

The Mineral Minutes

“Evolution of the 3.2 Ga Lewisian Gneiss Complex: a Mineralogical Perspective” by Dr. George Guice

by Yury Kalish, MSDC Vice President

Our November presentation will focus on mineralogical aspects of studies of the Lewisian Gneiss Complex (LGC) in northwest Scotland. Our presenter, Dr. George Guice, earned his Ph.D. earlier this year from University of Cardiff, studying Archaean ultramafic rocks in Scotland and South Africa. He spent over 4 months in northwest Scotland conducting fieldwork, and co-led the 2018 “Granulites” conference fieldtrip in the region. George is currently a Peter Buck Postdoctoral Fellow at the Smithsonian National Museum of Natural History.

George’s talk will briefly outline the historical significance of the region, before summarizing the magmatic and metamorphic evolution of the LGC from a mineralogical perspective. Amongst other things, we will discuss how:



- zircon has been utilized to understand the evolution of northwest Scotland;
- cm- to m-scale garnets grew during a high-pressure metamorphic event 2.7 billion years ago;
- olivine and pyroxene variation records 2.8 billion year-old magma chamber processes; and
- cm-scale zircon crystals became associated with ultramafic rocks.

Please join us in taking George to dinner on November 6th at 6:00 pm at the Elephant and Castle at 1201 Pennsylvania Avenue, NW. If you cannot make it to dinner, please go directly to the lobby of the Natural History museum (Constitution Avenue entrance) at 7:30 pm. We will head upstairs to the Cathy Kerby Room at 7:45 pm for George’s presentation.

Sharing Time

by Dave Hennessey, MSDC President

Let’s go without a theme for sharing time this month. Bring in whatever you want to share with your fellow club members for whatever reason you want to share it. Bring it in because it’s beautiful, or interesting, or unusual, or amazing, or ugly, or unidentified, or the circumstance of collecting it make for a fun story. I am reminded of a young boy at a mineral show who showed me his fossil trilobite, telling me it was 500 million and 2 years old. I asked him how he knew how old it was so precisely. He told me that a paleontologist identified it for him and told him it was 500 million years old, and that was 2 years ago.



Volume 77-11
November 2019

In this Issue:

Evolution of the 3.2 Ga Lewisian Gneiss Complex: a Mineralogical Perspective	1
Prez Says...	1
Sharing Time	1
October Business Meeting Report	2
October Show and Tell Report	2
October Program Report: “The Story of Santorini”	3
Club Information	13
Useful Mineral Links	14
AFMS Code of Ethics	15
Club Membership Form	16



Prez Says...

by Dave Hennessey
MSDC President

The first mineral specimen I collected was (is) pretty unspectacular. I was a second grader rooting around in the gravel at the bottom of a window well at my family’s home in Park Forest, Illinois. What I found in the gravel there was a drusy quartz, about the size of my thumb. It was dazzling, sparkling away in the sunshine. I was hooked. A few years later, my parents got me “A Golden Guide” book called “Rocks and Minerals”.

(cont. on p. 2)

MSDC's October 2, 2019 Business Meeting Report

by Andy Thompson, MSDC Secretary

Dave Hennessey, President of MSDC, welcomed everyone to the meeting which, unexpectedly was held in the far end of the western basement of the National Museum of Natural History. Tim Rose, the club's sponsor and guide to the unfamiliar room, assured everyone that despite the long hike, they were not beneath the Washington Monument and that once the inspection of the elevators was properly completed that evening, our future meetings would return to the Cathy Kerby room.

Dave thanked the past presidents in attendance and he provided an update on the club's checking account whose balance is in the black. Susan reported the club provided copies of the updated MSDC publicity brochures for local mineral shows and are available for anyone to deliver to additional shows. Yury, as program chair, discussed plans for upcoming programs.

Members shared information on upcoming field trips, the Eastern Fed's new newsletter editor, well known and respected Mary Bateman, on website competition and the annual EFMLS convention which will be held March 27-29 in Hickory, NC. For more information on that gathering of Eastern Federation clubs, go to: <https://efmls.org/annual-convention>.

To make up for the lost time in getting members to the evening's temporary meeting place, Dave Hennessey brought the business meeting to a speedy close and turned the floor over to Yury to introduce the evening's speaker, Dr. Hutch Brown.

MSDC's October 2, 2019 Show and Tell Report

by Andy Thompson, MSDC Secretary

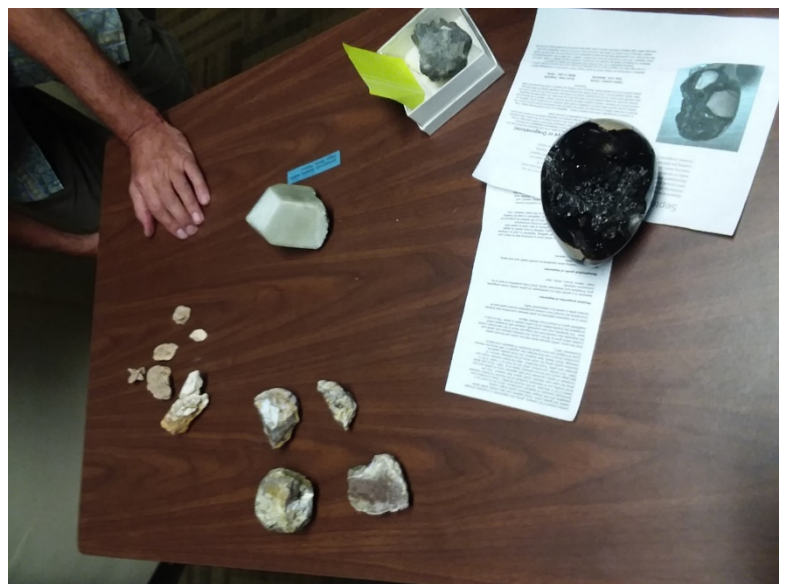
MSDC members brought in and displayed a wide array of minerals, many of which they recently collected. Dan and Sean shared glauberite pseudomorphs after calcite collected from the Camp Verde area which is about 22 miles from Sedona, Arizona.

Dave H. also brought in a large calcite and Dave N. brought in a handsome fist-sized nodule which included hematite collected from the Lebanon, PA area. Amelia and Andy displayed a thunder egg with an opal interior they harvested during an Oregon trip. Tim S. demonstrated the translucence of a deep green Willamsite (magnesium, silicate, hydroxide) which is a gemmy variety of antigorite, a type of serpentine.

By way of association, MSDC sponsor Tim Rose then told the story illustrating that mineral identification without high tech analytic instruments can be challenging. He related how one donor gave the Smithsonian NMNH a large amount of "jade" many of which specimens actually were later determined to be serpentine, which is less durable and easier to carve than real jade.

The surprise Show and Tell mineral of the evening, for some, may have been a large rheniite specimen which was collected from the active Kudriavsky volcano located on the Kuril Island Arc. Those islands divide the Sea of Okhotsk from the Pacific Ocean. In the early 1990s, Russian scientists studying the fumarole vents found black pieces of pyroclastic debris having spotty coverage of lustrous

How many of you had this book when you were little? Black cover, paperback, 160 pages, about 4" x 6", color illustrations of minerals, not photographs. I devoured it from cover to cover, repeatedly. I still have this book in my library, not for reference but its nostalgia value is high. It is ragged and the poor cover is in tatters. Looking back through it now, it is actually pretty ambitious. It covered collecting, identification, classification, labeling, lapidary, basic chemistry of minerals, properties like hardness, streak, index of refraction, specific gravity, cleavage, luster, UV response, magnetism, radioactivity, and more. Minerals were divided into four categories – metallic, non-metallic, gem minerals, and rock-forming minerals, and there were chapters on igneous, sedimentary and metamorphic rocks, and economic minerals. The coverage of these topics was not in depth, but it was perfect for me at that age. The copyright on the book is 1957 and my copy is from the "Seventeenth Printing, 1963". The price on the book cover is \$1.00. Because my copy is so tattered, I picked up a newer copy at a club auction a few years ago. The inside cover no longer notes what Printing it is, but the price on the book cover is \$3.95! Worth every penny. OBTW, I still have that little drusy quartz specimen too.





metallic microcrystals which turned out to be a then-new species, ReS₂, certified in 2004 as rheniite. It is the only mineral species having Rhenium as an essential component. The problem that has frustrated many mineral hunters is that the volcanic vents' high temperatures, around 600 degrees Centigrade, vaporizes the minerals, literally destroying the rheniite. Susan, the mineral's presenter, said she was fortunate to come across the specimen early on, before its rarity and story became widely known.

Given that the evening's program about Santorini featured islands formed by plate tectonics and extensive volcanic venting, one might wonder if MSDC mineral collectors connected the dots. Now that they and readers of this newsletter know something about rheniite, will they be on the lookout for this mineral rarity around any volcanic vents they visit during their future field trips?

October 2, 2019 Program Presented by Hutch Brown, Ph.D. "The Story of Santorini: Greek Island in the Aegean Sea"

Synopsis by Andy Thompson, MSDC Secretary

The geology of Santorini has complexities which writers and researchers have been probing for centuries. In his presentation to the MSDC mineral club, Hutch told the story of this island's origins in three chapters: through initial very early tectonic plate movements, through volcanic activity, and lastly, with the Minoan great eruption. He drew on his personal experience visiting the island, subsequently researching the geological literature and lastly, incorporating very recently published evidence and explanations.

During his presentation, Hutch used an extensive number of PowerPoint slides which by themselves explain the geological processes and events. They go well beyond simply illustrating the island's topography. Readers wanting to read more extensively about his findings can find four installments he wrote for and published in the Northern Virginia Mineral Club's newsletter, which he edits. These can be found in the 2019 February through May editions on the following website: <https://www.novamineralclub.org/newsletters>.

For his October presentation to the MSDC club, Hutch incorporated additional findings drawn from the June 2019 publication "Elements, The International Magazine of Mineralogy, Geochemistry and Petrology," Volume 15, No. 3. That new information became available only after his four installments were published in the Northern Virginia Mineral Club's "The Mineral Newsletter."

Hutch introduced the story of Santorini as having three phases or chapters in the island's formation: 1. Plate Tectonics; 2. Volcanic Activity; and 3. The Minoan Eruption.

1. Tectonic Plate Movements

Hutch described the geographic shape of Santorini as a crescent-island, illustrated below, which is located in the Aegean Sea, flanked to its north by the mainland of Greece and Turkey and to its south by the much larger island of Crete. The name for the island, Santorini, derives from an Italian variation of Saint Irene, and is named after the Crusaders' 13th century chapel, Santa Irini. To the Greeks, the island is known as Thera. Today, the island is the largest of a complex of five neighboring islands but originally it was a single small island shaped by tectonic plate movements which eventually morphed into the 5 islands pictured and illustrated below.



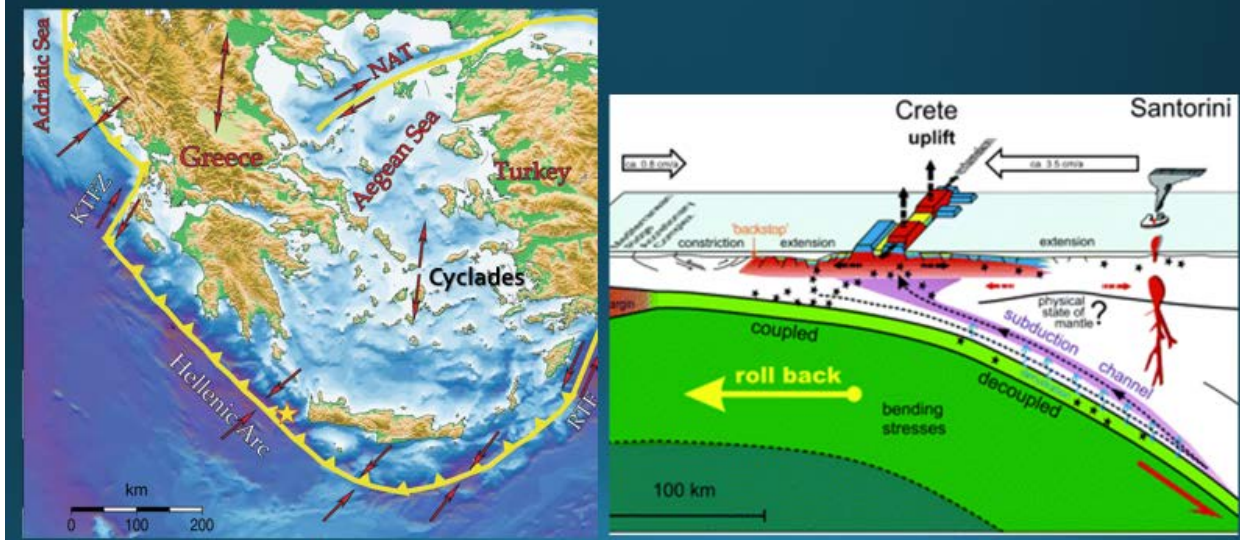
Hutch said the formation of Santorini was not simply a result of two colliding plates, as some might imagine, with the heavier African Plate pushing beneath and uplifting the lighter Eurasian plate. As shown below with color-coded illustrations, at least four plates were jostling one another, exhibiting all three types of plate dynamics: sliding past (transverse), pulling apart (divergent) and colliding with one another. The initial island which surfaced above the Aegean Sea was much smaller than the island's remnants we see today. It emerged from the sea floor some 60 million years ago and well before the extensive volcanic activities which would follow millions of years later and would expand the island's size.

Colliding plates



Blue/purple = colliding
 Green = transverse (sliding past)
 Red = divergent (pulling apart)

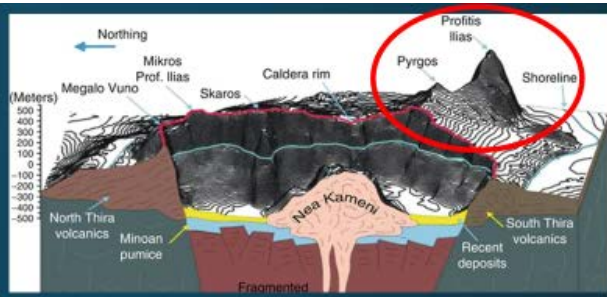
Mountain building and subsidence



As a result of these plate tectonic motions, the lifting and folding of the sea floor provided a solid metamorphic rock foundation for Santorini, as it did for most of the Aegean islands. However, the uplifting also brought up some limestone from the seafloor. That island-forming process in the Aegean is in contrast to the many oceanic islands which have been formed primarily by volcanic activity. The time-frame for the original Santorini island uplift was about 60 million years ago and initially was a small bedrock island illustrated below as the grey section of the subsequently larger island illustrated as orange. The illustration and photo further detail that area which is in today's southeast corner of the island.

Santorini bedrock: metamorphic

Marble, metapelite, metagraywacke ...
Limestone



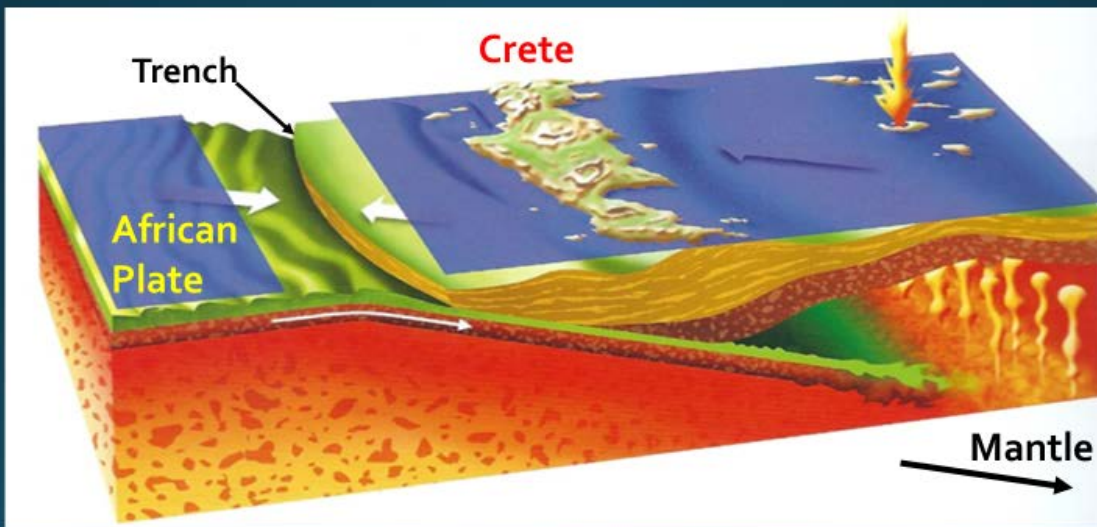
Profitis Ilias,
1,720 feet

Beyond the marble, metapelite, metagraywacke and limestone metamorphic rock noted above in grey and found in the Profitis Ilias mountainous area, one also finds mafic rock containing calcium, iron and magnesium oxides.

2. Volcanic Activity

Whenever one plate subsides beneath another, the resulting melting of the rock eventually leads to volcanic activity as illustrated below.

Santorini volcano



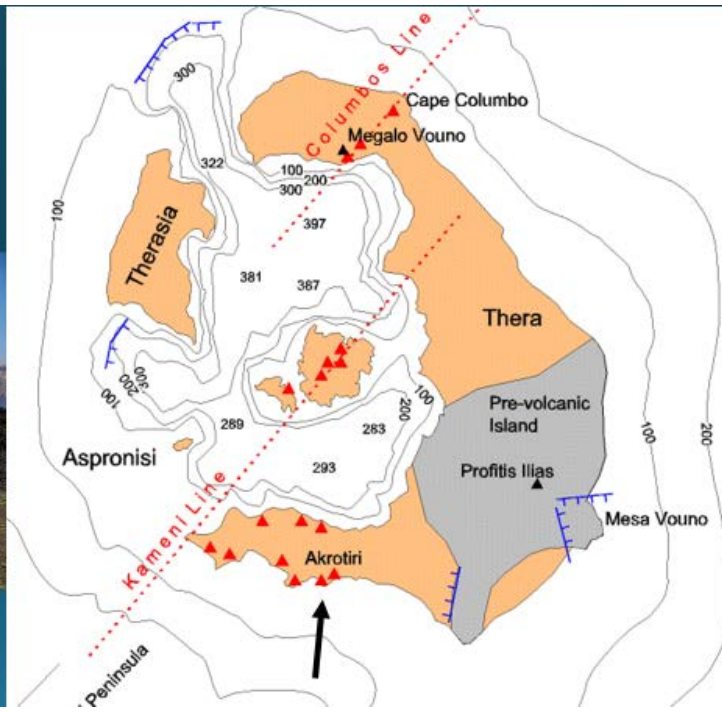
As an example, between 2 million and 500,000 years ago, the upward flow of lava expanded the island to the south-west and formed what is today the Akrotiri peninsula. Similar expansions took place over time resulting in an expanded island size and in it taking on the shape of a large circle. The mineralogy of those newer sections of the island is not metamorphic rock but instead is volcanic and includes lighter materials such as rhyolite (feldspar and quartz), pumice, and scoria which is a form of andesite.

As illustrated below, the northwest and southwest areas of that original circle have disappeared due to volcanic activity and the surrounding sea has surged into the interior of the now crescent shaped island.

Volcanic vents on Santorini

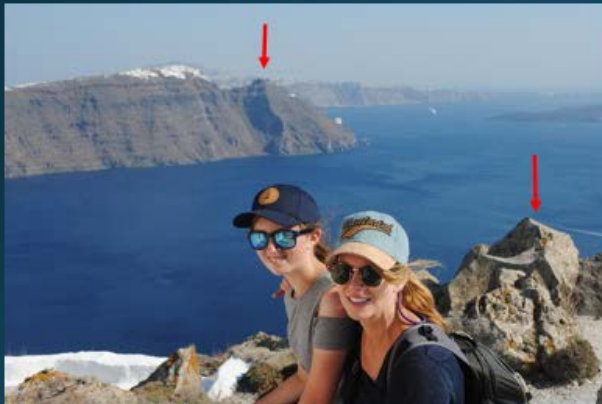


Nea Kameni crater, with northern Santorini and the tourist town of Oia (white) in the distance.



It is helpful to keep in mind that the crescent shape of today's Santorini is the remnant of what was once a large circular island whose vast interior disappeared due to massive volcanic activity. What we see today, Hutch explained, is a crescent shape having the high walls of what was once a very steep caldera.

Volcanic rocks of Santorini



Caldera view from Megalo Vouno, northern Santorini



Akrotiri harbor, southern Santorini

SiO₂

Rhyolite

>78%
SiO₂

Dacite

>63%
SiO₂

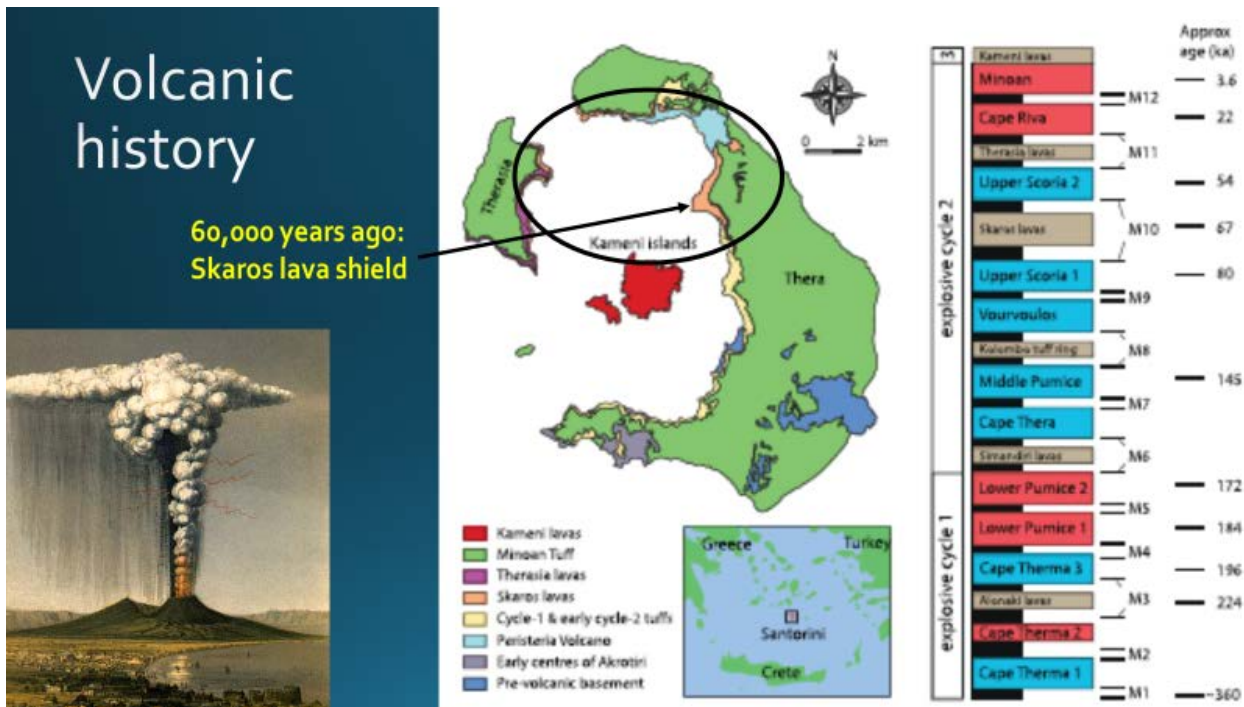
Andesite

>57%
SiO₂

Basalt

<52%
SiO₂

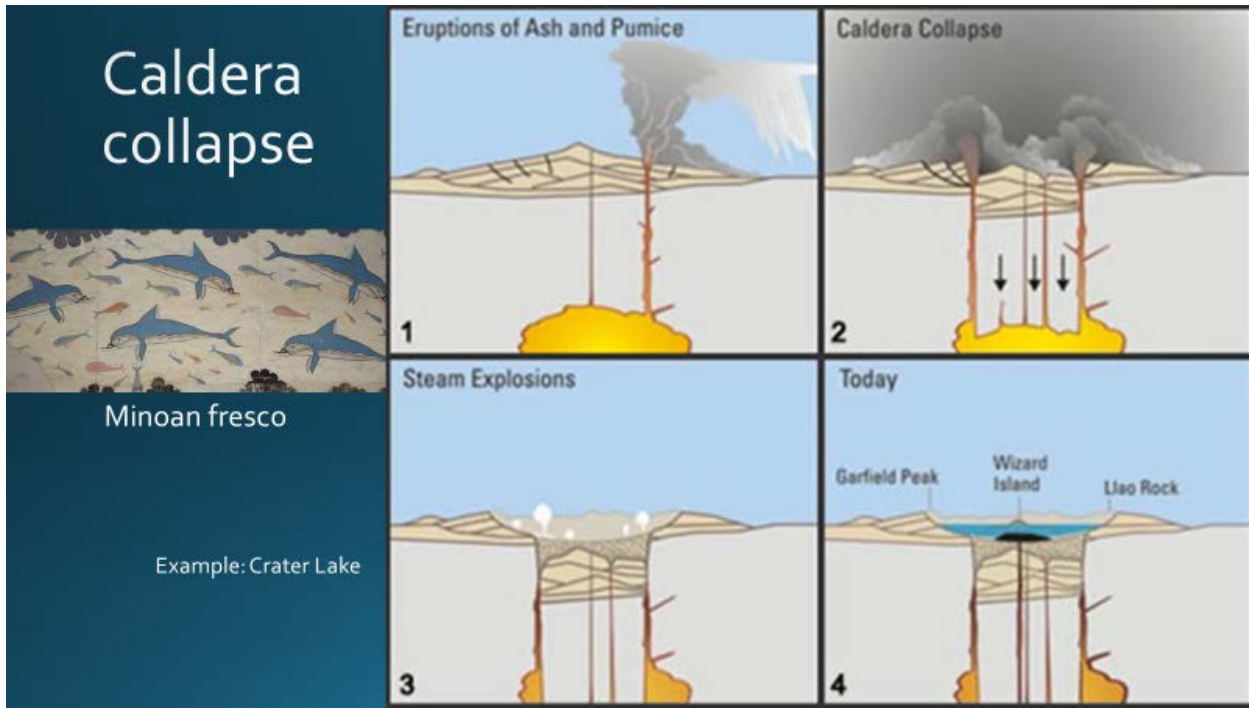
The growth of the circular shape of the island took place over several hundred thousand years. The chart below illustrates eight different periods in the volcanic history of Santorini and its four neighboring islands. The depositions are noted in the color-coded periods which range from the early Cape Therma deposition 360,000 years ago to the Minoan volcanic activity which took place about 3,600 years ago.



Hutch pointed out that the volcanic ash depositions found throughout the island took place as the subsurface melting rock within the magma chambers was under pressure and was driven upward through cracks in the above rock depositions. When it reached the openings at the top or on the sides, the vents, the hot lava slowly spilled outward in a fan-like manner which geologists name a lava shield. That type of venting process takes place under relatively low pressure and is illustrated above as having formed the Skaros lava shield, shown as light brown, which formed 60,000 years ago in the northeast section of the island. It stands in sharp contrast to the high-pressure volcanic explosions such as that of Mount Vesuvius in 79 AD.

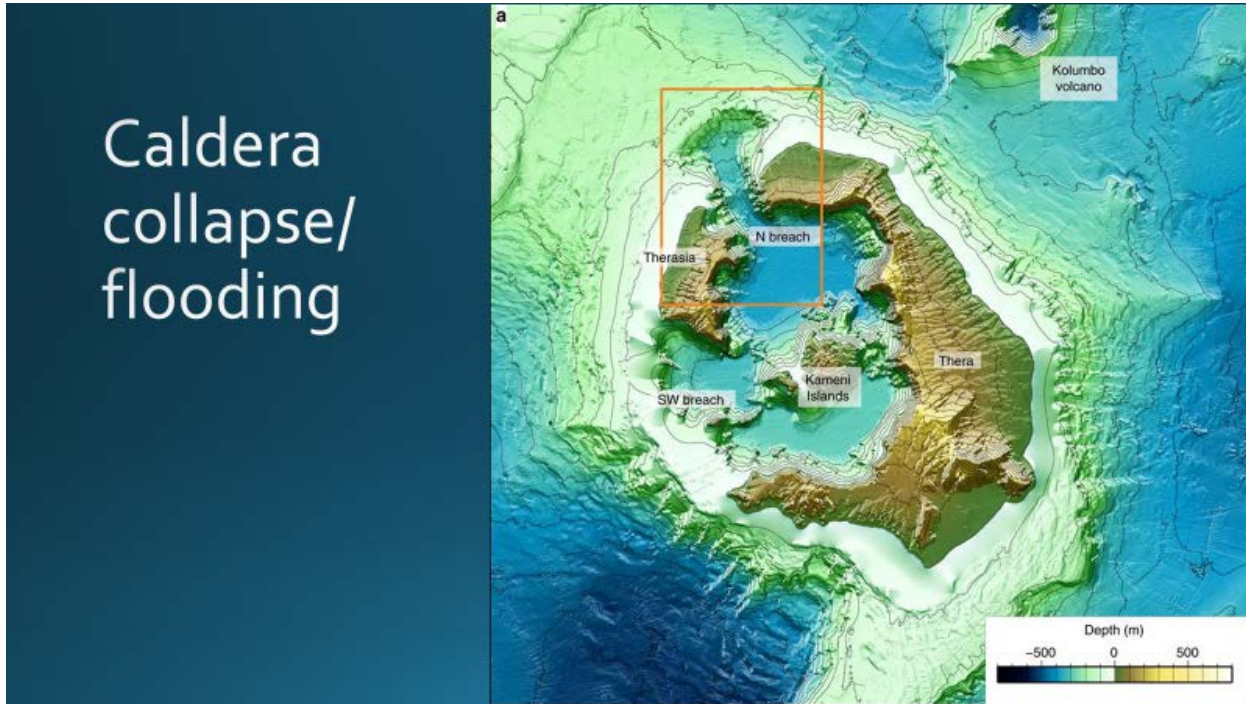
3. The Minoan Eruption

In telling the MSDC audience about his third and final chapter in the story of Santorini, Hutch then described an event having geological clarity and cultural mystery, known as the Minoan volcanic eruption. It is so named because it happened about 1,600 BC, when the Minoan culture and navy ruled the seas and dominated trade throughout the Aegean and Mediterranean regions. The geological elements were a series of volcanic eruptions which culminated in an explosive collapse of the mountainous interior of Santorini whose central caldera collapsed. That process is illustrated below and it resulted in hollowing out the interior of the island.



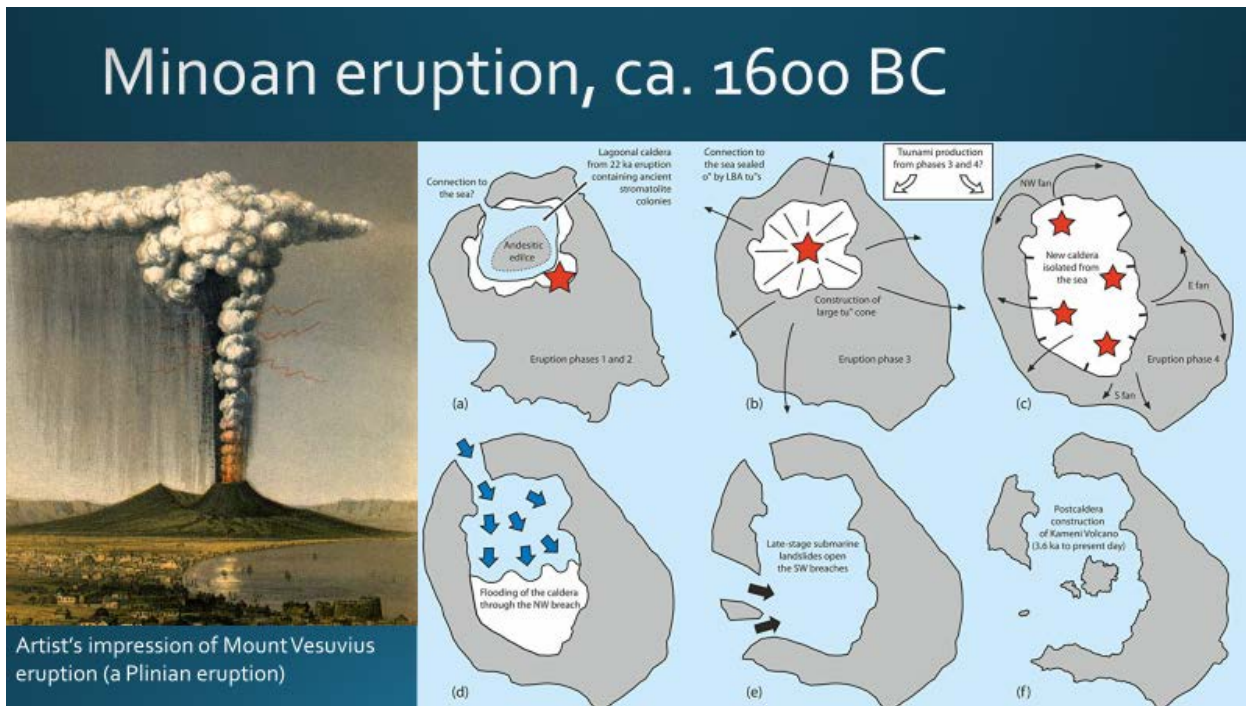
The geologic record for the last two million years documents several cycles of dome formation, eruptions and collapses. The most significant took place in about 1,645 BC and is the famous Minoan eruption. The illustration below shows the aftermath which is the creation of two smaller islands in the middle of the Santorini crescent and a tiny third island, Aspronisi, which is the sole survivor of the southern ridge from when Santorini was basically a complete circle.

The illustration below shows the two main islands, crescent-shaped Santorini in the east and Therasia to the west. In the southwest is the tiny island of Aspronisi which is the sole surviving remnant of the southwestern edge of the original circular Santorini island. In the center are two islands, Palea Kameni which was reported to have surfaced in 197 BC and the larger island of Nea Kameni which surfaced from the sea in 1707.



Caldera collapse/flooding

Six stages of the Minoan eruption are illustrated below and show the incursion of the collapse of the northwestern and southwestern sides of the Island, allowing the Aegean Sea to flood into the interior of Santorini.



Minoan eruption, ca. 1600 BC



Artist's impression of Mount Vesuvius eruption (a Plinian eruption)

Minoan eruption

Volcanic Explosivity Index = 7
100 times greater than Vesuvius (79 AD)



The illustration above shows where the ash was blown, mainly to the northeast and east of the Island, depositing as much as 12 centimeters in southern Turkey, 20 cm to nearby islands to the east. Some ash deposited onto the northern coastal region of Egypt to the south.

The white Minoan tuff deposited throughout Santorini, including on the walls near Fira pictured below, as well as depositions in the form of boulders and lava bombs still evident today showing varying degrees of weathering.

Minoan tuff

Near Fira, the administrative center



Minoan tuff



Weathering

Lava bomb



Eroded Minoan tuff

The name of the geologic event, the “Minoan” explosion, comes from the fact that the island of Santorini, as well as of that part of the Aegean Sea, was populated and dominated by the people known as Minoans. The culture is named after their mythical King Minos who ruled from the island of Crete. They had firmly established military and economic dominance over the entire region. Its primary rival was the Mycenaean culture which occupied mainland Greece to the north and to whom the citizens of Athens, centuries later, looked back to as their honored ancestors.

The geologic record and archeologic record show clearly that before the large Minoan explosion in 1645 BC, there were a series of smaller yet dangerous earthquakes on Santorini. Those warnings seem to have led to the wholesale evacuation of its largest city, Akrotiri. Archeological excavations of that destroyed city resulted in finding no skeletal remains, nor any valuable household items. That suggested the residents fled the area by ships with everything they could carry. The only object of value found to date has been the small golden ibex pictured below which was found beneath an excavated house floor.

Destruction of Akrotiri

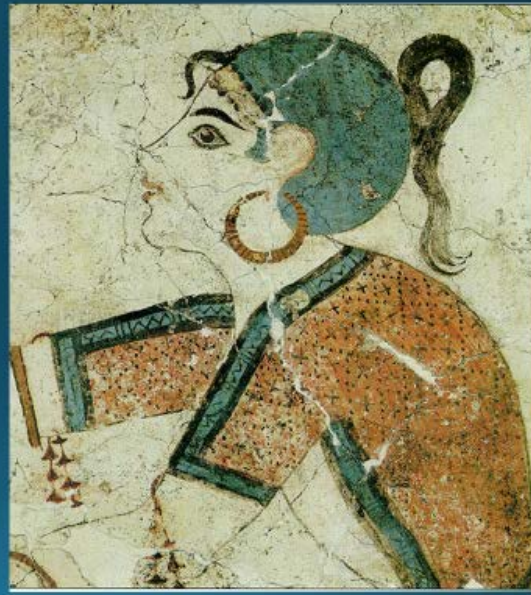


Breaking news! Trireme speeds away as island volcano erupts!
(Ibex News, 1600 BC)



Ibex figurine made from gold, found in Akrotiri.

Akrotiri excavation

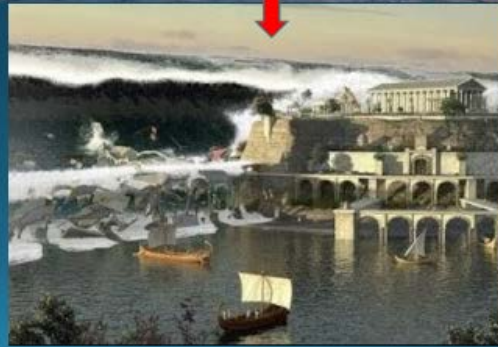


The size of that great Minoan explosion was determined to be a 7 on a scale whose highest measure is 8. That made it 100 times greater than the Mount Vesuvius eruption which buried the Roman city of Pompeii in 79 AD. The 1645 BC tsunami caused by the Minoan explosion resulted in extensive damage throughout the eastern region of the Mediterranean, including to the northern coast of Crete which was the center for Minoan naval and economic power. Similarly, the Minoan primary outpost on Santorini, affluent Akrotiri, suffered from the earthquakes, volcanic explosions and tsunami flooding.

Hutch noted that some people today believe that the historic explosive event may have given birth to the story of a very wealthy island nation named Atlantis. Plato, writing several of his dialogues about 400 BC, described its total destruction and sinking into the sea. In those accounts, Plato described a struggle between two nations, the people of Atlantis and of Mycenae, which he said took place 10,000 earlier. He told of the virtuous Mycenaeans, the ancestors of the Athenians, who struggled mightily against the domineering island-nation culture of Atlantis, which was militarily and culturally their superior. According to Plato, the gods became displeased with the people of Atlantis and took revenge against them by destroying the people, homes, ships and even having the island swallowed by the sea.

Tsunamis

Modeled pyroclastic flow and tsunami from the Minoan eruption



For centuries, historians and imaginative writers have speculated as to the whereabouts of the fabled wealthy island of Atlantis. Some writers have suggested that the people of Atlantis were the Minoans who in reality did actually dominate

and oppress the Myceneans in the centuries before the Minoan explosion of 1645 BC. Whether Plato's writings more than a thousand years later were simply an allegory showing his loyalty to his own Athenian heritage or were reports of actual historical events somehow conveyed down the centuries through oral history, is not at all clear.

Atlantis = Santorini/Thera?



But afterwards there occurred violent earthquakes and floods; and in a single day and night of misfortune all your warlike men in a body sank into the earth, and the island of Atlantis in like manner disappeared in the depths of the sea.

—Plato, *Critias*

Hutch concluded by saying that today, Santorini has extensive farmlands of rich volcanic soil which are excellent for growing grapes and producing expensive wines. Tourists who visit there and the surrounding islands will enjoy its beauty, even if late booking requires staying in a cave hollowed out from Minoan tuff as he and his family enjoyed doing.

Readers interested in learning about Hutch's explorations of additional Santorini cities and Aegean islands can gain access to those stories by visiting "The Mineral Newsletter" and his four stories cited at the beginning of this synopsis.

MSDC President Dave Hennessey thanked Hutch for his wonderful presentation and the attending club members signaled their appreciation with extensive applause.

MSDC Club Information

Meetings are the First Wednesday of the Month (Jan-Jun and Sep-Dec). We meet in the Constitution Avenue lobby of the Smithsonian National Museum of Natural History at 7:30 pm.

Website <http://mineralsocietyofdc.org/>

Facebook www.facebook.com/Mineralogical-SocietyOfTheDistrictOfColumbia

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THE MINERAL MINUTES

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NEWSLETTER OF THE MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA

Mineralogical Society of DC
Time Sensitive Dated Material
First-Class Mail

Useful Mineral Links

	<p>American Federation of Mineralogical Societies (AFMS)</p>	<p>www.amfed.org</p>
	<p>Eastern Federation of Mineralogical and Lapidary Societies (EFMLS)</p>	<p>www.amfed.org/efmls</p>
	<p>MINDAT</p>	<p>www.mindat.org</p>
	<p>Mineralogical Society of America (MSA)</p>	<p>www.minoscam.org</p>
	<p>Friends of Mineralogy</p>	<p>www.friendsofmineralogy.org/</p>
	<p>WebMineral</p>	<p>webmineral.com</p>
	<p>The Geological Society of America (GSA)</p>	<p>www.geosociety.org/</p>
	<p>Jeff Scovil Mineral Photography (not advertising - just great photos)</p>	<p>scovilphotography.com/</p>
	<p>United States Geological Survey (USGS)</p>	<p>www.usgs.gov</p>
	<p>The Geological Society of Washington (GSW)</p>	<p>http://www.gswweb.org/</p>



AFMS Code of Ethics



- I will respect both private and public property and will do no collecting on privately owned land without the owner's permission.
- I will keep informed on all laws, regulations of rules governing collecting on public lands and will observe them.
- I will to the best of my ability, ascertain the boundary lines of property on which I plan to collect.
- I will use no firearms or blasting material in collecting areas.
- I will cause no willful damage to property of any kind – fences, signs, and buildings.
- I will leave all gates as found.
- I will build fires in designated or safe places only and will be certain they are completely extinguished before leaving the area.
- I will discard no burning material – matches, cigarettes, etc.
- I will fill all excavation holes which may be dangerous to livestock. [Editor's Note/Observation: I would also include wildlife as well as livestock.]
- I will not contaminate wells, creeks or other water supply.
- I will cause no willful damage to collecting material and will take home only what I can reasonably use.
- I will practice conservation and undertake to utilize fully and well the materials I have collected and will recycle my surplus for the pleasure and benefit of others.
- I will support the rockhound project H.E.L.P. (Help Eliminate Litter Please) and will leave all collecting areas devoid of litter, regardless of how found.
- I will cooperate with field trip leaders and the se in designated authority in all collecting areas.
- I will report to my club or Federation officers, Bureau of Land management or other authorities, any deposit of petrified wood or other materials on public lands which should be protected for the enjoyment of future generations for public educational and scientific purposes.
- I will appreciate and protect our heritage of natural resources.
- I will observe the "Golden Rule", will use "Good Outdoor Manners" and will at all times conduct myself in a manner which will add to the stature and Public "image" of rockhounds everywhere.

MEMBERSHIP APPLICATION OR RENEWAL
THE MINERALOGICAL SOCIETY OF THE DISTRICT OF COLUMBIA (MSDC)

(___) Family – \$25.00 per year. One address.

(___) Individual – \$20.00 per year.

(___) New * (___) Renewal Dues are for Year _____*

For new members who join in the last months of the year, membership will extend through the following year with no additional dues.

ANNUAL DUES – PLEASE PAY YOUR DUES PROMPTLY.

Pay at next meeting or mail to:

Mineralogical Society of DC
c/o John Weidner
7099 Game Lord Drive
Springfield, VA 22153-1312

Name(s) (First and Last) _____

Address _____

City _____ State _____ Zip: _____

Phone(s): Home/Work/Mobile _____

Email(s): _____

OK TO INCLUDE YOU ON CLUB MEMBERSHIP LIST?

() Yes – Include name, address, phone, email.

If you want any information omitted from the membership list, please note:

Omit my: () Email; () Home phone; () Work phone; () Mobile phone; () Address; () Name

SPECIAL CLUB-RELATED INTERESTS? _____

Meeting Dates, Time, and Location: The first Wednesday of each month. (No meeting in July and August.) The National Museum of Natural History, Smithsonian Institution, 10th Street and Constitution Ave, Washington D.C. We will gather at the Constitution Avenue entrance at 7:30 PM to meet our guard who will escort us to the Cathy Kerby Room.