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The ferns: Artefacts or natural formations?

Abstract

The ferns are a series of plant like formations discovered by the author on the 28th November 2014. The name was actually given by the HiRise team, it refers to a series of dark structures in Antonialdi Crater that resemble plants. The natural hypothesis is a channel network, that a series of rivers and their sediments were more resistant to erosion than the surrounding terrain. Over time the ground around these channels eroded away leaving the fern shapes above ground. The alternate hypothesis is they are artificially constructed, this paper attempts to show geological explanations do not work with these formations.

Keywords

Mars, Ferns, Fronds, Fibonacci, Channel, Erosion, Artefact.

INTRODUCTION

The ferns are found on a great circle also occupied by the Nefertiti formation, Cydonia, and the King's Valley. This is explained further in my book[2]. A part of the great circle is seen in Figure 1 as the bottom horizontal line. It has one of the fern images PSP_007095_2020 almost directly on it, the others are clustered around it. The other two lines in Figure 1 lead to more candidate artefact sites on different great circles. Some of these are examined in my book, however the closeness of the ferns to the more vertical lines implies they also line up with those candidate artefacts.

The best evidence for Martian artefacts so far happens to fall on the one great circle as the bottom line in Figure 1, this is like an equator or longitudinal line that bisects Mars. One theory as to why these anomalies occur on lines is random chance, this would be the null hypothesis. Another hypothesis is to mark latitudinal and longitudinal lines as part of an ancient navigation system, still another might be to make them more noticeable. The ferns are also significant because they are the fourth candidate artifact to be found on this great circle, they then represent a successful prediction. This a priori prediction is that future discoveries of candidate artefacts will fall on great circles more often than they should by chance, also that they would form a mathematically significant pattern.

Location

The ferns are found in Antonialdi Crater in Syrtis Major Planum, approximately at 21N 60E. In Figure 2 the pins represent HiRise images of the area, the pins in the top right corner are where the ferns are found. Only part of the overall formation has been reimaged.

CTX image

The ferns are also visible in the CTX image[3] shown as Figure 3, this is a context image from HiRise while the pins in Figure 2 are images with higher definition. This context image gives an idea of the size of the formation. The ferns appear to be clustered together in one small part of the crater. This makes the natural hypothesis less likely as the same geological conditions should exist throughout this crater. For example the

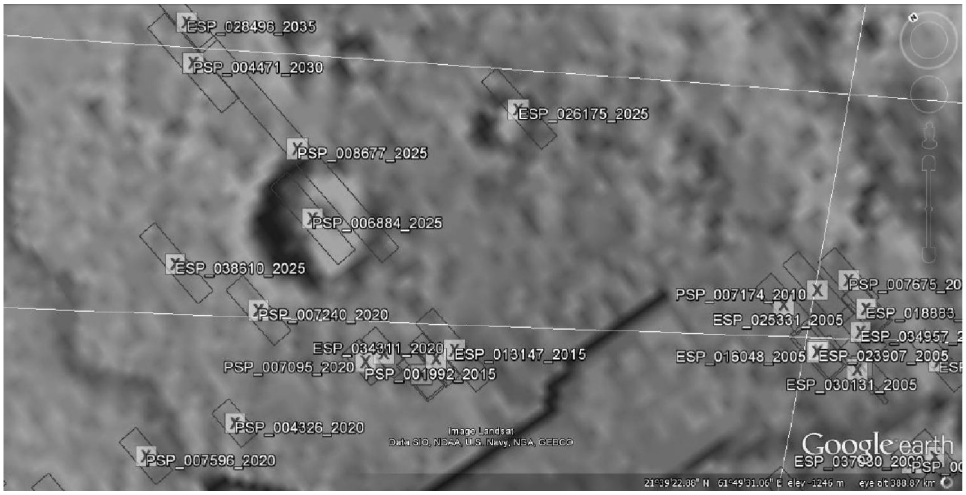

Figure 1 : Position of the fern formations on the great circle

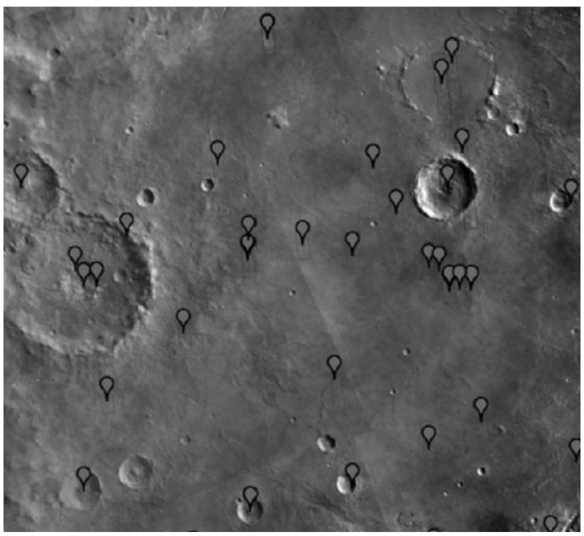

Figure 2 : The area has only been partly imaged by HiRise

Martian spiders are a highly unusual natural formation, they are widely distributed on the South Pole. The terrain is similar throughout Antonialdi Crater and similar dark soil patches are seen all over it. But these are not in fern shapes, instead they appear to be randomly distributed. This implies a simple construction method, the ferns would have been formed by pushing this existing soil and rocks into the plant like shapes.

No ferns are found elsewhere on Mars so far despite similar geological and weather conditions elsewhere. The idea of forming recognizable shapes with dark soil occurs in other candidate artifacts, Nefertiti is a face that is formed from dark dunes among random dunes. The Meridiani Face is also formed from these darker dunes. Both can be seen in my book “Why we must go to Mars: The King’s Valley”[4].

The original image

This area also appeared in the MOC image R1303336, the ferns section is shown in Figure 4. For example the elongated hill in the top right is in PSP_001952_2015 analyzed in this paper. It indicates the ferns are in one area clustered together. This presents problems for a geological explanation, the crater is very flat and water might be expected to create pools or lakes, however there are no actual pools like this in the ferns. When they rarely touch each other there is no increased flow to that point. But rivers flow down gradients and so as the lowest point there should be more signs of water where the fern leaves join. Rivers need a gradient to flow down, however these branches point in all directions.

HiRise explanations

The HiRise team[5] pointed out the resemblance to ferns[6], they state they are made of rough rocky materials. However this is incompatible with a finely structured river network, a river cannot carry boulders along with it. This is because rocks are much heavier than water, any slow river like a delta can only contain fine silt and mud. These rocks are visible in the HiRise image, this should indicate that some are a meter in diameter or more. If flooding moved the large rocks then it should have created a flood plain seen elsewhere on Mars, not fine branches like this. If the rocks were moved by ice then this is also seen elsewhere on Mars, it forms large areas of scree and not fine branches. This is then falsified by gravity. There is also no sign of a water source for these ferns, however their large number should indicate a source as visible as they are. The explanation by HiRise further states this is a channel network in inverted relief, they formed and then the less resistant materials around them were eroded away leaving the ferns. However there are no signs of former river banks containing them, even so how these rocks could move in water is not explained. Also the ferns are similar in rock color to other clumps in

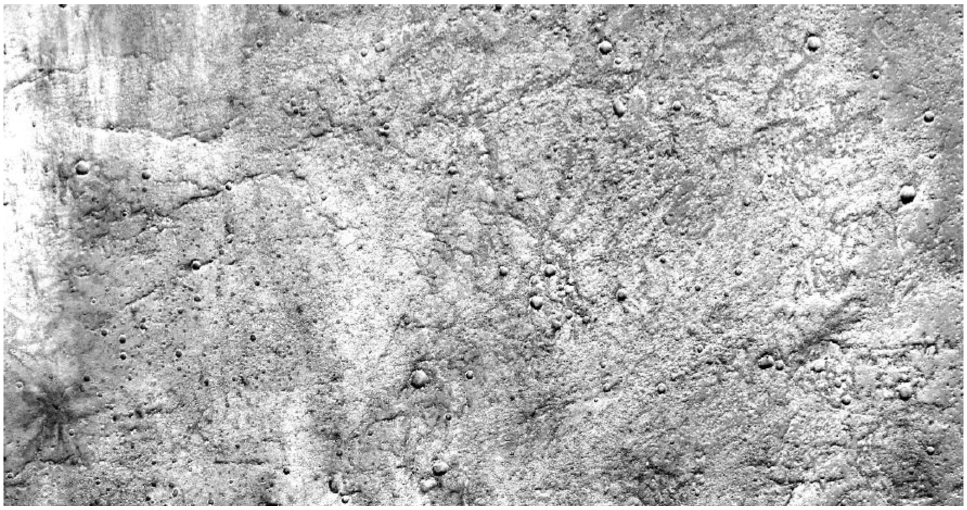

Figure 3 : CTX image of the fern formations

Figure 4 : Mars orbital camera image of the ferns

Antonialdi Crater, however those clumps are not in a channel system. So if these other clumps are close by then it implies they too are the resistant remains from erosion, they appear identical except for their random shapes. The HiRise team state a warmer wetter Mars is involved in the ferns formation, and also possible microbiological life. This is then consistent with the idea of Martian artifacts associated with life there.

Alternate hypotheses

NASA suggesting life may have occurred around this time is highly significant, the issue is then how advanced this life was. NASA's position is this life was very simple, however panspermia by meteor impacts might have brought life from Earth speeding up Martian evolution. Meteors falling into the Northern Ocean might then have protected more of this life from the impact, and provided Mars with life that evolved more quickly. It could have formed a primitive civilization that created these artefacts. Because Mars is much colder these hypothetical inhabitants would have died out as the Martian atmosphere froze. The other hypothesis is that aliens came to Mars at this time, they may have terraformed Mars in ways detailed in my book. The candidate artefacts such as the ferns would have either been formed by these aliens or by life seeded by them. In that hypothesis life on Earth might also have been seeded by them, we might then be a successful terraforming experiment much like those NASA is planning for other worlds.

The scientific method

Observations have been made of Martian formations, the next step then is to advance hypotheses that are consistent with these observations including the null hypothesis of their being random. There is no real evidence that aliens or indigenous Martians existed.

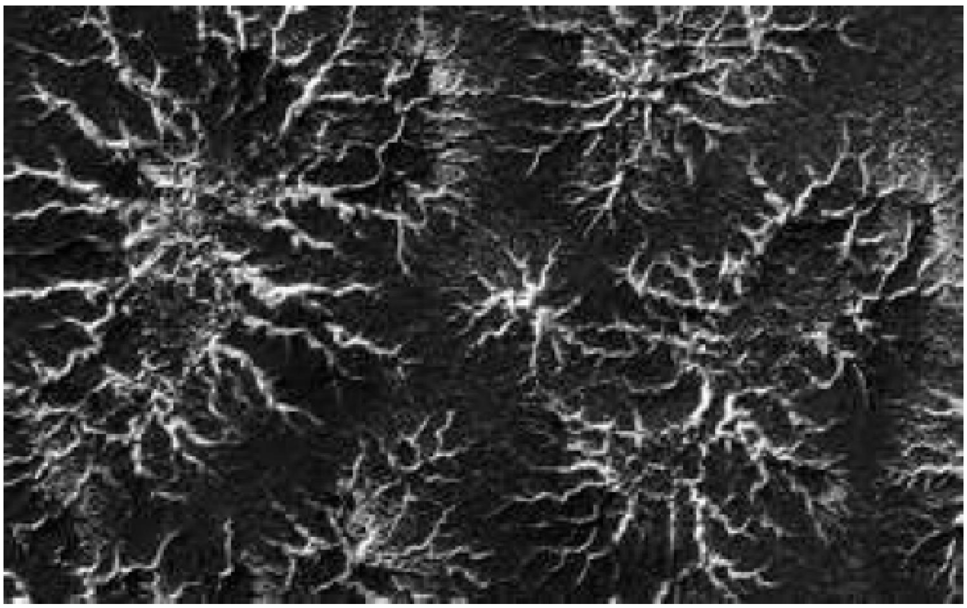

Figure 5 : These are similar to Fibonacci branchings but are also random

Figure 6 : Waterways have random branches only sometimes fibonacci

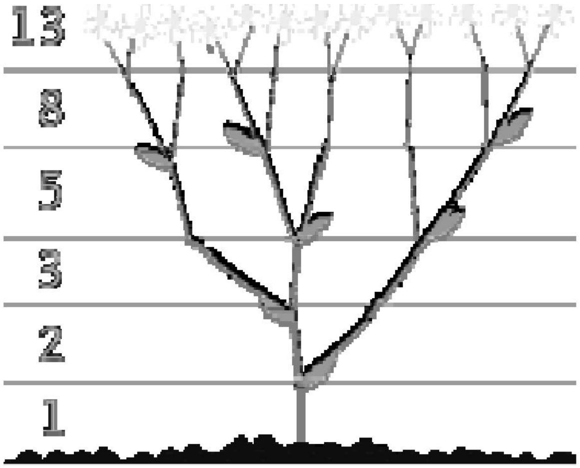

Figure 7 : Fibonacci branching never has errors in plants unlike in rivers

The geological and null hypotheses are often regarded as the default or status quo on Mars, extraordinary evidence is needed to prove otherwise according to Carl Sagan. This then implies that a very high standard deviation should occur in the data to rule out chance, much more than with a more conventional hypothesis. However a geological argument also needs to stand on its own merits, for example there were many competing natural explanations for the Martian spiders. With a single explanation there is a false assumption of proof, there may be other natural processes involved with the ferns not considered yet. So they may not be channel systems but they may be formed by another natural process. It is important then not to give geological models a free pass where they have problems, they get no such treatment when artificiality is not a possibility.

Figure 8 : Each branching is a perfect fibonacci pattern

Instead this paper tries to show the null hypothesis is incorrect. It does this in two ways. The first is that geological processes could not form the ferns, for example that they are not channel systems. The second is a statistical argument, that the fern branches are in a Fibonacci pattern used by Earth plants. This pattern occurs more often than chance should allow, this gives a high enough confidence level to disprove the null hypothesis.

Martian spiders

Another plant like shape found on Mars is the spiders[7], however these are ravines while the ferns are above ground. Also the spiders are likely to be formed along polygonal cracks in the polar areas, the ferns are more varied like representations of plants would be. Where there are polygonal cracks the branches appear to have formed independently of them, cutting across them rather than following them. Spiders are also formed by CO2 outgassing on the South Pole, on the Martian equator this does not occur[8] in a similar process.

Circular arguments

Methods of proof

Next the HiRise images are analyzed in depth. The main process is falsification, to attempt to prove geological explanations are not possible here. This then only leaves artificiality. It is not very useful to just present evidence for artificiality, the ferns look like plants but many natural things on Mars appear artificial. Another method is reduction ad absurdum, for example it is highly unlikely every fern branch looks plant like if formed by geological processes. By random chance some might appear this way, sometimes a field of dunes might randomly form shapes that look artificial. A river system might occasionally look like plant roots but many do not. A large enough area with sharp rocks might sooner or later present one that looks like a symmetrical pyramid.

Fibonacci branching

On Earth plants form branches in specific patterns, the angles between them are similar and they branch every second time in a Fibonacci sequence[9]. The river system below looks similar to the ferns, however many river channels join up together while this only happens once in the ferns imaged so far. The branches appear Fibonacci like but are random, the ferns have every branching in the correct Fibonacci sequence. The angles between the river branches below are also random, however they are roughly equal in the ferns. A plant has a fractal shape that is more constant, smaller branches occur at a fixed ratio to larger branches. While rivers can be fractal the variations are much larger and more random. Also the ferns do not connect to a major river, often they are not connected to other branches at all so there is no way for water to have flowed to them.

In Figure 7[2] the Fibonacci sequence is shown, at the bottom the tree branches to the right, then following that branch it next bifurcates to the left. The result is a branching every second time in the sequence 1,2,3,5,8,... Following this sequence on the ferns seems to show a perfect pattern, each times this happens it is less likely to be occurring by chance. This allows for a statistical argument much like tossing a coin, each time the Fibonacci branching occurs could be heads and a deviation could be tails. Assessing this as an even chance of either occurring then the ferns can be evaluated on a normal curve.

The difference between plants and a natural river system is that plants always branch in a Fibonacci pattern, a river might randomly do this a fraction of the time like random coin tosses. As the fern branching is clearly visible it is possible to follow each branch to see whether the bifurcations follow this pattern. Another test is to compare the angles between the branches, plants of one species tend to use the same angle unless the wind bends them in some branches. If the angles appear to be similar then this also allows for a statistical test, there can be some error around this angle because of the difficulty of measuring thicker branches. Also a hypothetical builder may have constructed some branches to be bent in a more realistic way. Assuming conservatively that a three part Fibonacci set of branches each has a ½ chance to have the same angle or different this allows each branching to appear on a normal curve like coin tosses. The river in Figure 6 clearly has some randomness in its branching, but as will be seen the ferns do not.

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In Figure 8 a section of the ferns are shown. It appears to be different from the river network in Figure 6, the branches all have about the same angle. Following each branch the Fibonacci patterns can be seen. Some branches also do not connect to each other, this is impossible if they are formed by water as this water could not connect to them. Because there are many large rocks in the ferns this is a problem for the geological hypothesis as the rocks cannot disappear, they might be buried but the ground appears flat in the gaps according to the shading. In the bottom right at **A** there is a darker area like a main river, however the ferns don't connect to it unless this is buried. A natural river would have the strongest and deepest branches here and yet they are not seen, they are the least likely to be missing.

The craters at **C** show the branches are all about the same depth as there is no branch material under the crater, the branches are not deep V or U shaped ravines but just sit on the surface as if moved onto flat ground. If these are channel systems that were resistant to erosion then they should thin out in some areas as only the lower parts of the channel remain. Instead they are either there or missing, when thinner they have the same width. This might occur sometimes by random chance but there are too many examples of this.

In the bottom right at **B** there is a large ridge that cuts across the ferns, however water could not flow over a

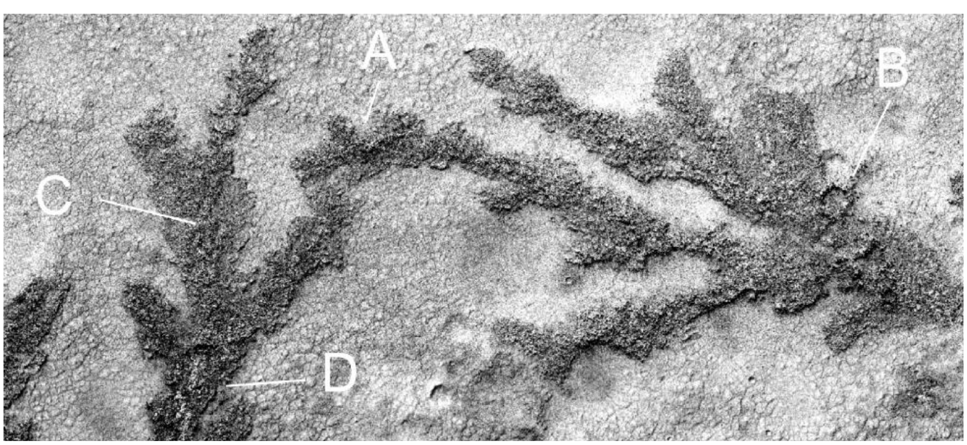

Figure 9 : Rivers should not connect together downstream without pooling

ridge to the other side as shown. If this did happen originally then there should be at least some deviation of the water around this ridge. Artificial construction however can ignore the elevation to maintain this organic pattern. The ground is uneven in many areas, however the ferns don't point to the lower areas as a water flow would. There appear to be no clear areas where these branches follow the terrain.

In Figure 9 two ferns connect at **A**, this is the only merging of two branches in the total formation but would be expected to happen more often in river networks. However there is no pooling of water there, the branches are no thicker where they join. It appears as if the right branch is thicker and overlays the one coming from the left, like plants with their leaves overlapping. There is some shading indicating the ferns are not flat on top, the centers are higher here. However channel systems should be thicker in the middle underneath not on top.

Water should leave a deposit that is flat because of gravity. The individual rocks can also be seen here, too large to be moved by a slow river. At **B** there is a crater covered by the fern branch, this is different from other craters that would have formed afterwards and damaged the fern structure. The fern material did not fill the crater like water would, it seems to have coated it evenly without affecting the fern shape. The crater walls appear to be higher than the ferns, they should have either gone around the crater or some of the crater wall should be protruding. This is consistent with a builder heaping rocks all over it. At **C** there seems to be a ridge going down the fern like a leaf rib, more is seen at **D** catching the light. This is a common feature of the ferns, the interior structure seems to be consistent with branches and leaf ribs. From **D** to **C** is an example of the Fibonacci branching with similar angles, one branch to the left then two to the right.

In Figure 10 **A**, **B**, and **C** follow ribs or branches that are raised higher than the rest of the fern leaves. The sun angle can be seen as coming from the top of the image from the craters shown. This is difficult to explain geologically, the river system is supposed to have formed slowly over time and then resisted erosion. However a river has to have a flat top from gravity, these tend to have a sharper peak in the center. There are too many examples of this to happen by random chance. One explanation could be the rocks were eroded more on the edges than the center, however the material appears to be identical throughout the branches. In many cases the branches have a sharp cliff like edge rather than a slope caused by erosion.

However someone constructing this could just heap up rocks higher in the middle of the branches. This is so common it is likely all the branches had this and erosion has leveled some of them. The angles between the branches remains about the same as before, Fibonacci branching is more difficult to count here because of erosion. At the end of the middle line from **A** one rib goes across another, this is unlikely to happen with a water flow without them affecting each other. A leaf also has Fibonacci branching in it on Earth, there is an impression of striations in the leaf that are parallel to each other. This indicates a common angle as with the branches.

Figure 11 at **A** shows some of the rocks forming the fern shapes. **B** shows where this has been eroded away leaving just dark soil. Polygonal cracking is common in the area, however the fern leaves are much larger than these cracks. One theory of spider formation, proposed by the author, is that CO_2 moves along these polygonal cracks forcing them open into the spider shape. This would occur from CO_2 outgassing under an ice layer, with nowhere else to go the CO_2 forces its way along the polygonal cracks. Those pointing more towards the source then are opened more, the cracks more at right angles to the CO_2 source would

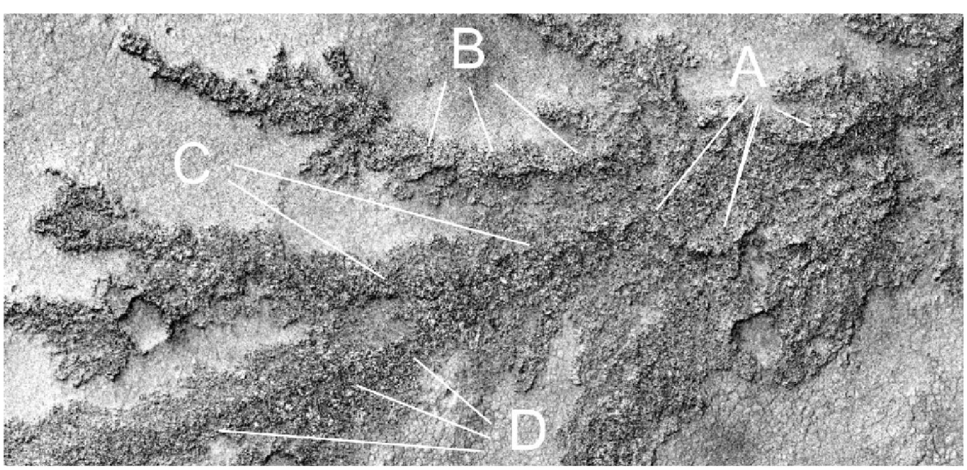

Figure 10 : The leaves have raised ribs down their centers

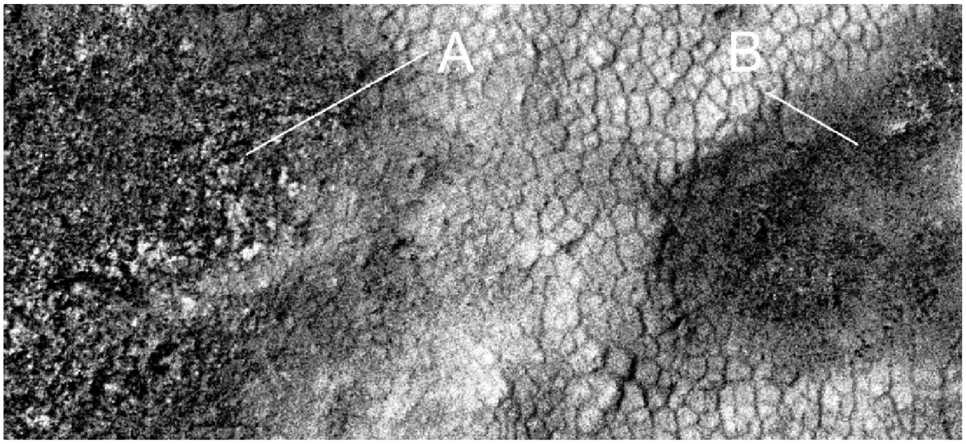

Figure 11 : The leaves are not created or controlled by polygons

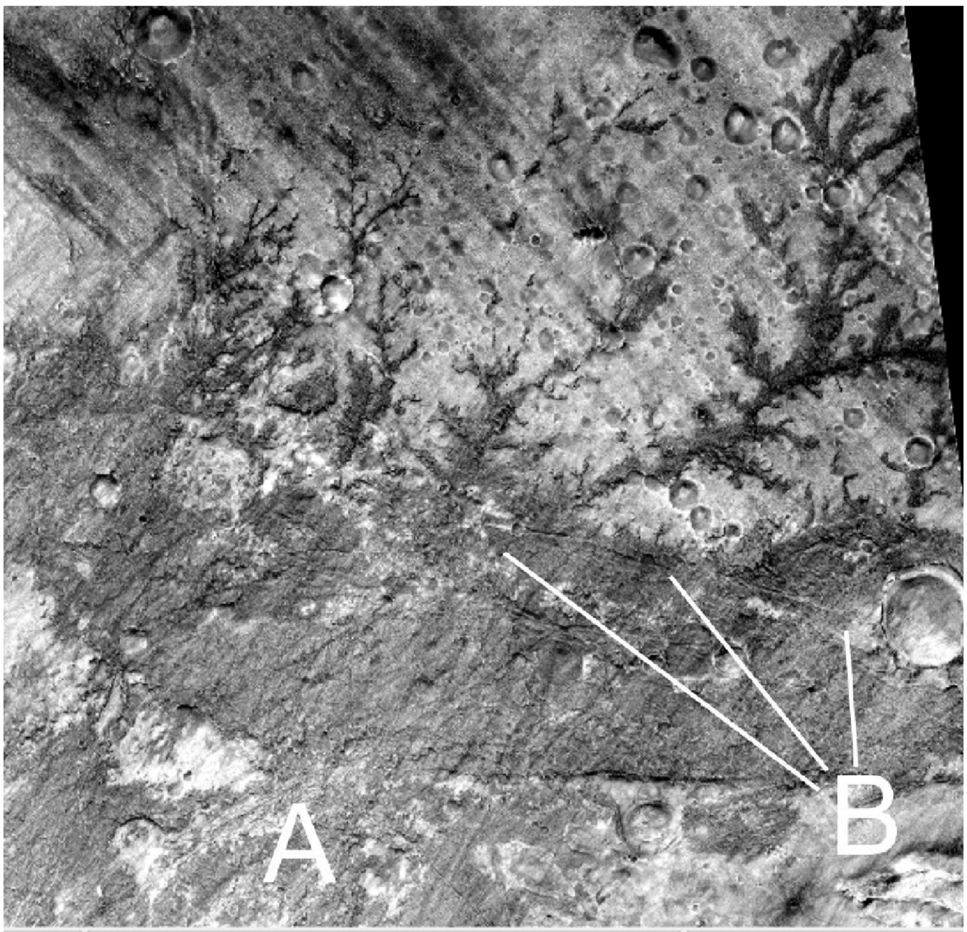

Figure 12 : The branches may be from the trunk material moved by the builders into the fibonacci pattern

be forced shut. However because the fern branches are much larger here the polygons are unlikely to control them, the rocks are larger than the cracks and so could not have originated from them.

In the full HiRise image there are approximtely 80 Fibonacci branchings and no exceptions to this. However some are too unclear to determine. Assuming each set is 3 branches then this gives about 240 angles in these branches. In estimating the odds of this occurring by chance odds of ½ are used, that it has an equal random chance of being a Fibonacci branching or not. In terms of the angles ½ is again used, that it has an equal chance of ½ of being similar in angles to the others. This then would give an odds against chance of.5^{320} to 1 where the exponent is 80+240. The numbers will then accumulate through the paper.

Later a more complete analysis of each Fibonacci branch and angle will be done to make this more rigorous, however it can be used here as a guide. A channel network might tend to also have high odds against chance and similar angles, however this would be divided by the non Fibonacci branchings and different

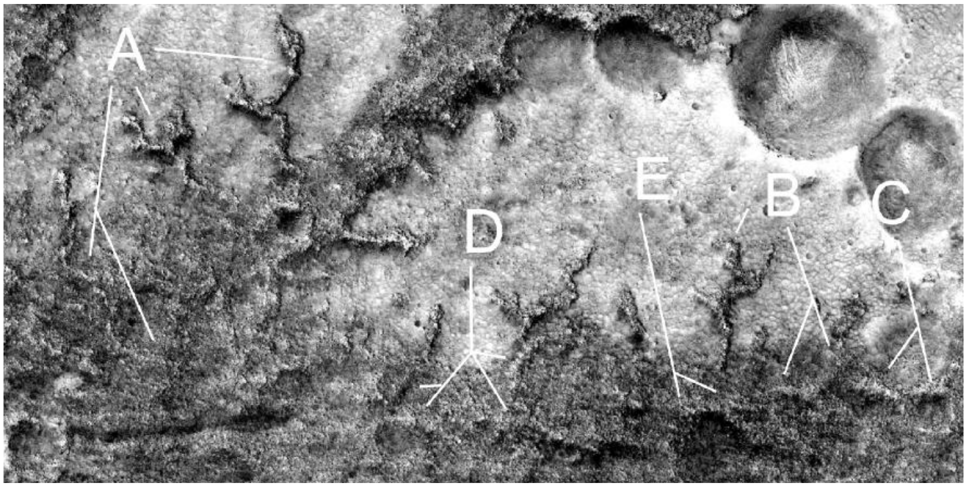

Figure 13 : The fern branches are buried under the dark soil here

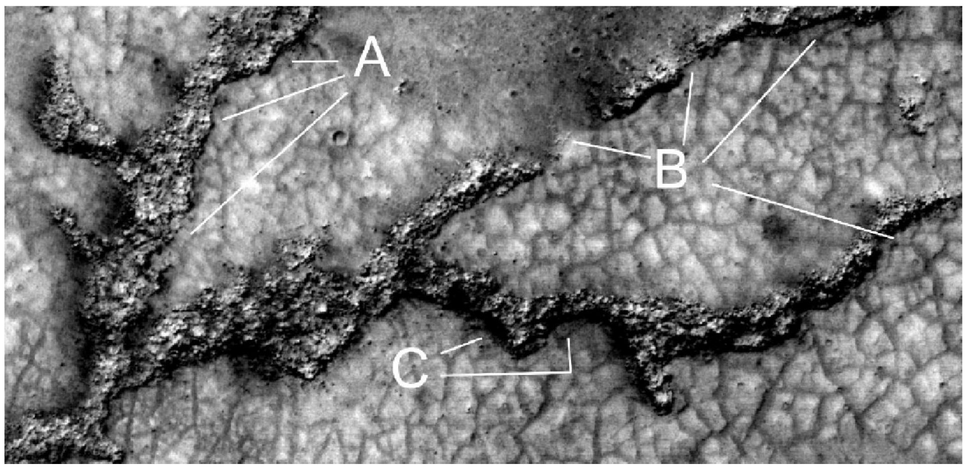

Figure 14 : The branches do not line up on the polygons and so are not formed by them

angles that are arguably absent here. Some do appear to be non Fibonacci branching here and different angles, however they are accompanied by vagueness in the image, crater damage, etc.

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Figure 12 shows more ferns coming from a central trunk area. In the geological hypothesis then the ferns would be rivers coming from this central lake deposit. This explanation has problems because on the lower side at **A** the dark areas don't form fern shapes but are random. This is a recurring problem, the fern shapes seem to be arbitrarily positioned near random looking formations of the same soil type and color. This color is seen in other HiRise images, the image numbers can be used to examine them at the HiRise site. If they are formed the same way then both should be either random or fern like, not such an extreme difference between the two. However this was a problem also seen with the Martian spiders, they were near areas without polygons also free of spiders. This might indicate the polygons do have something to do with the fern formation. At **B** there are grooves running down the trunk, this is a feature of most trunk areas. They may provide a clue to a natural process, be unrelated faults, or represent capillaries seen in plants.

In Figure 13 the right hand line from **A** shows a perfect Fibonacci branch as does the middle line. The most vertical line from **A** traces how these branches go deeply into the dark soil. **B** shows a continuation of a branch along to **C**, a water flow should have been flat on top. Also these are covered in dark rocks and soil, if they were overlaying ridges then the lighter ridges should be showing through at some points. The dark soil is not thick, this is near the edge of it. **D** and **E** show more continuations of these branches, each seems to have the same angles as other fern branches.

In Figure 14 **A** shows how the polygonal cracks line up randomly against the sides of some branches. It may be the branch material influenced the cracking around them by a temperature difference. The ferns are darker and so would heat up more during the day than the lighter soil around them. However the polygons are unlikely to control the fern shapes because much larger ferns have the same proportions. This is different from the spider formations, they typically

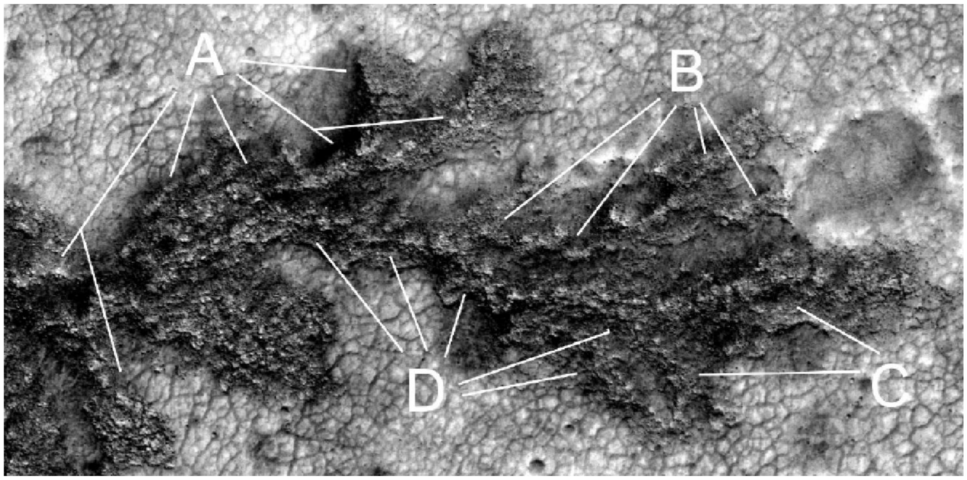

Figure 15 : A river could not make ridges of material in fibonacci patterns

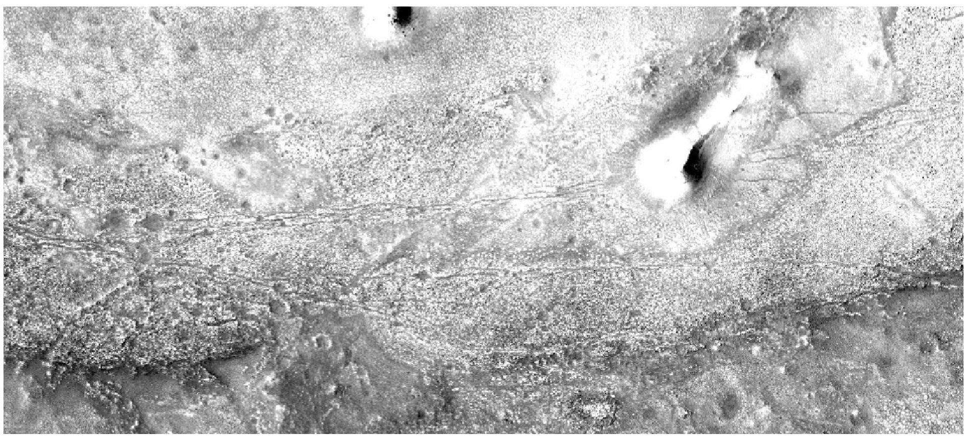

Figure 16 : The grooves could be faults or might represent capillaries

had branches the same size and following polygonal cracks.

The surface here shows some of the polygonal cracks have continued on under the ferns. This makes the channel hypothesis less likely because the ferns should be U or V shaped underneath. This then would interrupt the cracking so that each side of the ferns was independent. The left line from **B** shows a gap, the branch material has disappeared here. The next line clockwise shows another gap. This is difficult for the geological hypothesis to explain, first it should not be possible for large rocks to move along a narrow channel like this. Then gaps imply there was a section of flat ground the rocks jumped over without depositing there. However a builder might have been short of larger rocks in some areas, smaller ones might have fallen into the cracks or here been blown to above the gaps. The third line clockwise shows the polygon cracks here don't line up with the branch edge and so are unlikely to control its shape, this is also seen on the fourth clockwise line. It appears as if the fern material is just sitting on top of the polygons, not going into it or attached. **C** shows how these branches also don't line up with the polygons. The rocks appear small enough here for many to go into the polygonal cracks, this can degrade the branch shapes.

In Figure 15 the internal branches are very common, the polygons also seem to have degraded the ferns rather than be controlling their direction and shape. The right line from A points to a flat end of the branch, like it is cut off. It shows the cross section is roughly U shaped and high in the middle. The rest show so many ribs it is like tracing out the leaf ribs from an Earth plant. A geological explanation needs to explain these ribs as they are very common. The ribs also appear to be in Fibonacci patterns with the same angle, some of this is difficult to measure because of the limit of the image resolution and erosion. Being made of large rocks is also a problem for a water flow causing this.

This image has approximately 25 Fibonacci branchings and thus about 75 similar angles. This gives a running total of.5^{105} to 1 for the branching and.5^{315} to 1 for the angles.

PSP_001992_2015

The section below shows many lines running from left to right, they might be faults or design features of

Figure 17 : Kelp fronds have rounded leaves like some of the ferns

the plants. Capillaries are always found in plants running along the trunk, however these seem more random. The large mound and ridge in this image was seen in Figure 4, the MOC image then shows this section. It has an almost square symmetrical shape to its right.

Figure 17 shows kelp fronds on Earth[10], this has some similarities to the next fern image. There may be four different kinds of ferns here with their own leaf shapes and branch angles, these ferns may be acquatic. So far the ferns appear to be two dimensional rather than looking at an image of a three dimensional tree, that would change the angles of some branches pointing to or away from the observer.

Figure 18 is similar to kelp fronds in the previous figure. Some fern leaves come from a narrow branch and then fan out into the full leaf. Others like this image seem to have thicker or no branches but instead have fronds connected to each other. There is then some variation which might indicate different kinds of plants. The angles between the branches may also be unique to each type though this is hard to judge. Earth plants also have this variation in angles, one kind of tree is usually distinguishable from others by this. The fronds also have less of a peak along the middle of the branches and leaves, however they have more of these lines like faults along them.

A shows some fronds which are degraded, the other branches are much larger but seem to come from this smaller source. Rivers typically work the opposite way, they get smaller further out as the tributaries narrow. **B** shows how these fronds are taller than the previous ferns and also have about the same height. **C** appears to show darker lines along them instead of ridges as before, perhaps like capillaries. The Fibonacci branching is continuing as before.

In Figure 19 the fronds are missing at **A**, instead there is a shallow groove. This may indicate a shallow channel system, or that a builder laid these fronds in them. It might also mean the weight of the fronds has compressed the ground under them forming the hollows. If the leaves are erosion resistant then some areas should have eroded aroudn them faster than others. Some then should have remained partially buried while other areas formed gaps under the fronds and ferns. The uniformity is then a problem, the ground is uneven and yet the leaves still appear to have been overlaid on it. If the ground did erode away then how did the polygons form so uniformly around the leaves.

At **B** there is another gap, this may be caused by a crater or the branch may curve around it. These fronds are very long, they continue off the image to the right. Each has the Fibonacci branching but more like kelp.

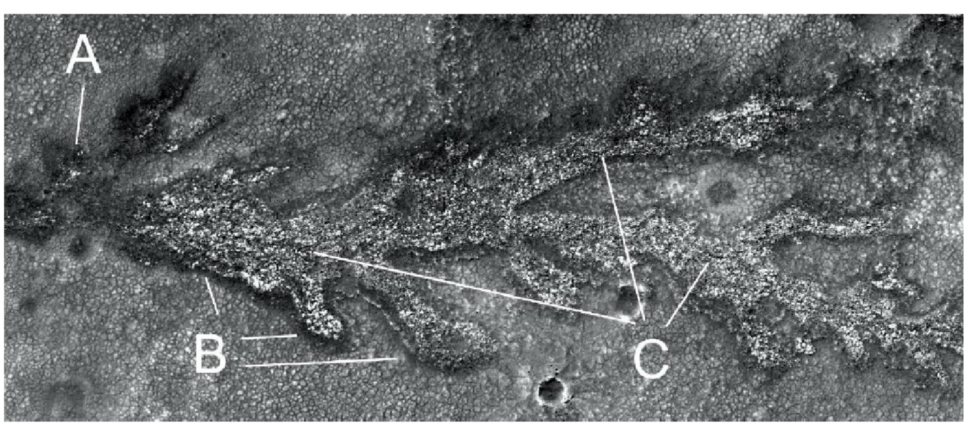

Figure 18 : The fronds are thicker and flatter on the top

Figure 19 : The fronds are highly eroded, the craters were formed later

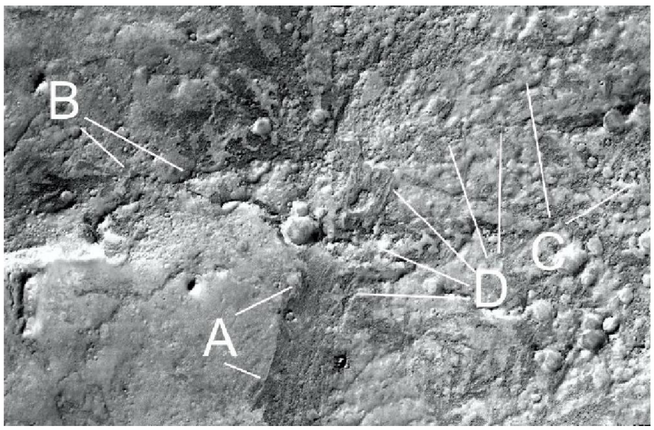

Figure 20 : The uneven terrain has degraded the ferns more to the upper right

This is similar to the Martian spiders, they also had several distinct forms but are natural.
The HiRise image has approximately 33 Fibonacci branchings and hence 99 angles, this gives a running total of.5^{138} and.5^{412} to 1 against chance.

ESP_013147_2015

Figure 20 shows ferns that are more like the top of a tree or bush, the trunk ends and there are ferns above it and to the side. **A** shows the trunk, it appears to have grooves along it like the grain in wood. To the right of **A** there are some more fern leaves, one set with a branch coming off the main trunk. **B** shows fern leaves pointing out from this common source which is separate from the main trunk. It may also show a branch with leaves coming from the lighter ridge at the left, then crossing one coming from the trunk at **A**. This is more difficult to explain geologically, that one river could flow over another, if they occurred at different times then they appear on the same level of eroded ground. **C** shows areas that are either highly degraded or are random shapes unrelated to the ferns. This is a problem for a natural process because it forms distinct branches with similar leaves

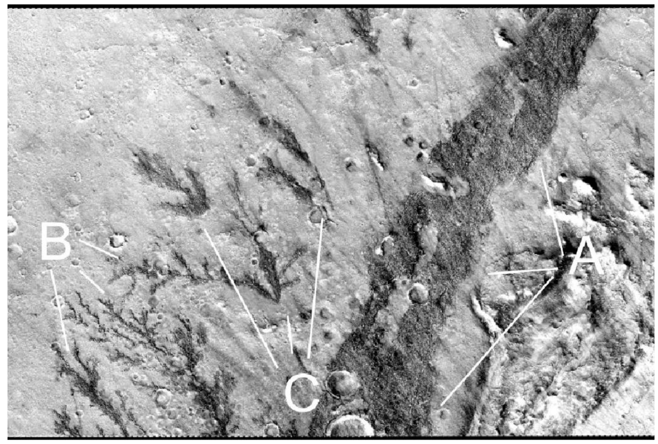

Figure 21 : There is no channel from the trunk allowing gravel to travel through to the branches

and angles on the left and then random shapes on the right. **D** shows one of these ridges going from the trunk and ending at some fern leaves. They appear to be ridges because of their shading compared to the craters.
This image is highly degraded but there appears to be 42 Fibonacci branchings, this gives a running total of.5^{180} to 1 and.5^{540} to 1.

PSP_034311_2020

In Figure 21 there is a more distinct trunk, also the ferns are more like branches with small leaves. **A** shows the extent of the trunk, it is of more even size and does not have the longitudinal grooves like a wood grain seen earlier. **B** shows finer branches similar to Martian spiders, however the spiders are usually radially shaped from a central source. In some cases the spider legs can extend from a larger mass, however they are always very small and follow the polygon cracks. These ferns are always coming from larger branches and usually pointing towards a trunk like plants would be. In some cases the connection is missing completely. The cleaner terrain here could be from less soil being available to construct these branches. **C**

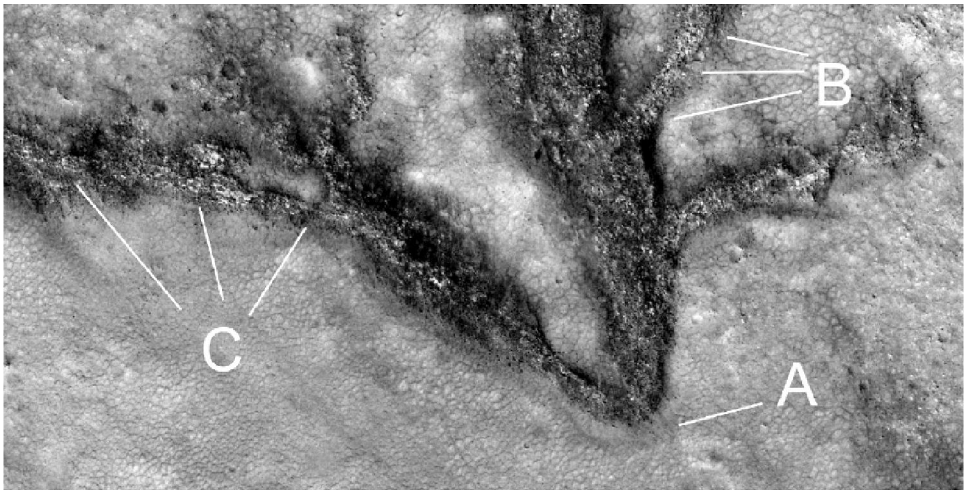

Figure 22 : Some branches have striations like a wood grain

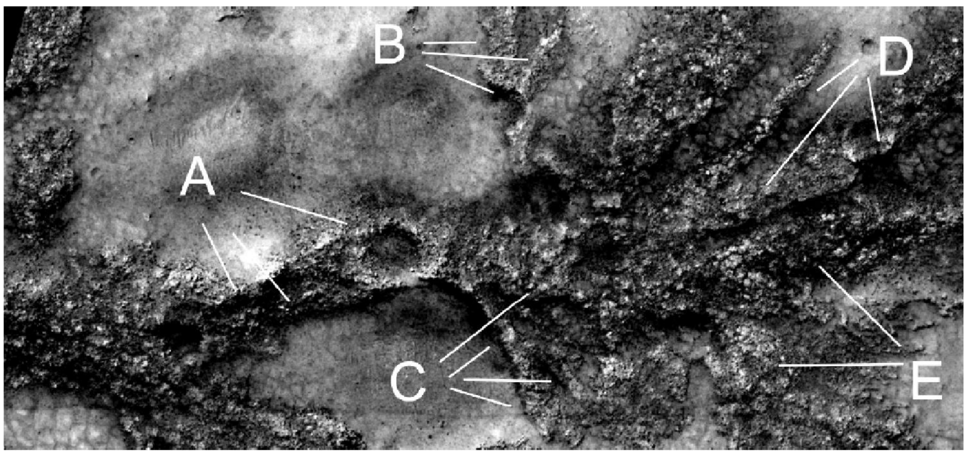

Figure 23 : The ribs are sloping in different gradients counter to gravity forming water channels

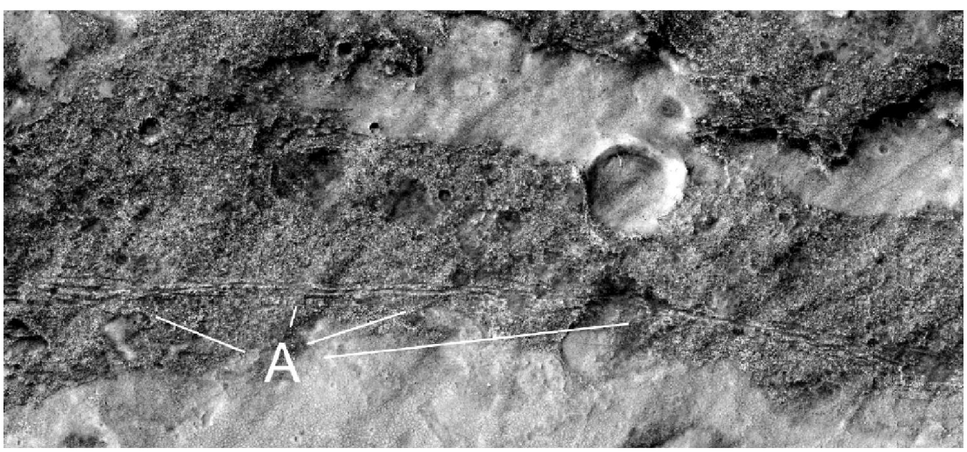

Figure 24 : These striations may be natural faults or capillaries

shows how many of these do not connect to the trunk, this makes it harder to explain them as rivers because there is no channel hollowed out connecting them to the trunk. Only in Figure 19 so far as there been any sign of a hollow where branches are missing. All the ferns here have Fibonacci branching. With so many hundreds of branches so far there should have been obvious evidence of random angles and branching, however this is not seen. Some branchings might be argued about but a channel system should have abundant and clear exceptions to the Fibonacci branching. In Figure 22 there is a close up of a branch, it does not connect to the main trunk and is a long way from it. **A** shows there is no hollow or trail to the trunk. These ferns appear slightly lower than the ground around them, they might have sunk from their weight. **B** shows how this branch juts out from another at a sharp angle like some tree branches do. **C** is also like

Figure 25 : These ferns are a different type, they surround a similar shape to the cydonia face

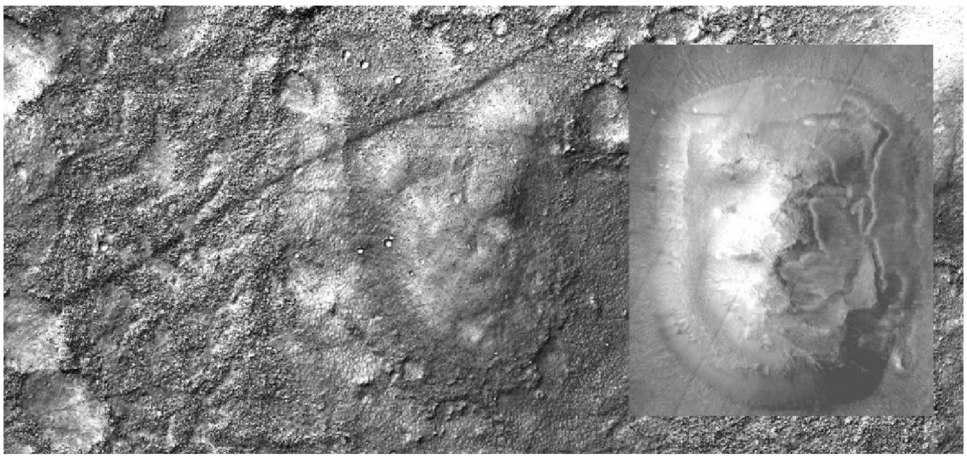

Figure 26 : The Cydonia Face is on the same great circle as this formation

this, it appears to have striations along it like a wood grain.

The leaf structure in Figure 23 has many ribs clearly visible. **A** shows a crater, this seems to have occurred after the leaf was formed and shows how deep the dark material goes here. The texture is almost extreme in the number of gradients forming the ribs, it would seem impossible for water to create this. All the branches are Fibonacci and seem to have the same angle, many however are too unclear to check this.

A in Figure 24 shows a section of the trunk, there is again the long striations like faults or perhaps a wood grain. This section appears more randomly shaped, it may be these striations are natural.

This image has approximately 30 Fibonacci branchings in it, this gives a running total of.5^{210} to 1 and.5^{630} to 1 for the angles.

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Figure 25 has enormous numbers of ferns emanating from a large hill. They all seem very similar to each other, similar angles in the branches. They may be a fourth kind of plant, they are more like fronds as before but with more even width in the leaves. In with the ferns is a shape similar to the Cydonia face, this is significant because that is also on the same great circle as the ferns.

This is a close up of the face like formation. There are no clear facial features but the outline is similar. The Cydonia Face is shown on the right for a comparison. If artificial then extreme age would have caused this amount of erosion. In this image the branches are over a different type, there are at least 15 Fibonacci branchings and many more than 45 similar angles. This gives a total of.5^{225} to 1 and.5^{625} to 1.

CONCLUSIONS

This paper has tried to show as many features of these ferns as possible. The intent is to falsify the null hypothesis and the geological hypothesis. Martian spiders were also regarded as plant like but turned out to have a natural explanation. However the sheer amount of evidence here is hard to reconcile with a geological hypothesis. They are surrounded by formations that do appear to be random and consistent with geology, this small area however seems to defy all those explanations. The ferns seem to have four different types each consistent with known kinds of plants on Earth. This might indicate an intention to present a more varied flora. It also makes a natural explanation more difficult, it must explain how channel system can look like four distinct species.

Water based theories seem to fail because the ferns are not flat on top, they have intricate ribbing in leaves that would require something on top to mold these shapes. This could only be ice but there are no other examples of geology doing this. Even elsewhere in Antonialdi Crater there are patches of soil similar to the ferns but randomly shaped. It would seem a geological process that created the ferns would create them elsewhere on Mars or at least more widely in this area. Instead they seem to only be in one small patch.

The ferns are on the great circle along with the Nefertiti formation, the Cydonia Face, and the Crowned Face in the King's Valley. They would then appear to be a successful prediction of more unusual formations on this great circle, especially with a similar formation there to the Cydonia Face. The most likely theory of construction is simply to heap soil and rocks into these shapes, the more natural formations around the ferns would have been left untouched. The purpose of this is unknown as with the other candidate artifacts found so far.

They appear to have Fibonacci branching, the Martian spiders also had this to some degree because of being imprinted on polygons. There are polygons here as well but instead of the spider ravines falling on polygons these ferns are much larger. Also the branching is virtually perfect as Fibonacci sequences instead of approximate with the spiders. Each type of fern has a similar angle to its branching as with Earth plants, there seems to be four different angles in all. A statistical argument could be framed with this as explained, each Fibonacci branching having odds of ½ as it either happens or it does not. Then a similar argument can be used with similar angles, ½ is a conservative estimate as within say 15° it could be regarded as 1/6 between 0° and 90°. Each time these occur it is an independent event and so the odds multiply, the total is.5^{850} to 1 or approximately 1.3×10^{256}.

A number like this is far outside random chance, an exponent of 9 would be considered virtual proof in a normal statistical analysis. Because there are so many branchings and angles the power to refute the null hypothesis is also very high. No statistician would say a data set this large and odds this high occurred by chance. This number might go up or down when each branching is examined carefully, however it shows there is a strong case to answer here. If the null hypothesis is refuted then a hypothesis based on nonrandom branching is needed. So there would have to be a geological process that virtually always creates Fibonacci branching, but this is not known to exist. Without a geological explanation the ferns represent strong evidence even proof of artificiality. This is because if nothing natural can create structures like this they must be artificial as the only other alternative. A builder would make virtually all the branchings Fibonacci with similar angles because they would be depicting plants that do this.

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