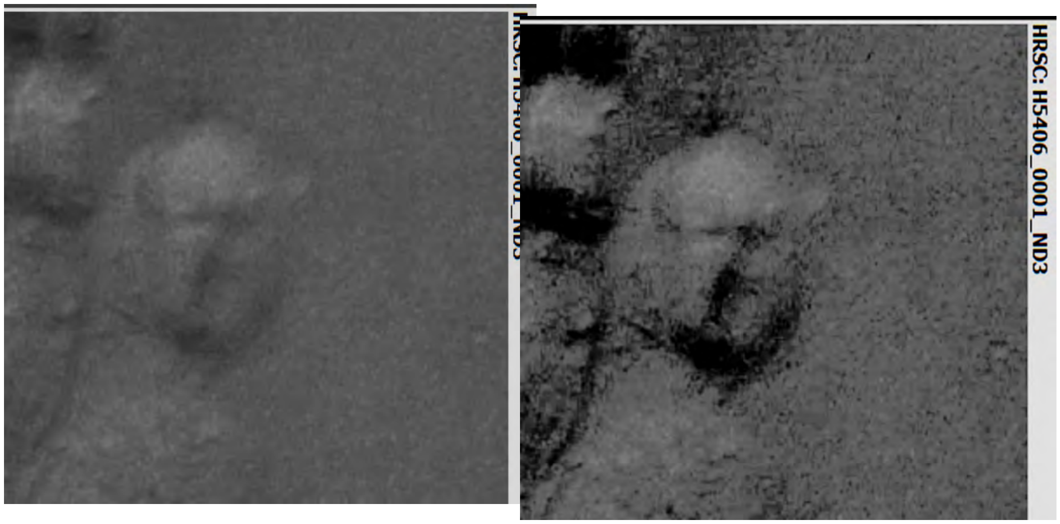

Figure 41. An Image of Face 1 from European Express High resolution image H5406_0001_ND3 , (left)and a contrast enhanced version (right) showing eyes, helmet and mouth.

In the original article CH article, it was noted that Viking images of the faces in Galaxias (Utopia) shared ornamental details with the face in Cydonia, in it is seen that the new images confirm these shared details. Such shared details are consistent with cultural equilibration around the shores of the Northern Ocean and therefore supports the CH.

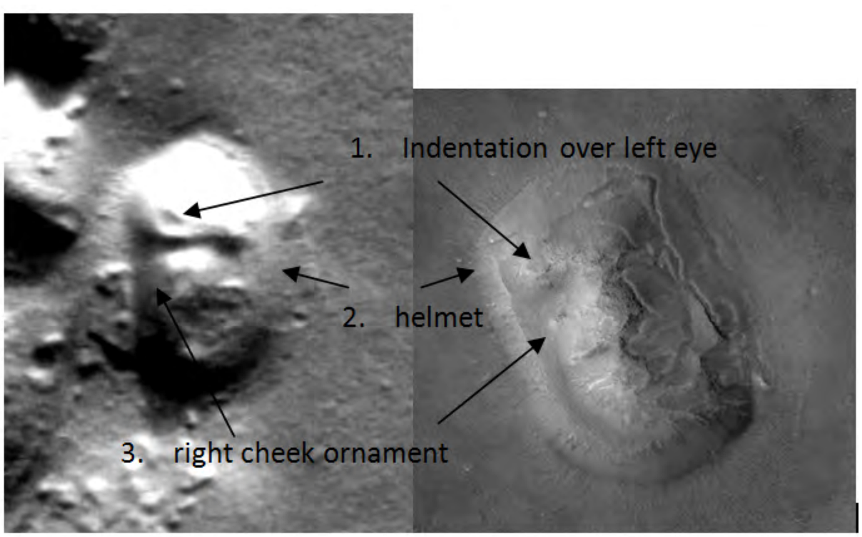

Figure 42. Comparison of new Cydonia and Galaxias images confirming matching details between faces.

The MRO images appear to show the face has suffered an erosive fissure along its length. However, the new image also shows apparent symmetric brickwork on the nose of the face.

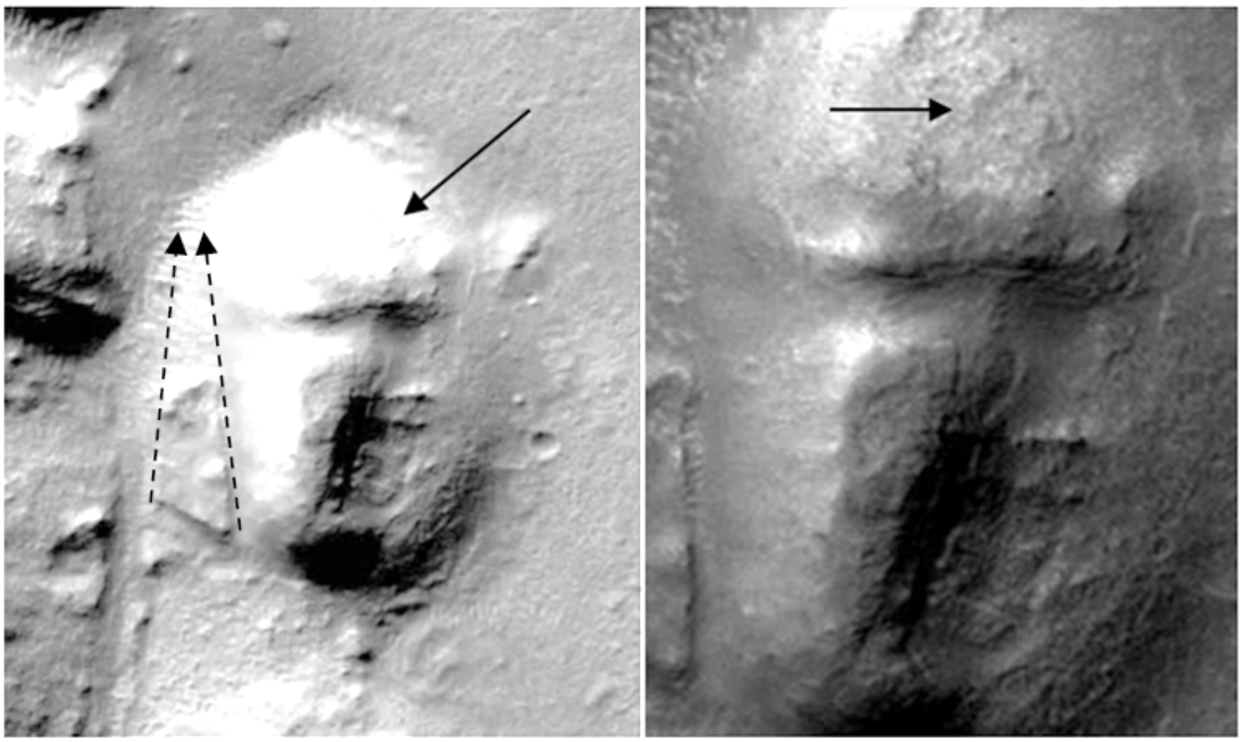

Figure 43. Galaxias Face A, MRO images P04_002714_2144_XI_34N212W and P14_006683_2131_XN_33N212W at oblique viewing angle. Helmet ornaments are seen (solid arrows) in both images, as is the frame corner seen on the Earthly Sphinx (dashed arrows).

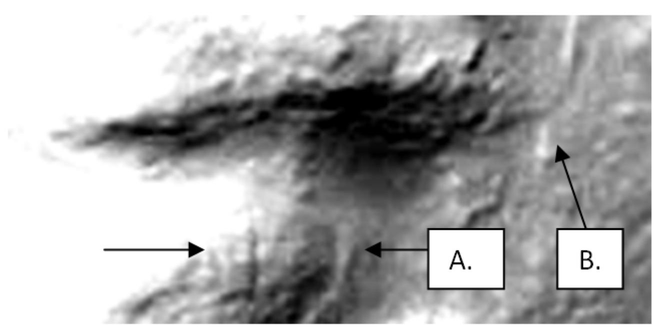

Figure 44. Enlarged portion of Galaxias Face, a MRO image P04_002714_2144_XI_34N212W showing eye and nose bridge area, A. symmetric brickwork is visible on each side of the nose (arrows) and B. frame-corner near right eye (arrow).

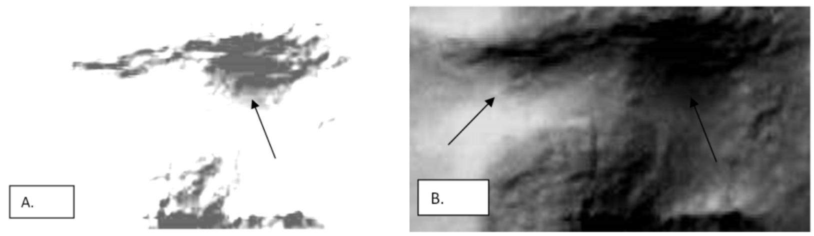

Figure 45. A and B. A. Apparent Pupils in eyes seen in MRO image of high brightness Galaxias A enlargement, and B. pupil identified in right eye at lower brightness.

Figure 46. Similar face from Mexico

Therefore, the new images of Galaxias Face A or “Galaxias” appear to strongly confirm the overall resemblance of the object to the larger Cydonia face and also confirm shared details. The MRO image also displays evidence of fissuring of Face Galaxias but also symmetric brickwork on the nose area. Accordingly, the Galaxias Face, is an apparent eroded artifact like that of Cydonia and also the product of similar global Cydonian culture on the shore of the northern Paleo-Ocean.

The face Chaos at Galaxias was also reimaged but appears to be of generally lower relief and thus more subject to erosion (Fig. 47).

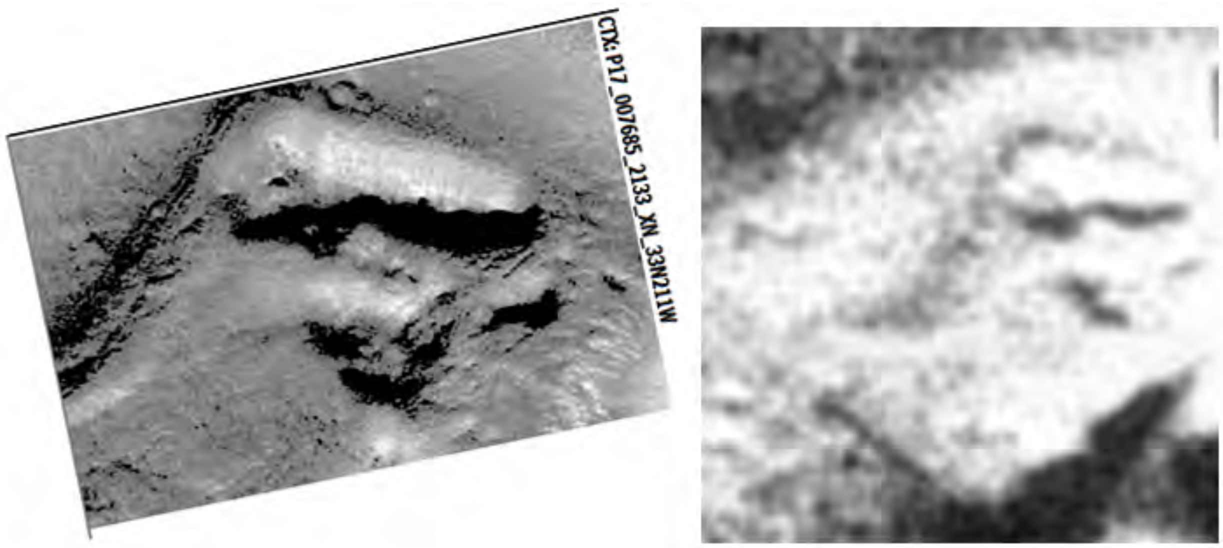

Figure 47. A contrast enhanced image of Face Chaos from MRO context image P17_007685_2133_XN_33N211W and comparison image from Viking image 86A10

4. Summary and Conclusions: The *Dark Star* Scenario

Based on evidence that Mars and Earth evolved with a liquid water environment on their surfaces for most of their history, as evidenced by an ocean bed on the youngest part of Mars, the high oxidation state of Mars surface and sediments, plus evidence that biology began early on Mars, as on Earth, and persisted for most of its geologic history, and finally higher resolution images of the face and D&M pyramid in Cydonia Mensa showing apparent brickwork and new anatomic and artistic details not seen in Viking Images, and the new images of the face "Galaxias A" in Galaxias Chaos (also called the Utopia site), that confirming its similar structure to the face in Cydonia Mensa as well as new details suggesting brickwork, the author now concludes that the CH has been confirmed. That is: apparent eroded archeology exists from a dead indigenous civilization on Mars at several sites, consistent with a long-lived and evolved biosphere on Mars in the past, as on Earth. It is also worth pointing out in passing, that the nuclear calamity discussed here may have left some bacterial species unscathed and intact, and these may well have been detected in the 1976 Viking Labelled Release Experiments of Gilbert Levin and Patricia Straat.

The existence of a dead humanoid civilization on Mars is completely consistent with its apparent long-lived Earthlike past climate and the Principle of Mediocrity, the idea that humanoid intelligence is not exotic or miraculous, but is a natural consequence of any long lived Earthlike biosphere.   This Martian civilization apparently perished due to a planet-wide catastrophe of unknown origin, that changed Mars climate from being Earthlike to its present state in a brief period compared to geologic time. However, what ended this civilization, was it a massive nuclear attack?

It is possible that, on Mars, we now have the answer to Fermi's great question: "Were the hell are they?" The answer is in the face of Mars and xenon isotopes of the atmosphere around it. The answer is perhaps that they have all suffered the same fate as Mars.

The Astronomer Edward Harrison suggested one major factor cutting short the lifetime of civilizations was older predatory civilizations who would wipe out young civilizations once they became detectable through radio broadcasts. The motivation for such genocidal actions would be to avoid later competition (Soter 2005).

Given the large amount of nuclear isotopes in Mars atmosphere resembling those from hydrogen bomb tests on Earth, Mars may present an example of civilization wiped out by a nuclear attack from space, such as seen in the movie ***Dark Star***. Therefore, the resolution of the Fermi Paradox may lie within easy reach of the human race: It is perhaps a Dark Star Scenario. It is possible the Fermi Paradox means that our interstellar neighborhood contains forces hostile to young, noisy, civilizations such as ourselves. Such hostile forces could range from things as alien as AI (Artificial Intelligence) 'with a grudge' against flesh and blood, as in the movie ***Terminator*** all the way to things as sadly familiar to us as a mindless humanoid bureaucrat like Governor Tarkin in ***Star Wars***, eager to destroy planet Alderann as an example to other worlds.

In either case, the most dangerous thing to intelligent life in the Cosmos may be other intelligent life. If this is so, discovering this fact on Mars may allow us to prepare to survive any confrontation with such forces. Therefore, the author suggests that the Cydonia and Mars nuclear data be viewed in the context of the Fermi Paradox and appropriate efforts to explore Mars with human archeologists be undertaken immediately.

Here is the Working Hypothesis concerning Mars at our present state of knowledge: Mars appears to become the home of life at the same time as Earth, but cooled earlier and achieved intelligence before Earth, ultimately having held a primitive civilization that built massive monuments which we recognize now despite some erosion. The civilization was global and concentrated in the northern hemisphere of Mars near its ocean. But, under this working hypothesis, Mars was then destroyed by a space power, like the planet Alderan in the movie ***Star Wars***.

The discovery of dead civilization on Mars, whose end was apparently catastrophic and due to unknown causes, reinforces our understanding that the cosmos can be a dangerous place and requires a vigorous response from the human race, to reduce the probability that we will perish the same way. The most likely cause of the Cydonian demise, the large asteroid impact from the Lyot impact basin, causing collapse of a Mars greenhouse system, is a hazard of the cosmos that we were aware of. However, the second possible catastrophe, a pair of large and anomalous nuclear events, centered apparently near Cydonia and also near Galaxias, and leaving no craters, is much more difficult to understand. For this reason we must maximize our knowledge of what transpired on Mars, and this requires an international human mission.

A human mission to Mars is now imperative. It must be an essentially one-way mission, with a permanent human occupation and settlement of planet following. Mars and the biosphere and culture it apparently supported is dead. The magnitude of such tragedy requires an intelligent response from us of equal magnitude. We must find out why they, and the planetary biosphere that they were part of, perished. This requires both human beings on Mars to maximize knowledge as much as possible of the life and death of Mars and also the acquisition of human skill in astronautics to accomplish this feat. Both acquisitions will increase the chances of humanity not sharing the fate of the Martian culture. Knowledge is our best defense against the unknown.

Despite the expectation of NASA, from its inception, that ‘artifacts’ might be found in the Solar System, (Brookings Report to NASA 1961) and the searches by Sagan and Wallace (1971) for signs of intelligent activity on Mars, and now, mounting evidence of prolonged Earth-like conditions on Mars in the past, some have insisted that such searches are foolish. Some have even said that attention given to what appears to be eroded archeology on Mars is merely a manifestation of “pareidolia,” which is the attaching of undo significance to random stimuli, however there is another well- known human phenomena: “denial” ,which is the inability to recognize unpleasant truths when one is ‘face to face’ with them. In an unknown and occasionally dangerous universe, to look for signs of past intelligent activity on the nearest terrestrial planet is merely prudent. To ignore possible signs of such activity in an unknown and dangerous cosmos, is negligence.

In summary, Mars has been found to have been both the site of intelligent humanoid life and its catastrophic death. This makes the cosmos both highly interesting and full of warning. Again, it is recommended that an international human mission to Mars be prepared including archeologists in the crew manifest, and that rovers and other spacecraft prepare the way for such landing at Cydonia Mensa, with additional landings at Galaxias Chaos and other areas, made to maximize knowledge. These landings must lead to permanent settlement of Mars by humanity. Only a human mission and settlement, with "boots on the ground" for the long haul, will maximize data for the human race of what exactly transpired on Mars, and only such a human mission will also maximize human advancement in astronautics, and extraterrestrial settlement, both key areas of knowledge for humanity survival. Given what lies on Mars, we must do, with dispatch, what is necessary to maximize chances of long term human survival in a cosmos that is both fascinating, beautiful, and dangerous.

Acknowledgments: I am grateful to Mr. Morgan Boardman, Mr. Paul Murad, Dr. Eric Rice, Dr. Horace Crater, and Prof. Stanley McDaniel, for their support and encouragement of this research. The author is especially grateful to Mr. Vincent DiPietro for urging that the Mars isotopic anomalies be investigated, and to Dr. Edward McCollough for pointing out the presence of the antipodal features in the K and Th maps.

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