

# Have the ancient cities of Sodom and Gomorrah been found?

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November 15, 2015

## INTRODUCTION

Ross Paterson, Ron Wyatt, and other young-earth creationists (YEC), claim in four videos that they have found the remains of five ancient cities (e.g., Sodom and Gomorrah) that were destroyed by a biblical “fire and brimstone” storm (Genesis 18:16 to 19:29). See **Figure 1** and these links:

<https://www.youtube.com/watch?v=KBCs4wexgRk&index=23&list=WL>

<https://www.youtube.com/watch?v=L7uHKn2ijKw>

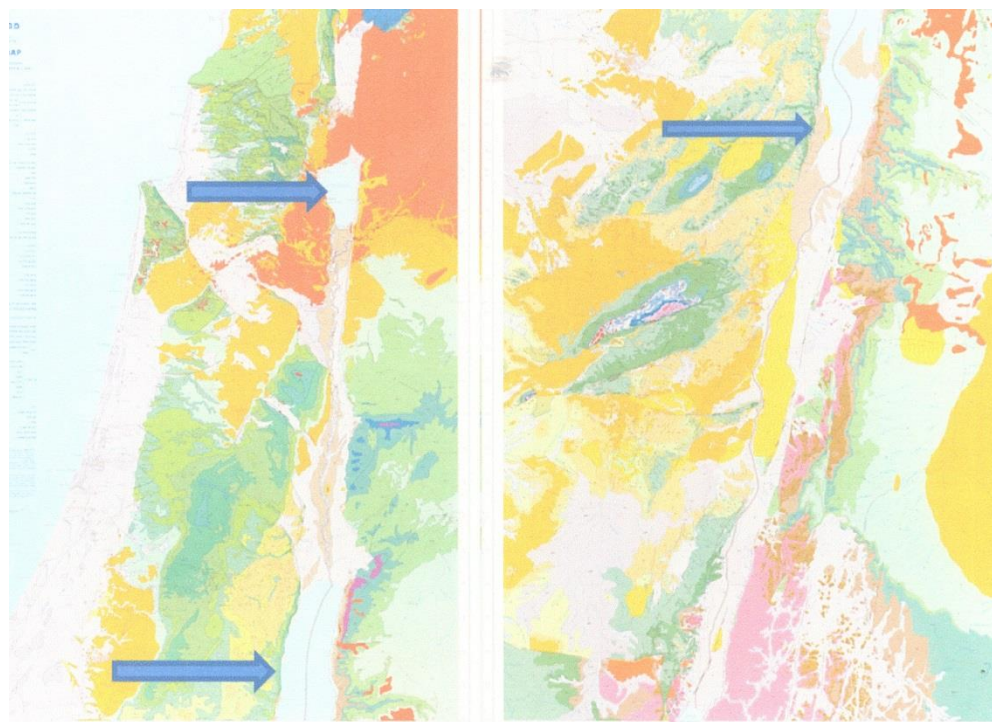
[http://www.arkdiscovery.com/sodom\\_&\\_gomorrah.htm](http://www.arkdiscovery.com/sodom_&_gomorrah.htm) "

<https://www.youtube.com/watch?v=XzVR5HTcR1I>



**Figure 1.** Location of Sodom and Gomorrah and other cities (Zeboim, Admah, Zoar) supposedly destroyed during the Genesis “fire and brimstone” storm. Image from first link above, video by Ross Paterson and <http://www.truediscoveries.org/sodom-gomorrah>

The supposed locations of the cities are in the Pleistocene Lisan Formation that borders the Dead Sea, and this formation extends north to the Sea of Galilee (not shown in **Figure 1** but shown in **Figure 2**). The supposed Sodom and Gomorrah sites are in the eastern part of the light-tan area (arrow) adjacent to the west side of the Dead Sea (light blue, right map **Figure 2**) and north of there.



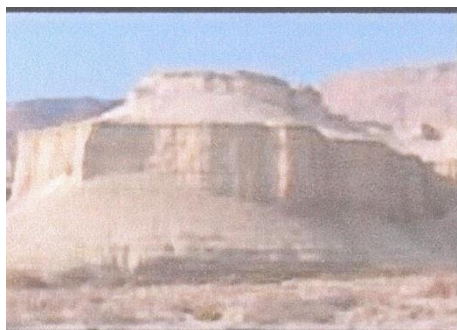
**Figure 2.** Geologic maps of a portion of Israel. Published by the Geological Survey of Israel in 1997 at a scale of 1:250,000. Dead Sea (light blue; top right, right map, and bottom arrow, left map). Sea of Galilee (left map, light blue, upper arrow; surrounded by basalt (red)).

The five cities destroyed by the “fire and brimstone” storm are further described by Steven Collins (2013).

The videos show eroded landforms that the YEC thought looked like buildings, temples, sphinxes, and ziggurats. A ziggurat is a Babylonian or Assyrian temple of Sumerian origin in the form of a pyramidal tower. **Figures 3, 4, 5, 6, and 7** show images of some of the landforms that are supposed to be man-made structures. Some of the “buildings” appear to have archways, doors, and square windows and have walls at right-angles to each other, which YEC believe are characteristic of man-made structures and not found in natural rocks.



**Figure 3.** Near-shore section of Lisan Formation at Perazim Valley, a supposed former building (?) or buildings (?) [back left] in the western area of Sodom in **Figure 1**. Image from:  
[http://www.gsi.gov.il/Eng/\\_Uploads/59steinf.pdf](http://www.gsi.gov.il/Eng/_Uploads/59steinf.pdf).



**Figure 4.** An alleged former temple? Image from:  
<http://www.amazinghope.net/sodom-and-gomorrah-a-unique-layered-ash-and-sulfur/>



**Figure 5.** An alleged building with former arches? Image from:  
<http://www.amazinghope.net/sodom-and-gomorrah-a-unique-layered-ash-and-sulfur/>

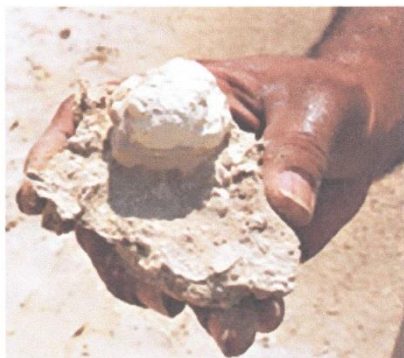


**Figure 6.** An alleged man-made sphinx? Image from:  
[http://www.discoverynews.us/DISCOVERY%20MUSEUM/BibleLandsDisplay/Sodom\\_and\\_Gomorrah/sodom\\_and\\_gomorrah\\_1.html](http://www.discoverynews.us/DISCOVERY%20MUSEUM/BibleLandsDisplay/Sodom_and_Gomorrah/sodom_and_gomorrah_1.html)



**Figure 7.** An alleged ziggurat? Image from:  
<http://www.amazinghope.net/sodom-and-gomorrah-a-unique-layered-ash-and-sulfur/>

YEC think that the layers in these landforms contain ash produced by the firestorm. Further evidence for their model are nodules of white sulfur (brimstone) in some of the layers (Genesis 18:16 to 19:29). The white sulfur nodules are enclosed in a crust (0.5 to 1 inch thick), and this crust is black next to the sulfur and may grade to orange-brown in the outer part; some lack a black crust (**Figure 8**). Chemical analysis shows that the white sulfur is 98% pure sulfur, but YEC claim that the yellow sulfur that occurs in hot springs and volcanic areas does not have this purity.



**Figure 8.** White sulfur nodule. Image from:

[http://www.discoverynews.us/DISCOVERY%20MUSEUM/BibleLandsDisplay/Sodom\\_and\\_Gomorrah/sodom\\_and\\_gomorrah\\_1.html](http://www.discoverynews.us/DISCOVERY%20MUSEUM/BibleLandsDisplay/Sodom_and_Gomorrah/sodom_and_gomorrah_1.html)

Some folded and “swirling” layers also occur in some places in lower parts of the Lisan Formation, which YEC claim are evidence of extreme heat during their deposition.

The white layers in the Lisan Formation are composed of gypsum, and the gray layers are composed of calcite or aragonite. Aragonite has the same composition as calcite (calcium carbonate) except that it crystallizes in a different mineral structure.

YEC think that sulfuric acid rain produced in the firestorm caused a reaction with the limestone blocks in the former buildings of the ancient cities to convert the limestone (calcium carbonate) into anhydrite (calcium sulfate) but still left the buildings standing in place.

Ross Paterson also reported that magnesium is found associated with the white sulfur nodules.

## DISCUSSION

The “Lisan Formation” is described in several scientific articles and books, and this literature is the source of much of the information in this article. See: Machlus and others (2000), Enzel and others (2006), Warren (2008), and Bishop and others (2013).

The sediments in the Lisan Formation were deposited in Lake Lisan about 14,000 to 70,000 years ago and are 40 meters (120 feet) thick at their maximum thickness. This lake had greater depths than the present Dead Sea. See the following link in which lake levels and stratigraphic sequences are described:

[http://earthquakes.ou.edu/reches/Publications/Bartov\\_2002\\_lake\\_levels.pdf](http://earthquakes.ou.edu/reches/Publications/Bartov_2002_lake_levels.pdf)

Lisan means tongue in Arabic and relates to the shape of the Lisan Peninsula where studies of the lake sediments were made. The Lisan Peninsula is a large spit of land in the Dead Sea which occurs east of where Gomorrah is said to be found (**Figure 1**). It also occurs near the top of the right map of **Figure 2** as a light tan “tongue” in the Dead Sea. Lake Lisan had its highest stand at 180 meters below sea level about 24,000 to 25,000 years ago and formed a lake completely filling the Jordan Valley. Former wave-cut beaches can be found at this level. At this time, this high stand was 200 meters above the current level of the Dead Sea, which is 427 meters (1,401 feet) below sea level – the lowest sea on Earth.

The sediments in the Lisan Formation were deposited in three environments: (a) an offshore environment with alternating aragonite and eroded and transported grains in thin layers consisting mainly of silt-sized calcite, dolomite, quartz, and gypsum, (b) a near shore environment with the same minerals as in the offshore but a bit more coarse-grained, and (c) a shore-delta environment with transported sediments that consisted of clay, sand, pebbles, and boulders eroded from Cretaceous rocks that border the Dead Sea/Red Sea rift zone (yellow and orange areas in the maps of **Figure 2**).

The aragonite, calcite, and gypsum layers were produced because of the evaporation of the great volume of water in Lake Lisan that contained large amounts of dissolved ions of calcium, carbonate, and sulfate. In a few places layers of halite (salt) are also found. In the area where the supposed man-made structures are this halite is not visible and available for the YEC to see because it was found in drill cores as is reported in:

<http://www.gsi.gov.il/Eng/Uploads/59steinf.pdf>.

However, just west of the Lisan Formation is Mt. Sedom (another name for Sodom) where the Sedom Formation was deposited (Zak 1967).

[https://en.wikipedia.org/wiki/Mount\\_Sodom](https://en.wikipedia.org/wiki/Mount_Sodom)

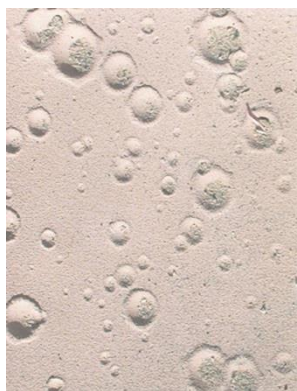
The Sedom Formation consists mainly of halite (salt), gypsum and minor amounts of dolomite and chalk (aragonite) and reaches a thickness of 1,500 to 2,000 meters (4,921 to 6,562 feet) on Mt. Sodom. These evaporite deposits are in a basin separate from the Lisan Formation and were laid down at a different time but are similar in character to the deposits in the Lisan Formation. One erosional structure on Mt. Sedom is a pillar that is called “Lot’s wife” and is southwest of the Dead Sea in the same area that the supposed city of Sodom that Ross claims is there.

The chemically precipitated aragonite crystals (another kind of “salt”) appear in thin (~0.5-1 mm thick) layers alternating with eroded and transported grains in thin layers of similar thickness. Some transported grains in thin layers consist of quartz grains and clay minerals that are probably of wind-blown origin and were derived from the Cretaceous wall rocks of the Rift Valley. Prominent gypsum layers (more than 30 cm thick) can be traced laterally across large distances toward the center of the lake deposits. The Middle Member of the Lisan Formation contains large portions of sandy layers that were deposited during storms and can be traced from “building to building” in the YEC model at the same elevations as resistant-to-erosion layers that stand out in the formation (e.g., **Figures 3, 4, and 5**).

Because the formation consists of layers of evaporites – gypsum (calcium sulfate with 2 water molecules) and aragonite (calcium carbonate, in marl or chalk), and because both minerals are quite soft (gypsum, hardness 2; aragonite, hardness 3) and their crystals were poorly cemented together, these minerals crumbled easily in Ross Paterson’s hand. Therefore, he thought that they must be ash. In the lower layers, because of burial pressure and higher temperatures at depth, the gypsum lost its water to become anhydrite. Ross Paterson and other YEC found only anhydrite in most places because they were examining the rock “landforms” in the Lisan Formation at the base of the “buildings.” Most upper parts of this formation contain only gypsum, but some gypsum occurs in upper parts of the lower levels instead of anhydrite.

The sulfur nodules were likely generated by anaerobic bacteria that locally converted the sulfate of the gypsum (or anhydrite) into elemental sulfur. The biologic processes that produced the elemental sulfur are described by Bishop and others (2013) and are too complicated to explain here for the average reader who is not trained in chemistry and microbiology.

If the nodules of white sulfur were truly burning masses that rained down on soft ash which were produced by enormous temperatures in a “fire and brimstone” storm, then there should be evidence of the impacts of these masses on the soft thin layers of the anhydrite beds, disturbing the layering and creating craters with rims, and none is observed. Even large raindrops (much smaller than the sulfur nodules) falling on soft mud can create craters with raised splash-rims that are commonly preserved in some sedimentary rocks, and these craters then give evidence to geologists as to the orientation of an “up-direction” in layered rock sequences (**Figure 9**).



**Figure 9.** Underside “crater” casts of raindrop prints with raised rims pointing into the mud; “up-direction” into the mud. Image from Wikipedia.

Therefore, because of lack of any cratering and disturbance of layering in the supposed ash, the white sulfur nodules did not rain down from the sky but were formed in place by anaerobic bacteria.

The reason why the crust around the white sulfur nodules is black may be because iron increases toward the sulfur nodules while manganese decreases. Because manganese is quite soluble and iron is rather insoluble, this relationship suggests that the rocks were in an open system in which water was released and escaped the Lisan Formation as the gypsum was converted to anhydrite. On that basis, this open system also permitted the anaerobic bacteria to convert some of the gypsum (or anhydrite) into elemental sulfur (Bishop and others, 2013) and allowed much of the soluble manganese to be carried away in the escaping water while diffusing iron was precipitated.

The sulfur in the nodules that YEC found is white monoclinic sulfur in most places in the Lisan Formation, but in a few places traces of yellow orthorhombic



sulfur can be seen in the videos. Generally, yellow sulfur occurs associated with volcanic rocks and hot springs and forms at temperatures near 96°C, but the white sulfur requires slightly higher temperatures near 100°C. These higher temperatures were likely present at greater depths where the gypsum was converted to anhydrite. Sulfur forming in volcanic sites is commonly orthorhombic and yellow instead of monoclinic and white. I have seen such yellow sulfur crystals in photos following the eruption of the volcano Surtsey off the coast of Iceland. But that does not mean that such monoclinic white sulfur could not be produced in other kinds of environments with different temperatures and pressures and need not result from the creation of fire by God and be rained down as burning-sulfur bombs.

Although, Ross Paterson claimed that yellow sulfur is not as pure as the white sulfur in the Lisan Formation; this is not true. In many places yellow sulfur is also nearly pure sulfur.

Although YEC claim that right angles are characteristic only of man-made objects and not of rocks in nature, the Lisan Formation clearly shows that this kind of jointing can occur in these naturally-formed lake-deposited rocks, and such right-angle joint systems are commonly present in other rock formations around the world, particularly limestone formations; e.g., pink and white limestone layers with right-angle jointing in Bryce Canyon National Park, Utah (**Figure 10**).



**Figure 10.** Bryce Canyon white and pink limestone with right-angle vertical jointing (cracks). Source of image: <http://www.zionnational-park.com/bgeology.htm>.

The folded and “swirled” layers at the bottom of the Lisan Formation likely resulted from slumping, crumpling, and lateral sliding that were caused by earthquakes early in the history of the lake when the lowermost layers were deposited.

The reason why Ross Paterson reported magnesium to be associated with the white sulfur nodules is because Lake Lisan during part of its history became quite rich in dissolved magnesium (Mg) ions with high magnesium/calcium (Mg/Ca) ratios. For this reason, some of the aragonite and calcite-bearing layers have been dolomitized. That is, the already-crystallized calcium carbonate was converted to calcium-magnesium carbonate (dolomite). This is not unexpected because magnesium is a common element (ion) dissolved in sea (salty) water and because the weathering of magnesium-rich minerals in basalt provides this element to the sea water by weathering and stream erosion. We get much of our magnesium metal by extracting it from the ocean. Such basalt in a large area occurs near the Sea of Galilee (**Figure 2**, red area, left map), and these volcanic rocks could have been the source of the magnesium ions that accumulated in Lake Lisan (as well as calcium and sulfate ions). The model by the YEC does not take this fact into account because dolomite could not have rained out of the sky during the “fire and brimstone” storm or be created by the reaction of the sulfuric acid rain with limestone. See: The limnological history of late Pleistocene – Holocene water bodies in the Dead Sea basin, <http://www.gsi.gov.il/Eng/Uploads/59steinf.pdf>.

Because the aragonite layers in the Lisan Formation contain ~3 parts per million U, this uranium was used in the  $^{234}\text{U}$ - $^{230}\text{Th}$  age-dating method to establish the times of deposition and fluctuations in the lake level in its 56,000 year history (70,000 - 14,000).

Locally, gravels and sands that were transported by streams into the lake waters form layers on top of the gypsum and aragonite layers. These gravels and sands are relatively hard and act as resistant-to-erosion, horizontal, cap rocks that protect the underlying softer rocks from erosion, as shown in **Figures 3, 4, and 5**. Therefore, when the layers of the Lisan Formation were eroded, they produced landforms that to the YEC looked like flat-topped buildings and temples. All these landforms have the same-elevation-tops for thousands of feet laterally which would be highly unlikely if produced by human building-construction. Other hard layers at mid-levels (**Figure 4**) also can be traced laterally for these same distances and at the same elevations. The alleged sphinx (**Figure 6**) is a place where the cap rock has finally been removed by erosion, and its shape results from differential rates of erosion of the underlying softer layers; that is, layers where the supposed “head” is are better well-cemented (harder) than layers extending toward the “back end” and do not erode as fast.

Moreover, the alternating thin layers of aragonite and gypsum (or anhydrite) cannot possibly be the result of hot sulfuric acid rain reacting with

limestone blocks of man-made buildings, as Ross Paterson postulates. That is physically impossible, particularly when these thin layers alternate with each other. There is no way that the acid rain could penetrate limestone blocks of buildings in narrowly spaced horizontal fractures and leave the rest of the limestone blocks unaltered and still in place. Moreover, the calcite in the limestone could not have been converted to aragonite “ash” in this process. Aragonite is a carbonate mineral and does not precipitate as “ash” from sulfuric acid-bearing rainstorms because the acid would have broken down the aragonite and released its carbon dioxide component as gas to the atmosphere. Aragonite can *only* be formed in the Lisan Formation by evaporation of water in Lake Lisan.

YEC claim that the remains of the buildings in Sodom and Gomorrah have windows, archways, and doors, but in not one of these places can it be demonstrated that empty space exists behind the windows in a room or that the archways and doors open up to empty rooms or hallways. If ash had fallen from the sky on top of former city buildings or if the buildings had been burned in place by enormous heat and fire, one would expect ash to be draped over the top of a solid window frame that was resistant to burning, if that window were to be preserved as a rectangular frame, but that is not the case. Horizontal layers are continuous on top of and through the window without disruption from one side to the other. In any other places in Israel where ancient cities are found that once housed large populations, limestone block walls surrounding former empty rooms can be found. See the following link.

<http://www.biblearchaeology.org/post/2008/04/16/The-Discovery-of-the-Sin-Cities-of-Sodom-and-Gomorrah.aspx>

But such walls and foundations surrounding empty spaces are not demonstrated in any of the YEC videos showing the supposed remains of cities with huge populations that are claimed to have once existed. All that is shown are eroded landforms that are clearly solid masses that contain layers of former lake beds. This is particularly obvious in **Figure 3** which shows horizontal sedimentary layers of different thicknesses, color, and hardness (resistance to erosion). No evidence of any kind of foundation for a building occurs at the base of the outcrop. If five different cities are said to exist once in this area west of the Dead Sea, surely at least one place can be found with the remains of a former limestone-block foundation still present, and the YEC have not shown any such place anywhere.

## CONCLUSIONS

The YEC in their model for the origin of Sodom and Gomorrah have picked rock and mineral characteristics in the Lisan Formation which are mostly from areas at the lowermost part and in the offshore environment where they could collect samples and observe the rock layers. They ignored places higher in the formation that they could not climb to, and they did not expand their studies and observations laterally to observe how the rock layers graded into and interfingered with rock layers of different compositions near the shores of Lake Lisan. For example, **Figure 3** is an illustration of near-shore sedimentary layers that are a bit coarser than sedimentary layers that YEC show in their video images but which are gradational to these layers. If only data that fit a model are chosen and if data that do not fit a model are ignored, any theory can appear to be strongly supported. But **salt, aragonite, clay, silt, sand, and dolomite** cannot rain as ash from the sky during a “fire and brimstone” storm or become residual ashes of former burned limestone-block buildings. Therefore, the model of the YEC that the ancient cities of Sodom and Gomorrah occur in the Jordan Valley west of the Dead Sea in a geologic rock formation (the Pleistocene Lisan Formation) has no merit.

Observations and geologic evidence presented in this article do not negate the possibility that some kind of catastrophic event occurred in biblical times that destroyed these cities, but the data show that the supposed buildings, temples, sphinxes, and ziggurats do not exist in this part of Israel. Therefore, what YEC suggest are the sites of Sodom and Gomorrah is incorrect. YEC, who have no training in basic geology, chemistry, and microbiology and imagine processes that are impossible, break the natural laws that the Creator made.

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## **ACKNOWLEDGMENTS**

I wish to thank the following persons who assisted with editing or providing information that made it possible for me to write this article: Carol Hill, Nancy Bishop, Larry Baresi, Ronald Oremland, Steven Haukdahl, David Liggett, and Stephen Kellemeyn.

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