Scientific Research Publishing

Open Journal of Geology, 2023, 13, 269-275
https://www.scirp.org/journal/ojg
ISSN Online: 2161-7589
ISSN Print: 2161-7570

The Legend of "Atlantis Legend" on Santorini Contribution to the Geology of Santorini

Vaios Avdis

Former IGME Geologist, Athens, Greece
Email: vaios.avdis@gmail.com

How to cite this paper: Avdis, V. (2023) The Legend of "Atlantis Legend" on Santorini Contribution to the Geology of Santorini. *Open Journal of Geology*, **13**, 269-275.
https://doi.org/10.4236/ojg.2023.134012

Received: March 4, 2023
Accepted: April 16, 2023
Published: April 19, 2023

Abstract

Santorini has attracted the attention of both Geoscientists and Archeologists. The numerous high-angle faults of small dip-slip displacement were ignored by the geoscientists. The formations of domes by high-angle faults were also ignored. The discovery of a buried town, Akrotiri-with excellent buildings and artifacts, by Archaeologists and the destruction of the flourishing Minoan civilization and Knossos (Crete) in c. the same era caused a lot of interest. Plato in his "Dialogues" of Socrates with Kritias and Timaeus talked about a catastrophe of the island of Atlantis. Galanopoulos, who was the first and Archeologists suggested that the "Legend of Atlantis" was associated with the fall of huge Areas in Santorini, due to the "vacuum" after the gigantic amounts of ejecta. They miscalculated the amount of volcanic ejecta and misinterpreted the lineaments on the walls of the so-called "Caldera (s)" due to pseudo-layering. The author using the importance of the high-angle faults proves that the topography is mainly the result of faulting and neither of erosion nor of volcanism. The juxtaposed slopes of Thira-Thiresia formed fold-like structures and there was not any caldera collapse.

Keywords

Domes, Solidified Volcanics, Faults, Pseudo-Layering

1. Introduction

There is a lot of confusion among the geologists about the geology of Santorini. The occurrence of both metamorphic rocks and volcanic rocks increased the confusion. The numerous high-angle faults of small dip-slip displacement were ignored by the geoscientists. Because of the formation of domes by high-angle faults [1] [2], volcanologists assumed some heights to be "volcanic vents".

2. Previous Work

Galanopoulos [3] equated the "large Eruption", the so-called "Minoan Eruption" with the catastrophe of the Minoan civilization in Crete. He equated the "fall of the Caldera (s)" among the islands of Santorini with the sinking of the island of Atlantis in the Atlantic Ocean. This idea was adopted by most geoscientists and Archaeologists. The very steep cliffs have reinforced all the above. The estimation of the huge amount of volcanic ejecta was considered as the cause of the fall of the cover of the volcanic rocks, that is the formation of the Caldera(s). [4]-[19], and many others considered that the topography was the result of deposition of volcanic rocks, the fall of the Caldera(s) and erosion

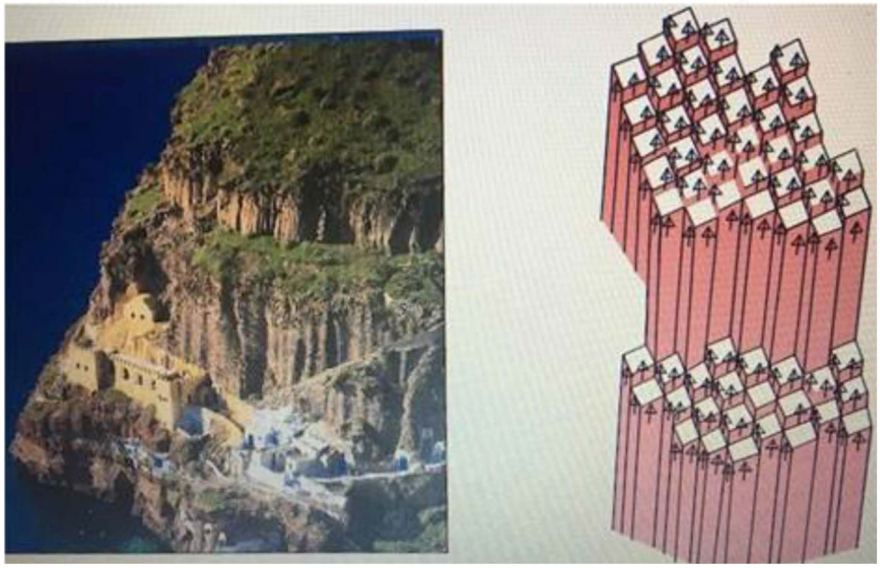
In addition, [5] considers that the primary shape of the Santorini group islands used to be a ring.

3. Author's Views

The geoscientists so far consider that the geomorphology of Santorini is mainly the result of the deposition of the volcanic rocks.

To the author's mind although the contribution of the volcanic rocks is very important in the geomorphology of the island, the occurrence of high-angle faults of small dip-slip displacement is (the first and the last event) the main factor of geomorphology and should not be ignored. The thickness of volcanic rocks on topography of metamorphic and preexisted volcanic rocks is more or less unknown. There is a lot of confusion between the faults and Joints visible in the rocks and especially the solidified volcanic rocks. They are usually called joints in the field. The present author has clarified the meaning and the difference between FAULTS and JOINTS. These faults occur in all the compacted rocks and they are not related to any temperature variation [2]. They are associated to the differential uplift. A lot of geoscientists invoked unconformities (in volcanic rocks the unconformity is meaningless) [7] considered that there was layering and erroneously estimated the thickness of the volcanic rocks. The Metamorphic rocks which outcrop in many areas of Santorini were not flat. The volcanic rocks draped the metamorphic rocks, after their solidification were affected by differential forces upwards forming vertical to sub-vertical faults. These vertical faults had formed domes (see **Figure 1**). Some peaks of these domes were mistaken as vents of eruption [9]. In the height on Skaros for example, we can see a topography that cannot be the result of volcanism itself (**Figure 2**). To the author's mind this can only be formed either by human intervention which has not been historically recorded or by vertical to sub-verical faults which are faces of prisms. The fault faces are rarely fault "mirrors" because the faults are either filled by mobile minerals such as quartz, calcite, iron oxides flowing lava, etc. If the rocks are homogeneous and brittle (the solidified volcanic rocks are brittle) they are regular quadrangle prisms (sometimes hexagonal prisms) [2]. Repetitions of outcrops of some various units especially pumice have been mistaken as various "pumice layers" [19], so did Friedrich [15], (**Figure 3**).

A younger volcanic unit lying topographically lower than adjacent volcanic unit is interpreted as older [9].



(a) (b)

Figure 1. (a): Photograph of "George Meis company" from the old harbor of Santorini. We can clearly see numerous vertical faults of small dip-sliip displacement. The terraces are the result of faulting and human intervention. Human intervention has uncovered faults everywhere. (b): Schematic Interpretation of (a). (Key: hatched surface = faults, arrows = upward movement, white face = upper surface).

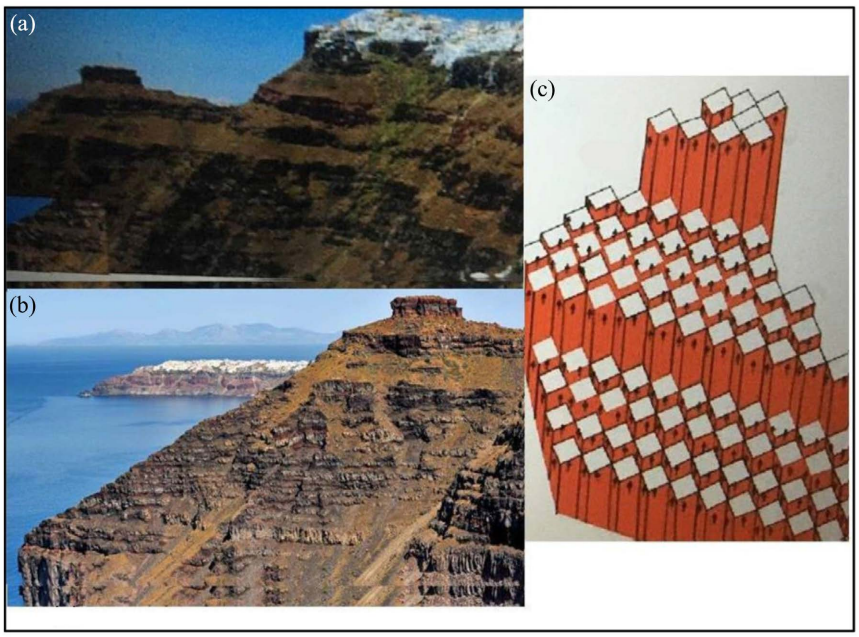


Figure 2. Faulting in two sets (the volcanic vent cannot be excluded) Lava itself cannot form this topography. (a) Photograph by "Greeka". (b) Another view of Skaros height "Greeka" photograph. (c) A schematic interpretation of (a) & (b). The steps witness the faults (key as in **Figure 1**).

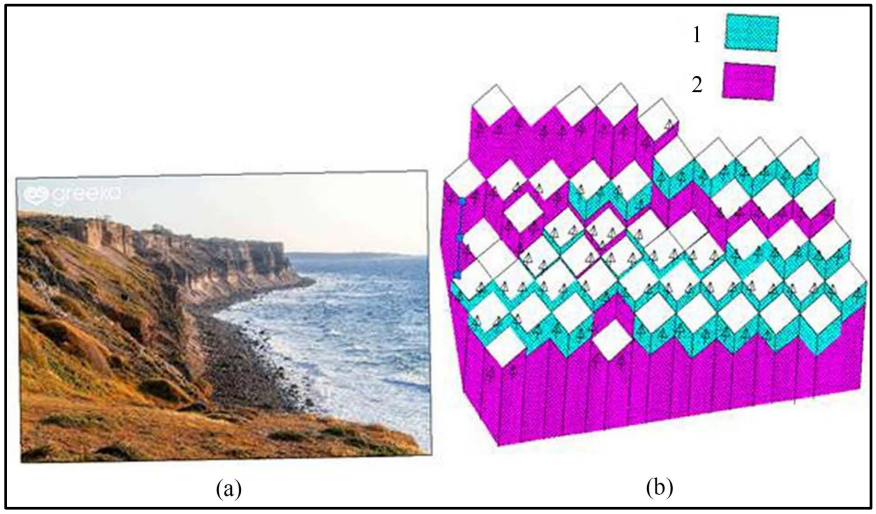


Figure 3. The high angle faults create two or more apparent outcrops of pumice. 1 = volcanoclastic material 2 = Pumice. (a) A photograph by Greeka company. (b) Schematic interpretation of (a) (key as in **Figure 1**).

The occurrence of Santorini pumice in areas far from Santorini (Crete, Asia Minor) is mainly the result of the strong winds which are frequent in the Aegean Sea region.

[15] [19], consider two or three pumice outcrops which in fact are identical. [18], consider them as one due to slumping. To the author's mind this is an apparent repetition in different elevations due to faulting, (**Figure 3**) and not due to slumping.

The field geologists only have access to the surface and to the maximum displacement of faults. The geoscientists can only see prismatic structures usually of four faces (faults) which with the top and base faces forming quadrangle prisms. Each one will be called Tectonic Unit (TU) [1]. In this work, for simplicity, it is assumed that these TUs are regular quadrangle prisms and about the same size.

[6] in a Santorini guidebook considered that the activation of volcanoes left a "Vacuum". To my mind this is not possible to have a vacant space because lava is under pressure of various gases and the volcanic conduit cannot work as a siphon. The volcano works until the pressure in the magma chambers becomes equal to the atmospheric pressure, because lava is under pressure. [5], estimated the volume of volcanic rock up to 86 Km^3.

The steep cliffs form a fold-like structure and it is obvious that there was no collapse of the caldera. Of course the geomorphology of Santorini is mainly the result of faulting in two sets perpendicular to each other. (In Causeway in N Ireland 6gonal prismatic TUs are frequent) [2]. The successive TUs and the contact of successive "hanging walls" and "footwalls" result in pseudo-layering. The upper surface of the faulted rocks creates an illusion of layering too (**Figure 4**).

Geomorphology—A definition by the British Society of Geomorphology—includes the processes for the formation of landforms and the factors which cause

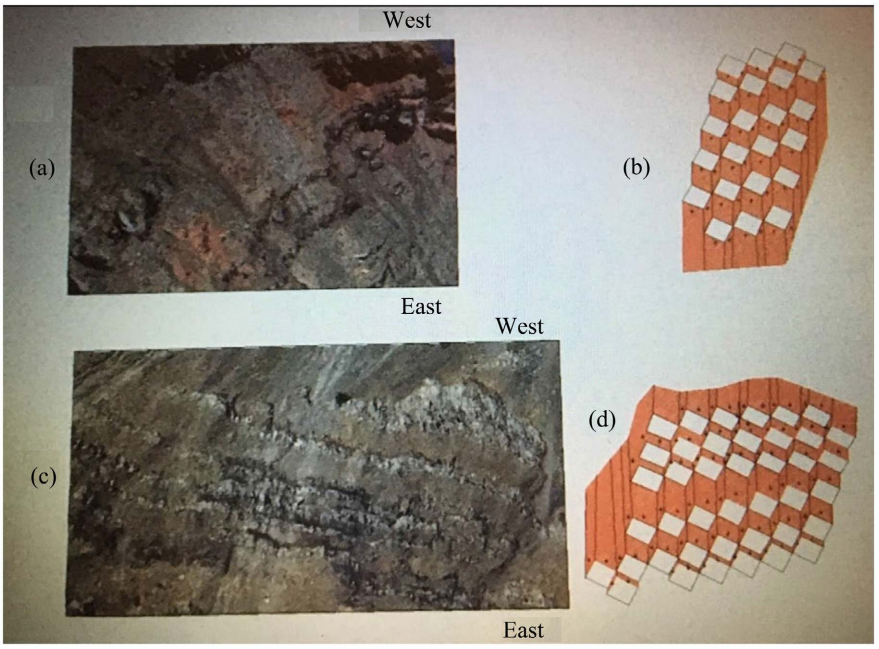


Figure 4. (a) Details of the steep cliff on Thirasia (Google Earth Image) (b) Schematic Interpretation of (a). (c) Fira steep cliff a lot of steps (faults) are covered by volcanoclastic material, (Google Earth Image) (d) Schematic interpretation of (c) (Key as **Figure 1**).

them "erosion & deposition" as rock and sediment is worn away by earth-surface processes and transported and deposited to different localities. The geomorphology of Santorini (and elsewhere) is mainly the result of faulting and the volcanic ejecta [2]. Only the current relief can be recorded as a base of the future volcanic rocks. The vertical and sub-vertical faults are activated or reactivated above the transition of Ductile-Brittle rheological behavior. (Provided the whole column consists of compacted rocks). Unfortunately, my sources (photos) cannot provide information about the effect of faults on recent volcanic rocks. I suspect though that the solidification of lava was relatively fast and the uplift is associated with vertical faults. The last volcanic eruption was in 1951 (Ganas A. oral communication).

The uplift of any rocks (sedimentary, metamorphic and igneous rocks) began at the same time as the upwards movement due to various structures at depth; such as subduction, folds, nappes, thrusts. The vertical faults are the indicators of uplift but they are mostly hidden by debris. The shallow focus earthquakes are also very good indicators of uplift.

[6] in a Santorini guidebook considered that the activation of volcanoes left a "Vacuum". To my mind, it is not possible to have a vacant space because lava is under pressure of various gases and the volcanic conduit of a volcano cannot work as a siphon. The volcano works until the pressure in the magma chambers becomes equal to the atmospheric pressure plus the weight of the rocks in the crater.

Each earthquake, that is, activation of many TUs, limited, at least, by four vertical to subvertical faults [2].

4. Conclusions

Dubious and intricate methods have been used by geoscientists to estimate the thickness of the so-called "Minoan Eruption". On the other hand, they ignored the high-angle faults of small dip-slip displacement of the solidified lava, as negligible [2]. Faulting is the main factor of geomorphology even in an area of volcanic rocks.

The steps created in the solidified rocks were misinterpreted as layering of volcanic rocks. The volcanic rocks are devoid of layering unless there is different lithology. Volcanologists mistook the tectonic slopes due to faulting as profiles. The topography is mainly the result of faulting in two sets perpendicular to each other; of small dip-slip displacement of the solidified volcanics. The occurrence of Santorini pumice in areas far from Santorini (Crete. Asia Minor, etc.) the result, of the well-known Aegean strong winds. The steep juxtaposed slopes form a fold-like structure and there was not a caldera fall.

Acknowledgements

This work is based on my short visits to Santorini but mainly on photographs of the "George Meis" and "Greeka" companies and "Google Earth" images for which I am grateful. I would like to thank my friend prof. Spyros Pavlides for providing me with a lot of relative literature. My friend John Farnell for reading the manuscript critically is acknowledged. I would thank my sister-in-law Yvonne Marsden for correcting the text. My wife Giota Belitsi for her endless patience.

Conflicts of Interest

The author declares no conflicts of interest regarding the publication of this paper.

References

[1] Avdis, V. (1991) The Effect of Movement on High-Angle Faults on Stratigraphy and Structure: The Attico-Cycladic Massif, Greece. *Tectonophysics*, **192**, 293-311. https://doi.org/10.1016/0040-1951(91)90105-2

[2] Avdis, V. (2022) Faults, Joints, Uplift Mechanism-Orogeny and Geomorphology. *Journal of Earth and Environmental Sciences*, **5**, Article No. 195 https://doi.org/10.29011/2577-0640.100095

[3] Galanopoulos, A. (1957) The seismic sea wave of July 9, 1956. Quoted in Friedrich (2007).

[4] Johnston, E.N., *et al.* (2014) Revised Estimates for the Volume of the Late Bronze Age Eruption, Santorini, Greece. *Journal of the Geological Society*, **171**, 583. https://doi.org/10.1144/jgs2013-113

[5] Johnston, E.N., Sparks, R.S.J., Nomikou, P., Livanos, I., Carey, S., Phillips, J.C. and Siguardsson, H. (2015) Stratigraphic Relations of Santorini's Intracaldera Fill and Implications for the Rate of Post-Caldera Volcanism. *Journal of the Geological Society*, **172**, 323-335.

[6] Fytikas, M. (2013) A Window to Volcanology. A Guidebook of Santorini. Munici-

pality of Thera.

[7] Nomikou, P., Druitt, T.H., Hübscher, C., Mather, T.A., Paulatto, M., Kalnins, L.M., Kelfoun, K., Papanikolaou, D., Bejelou, K., Lampridou, D., Pyle, D.M., Carey, S., Watts, A.B., Weiß, B. and Parks, M.M. (2016) Post-Eruptive Flooding of Santorini Caldera and Implications for Tsunami Generation. *Nature Communications*, **7**, Article No. 13332. https://doi.org/10.1038/ncomms13332

[8] Nomikou, P., Vouvalidis, K. and Pavlides, S.P. (2019) The Morphodynamic Evolution of Santorini Volcanic Complex. Regional Conference on Geomorphology, Athens.

[9] Athanassas, C.D., Bourles, D.L., Brailor, R., Druitt, T.H., Nomikou, P. and Leoni, L. (2016) Evidence from Cosmic Ray Exposure (CRE) Dating for the Existence of a Pre-Minoan Caldera on Santorini, Greece. *Bulletin of Volcanology*, **78**, Article No. 35. https://doi.org/10.1007/s00445-016-1026-3

[10] Athanassas, C.D., Modis, K., Alçiçek, M.C. and Theadorakopoulou, K. (2017) Contouring the Cataclysm: A Geographical Analysis of the Effects of the Minoan Eruption of the Santorini Volcano. *Environmental Archaeology*, **23**, 160-176. https://doi.org/10.1080/14614103.2017.1288885

[11] Cook, T. and Abbot, L. (2018) Travels in Geology Santorini: Dangerous Volcano, Postcard-Perfect Jewel of the Aegean. Earth: The Science behind the Headlines.

[12] Druitt, T.H., Edwards, L., Mellors, R.M., *et al.* (1999) Santorini Volcano. Geological Society of London, London.

[13] Druit, T.H., Mellors, R.A., Pyle, D.M. and Sparks, R.S.J. (2019) Explosive Volcanism on Santorini, Greece. *Geological Magazine*, **126**, 95-126. https://doi.org/10.1017/S0016756800006270

[14] McCoy, F.W. and Heiken, G. (2000) The Late-Bronze Age Explosive Eruption of Thera (Santorini) Greece: Regional and Local Effects. Volcanic Hazards and Disasters in Human Antiquity. https://doi.org/10.1130/0-8137-2345-0.43

[15] Friedrich, W.L. (2007) Fire in the Sea. Paschalidis Editions, Athens.

[16] Friedrich, W.L. (2013) The Minoan Eruption of Santorini around 1613 B.C. and its Consecuences. Tagungen. Des Landesmuseum fuer Vorgeschichte Halle, Band 9.

[17] Friedrich, W.L., Sorensen, A.H., Wilson, J.R., Fytikas, M., Pavlides, S. and Katsipis, S. (2017) A Major Change in the Stratigraphy of the Santorini Volcano in Greece. *International Journal of Geosciences*, **8**, 767-780. https://doi.org/10.4236/ijg.2017.86043

[18] Sparks, R.S.J. and Wilson, C.J.N. (1990) The Minoan Deposits a Review of Their Characteristics and Interpretation. In: Hardy, D.A., Ed., *Thera and the World III*. The Thera Fouatndion Aegean.

[19] Pinchler, H., Guethner, D. and Kussmaul, B. (1980) Geological Map 1:50000 Sheet Thera. IGME.