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Martian dams: Artefacts or natural formations?

Abstract

Unusual formations have been found in many Martian craters resembling dams. Some geological explanations have been offered, in this paper many of these dams are examined. With many candidate artifacts such as in Cydonia, the Nefertiti formation, and in the King's Valley found there may be an artificial explanation for these dams. Attempts are made here to falsify the natural explanation, to show they could not be formed by a geological process. Dams can occur naturally, a river for example might become silted up enough to block the water flow. Mud can also slump down in a crater to create a shape like a dam, then possibly catch water in it. However many of these dams have features hard to explain in this way.

Keywords

Mars, Dams, Cydonia, King's Valley, Artefacts.

INTRODUCTION

Since the Mars Orbital Camera has been imaging Mars dam like structures have been found in a small number of craters^[2]. Many follow the temperate zone around the great circle candidate artifacts have been found on. This can be seen in a 2009 paper in Icarus by Dickson and Head^[3], they show brown dots on a map roughly between Cydonia and the King's Valley as water gullies. This suggests the great circle is an equator that coincided with water available for life in these ravines.

Since the discovery of possible Martian artifacts on Mars the search for an ancient supporting infrastructure has been important. If sentient life was capable of building these artifacts then it is likely they needed to acquire food and water in the meantime. The Martian dams represent a proposed component of this infrastructure, because there are hundreds of these dam structures they give an opportunity to falsify geological explanations. Only one needs to be artificial to prove this hypothesis.

The candidate artefacts are all extremely old, at least hundreds of millions if not billions of years old. It is

likely then most would have long disappeared except for those made of rock and similar materials. This can explain the enigmatic nature of these possible artefacts, they need not be representative of this civilization but be all that could survive this long. Dams are another feature likely to survive, they would be designed for resistance to water erosion, being in craters would shield them from wind erosion as well. The strength required would also make them more resistant to earthquakes, meteors etc.

Reasons for constructing dams

Three of the most persuasive areas for artefacts all lie on a great circle, a possible former equator on Mars. This idea was originally suggested by Tom van Flandern, that the Cydonia face might be on an equator of a former pole position. It is known the poles wandered on Mars at some stage^[4], when this great circle was an equator the candidate artifacts and dams could have been constructed.

This would then date the construction of these dam to long ago, before the poles moved to their current location. Recent announcements by NASA increasingly point to a warmer and wetter Mars in this dis-

tant past, this connects to the idea of possible inhabitants. Organic life needs water and so if they were able to construct monuments then they would also be able to construct dams to get what was likely to be scarce water. The most abundant source of this appears to have been water leaking out of an artesian basin into some craters, also some rivers. The Northern Lowlands probably had an ocean at this time according to Doctor Brandenburg^[6] however evidence of artefacts would likely be buried or eroded.

Methods of proof

Many of these dams look artificial, however that is not necessary or sufficient in this case. Rather, this paper attempts to show geological processes could not account for them. This leaves artificial construction as the only other possibility. Accumulating evidence in favor of artificiality is not always useful, many things clearly natural look artificial such as faces in clouds. People also have a tendency to see patterns that aren't really there such as faces, this is called Pareidolia. Dams are a specific kind of construction, to work they need to hold water and to have lasted perhaps hundreds of millions of years. They are rare in nature so it should be possible to differentiate an artificial one from a natural process.

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This image, shown in Figure 1, is an ambiguous dam as a starting point, there are many craters with a dune similar to this. The interior of the crater is clearly on an incline because the water moved to the bottom right from the ravines at **A**. The dam shape here then would have collected water as long as it was not porous. Another problem in constructing dams is if the crater floor itself was permeable to water at **B**, this

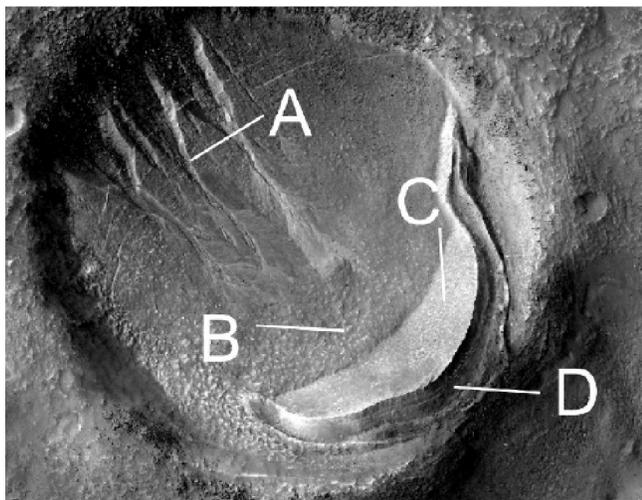


Figure 1 : This has few signs of artificiality and may be natural

might have to be treated as well or the water would be lost. If a crater floor in the dam appeared to be rubble and fractured then this would detract from their possibility of being artificial dams.

The dam shape appears very flat along this area at **C** while most dunes are curved, also opposite the water ravines at **D** it is flat like it was molded. An artificiality hypothesis then might have this dune covered by a form of cement or concrete. Water might have collected here either as a natural or artificial dam, it is not enough to show water collected but that a natural dam of this kind could not form. If there was regular water here when Mars had an atmosphere then life might have existed in it. Some ravines are still leaking water and so a well-constructed dam might have had water in it for millions of years. The Northern Ocean and perhaps snow would have recharged the artesian basin to perhaps give a constant flow like an Earth spring.

If there was sentient life on Mars at the time it would make sense to adjust this supply of water to make it more useful as a dam. For example the floor at **B** might have been sealed and the dune covered with a sealant like a cement at **C**. This would be hard to see in images because the ravines would have covered this in muddy water and silt. This is then no different to on Earth where people might build a dam to capture water from a spring. Research on how to make cement

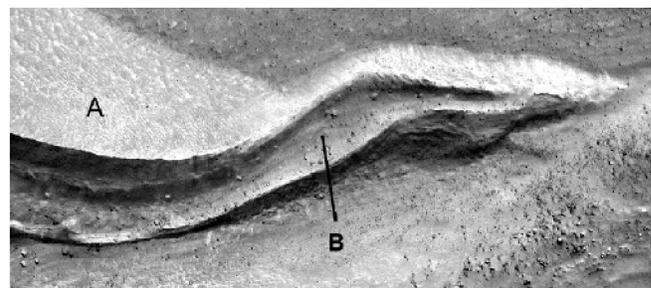


Figure 2 : This groove is hard to form naturally

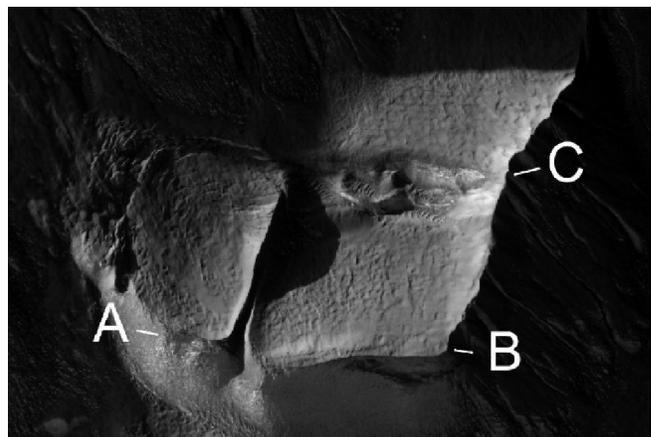


Figure 3 : The walls could not form right on the cliff edge without toppling over from their weight

and concrete on Mars has already been undertaken. According to Lin et al^[7] CaO or calcium oxide is needed to make this and is likely to be found as evaporates near water deposits. With an ancient ocean, rivers, and water ravines then it is likely cement would be possible to make in these craters. Water is needed which would be available in abundance. Zeolite cement is likely to be naturally present according to Towell et al^[9]. With the materials to make concrete then it would present little difficulty to create these dams and candidate artifacts like the Crowned Face, NASA is already working on how to do this on Mars in the future.

The right corner of the dam shape is unusual, seen below in Figure 2. The interior of this has a groove at **B**, this might be formed on one side by the dune at **A** pushing upwards. However it is not clear what would push from the other side to create this groove. It may be two mud slumps, the distance between the two creates a hollow. However they join together into one edge and the mud slumps should not be able to do this. The relative pristine condition of this structure compared to the soil around it may indicate a Martian variation of cement. If so then this might be detectible spectroscopically, however it might be too covered in dust to do this from space. Overall then this dam is suggestive of artificiality but is not distinguishable from natural geological processes. To prove this hypothesis then features need to be found that could not be made naturally.

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The dams in Figure 4 are harder to explain, instead of a possibly modified dune shape here there are flat platforms with water ravines above them. Water should have collected in these dams, there is a lip or wall around the edge at **A** and **B** which would have held this water in. At **C** there appears to be a depression. The structure is completely different from the previous dam. Whether natural or not this should have held water, the bottom of the reservoir area should not be porous because this appears to be rock or possibly concrete. The problem with a geological explanation is the flatness of the floor and what would have created this lip of the dam. This high up from the crater floor nothing could be in the crater itself to smooth out the shape of the lip and floor, it is not rough in texture like the rest of the crater. If this is a mud slump then it would have had to stop exactly on the cliff edge, in practice this is impossible.

A close up in Figure 4 below shows how thin the lip of the dam wall is at **A**, there may be horizontal layers in the wall related to its construction. Some whitish material is seen here in the dam wall, this seems to

extend right into the wall itself despite it being so thin. **B** is a chasm between the dam walls, it separates the other thin walls at **C** and **D**. **E** has a very thin edge on top, this appears to be darker or may be curled over to give more of a shadow. **F** is a large dark mass that also extends into this wall. This creates a problem because the dam wall seems to have formed around the dark area. The wall here is probably less than a meter in thickness, however there are no breaks or cracks.

To the right of **F** there are more ravines going down from the dam wall, perhaps water that leaked from the dam. This can be seen in the LPSC paper by Kolb et al^[10], they point out that dendritic ravines at multiple levels in a crater are unusual. This is because two artesian basins separated by tens of meters might be expected to merge into one, a water table would have been separated by non-porous rock into two and leak into the same ravine. But if the dam is functional there is no difficulty, the water from ravines above is directed into these dams. Then some water over time leaks out the side of this dam at **F** creating a second set of ravines below it. This then would make a dam here much more likely, the water from two areas is connected.

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Figure 5 shows a third kind of dam structure. As can be seen there are water ravines which point downwards into the dams, this indicates the dams whether natural or artificial were functioning. **A** shows a highly curved dam shape, this is commonly used in Earth dams to confer strength. For example arches are used for strengthening in architecture, most dams on Earth use a curve which is stronger. The previous dam was a straight lip on the edge of a cliff, here there is some latitude on where the wall could have formed. Instead of the dam wall being on the edge of a cliff here it is against the rock of the crater floor.

B has an unusual shape where it curves in sinusoidally, this can also give strength to the wall from its curvature like an arch does. The sides of the dam continue on back up the slope, the same process that formed these dam walls seems to work both horizontally at right angles to gravity and also vertically. This is hard to explain if the shape is assumed to form by slumping of mud down the slope. With concrete however this should hold its shape at different angles.

There is also no sign of where the dam material came from, the crater walls are smooth above them with no gaps. These dam shapes are very large and not like an amorphous slumping of mud, there should then be areas above it where this rock broken off. This would also be problematic, that they would fall and land in

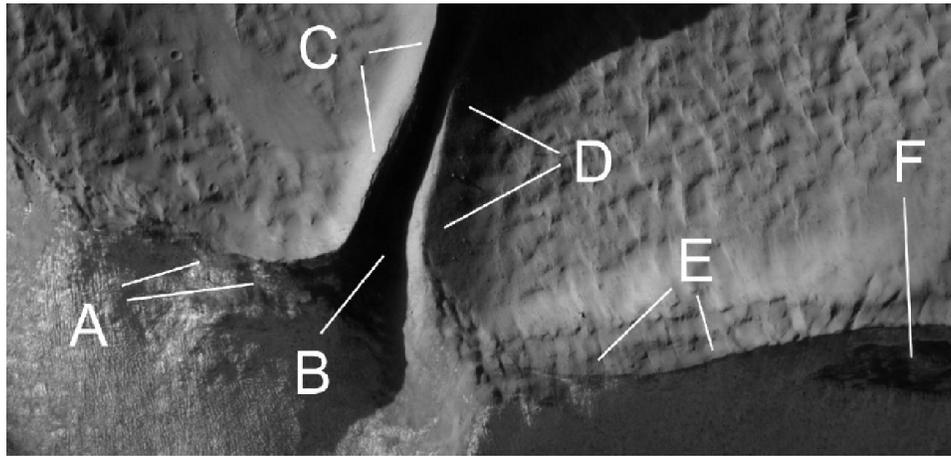


Figure 4 : The walls have not fallen even when the crater is highly eroded

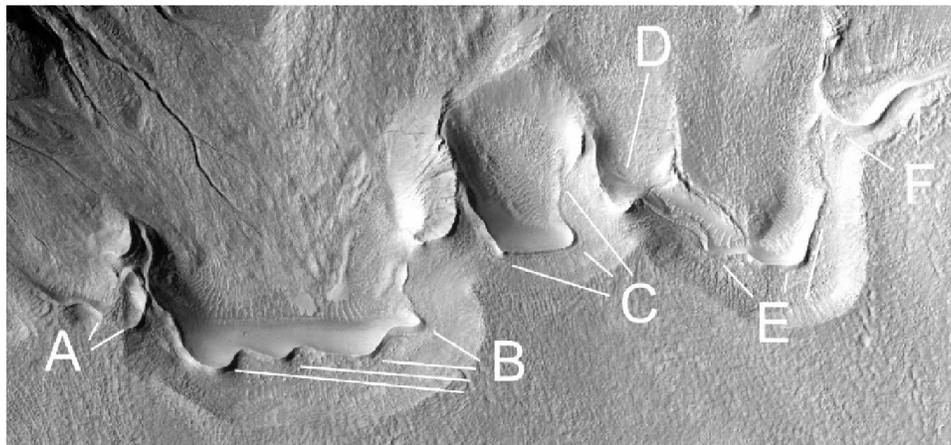


Figure 5 : The walls appear very elastic in shape though mud is not elastic like this

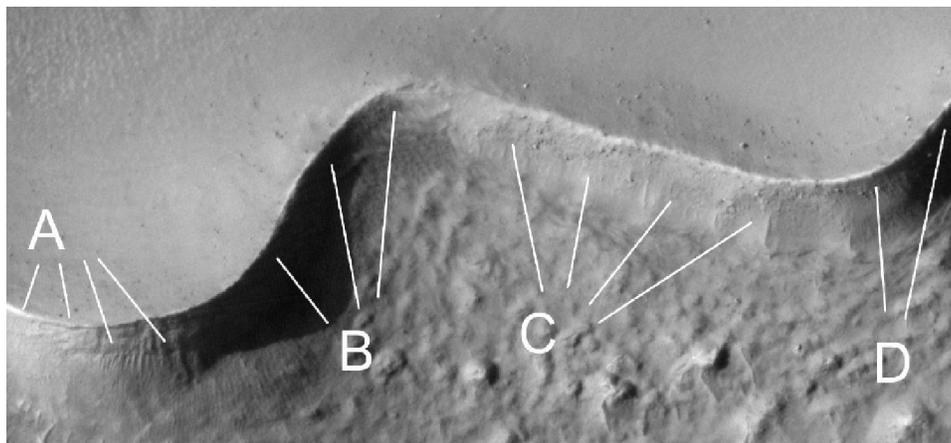


Figure 6 : The wall undulates though gravity should be equal on the slope

such a neat arrangement, but the dam walls have to come from somewhere.

Also the dams have a very smooth texture while the crater walls are darker and much rougher, this is consistent with a cement or concrete resisting erosion in the thin atmosphere. A crater is formed from an enormous explosion in a meteor impact, these dams would have had to form after the impact and not be surviving rocks jutting out from the bedrock. If the dams were formed by slumping material then something

would have to smooth it on both sides, the side facing the water might be smoothed by water erosion but the other side should not be. A different texture then should indicate the material is different.

In between the two lines from C this dam is squarer shaped like in the previous crater, the wall has no sinusoidal shape but is nearly straight. The sides also extend back up the slope, the forces that created it then had to function the same way vertically and horizontally all without cracking the thin walls. All these

dams seem to have about the same height in the walls as well as thickness, consistent with being made that way. **D** shows a separate dam and a funnel that also curves back up the slope. On the left then there is a small dam and on the right it is like a funnel or groove that guides the water to the dam below it. Again this would function as a funnel whether the dam was artificial or natural, why the lip would form on the left dam but create a funnel on the right is hard to explain naturally.

E shows another pair of dams where the same wall curves to give two areas to hold water. The two walls meet at an angle but if slumping mud created them then it should not have left the depression below them. If the dams were formed with gravity then the material should have continued on to the crater floor, not stopped here. **F** shows the last dam, each seems to be at a different angle to the slope. Slumping of mud seems to be ruled out for this dam because the upper wall curves back to the right, at some stage then this mud would have been travelling back up the slope against gravity.

This creates a problem for the geological hypothesis because mud slumping should move directly down the hill, here it forms sinusoidal shapes, square walls, and seems to slump down the crater wall by moving at an angle to straight down. Each dam should hold water if the rock is not too porous, they would represent a logical kind of construction. Underneath each dam there is a cleared area like another depression, the dams then don't seem to have stopped there by running into something else. The lower edge of these depressions could be from slumping material or it could have been cleared, the material for the dam is more likely to have come from the depressions under them rather than from above. The dams then appear to be perched over a much steeper incline, in each case they would have stopped just where gravity should have urged them onward.

Nowhere are there any signs of cracks or breaks in these walls, they would have had to elastically move down the slopes to form these walls yet not break. Also despite having water moving onto these walls for millennia this has not dissolved the walls, yet to have moved there they would have had to have been dissolved material as mud. They would seem then to have lost their ability to absorb water and form a mud, this would be explained by their being concrete.

This image has a resolution of 25 centimeters a pixel, being able to see these fine edges of the walls implies they are a few meters thick or less. This then would be at the limit of how strong rock can be in this environment, subjected to quakes, impacts, etc. shaking

the ground. The walls by contrast would appear to be tens of meters in height, a wall like this would have stresses in it capable of making it collapse or topple over. But even though these are on a slope and perched over the edge of a depression there is no sign of damage.

In Figure 6 **A** shows the edge casts a shadow as if thicker around the top, hard to explain geologically. The two right lines from **A** show an apparent layer in this wall running parallel to the top, this may be where layers are constructed internally with a concrete skin over them. **B** is looking close to directly up the wall, it shows it is perhaps a meter wide compared to its height. How it could bend like this without breaking is also unusual, a mud should not form tens of meters high and a meter wide without collapsing before it dried. **B** then shows the wall curving in an S shape, slumping material should be moving directly down the slope. **C** shows a slightly concave area or perhaps it is a darker material. It also appears to be a series of arches which could increase its strength. **D** shows yet another curve with no signs of breaks. Mud and rock is not known to have this kind of elasticity. A wall like this on Earth might be assumed by most people to be artificial.

The dam in Figure 7 has a different shape to the one in Figure 6, the left side is a sharp angled turn while the right is more arcuate. **A** shows from the left line how narrow the top of the wall is. The middle line shows how sharply the dam wall bends without breaking, this is supposed to be either rock or mud but is highly elastic like concrete. The third line on the right from **A** shows a dark band like layers in the wall perhaps from erosion. **B** shows a continuation of more layers, the dunes have formed along the wall giving an impression of struts. **C** on the left line shows the lowest part of the wall, it seems surrounded on the outside by sand but this is apparently not material from the wall itself eroding. Then the next two lines from **C** show how the wall again curves smoothly without breaking. It appears to be thicker at the base internally which is how modern dams are constructed.

The dam in the image below^[1] is in Ontario, it has a similar S shape where the curves give strength to the dam wall.

In Figure 9 the left line from **A** shows some marks or damage on the wall. The other two lines from **A** show a ridge or depression running parallel to the top of the wall. Some craters do have layers in them, however the dam should not have formed from the crater bedrock as an explosion like a nuclear bomb created this crater. Protruding rocks like these dams then would have been vaporized. **B** shows a similar band casting a

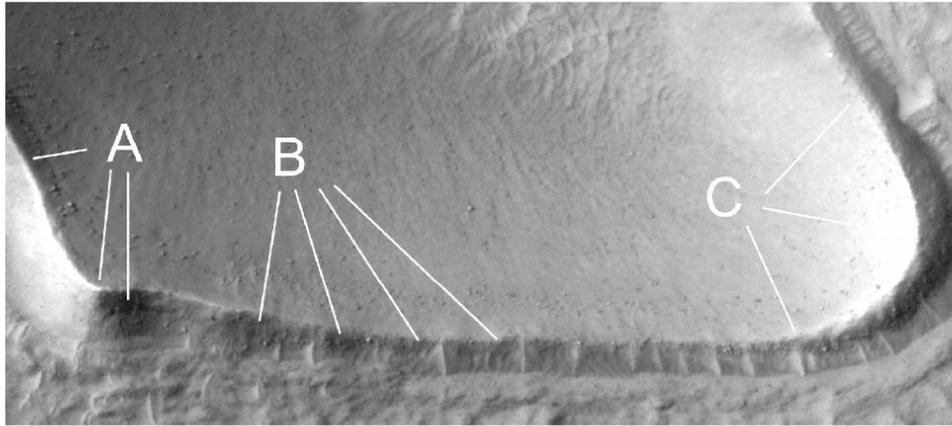


Figure 7 : Mud should have broken at A, the downward side is nearly vertical



Figure 8 : Curves in dams are made to increase their strength like with arches



Figure 9 : The wall appears to be a different material to the dunes and the rocks below it

shadow, it seems there is some layering going all the way around in these walls. C shows where the inside of the wall is much thicker towards the base, this may be because of silt or the wall may be thicker here. The dunes don't reach into this area, one possible construction technique then might be soil from below is pushed into shape and then covered in concrete. The wall might be built in layers using some other material to make it more elastic, like rebar is used on Earth. Concrete is often mixed with gravel to make it less brittle.

It is common on Earth for walls or dams to follow the terrain rather than being straight. The Great Wall of China^[12] below is an example. Another material used in the dam construction might be bricks, perhaps interlocked in a tongue and groove shape. Mars has plenty of clay, bricks might have been made by heating this clay and might last like the Great Wall below. This also shows how bricks made from clay and mortar can be built with simple technology. Tamped or compressed earth was also used, this might give strength inside the dam walls by simply tamping it down in



Figure 10 : Long walls on Earth have a similar shape on uneven terrain

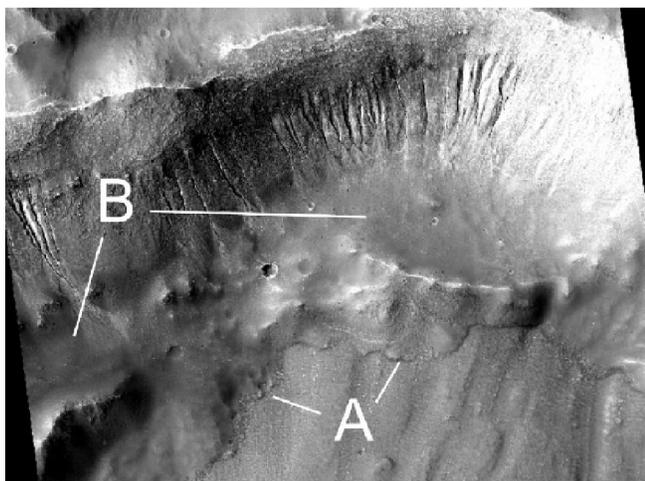


Figure 11 : Natural dams from craters may have been imitated

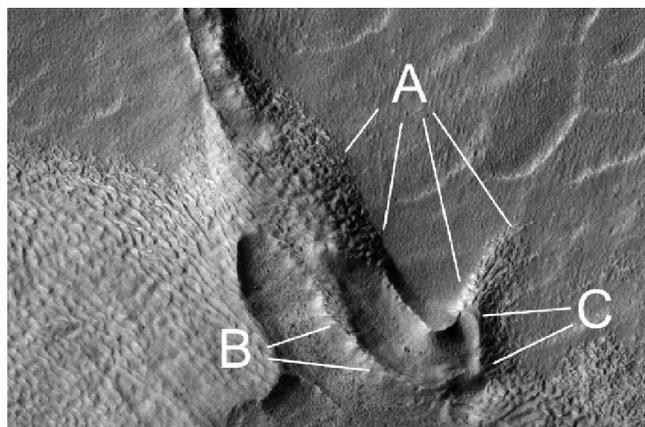


Figure 12 : The smooth walls should have eroded all over like the ground to the left layers.

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The dam in Figure 11 may be natural, this however should still have filled with water at the time. **A** shows

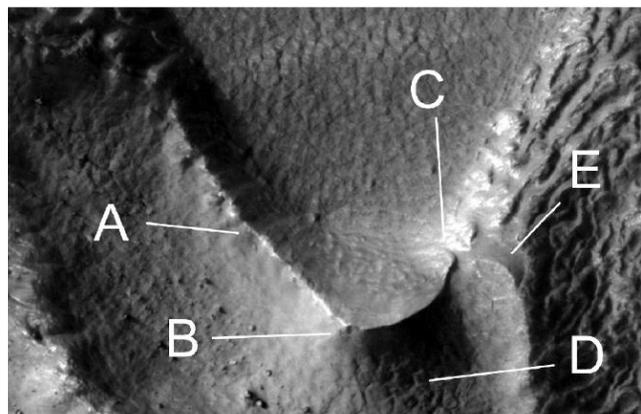
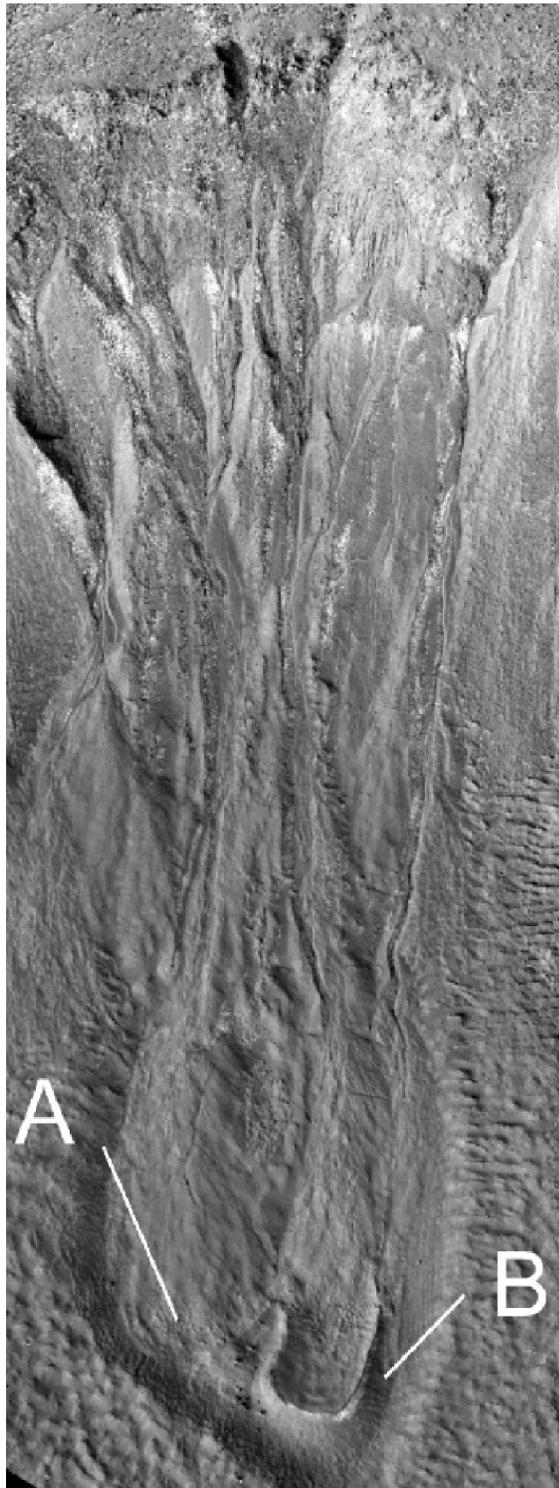


Figure 13 : Some wall parts remain smooth with polygonal cracking all around them

where there is an unusual edge to the soil, perhaps silt has fallen down here. Similar edges to this are seen in many natural formations. Natural dams like this may have formed by a meteor impact in an existing crater half way up its rim. However it would have been possible to shore up the sides to hold more water, **B** shows here water would have accumulated. Natural dams then might have inspired the inhabitants to imitate them.

ESP_037224_1405

Figure 12 shows a small dam, however it is a continuation of a rougher and more natural rock in the crater. On the left line coming from **A** the rock is much like in the rest of the image, however at the second line from **A** anticlockwise it turns into this smoother dam wall material. In the middle the dam is highly curved and thin but does not break. It then appear to be highly elastic like many other dam walls. It can be seen that it is the same material as what it is joined to, however this other rock has completely different char-



Figures 14

acteristics. **B** shows how a second lip or wall, seen on many other dams, also merges into a smoother and thinner dam wall without breaking. On the right it ends in a vertical groove at **C**, this smooth face also connects onto much rougher rock. Below the dam as is common elsewhere the rock is smoother as well, like it has been scooped out perhaps to build the dam. The more natural rock then appears to have a random texture but suddenly forms this dam, it would

seem impossible to explain geologically. If this dam is formed by the rock material slumping it should not have smoothed itself out on both sides in the process. A close up of the dam shows more features. **A** shows where the dam begins, the wall suddenly thins into the typical narrow top edge. **B** shows a small break in the wall or where the two edges would have met at an angle. Any kind of damage is very rare in these walls. **C** shows the edge curls around in an artificial looking arc, it avoids connecting onto the natural looking rock. **D** shows material similar to above the dam, but very different to that on both sides. There seems to be polygonal cracking which merges into the crack free dam walls. **E** shows another smooth arc shape that merges directly into the natural rock. Like some of the others, this dam may have filled up with silt from the water ravines. If artificial they may have needed to be cleaned out regularly.

ESP_037168_1385

In Figure 14 below the ravines are much higher, the water would have had further to fall. On the left at **A** there is no dam, but with nearly identical terrain on the right at **B** a dam is found. There is no missing soil further up the slope to form a neat dam shape on one side and nothing at all on the other. There may however be the remains of another dam at **A** buried in the mud, there is a faint outline. In Figure 15 the lines from **A** show a symmetrical shape joining up to the left dam wall. The upper line from **B** seems to show and angled start to the wall, there also seems to be a double groove along the wall top or else it is more eroded. The lines from **C** show damage in the wall at each point, the top two show a small piece missing in the usually narrow top. **D** shows how the base is angled to be thicker like with most Earth dams. **E** shows a

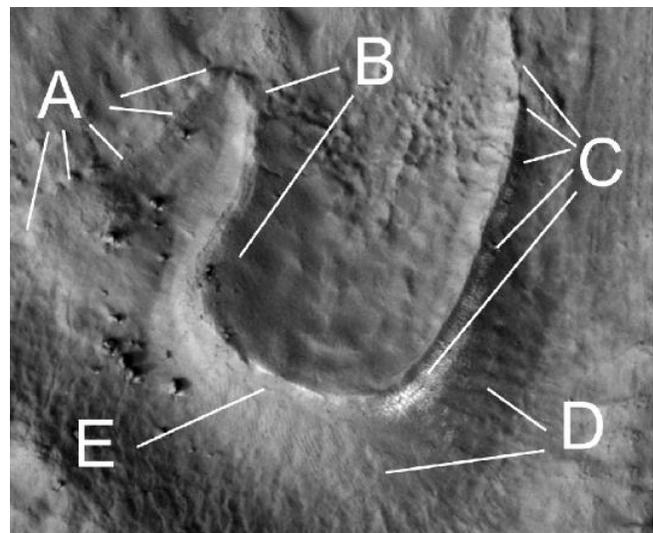


Figure 15 : A mud slump breaks a dam wall

very straight piece of the wall top.

ESP_036838_1365

Figure 16 has multiple dam shapes similar to Figure 12. The rock below is highly random in shape but then suddenly becomes smooth in the dam walls, this is a recurring feature in all settings and is consistent with concrete being used. In some cases the dam walls are separate from this rock and in others they merge into it. **A** shows a series of three dams with two overflow ridges. The first line from **A** on the left goes to a small dam, the second line from the left shows the bottom dam. The third line shows an angled ridge which should move water to the fourth line and the second dam. Even if natural it should act this way, water from the first dam would overflow to the second and then to the third.

Any inhabitants would think themselves fortunate to find a natural dam doing this. **B** shows four separate dams with smooth faces in this rough rock. **C** points to two cases where the dam walls are close then merge together leaving a hollow, another dams are adjacent to these. **D** shows water ravines above the dams, **E** shows a standalone dam. The left line from **E** shows a ridge similar to the others, this would catch water like the side of a funnel. The right line from **E** shows a ridge going downwards from the **E** dam, this also has a depression or cleared area under it.

The close up below in Figure 17 shows the operation of the leftmost series of dams. The first line from **A** on the left shows a small curved ridge, this would catch some water running down the slope and direct it to the right. The ridge at **B** would catch this water and move it further to the right, this would happen whether the dam was natural or artificial. There is another ridge directly above **B**, this would catch a stronger runoff from **A**. Both water flows would then end up in **C**, when this overflows the gap shown would allow the water to go further down rather than overflow. This would direct it to **D**, it would bounce off the opposite wall which directs it towards the middle of the dam. A scenario like this being natural strains credibility, imagine watching this operate.

The four lines coming from **E** show four dam walls, the line points to the base of each. These walls are very straight even though the rest of the rock is highly random in shape. Even the dams to the left are curved in their shape, the straightness of these dam walls should not occur if they have been worn into the rock from erosion. The same kind of water flowing down a slope should not then form such different shapes. **F** shows another pair of straight dam walls, they are separated by a straight base line that should not be worn

in this shape from water erosion.

In Figure 18 the left line from **A** shows how the rough rock suddenly becomes smoother in connecting to a dam. The right line shows how two dam walls come very close together. This is difficult to form geologically, if the dams were caused by slumping mud then they should not form straight edges as in Figure 17. If they are eroded this way from rock then they should not suddenly change from rough to smooth textures. Also then how this hollow between the two dam walls would form is also problematic. They are close together, perhaps less than ten meters apart. Something would have to get between them to erode the hollow area but they do not face upwards into the path of any water, it should have eroded away the top wall if it could erode this hollow underneath. The top wall also merges into rough rock as does the left wall, but no explanation as to how. But this would be relatively simple for someone to construct, smoothing walls with a kind of cement. The hollows then would be used to supply material for the walls.

The left line from **B** shows again how the rough rock becomes a smooth curving dam wall. The middle line shows two small defects in the wall perhaps meteor impacts. This appears to have broken off the top of the dam wall here. The right line from **B** shows how the dam again comes close to another wall but still leaves a gap, then this opens up under it. **C** shows how the top of this dam wall has eroded almost down to the crater bedrock. There appears to be striations in this rock at right angles to its length, they might be bricks made from clay inside the wall and covered in concrete.

The dam in Figure 19 is free standing, as with the ones shown earlier there is no sign above them of where this dam material came from. **A** shows a distinct edge to this wall, **B** shows a distinct band as is there is a layer going through the wall parallel to the top. These exterior walls usually appear to be flat rather than curved, here the shading from the sun indicates a flat gradient. This is similar to how Earth dams are made, the water pressure increases linearly and so this shape is optimal. This should not occur with a mud flow, it would tend to slump in a curved shape, however so far there are no mud flows remotely resembling these dams.

C shows actual mud and what it looks like when it falls down the slope, this has filled up much of the dam but has not formed a smooth surface like these dams have. It also has cracks in it but the dam walls have no cracks. If the dam material came down this slope then it should look something like this mud. **D** shows some damage in this wall, the left line from **D**

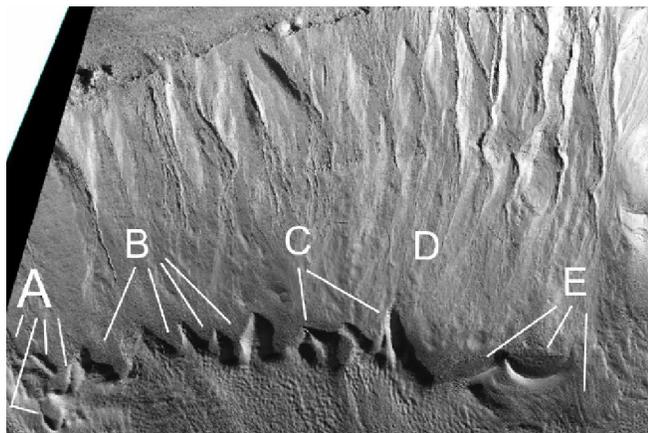


Figure 16 : These parts point up the crater against gravity, they should have slumped to around the same level

then be viewed side by side, the mud here can be regarded as forming these dams. However in other examples there has been no mud, no slumping, no cracks in the mud, and nowhere for the dam material to come from. And yet the same dam features are still there.

ESP_036839_1420

Figure 22 has an enormous number of possibly artificial formations. Each letter has lines coming from it, the first line referred to has a 1 next to it. Then the lines will proceed anticlockwise from the 1 to be analyzed. The first line from A with a 1 shows a small eroded dam. The next line anticlockwise shows a possible gating point, to the left the water would fall

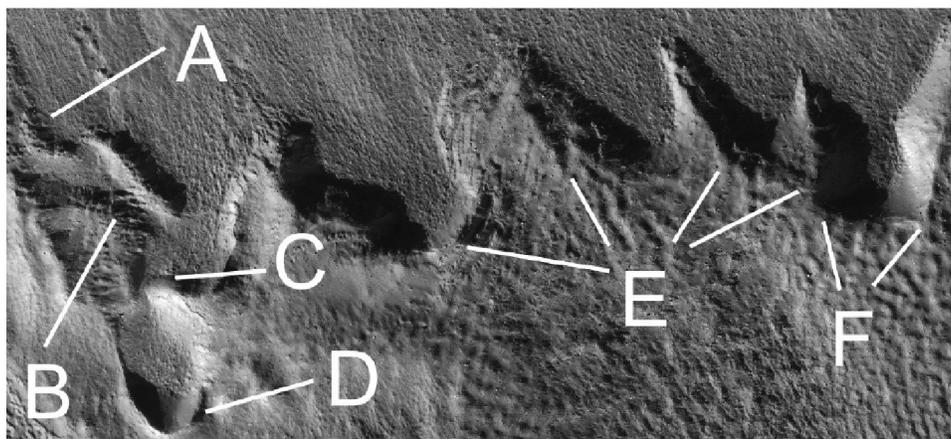


Figure 17 : The ridges direct the water to break its descent

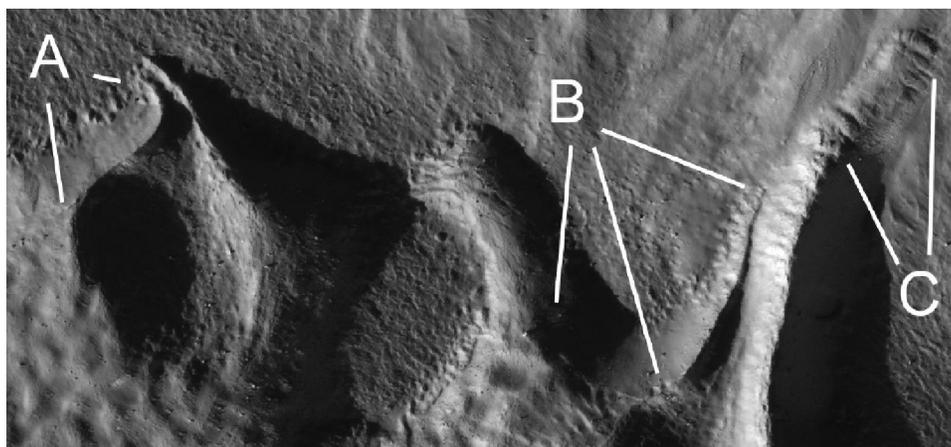


Figure 18 : The walls form the same at right angles to gravity, mud cannot slump like this

appears to show a piece has cracked off like a layer near the top. The right line from D may show another piece that has come off. E shows some degradation on the wall top. It however should never have been smooth and regular if formed from erosion. This jagged top to the wall then only makes it appear more natural but it looks more like it has eroded to look like this from a previously smooth and narrow top to the wall. This should not then have begun as a natural wall eroding like this. The striations are at right angles

to the wall surface and so may be a series of bricks exposed. The spacing between them appears to be highly regular but this is at the limit of the resolution to measure.

Figure 20 is a close up of another part of the crater. Here it appears mud has slumped down from water ravines above this area. The light is coming from the bottom of the image, this casts a shadow so the right line coming from A shows a dam. The left line shows some mud that has come down from the ravines. This

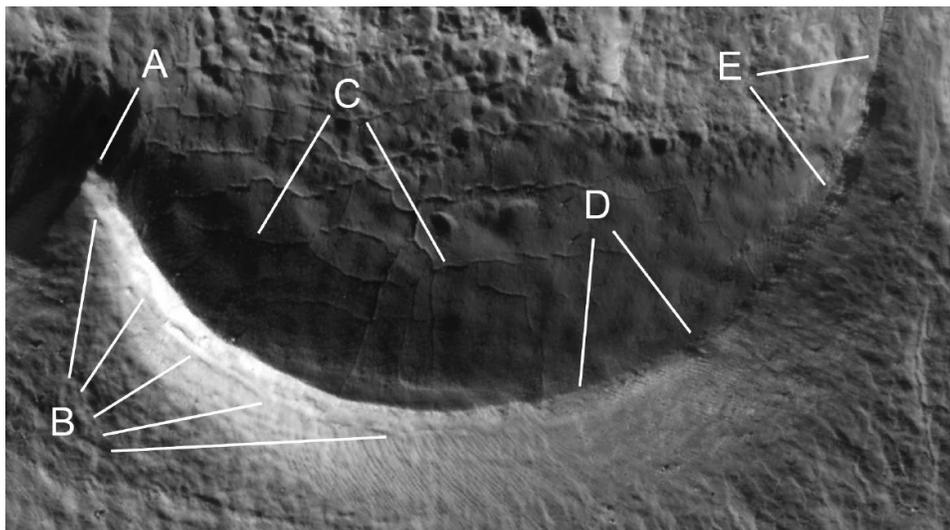


Figure 19 : Mud that slumped into the dam is nothing like the wall material

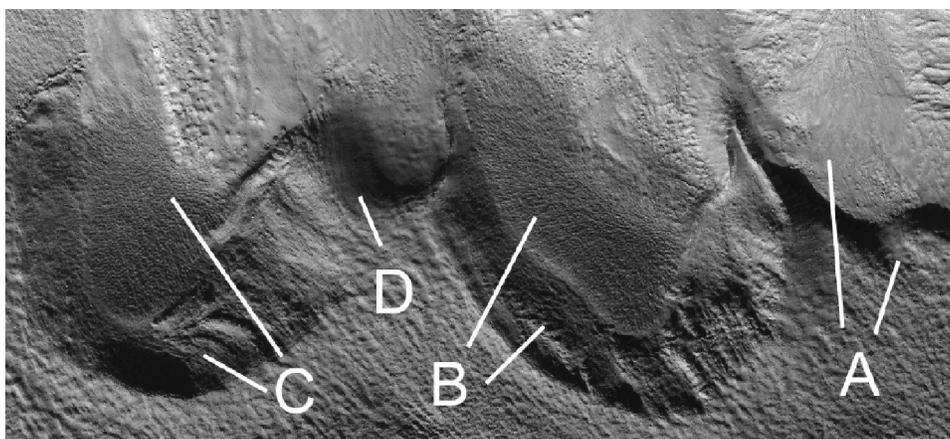


Figure 20 : Mud fills the dams with a different shape, it cannot form both

process is one explanation for how these dams are formed, it slumps down the crater and the bottom part creates the dam walls. However this mud seems to only fill the dams in an amorphous way not create new walls. **B** shows from the right line the dam hollow, this is separate from the slumping mud which seems to have filled and dam and buried it.

The left line from **B** shows this mud, it seems to be a completely different shape from the dams seen so far. It is also a completely different texture to the dam walls, however this is the smoothest mud flow so far. Mud flows seem to have small wave like shapes in them, however the dam walls do not have these. **C** shows another dam with the slumping mud partially filling it, again there is no dam wall formed by the mud. **D** shows another small dam with no mud in it. A comparison between this mud flow and the dam shapes so far shows no similarities. But if the dams are not mud then they must be either something else geology can produce, or they are artificial.

Figure 21 shows a more ambiguous pair of dams. The bottom line from **A** shows the smooth dam wall and an arcuate shape as with many previous examples. The next line up shows the dam is apparently filled with mud that has come down the slope. The smaller third line from the bottom shows apparent damage of this dam wall. The top line from **A** shows cracks and faults in this mud and rock. One interpretation is this dam is artificial and filled with mud, this has cracked over time perhaps from temperature variations and quakes. Even with this extreme erosion the main dam walls look dissimilar to the surrounding rock.

The bottom line from **B** shows the same smooth arcuate dam wall. The next line up shows apparent dunes obscuring part of the top of the wall. The next line shows the dam is again full of mud, the flow shows it coming from the ravines above. Space does not permit showing this but the full image shows extensive water ravines over these dams. The top line from **B** shows a connection from a small ridge to the dunes that goes down to the dam wall, it's likely this is a mud flow. The natural and artificial explanations can

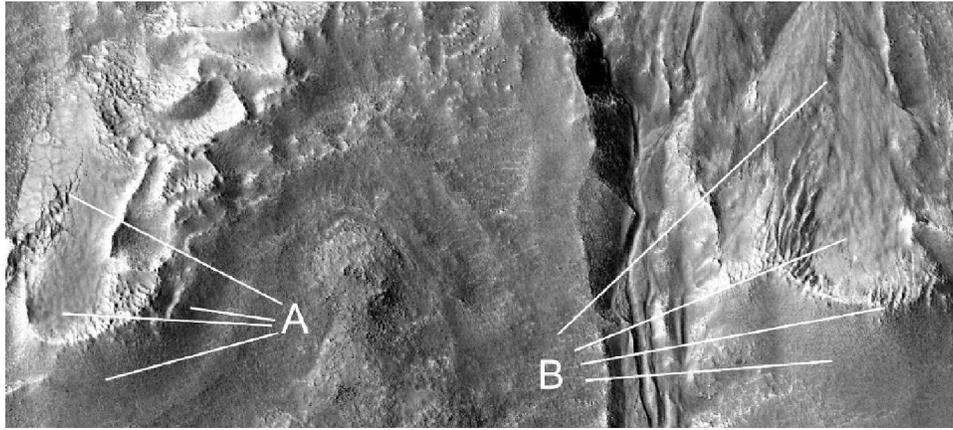


Figure 21 : More mud slumps with cracks fail to damage the dams with their weight, so they are different materials

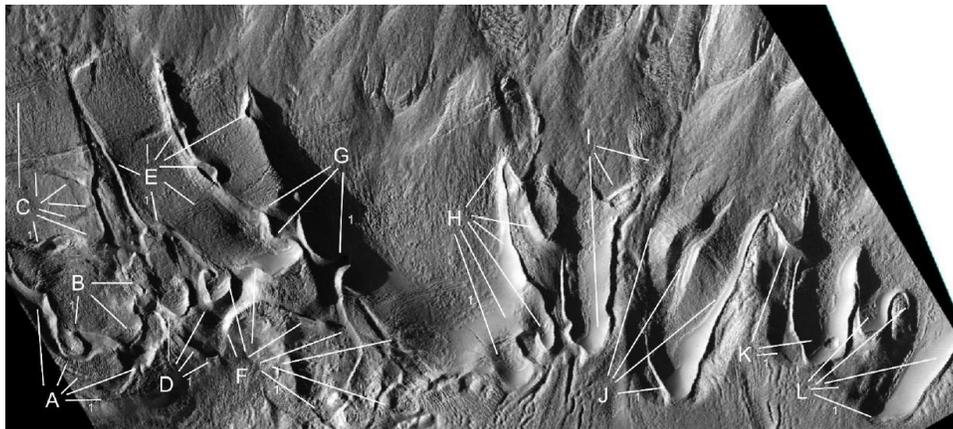


Figure 22 : Almost nothing here can occur naturally, the walls are very smooth and elastic compared to the crater material

through a groove to this dam. More to the right the water would fall through another groove to another eroded dam below it directly below the D. the third line anticlockwise from A shows another eroded dam. The fourth line shows two dams, one under the other. The top dam would receive water directly from the slope, the bottom dam would have water directed to it shown by the 1 line from B. The last line from A is vertical and shows how smooth the dam wall is compared to the rough rock of the crater, typical of these dams. The next line counterclockwise from B shows either another dam or a funnel system directing water to the dam below it. The third line from B is horizontal and shows another small dam.

The 1 line from C shows a small dam, the second line anticlockwise shows another dam. The third line appears to show a ridge where water would be diverted to the left into the dam shown by the 1 line from C. Some might also go into the dam below it. The next three lines from C appear to show fracturing of the rock, none of these seem to be a natural process forming dams. They may also be ridges to divert water that have eroded away or broken off. The 1 line from D shows another dam. The next line anticlockwise shows the smooth dam wall. The next two lines shows

grooves where water would be diverted downwards by ridges into this dam. All of this water flow so far should have happened whether natural or artificial. However to see water collected like this naturally would beggar the imagination.

The 1 line from E shows a groove which would funnel water to the dam below it. The next line shows some slumping of the rock or mud, however this doesn't form a dam shape. This is significant because there should be signs of natural processes forming dam shapes if this is possible. The third, fourth and fifth lines anticlockwise from E show where two walls have come close together, the walls are the same type as dam walls. So to form naturally they would have to come together like this without breaking or filling in the gap between them. The vertical line from E shows another ridge which should divert the water to the left to the funnel shape directly under its end and to the dam below it. The last line anticlockwise from E shows the smooth sides of this wall.

The 1 line from F shows an eroded dam. The next line anticlockwise shows another eroded dam with a funnel like shape above it. The third line shows a groove and arcuate ridge which should let some water drop down to this dam, and other water is moved to the

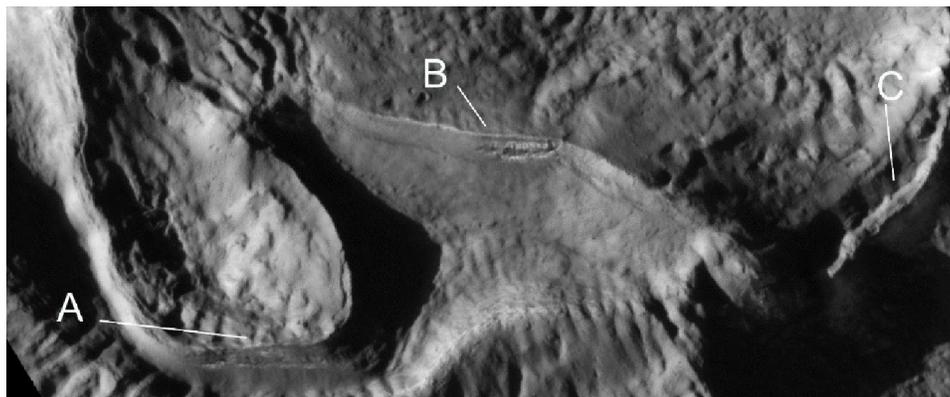


Figure 23 : Breaks in the walls show layers impossible to form in slumping mud

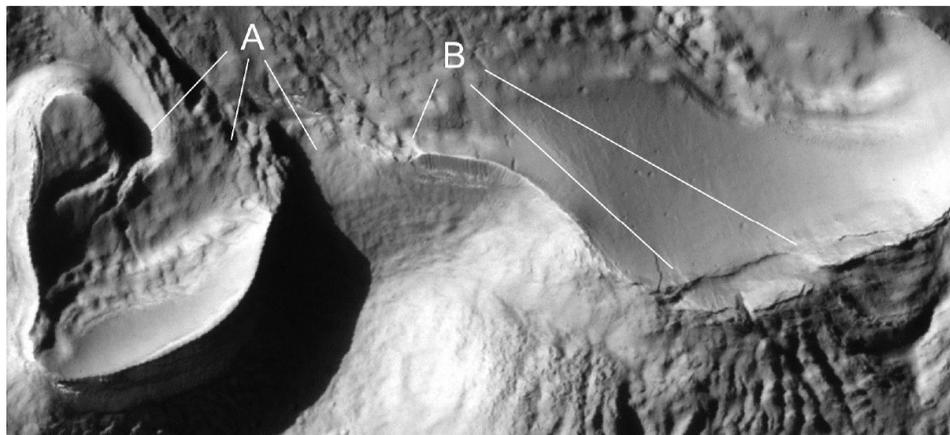


Figure 24 : Layers cracking as the ground underneath is eroded away

right. The fourth line from F shows a remarkable long ridge which would direct water to this dam, on its left it becomes arcuate and directs water to another dam. The sixth line from F is nearly vertical and shows another dam with smooth sides, the last line shows a groove which would funnel water to the dam below it.

The 1 line from G shows a groove where water would be funneled to the dam below, this would also be directed by the curved wall to the left of it. Here it is simpler to go clockwise, the middle line shows a small dam and the next line a funnel which could direct water all the way down through these funnels breaking its fall to the dam at F. This would be necessary as if the water moves too quickly it would spill out.

It should be apparent by now serious questions arise as to how this could form by coincidence. The engineering here would rival the Ancient Romans in its complexity. If artificial these ridges would have been covered by concrete and have been much smoother. The 1 line from H shows another dam with smoothly curving walls, there are some cracks in the dam floor where it bends to a steeper decline. The next line anticlockwise from H shows the smooth curve extending up to the vertical wall. The third line shows another small dam. The fourth line shows how this

smooth narrow wall leans over onto the rough rock below but is separate from it.

The fourth line nearest vertical shows where two dam walls join up leaving a hollow. The long 1 line from I shows a deep dam, there may be runoff ravines eroded into the wall below it as water escaped, perhaps from the long fall. The next two lines from I show another two highly eroded dams. The 1 line from J shows another long dam with a squarish bottom to it. The next line anticlockwise shows how this wall should funnel the water down perhaps breaking its fall. The last two lines from J are near vertical and show grooves which may have been formed to direct the water to this dam. K shows three more dams. The 1 line from L shows a very deep dam. The next line shows how this smooth material is draped around a large rock, hard to form naturally as it shields this rock and acts to divert water smoothly around it to the last line from L as another dam.

There are far too many dam features here to analyze in close ups, some selected areas will be examined. In Figure 23 below there are three areas where the dam walls are broken, this can give some clue as to their nature. A appears to show two layers, an inner one is still standing and the outer wall has peeled off. B appears to show a near break in the wall, there is a con-

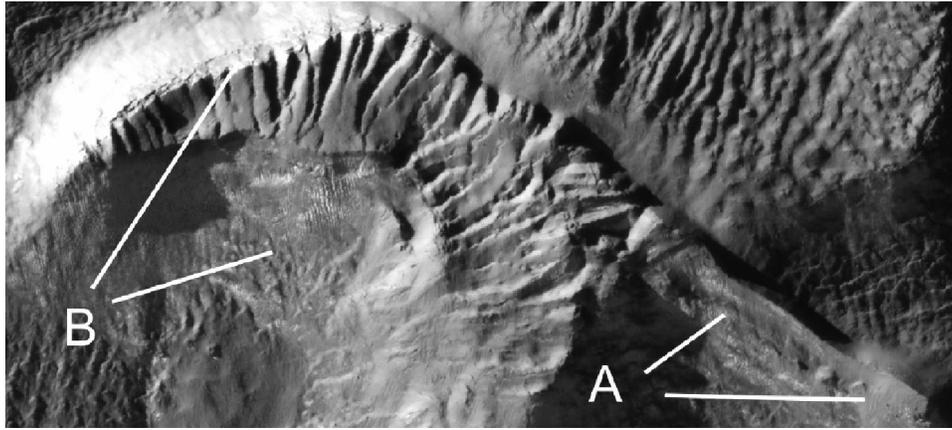


Figure 25 : A is highly unnatural with no erosion, it connects to the whole shape but is a different material

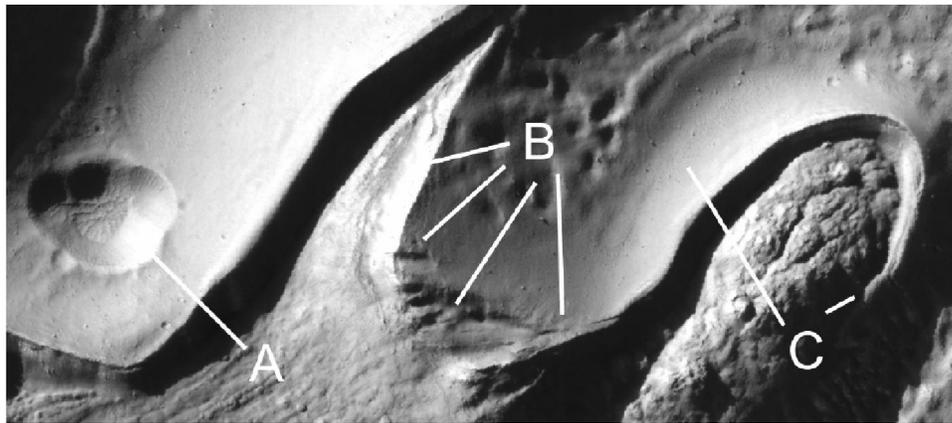


Figure 26 : The wall curves around and under C against gravity, it also doesn't fill the hole at A

cave band or missing skin going along the wall top connected to this damage. This can indicate an inner and outer layer for strength, plus horizontal layers in the walls. C is another example of how this outer wall has broken away from the bedrock, this may show how the walls were attached to a cliff face. It may also have two layers here.

In Figure 24 A shows three funnels directing water to dams, the middle one is choked up with silt. The left line from B shows there the dam wall has broken off, the damage indicates extreme age or perhaps more water flowed here for longer than the other dams. The dam wall then becomes smooth but the two lines from B to the right show breaking of layers under the floor. This indicates what this material could be made of. A floor of concrete might have been placed over the bedrock, over time this is beginning to flake off at the lower end. There may also be multiple thin layers on top of each other.

Figure 25 shows a ridge which would divert water, shown at F. A shows a more unusual wall, this one appears to be very straight with a fat top and a rectangular section on its end. This might be the inner wall after the outer skin has eroded away. The letter A is in a hollow but this is hard to explain naturally, how the rock would be hollowed out under this ridge. B

also points to a hollow, the ridge forms one piece diverting water to the left and right. B also shows where a wall might have been, there is some damage here like previous images where a wall had broken off.

Figure 26 below shows a large hole at A, this is hard to explain naturally as the dam floor is formed all around it. If the hole was there when the floor was formed then it should have created turbulence around it and shaped the erosion under it with the water flow. However the floor sharp is pristine on all sides of the hole. Instead it may have been coated with the same material as the floor. The left line from B shows a dark streak running along the wall, perhaps related to a layer in it.

The next three lines show damage to the dam wall and floor, there appears to be multiple layers that broke off. C shows how this wall material curves smoothly around this large rough rock without touching it, for mud to create this by slumping should be impossible. It is the same shape and texture vertically on the sides, also it curves around under it to some degree with the right line from C.

The use of contoured dam structures to hold water is well known on Earth, for example the rice paddies^[13] in Figure 27. They may have been used on Mars to hold water, grow crops similar to rice, raise fish, etc.



Figure 27 : Similar contoured dams are used on Earth

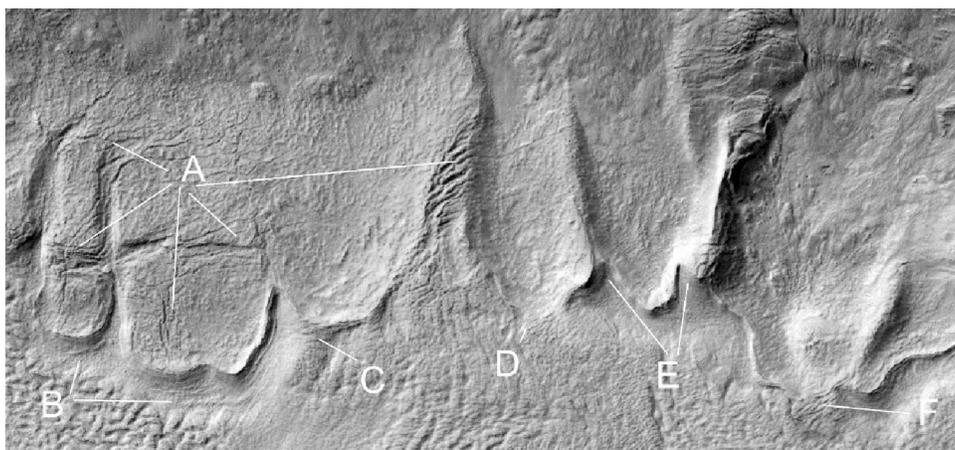


Figure 28 : Slumping mud forms cracks but not in the walls, they act differently to this stress so are not the same material

It also shows how the Chinese were able to hold water in these paddies without using concrete.

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Figure 28 shows dams in a highly degraded state, as the walls break it gives more clues as to their nature. **A** shows many areas where the ground has cracked and slumped, however this has not broken any of the dam walls. They would seem to be very strong and resilient to stress, more than the natural rock of the crater. **B** shows the same kind of cleaned up area under the dam walls, this makes them more comparable to previous images. They are unlikely then to be something else that happens to look like these dams. **C** shows a dam wall that has eroded away to virtually nothing. The next dam at **D** as also lost most of its wall. **E** shows a dam that connects to two ridges in an unusual way. **F** shows a very long dam that has the wall missing at one point.

The walls below in Figure 29 are severely degraded, **A** shows how the material is made of layers but the rock above is not. This makes it unlikely they were made by the same process, also slumping mud does not form layers. **B** shows many layers in the wall, there may have been a smooth coating that has eroded away here. **C** shows a bulging area of rock and a hollow, this may indicate a missing external layer. The top layer here is much darker, perhaps a different material to the rock above it. The left line from **D** shows the wall in much better condition but perhaps still missing some of the external coating. The right line from **D** shows a missing piece from a layer, perhaps this was an external skin of material missing elsewhere. The left line from **E** shows the top of the wall in good condition and then it degrades to the right.

In Figure 30 **A** shows the wall has disappeared, the dam might also be full of silt. **B** shows layers that seem to break up in pieces and perhaps a weaker ma-

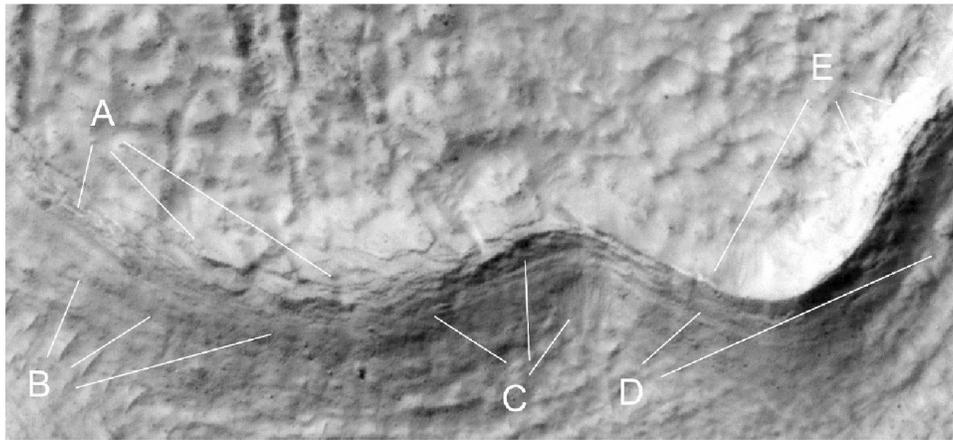


Figure 29 : The walls are layered, but could not have survived the crater impact

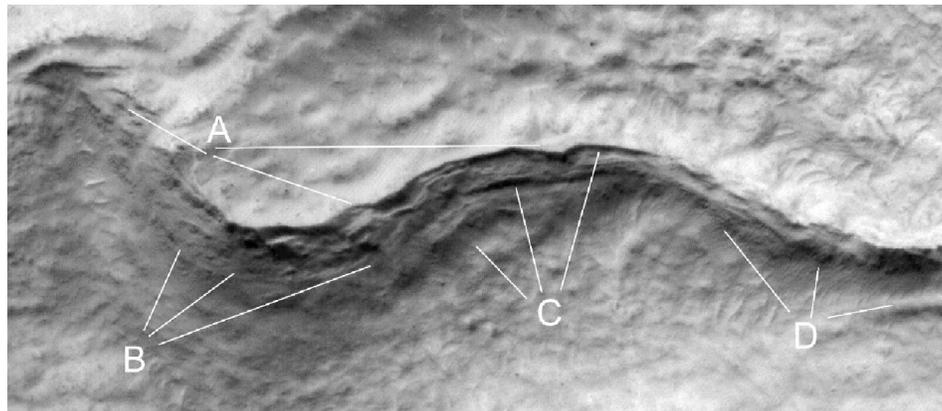


Figure 30 : The wall still holds despite the weight of mud and dust above it

terial between them erodes more easily. C shows more deep holes in the wall. D shows a dark layer in the wall and on the right perhaps the remains of the exterior wall.

CONCLUSIONS

The Martian dams are highly unusual, they range from the probably natural to seemingly impossible structures. This is not unusual on Earth, for example the pyramids probably imitated similar shaped hills in Egypt and some buried sites can resemble natural terrain. One major problem with the natural hypothesis is the lack of any missing material in the crater walls above them, instead the hollows occur under the dams. If they were formed by slumping materials then there should be a recognizable area where the mud came from. To suggest otherwise is to say the mass of the dams came out of thin air.

Another problem is their longevity, often the ground can be highly eroded yet the dam walls remain pristine. They can also be very convenient, water ravines form and usually water will wear a path down a slope. Here however the dams seem to do the opposite, they catch the water in intricate arrays that seem to slow the water and break it into smaller catchments to avoid

spillage. When there are signs of erosion the dams still degrade slowly as pieces of layers break off. They seem then to act like concrete would assuming it could last over hundreds of millions of years. However basalt contains a natural Zeolite cement that also survives this length of time, it is unlikely then radiation would destroy concrete on Mars.

These dams are not a feature on every crater wall with ravines, many look as they should be with no dams or obstructions of the water to the crater floor. Often this disparity occurs in the same crater, there can be multiple dams on one side and the other with the same geology has no dams at all. When they do erode they show extensive layering, the floor can be seen in some cases as a layer like concrete. The walls sometimes have horizontal layers and several vertical layers, they sometimes contain blocks that look like bricks. This is problematic if they form from mud slumping down the crater^[14], this is because the layers are parallel to each other not mixed up from a randomizing flow.

Where there is clear slumping of mud and faulting the dams seem to be very different from the result, often they are found side by side with the dams unaffected even when buried. This indicates the dam material is impervious to water even over millennia, it would appear to rule out any process of their forming with

water. The dams cannot be remnants of bedrock protruding from the crater wall and resistant to erosion, the explosion created by a crater vaporizes all rock or throws it out as ejecta. These dams have delicate shapes which could not survive an impact, the tops of the dam walls appear to be less than a meter wide and sometimes are tens of meters tall.

The wonder then is they can stand by themselves, to survive an impact like a nuclear bomb is out of the question. These layers cannot be those exposed in a crater impact because they curve around in the dam walls following their shape. If they were exposing contoured layers in bedrock then the layers would not remain parallel to the dam wall tops^[14], the dams can curve around into U shapes which layers could not do. NASA recently shows how these layered outcrops would appear from the rover^[15], they do not form shapes resembling these dam walls.

With the candidate artifacts they seem to cluster around the same great circle, many are between Cydonia and the King's Valley. Others are found at lower latitudes on the other side of Mars consistent with how the great circle lies at an angle to the current equator. If not artificial they represent a convenient read made dam structure useful to the inhabitants. If Mars was terraformed the artesian basin might refill and many of these dams start operating again for colonists. It would not be difficult for the hypothetical inhabitants to build them as long as a concrete like material could be made, it would be a logical step to improve the water supplies like this just as people do here on Earth.

For skeptics the dams should be less problematic than humanoid faces, it might be expected any kind of sentient carbon based life would need to collect water. It is also likely dams like this would survive long after any metallic and plant based buildings would have eroded away, for example there may have been pumps used but long gone. With the candidate artifacts the dams may give a highly misleading impression of what was there, they would just be the only large scale structures that could survive for over hundreds of millions of years on Mars.

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