Electric Discharge Caused the Formation of Upheaval Dome, Canyonlands National Park, Utah, USA.

R. Hawthorne Jr., Independent Researcher.

Abstract

This paper will provide evidence that Upheaval Dome, Canyonlands National Park, Utah, USA is the product of Plasma Discharge or Electrical Discharge Machining (EDM). Currently two theories compete explaining the site's formation, the first being a prehistoric salt diapir, or dome that has completely eroded away; the second theory being that of impact from either a meteorite or even a comet. This paper will provide new evidence that electrical discharge provided the forces necessary to cause the morphology and transitioned quartz crystals in the rock similar to those found in meteorites and other tektites. Evidence will be provided from experimentalist, Jacob Gable, using a low pressure chamber to create cratering patterns similar to those seen on the moon and other celestial bodies without impacts. Information will be provided on fulgurites, or rocks formed from plasma discharge which melted into glass. Also, how that glass forming mechanism could be attributed to a new form of the mineral analcime (NaAlSi□O□·H□O), eponymously named Obsession Stone, considered to be ejecta from the Upheaval Dome site. Scientists are baffled to this day as to its peculiar state and how the mineral is found in a crystalline structure.

Keywords: Cratering, Electrical Discharge Machining, Fulgurites, Geology, Lightning, Upheaval Dome, Utah

1. Introduction

Upheaval Dome is an intriguing geological formation in Canyonlands National Park, Utah, USA. The formation is 5.5 km across the outer rim and over 500 m above the floor's core. A writer for the Utah Geological Survey, William Case, writes on the site, "Upheaval Dome in Canyonlands National Park, Utah, is a colorful circular "belly button," unique among the broad mesas and deep canyons of the Colorado Plateau" [1]. He goes on to say, "Since the late 1990s, the origin of the Upheaval Dome structure has been considered to be either a pinched-off salt dome or a complex meteorite impact crater; in other words the 'belly button' is either an 'outie' (dome) or an 'innie' (crater)" [1]. After visiting Upheaval Dome with Dr. Eugene Shoemaker in 1996, I was of the mind that impact was the better model since Dr. Shoemaker took the time to share with me some of his findings. However, recently presented information on the subject of plasma discharge forming craters, causing surfaces materials to become vitrified, and a form of the mineral analcime that is said to "resemble devitrified glass" [16] found just outside of Canyonlands National Park caused this author to research the possibility that Upheaval Dome was created by a massive electrical event. This paper will present evidence of a more plausible theory; that lightning created the temperatures and pressures necessary to shock quartz, create craters, vitrify, and then eject the medium from the site.

Figure 1 : Photo of Upheaval Dome, Utah; NASA Earth Observatory [2].

2. Salt Diapir Theory

With regards to the pinched off salt dome theory, according to the paper, "Structure and Evolution of Upheaval Dome: A Pinched Off Salt Diapir" the authors, "propose that an overhanging diapir of partly extrusive salt was pinched off from its stem and subsequently eroded. Many features support this inference, especially synsedimentary structures that indicate Jurassic growth of the dome over at least 20 [million years]" [3]. They continue, "We infer that abortive salt glaciers spread from a passive salt stock during Late Triassic and Early Jurassic time. During Middle Jurassic time, the allochthonous salt spread into a pancake-shaped glacier inferred to be 3 km in diameter" [3]. This theory has less support lately because any evidence of the salt diaper has washed away. Further evidence from Dr. Bryan Kriens', "Geology of the Upheaval Dome impact structure, southeast Utah", along with Dr. Eugene Shoemaker (posthumously) give the evidence of, "the top of the underlying salt horizon is at least 500 m below the surface at the center of the dome, and there are no exposures of salt or associated rocks of the Paradox Formation in the dome to support the possibility that a salt diapir has ascended through it" [4]. This shows that the salt dome theory is losing support.

3. Impact Theory and Shocked Quartz

An impact theory also exists for the formation of the site. Dr. Eugene Shoemaker writes in his paper, "Upheaval Dome Impact Structure, Utah", that he, "earlier supported the cryptovolcanic theory (a theory no longer accepted) on the basis of deformation observed near the center of the dome and the results of geophysical surveys" [5]. However over two decades, he found the evidence supporting the impact theory to be more "compelling" [5]. Dr. Kriens states in his later paper, "planar microstructures in quartz grains, fantailed fractured surfaces (shatter surfaces), and rare shatter cones are present near the center of the structure" [4]. These shocked quartz grains were understood to be by this author at the time the tell-tale sign for impact material. In 2008, a paper titled, "Upheaval Dome, Utah, USA: Impact origin confirmed", Dr. Buchner and Dr. Kenkmann give the evidence, "we document, for the first time, shocked quartz grains from this crater in sandstones of the Jurassic Kayenta Formation. The investigated grains contain multiple sets of decorated planar deformation features. Transmission electron microscopy (TEM) reveals that the amorphous lamellae are annealed and exhibit dense tangles of dislocations as well as trails of fluid inclusions. The shocked quartz grains were found in the periphery of the central uplift in the northeastern sector of the crater, which most likely represents the cross range crater sector" [6]. This theory was understood by the author to be the most supported. The visit to Upheaval Dome with Dr. Shoemaker allowed the author to

actually see some of his findings in situ. This provided a strong argument, however the unresolved issue of what caused the later discussed rock sample of analcime to be in its present form without solid evidence of being impact material, caused for further research of a mechanism that could produce all of these features.

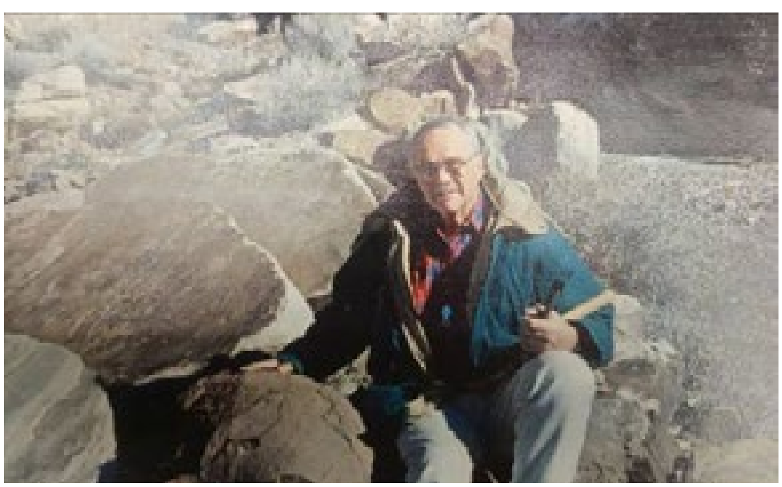

Figure 2: Photo of Dr. Eugene Shoemaker at the Obsession Stone site (1996); taken by Robert Hawthorne, Sr.

3.1 Electricity and Shocked Quartz

Geologists have discovered in 2015 that lightning causes shattered quartz, tektite-like rock and other features previously believed to be caused by meteor impact. Reto Giere, a mineralogist from the University of Pennsylvania, and his team ran simulations where " a moderately strong bolt of cyber lightning struck the virtual rock, it created pressure waves that peaked at about 70,000 atmospheres, well into the range needed to produce shocked quartz" [7]. A geochemist at the University of South Florida in Tampa who was not involved in the study named Matthew Pasek was quoted, "The result could cast further doubt on claims of asteroid impacts in
Argentina and Australia that relied on observations of shocked quartz. The analysis should serve as a warning to geologists not to rely only on that line of evidence...This definitely shows that geologists need to consider the geological context of their samples[.]", in Sid Perkin's article, "Lightning can beat up rocks like an asteroid strike, casting doubt on past impacts" [8]. To further elaborate on Argentina and Australia, H. J. Melosh writes in his letter Impact geologists, beware!, "More enigmatic occurrences include the Edeowie glasses in Australia, which are attributed to an impact [Haines et al., 2001], but for which no evidence of a crater exists, and glasses from the Argentine Pampas [Schultz et al., 2004] that, if taken at face value, would imply impact rates vastly higher on the Pampas than anywhere else on Earth. Could these latter two reports really be reflecting lightning strikes, rather than meteorite impacts?" [9].

4. Electrical Cratering

Electricity in the form of lightning has been documented to cause craters to form. In the Arizona Republic's article, "Intense lightning strikes can carve out craters in earth", Clay Thompson writes, "According to Scientific American, a lightning bolt in 1856 near Kensington, N.H., made a crater about a foot wide and 30 feet deep" [10]. He continues with another incident reportedly "8 inches in diameter and 15 feet deep" [10]. These evidences show that lightning can burrow deep, but can it machine wide amounts of surface like a shallow crater? Can it eject fine material from its core? A citizen scientist named Jacob Gable, from the Youtube channel "Electro Terra Vision", demonstrates in the pictures below, craters formed by electrical discharge in a small low pressure chamber partially filled with dirt and sand from outside his house [11]. His experiments, in the opinion of this author, have created craters similar to Barringer crater (see Figures 4, 5, and 6) and those found on the moon and other celestial bodies in the form of polygonal craters [12] and quite possibly transient lunar phenomenon [11], or moon flashes, which are also attributed to impacts.

Figure 3: "Before" screenshot of electrical cratering by Jacob Gable [11].

Figure 4: " After" screenshot of electrical cratering [11].

Figure 5: Jacob Gable pic resembling moon flashes [11].

Figure 6: Electrical polygonal crater by Jacob Gable [12].

4.1 Fulgurites

In the article, "Here's How Ancient Lightning Strikes Can Be Trapped In Stone", Robin Andrews writes, "Lightning is ludicrously energetic, with the average lightning strike estimated to involve one billion joules of energy . . . with that kind of energy and with temperatures exceeding 2500 [degrees] C, you'd expect that it can do some damage to pretty much whatever it ends up striking" [13]. Andrews later adds, "Despite the sudden temperature spike, the targets do cool off relatively rapidly, which means that the melted minerals don't have much time to rearrange themselves. This normally means that the texture of these once-melted segments is often amorphous and glassy. These deposits, dear readers, are what we call fulgurites" [13]. In Kimberly Genareau's open-access paper for Geology, her team proposes, "for the first time, a mechanism for the generation of glass spherules in geologic deposits through the occurrence of volcanic lightning. The existence of fulgurites provide direct evidence that geologic materials can be melted via natural lightning occurrence" [14].

4.2 The Obsession Stone

In 1996, rock hound James "Wes" Hill and enthusiast Robert Hawthorne, Sr. presented a strange rock to local geologists for identification. They believed the stone was connected with the Upheaval Dome site in Canyonlands National Park, but wanted more information to assure its value. After contacting scientists from Brigham Young University and University of Utah, they were unable to identify the rock. Hawthorne sought out some of the nation's leading scholars on meteors. He caught the attention of Dr. William Cassidy of the University of Pittsburgh. Cassidy had never seen anything like this rock before. After examining a specimen he writes in his letter, "Preliminary observations are that it consists primarily of irregular shaped, colorless grains of isotropic material, accompanied by rare rounded isotropic grains. Both the irregular and rounded isotropic grains are probably glass" [15]. Sometime after that, Dr. Cassidy, still unsatisfied with the previous attempts to identify the rock after three visits to the Smithsonian Institute. He referred Hawthorne to Mike Zolensky, curator of NASA's cosmic dust collection. An x-ray diffraction test was conducted and compared to the numerous standards available. The results came back that the rock was a mineral known as analcime (NaAlSi2O6*H2O a crystalline silicate of igneous origin), with traces of calcite. Zolensky goes on to write, "these secondary minerals have completely replaced the original mineralogy of the samples, so there is just no telling what they originally were. The gross petrography does resemble devitrified glass, but this could have been a volcanic glass" [16].

Figure 7: Picture of Analcime from Wikipedia [17].

Figure 8: Obsession Stone sample, taken by author (2017).

Figure 9: 10x magnification showing "rounded" grains of glass. Taken by author (1996).

5. Conclusion

Scientists have concluded through consensus that only impacts can create the necessary temperatures and pressure needed to form craters and shock quartz. Upheaval Dome has recently been accepted (again through consensus) as an impact crater due to recent findings of shocked quartz in specimens in the center of the dome [4] and its perimeter [5]. However, recent findings from the University of Pennsylvania have shown that lightning can produce the temperatures and pressures required to shock quartz [7]. Geochemist Matthew Pasek of the University of South Florida was quoted, "The analysis should serve as a warning to geologists not to rely only on that line of evidence[.]" [8]. Evidence has been provided through Jacob Gable's experiments that electrical discharge can form craters [11], [12]. These craters formed in his lab strikingly resemble craters here on Earth like the Barringer crater. This paper has provided information on a glass like stone of the mineral analcime discovered just outside of Upheaval Dome, yet it could not be verified as impact material [15]. This sample of analcime was said to possibly be made of volcanic glass [16], yet volcanic lightning has been shown to form glass out of the ashes [14]. All of the scientists involved agree the stone is unique, but they could not identify what caused this mineral to take its peculiar glassy form. Perhaps the issue of the formation of Upheaval Dome the crater can be at last conclusively agreed upon, that lightning machined the crater and left evidence in the form of samples containing shocked quartz, and other vitrified material in the surrounding area.

References:

[1]. W. Case, Geosights: Utah's Belly Button, Upheaval dome, Survey Notes, v. 41 no. 3, September, 2009.

[2]. Figure 1: Upheaval Dome, Utah; NASA Earth Observatory.

[3]. M. P. A. Jackson, D. D. Schultz-Ela, M. R. Hudec, I. A. Watson, M. L. Porter; Structure and evolution of Upheaval Dome: A pinched-off salt diapir. GSA Bulletin ; 110 (12): 1547–1573.

[4]. B. J. Kriens, E. M. Shoemaker, K. E. Herkenhoff; Geology of the Upheaval Dome impact structure,

southeast Utah; Journal of Geophysical Research E: Planets.

[5]. E. M. Shoemaker, K. E. Herkenhoff; Upheaval Dome Impact Structure, Utah; Lunar and Planetary Science XV, p. 778-779. Abstract.

[6]. E. Buchner, T. Kenkmann; Upheaval Dome, Utah, USA: Impact origin confirmed. Geology; 36 (3): 227–230.

[7]. R. Giere, W. Wimmenauer, H. Muller-Sigmund, R. Wirth, G. R. Lumpkin, K. L. Smith; Lightning-induced shock lamellae in quartz; American Mineralogist .

[8]. S. Perkins; Lightning can beat up rocks like an asteroid strike, casting doubt on past impacts; ScienceMag.org

[9]. F. Tsikalas and O. Eldholm, Malvinas (Falkland) Plateau structure versus Mjølnir crater: Geophysical workflow template for proposed marine impact craters, Meteoritics & Planetary Science, 54, 3, (544-557), (2018).
Haines, P. W., Jenkins, R. J. F., and Kelley, S. P. (2001), Pleistocene glass in the Australian desert: The case for an impact origin, Geology, 29(1), 899– 902.

Schultz, P. H., Zárate, M., Hames, B., Koeberl, C., Bunch, T., Storzer, D., Renne, P., and Wittke, J. (2004), The Quaternary impact record from the Pampas, Argentina, Earth Planet. Sci. Lett., 219 (3–4), 221– 238.

[10]. C. Thompson; Intense lightning strikes can carve craters in earth; The Arizona Republic. July, 2010. A Freak of Lightning; Scientific American; May 17, 1856 issue.

[11]. J. Gable; Crater Formation Compilation; Electro Terra Vision, Youtube; July, 2019. https://www.youtube.com/watch?v=sm9cI4Nzkmc&t=278s

[12]. J. Gable; Polygonal Crater Formed Electrically 8; Electro Terra Vision, Youtube; July, 2019. https://www.youtube.com/watch?v=b90CKjd7KGQ

[13]. R. Andrews; Here's How Ancient Lightning Strikes Can Be Trapped In Stone; Forbes.com.

[14]. K. Genareau, J. B. Wardman, T. M. Wilson, S. R. McNutt, P. Izbekov; Lightning-induced volcanic spherules; Geology, 2015; DOI: 10.1130/G36255.1 .

[15]. W. Cassidy; letter; University of Pittsburgh.

[16]. M. Zolensky; letter; NASA.

[17]. Figure 7: Image, Analcime – Wikipedia.

University of Pittsburgh

Faculty of Arts and Sciences
Department of Geology and Planetary Science

[illegible]
Pittsburgh, Pennsylvania 15260
[illegible]
Fax [illegible]

Sept. 9. 1996

Mr. Robert Hawthorne
5248 Keyport Dr.
Pittsburgh, PA 15236

Dear Mr. Hawthorne,

Our graduate student, Henry Prellwitz, has been examining a specimen you submitted as a possible impactite from the Upheaval Dome structure, in Utah. His preliminary observations are that it consists principally of irregular-shaped. colorless grains of isotropic material, accompanied by rare rounded isotropic grains. Both the irregular and rounded isotropic grains are probably glass. They are cemented with calcite. By association with the nearby Upheaval Dome structure, it seems possible that the glass grains had an impact origin and were deposited at a site where chemical precipitation of calcium carbonate was occurring.

In our experience, the specimen is different from other impact glasses, such as those associated with the Aouelloul Crater in Mauritania, the Henbury Craters in Australia. the Wabar Craters in Arabia and the Monturaqui Crater in Chile. All of these occur as large fragments with a generally slaggy appearance and contain imbedded spheres of nickel-iron alloy. Therefore, while it seems possible that this material is of impact origin, one would have to suggest the likelihood that it has undergone some type of secondary processing and sorting to remove associated nickel-iron inclusions before lithification. Pending chemical analyses of individual grains, we cannot commit ourselves further to its possible impact origin.

Sincerely,

W. A. Cassidy

William A. Cassidy
(Professor)

[15]. W. Cassidy; letter; University of Pittsburgh.

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
2101 NASA Road 1
Houston, Texas 77058-3696

Bob Hawthome 2-16-01

Dear Mr. Hawthome:

I enclose all of your samples, I think, that you sent to me, along with the results of an X-ray diffraction study of two of the samples, which cane out with identical results. The samples are a combination of analcime and calcite. I am afraid that these secondary minerals have completely replaced the original mineralogy of the samples, so there is just no telling what they originally were. The gross petrography does resembles devitrified glass, but this could have been a volcanic glass. I am afraid that I can do no more with the samples, because they have been so altered from the original mineralogy.

I suggest you consult Chris Koeberl, who might be able to tell you more. He is at Christian.koeberl@univie.ac.at

Sorry I could not be of mire help.

Mike Zolensky Mike

[16]. M. Zolensky; letter; NASA.