Venus impacts are not evidence against an astronomical trigger for the Flood

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Venus should have thousands of meteoroid impact craters, since Mercury, Mars and the Moon have numerous impact craters. The earth likely was bombarded with a minimum of 36,000 impacts that were deformed and destroyed by the Flood. About 1,000 pristine, random impacts have been claimed for Venus, suggesting that the surface has been resurfaced by lava, covering up most of the impacts. However, there is evidence that thousands more craters are visible, but these are assumed not to be impact craters. Hamilton provides a good case that coronae and other small to medium size quasi-circular features are impact structures. Other scientists disagree, but their arguments seem weak. When coronae are included as impacts, the impact distribution is slightly nonrandom. Therefore, the impact history does not rule out an astronomical mechanism as the cause of the Flood on Earth.

In a recent International Conference on Creationism article, Robert Hill[1] made a case that random impacts indicate that Venus was volcanically resurfaced not that long ago, probably by an episode of catastrophic plate tectonics. Moreover, the random distribution of these impacts is considered strong evidence against an astronomical trigger for the Flood, such as the earth passing through a large asteroid swarm. The reason for this deduction is because Venus rotates very slowly, in 243 days, and the random impacts show there was not a huge, quick bombardment that rapidly decreased in intensity with time, as deduced from the Moon.[2,3] Such a rapid bombardment has been suggested as the mechanism for the Flood by many creationists. However, there probably are many more impacts on the surface of Venus, and with a nonrandom distribution, that would call into question these deductions.

Impacts ubiquitous in the solar system

Every solid surface of the solar system, except Earth, Venus, and those moons that have been resurfaced, is riddled with impacts, including on asteroids.[4–6] In regard to the inner solar system, Mercury, Mars and the Moon all show numerous impact craters with a similar size-frequency distribution.[7] Some of these are of giant size, such as Hellas on Mars, 2,100 km in diameter and 9 km deep;[8] Caloris on Mercury, 1,550 km in diameter;[9] and South Pole-Aitken on the Moon, 2,500 km in diameter and about 7 km deep[10] with a maximum depth of 8.2 km below the reference ellipsoid.[11] Based on more sophisticated analysis, there could be five craters with diameters greater than 2,500 km on Mars.[12] Why should the earth and Venus be exceptions?

Furthermore, these impact structures are not random on at least Mars and the Moon. For instance, the Moon shows large impacts filled with basalt that dominate the near side.[2,3] Figure 7 on page 66 shows the large mare basins on the near side of the Moon. Such large impacts on the side of the Moon facing the earth could be responsible for the observed radial oscillation, or "ringing", of the Moon, and could be evidence for an astronomical trigger for the Flood.

It is interesting that Mars has a crustal dichotomy in which the Northern Hemisphere is about 7 km lower with the crust about 30 km thinner on the average than in the Southern Hemisphere.[8,13] It is called the Borealis basin. This crustal dichotomy is a mystery. Andrews-Hanna *et al.* state: "The origin of the crustal dichotomy remains one of the most fundamental unanswered questions in the study of Mars."[14] It has recently been claimed that the Mars crustal dichotomy was caused by one immense meteorite impact creating the 8,500 km by 10,600 km Borealis basin![13–15] The impactor was a whopping 1,600 to 2,700 km diameter asteroid! Other astronomers in the past have suggested that the hemispheric dichotomy on Mars is due to multiple large impacts.[16,17] Many quasi-circular features, some very large, are seen in the Northern Hemisphere of Mars.[12]

Only about 170 impacts have been discovered on Earth.[18] There should be 36,000 impacts greater than 30 km with about 100 craters greater than 1,000 km and a few possibly up to 4,000 to 5,000 km in diameter.[19] Astronomers attribute the lack of impacts to weathering, tectonics, subduction of ocean crust, and other factors. Creationists would mostly attribute the missing impacts on Earth to the effects of the Flood, such as tectonics, erosion, and deposition. It is likely that the largest impacts bombarded the Precambrian igneous crust, and that the Precambrian and Phanerozoic sedimentary rocks are from the Flood.[20]

The "resurfacing" of Venus

When the 1990–1994 Magellan space probe used radar to penetrate through the thick clouds on Venus, it made an unexpected discovery. It was able to produce high-resolution images down to 100 m horizontally and 80 m vertically.[1] Magellan discovered only about 900 fresh-looking craters that ranged in size from 1.5 km to 280 km[21–23] (figure 1). Judging from the rest of the bodies in the solar system, there should be tens of thousands of craters

of various sizes and erosional states. But such "pristine" craters imply the surface of Venus is young. So, uniformitarian astronomers believe that Venus was "resurfaced" by volcanic flows only about 500 Ma ago in their timescale.[24] This date is based on the number of Venus-crossing asteroids and the number of observed impacts.

Although Venus has been considered the earth's sister planet with a similar size and mass,[25] the results of Magellan showed that Venus was dissimilar in many ways to the earth. For instance, plate tectonics is apparently not occurring on Venus,[26,27] or at least not within recent history.[28] Therefore, many believe that Venus likely loses its heat by deep plumes that transport heat to the surface, which is then radiated into the atmosphere and eventually into space, assuming Venus is billions of years old.

Figure 1. One of about 1,000 pristine impacts on Venus (courtesy of NASA).

Although most astronomers do not believe in Venusian plate tectonics, some believe that Venus undergoes *episodic* plate tectonics, which possibly caused the resurfacing event.[29] Within a creationist framework, Hill believes that catastrophic subduction likely resurfaced Venus.[30] There has been volcanism on Venus, but whether it completely resurfaced the planet and whether it was caused by subduction is questionable.

Coronae and other quasi-circular features likely are impacts

However, other scientists have recently challenged the small number of craters and come out strongly that there are many more impacts, likely thousands of them, on Venus that have not been considered.[31–33] One group of possible impact structures are "coronae", which have been interpreted as volcanic by the majority of astronomers (figure 2).

Coronae are circular-to-oval structures 60 to 2,600 km in diameter with an average of a little more than 200 km.[34] Coronae are unique to Venus.[35] There are only four coronae over 800 km.[32] Most scientists believe they are the surface expression of mantle plumes that transfer heat from the interior of the planet to the surface. There are more than 500 of them. Most of them are rimmed depressions, similar to impacts.

There are many other small to medium scale quasi-circular features that are also not considered impact structures by most astronomers.[31] There are probably many more buried in the lowlands by volcanic flows or by debris. Many of these circular structures were seen on pre-Magellan radar imagery, and most early interpretations were that these features were impact structures. So, if coronae and the other small to medium sized features are impact structures, then Venus has been blasted with many more than 1,000 impacts.

As evidence for impacts, Hamilton[31,32] and Vita-Finzi *et al.*[33] point out that many of the structures, claimed to be due to internal processes, are too circular to be anything but impacts. Furthermore, claimed mantle plumes that originate from the core/mantle boundary of Earth (another controversial theory) do not resemble the shapes of the coronae and other generally circular objects on Venus. Furthermore, the sizes of many coronae are too large for plumes. Similar structures on other planets and moons are now believed to be impact structures, whereas earlier the majority opinion was that these features were volcanic or caused by some other type of internal mechanism. So, should not similar features on Venus also be interpreted as impact craters, especially when considering the perfection of many of the circular features? Hamilton emphasized:

> "Much of the surface of Venus is saturated with circular structures, from 5 to 2000 km in inner-rim diameter … . Most of these structures retain impact morphology, although all are more modified by erosion and deposition than are the pristine craters agreed upon by all researchers as of impact origin … . More than seven hundred of these large structures have been classified, hundreds more exposed large structures are ignored … . A great many—thousands?—of additional small circular structures also are ignored in conventional synthesis."[36]

If all these structures are impacts, the popular idea of the total resurfacing of Venus also comes into question. Hamilton stated that the resurfacing of Venus by plume-driven processes is really speculation.[31] Hansen and Young also admitted that Venus resurfacing is widely taught and rarely questioned, but does not stand up to reanalysis.[37] So, it is unknown whether Venus was totally resurfaced or not, or only partially resurfaced, in the recent past.

Therefore, Venus likely has thousands of visible craters, which is still small compared to other bodies of the inner solar system. However, there are two factors that would reduce the number of craters or visible craters. Since the atmosphere is 93 times as thick as Earth's atmosphere, many small to medium sized impacts would not penetrate the surface to form craters (see above). (This deduction of course assumes that the impacts did not cause the thick atmosphere through the release of volatiles). Second, many craters likely were buried by lava flows and debris

in a partial resurfacing event or events. So although there are fewer visible craters, the thousands that are visible (assuming coronae and the small to medium quasi-circular objects are impacts) seems about right under the unique conditions of Venus. So, Venus is not an exception to the blasting of the inner solar system by asteroids.

Arguments against coronae being impacts

However, the belief that coronae are impacts is controversial. The main arguments against coronae being impacts seem to be: (1) close circular fractures around the coronae are unlike impacts; (2) coronae have been related to rifts, which implies an internal mechanism for their formation similar to the rifts, (3) craters within and near coronae are highly modified, (4) coronae are not that circular while craters are circular, (5) Venus needs a way to release heat over billions of years, and (6) coronae are not random on Venus.[26,38]

Vita-Finzi dismissed arguments based on coronae that are close to rifts and the modification of craters within and near rifts as due to a *plume bias* for the origin of coronae.[39] Hamilton states that those who believe that coronae and other circular features are not impacts have only analyzed a small subset to make their point.[40]

Hamilton also counters that the coronae and other smaller structures are near circular and that many of them are rimmed depressions that have central peaks or peak rings, very similar to impacts.[41] Furthermore, less circular structures can be older or more modified.[33] And even oval-shaped structures could be impacts, since impacts at a high angle to the perpendicular create oval shaped craters.[42,43] Another possibility is that the shape of the basin was changed after the impact, as has occurred on Earth. The Hellas crater on Mars has an oval shape with a length to width ratio of 1.33, and the Aitken Basin on the South Pole of the Moon has a ratio of 1.38.[42] Furthermore, Hamilton argued that such huge circular structures as coronae are dissimilar to any modern terrestrial structures but are compatible with common impact structures.[40] If coronae and the other circular structures were discovered on the Moon, 81% would be classified as impacts.[33]

The first argument against coronae being impacts seems to be the most significant, as impacts on other solar system bodies have not produced such close circular to near circular fractures as deduced for coronae (figure 3). But, the variables that determine the final crater morphology are not completely known: "The reader should be warned that many details of the impact cratering process are still not fully understood."[44] This applies especially to the large basins.[45] However, it is known that impacts cause multiringed basins. So the close circular fractures may be due other variables on Venus such as the thick atmosphere or the type and temperature of the crust on Venus, which is dry making it hard to break.[1] The cratering variables are: gravity, density of the atmosphere, crustal strength, crustal density, and structure of the impacting bodies, which includes projectile flux, size, and impact velocity.[46] The thick atmosphere will burn up iron meteoroids less than 2 km in diameter and stony meteoroids less than 5.8 km.[47] Those meteoroids above these thresholds would slow down and be modified before they hit the surface, and so the craters may be quite different than observed on other solar system bodies with little or no atmosphere. So, any one of these variables could cause the closely spaced depressions and ridges surrounding coronae.

It is interesting that in some areas there are clusters of coronae that are superimposed on top of one another.[32] Such superimposition is typical of craters on other solar system bodies, supporting the impact origin of coronae, but hard to defend with a plume origin for coronae.

The arguments of coronae age, non randomness, and the need for Venus to release heat for billions of years would not be significant in a young-earth paradigm. So, it seems likely that Hamilton[31,32] and Vita-Finzi *et al.*[33] are correct in their challenge.

Impacts on Venus not random—similar to the moon and Mars

Although the approximately 900 fresh looking impacts up to 280 km in diameter after "resurfacing" are random on Venus, the coronae are not random.[32,48] A larger number of coronae occur on one side of Venus, a little like the Moon.[33] However, the non-randomness is not all that great, which would imply that impacts continued to occur at significant rates through at least one 243-day rotation of Venus. Of course, if all the buried impacts are included, the distribution of impacts on Venus could be very nonrandom, as seen on the Moon. Samec concluded that the large non-random impacts occurred on the near side of the Moon in

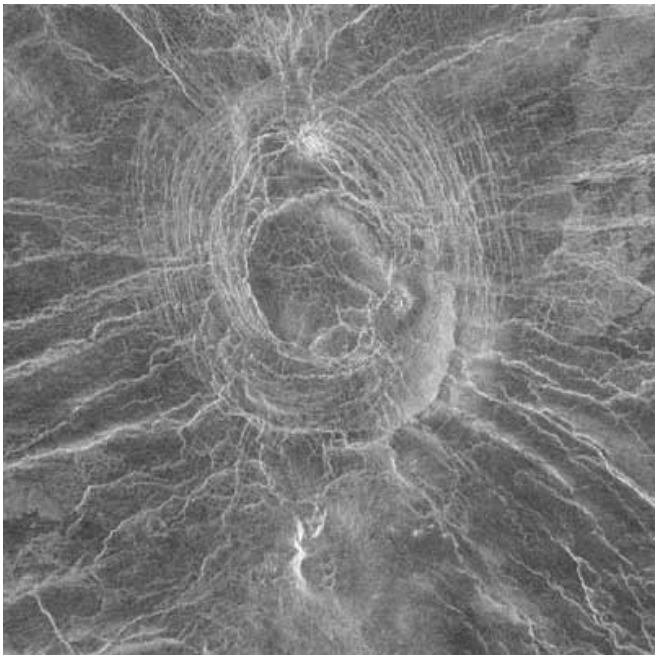

Figure 3. A corona on Venus (courtesy of NASA). Note the near circular, closely spaced white lines just beyond the circular depression. These represent ridges, separated by troughs.

less than 12 days.[2,3] This would correspond with what is called the Late Heavy Bombardment, dated about 3.90 Ga ago by uniformitarian scientists.[49] Thus, the Late Heavy Bombardment could have been over a period of days to weeks in the creationist model. The deduction from Venus is that impacts were spread out over a larger time, which may or may not have something to do with the origin of the impactors.

Such a nonrandom distribution could imply a catastrophic burst of asteroids in a relatively short time, followed by a slow decrease. Such a catastrophic burst is resisted by evolutionary astronomers. They are attempting to explain the non-random distribution by a variable latitudinal cratering distribution caused by a non-isotropic flux of planet crossing asteroids and comets.[50] It is probably because astronomers cannot contemplate catastrophic impacts on a scale of days to months that they suggest that the Northern Hemisphere of Mars was blasted by one huge asteroid instead of multiple asteroids. Marinova *et al.* stated: "exogenic multiple impact events are statistically unlikely to concentrate in one hemisphere."[51] If Mars were billions of years old, the concentration of several huge impacts in the Northern Hemisphere would be unreasonable. But if Mars is young and the impacts were bunched together, there is no reason why multiple large impacts could not have *preferentially* hit the Northern Hemisphere of Mars.

Mantle plumes on Earth and Venus probably fictitious

Hamilton also strongly criticized the strong bias of the plume hypothesis, not only for Venus but also for Earth.[31,32] The plume hypothesis states that mantle plumes cause hot spots and large areas of volcanism on Earth. The mantle plume is said to originate from the core-mantle boundary. Hamilton summarized:

> "Geomyths, based on dubious assumptions rather than data, are widely entrenched in geoscience as dogma insulated from analysis. … Thus, conjectures on which the original concept of plumes on Earth was based have all been disproved, yet instead of seeking alternatives, advocates evasively elaborate assumptions. Plume speculation was exported to Venus to explain features utterly unlike those for which it was devised on Earth, and was promptly accepted as dogma. William Abriel (2004, pers. commun.) speaks of 'the tyranny of the anchored model'—of the common unwillingness of scientists to evaluate assumptions behind their models. The anchored models of geodynamics and geochemistry have retarded geoscience for half a century. Too often the models are further shielded (as in the case for Venus) by peer reviewers who block studies and publications that seek alternatives to their own speculations."[52]

Creationists can identify with such sentiments by a well-established uniformitarian researcher, who indicates the sorry state of geoscience.

Conclusions

It is likely that there are many more than 900 random impacts on Venus. Hamilton provides a strong case that coronae are impact structures. There are also thousands of other small to medium sized, generally circular structures that are likely also from impacts. As a result, the idea of resurfacing of Venus is questioned. If the coronae and the quasi-circular structures are large impact structures, then Venus is generally similar to the other bodies in the solar system in being heavily cratered. There are two reasons why Venus should have fewer visible impact craters than other bodies of the inner solar system, namely the thick atmosphere and the covering over of some craters by lava flows and debris, which can be considered a partial resurfacing event. The visible craters likely have nothing to do with a catastrophic-plate-tectonic event, since Venus probably was not totally resurfaced (besides there are other mechanisms to cause volcanism on Venus). Mantle plumes are not needed if Venus is only thousands of years old; Venus is too young to have a problem with the release of interior heat. The slightly non-random distributions of impacts on Venus would also support the idea of a relatively quick burst of impacts as deduced from Mars and the Moon, but with a slower decrease thereafter. The slow rotation of Venus would imply that the astronomical event was longer than deduced from the craters on the Moon.[2,3] Finally, Venus would not be evidence against an impact mechanism for the cause of the Flood.

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