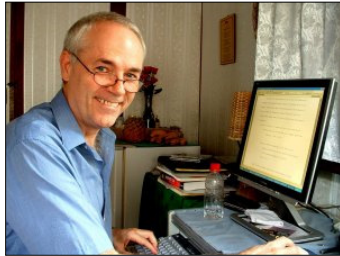




# Geology of Atlantis Physical Evidence

## Rod Martin, Jr.

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Rod Martin at home in Cebu, Philippines

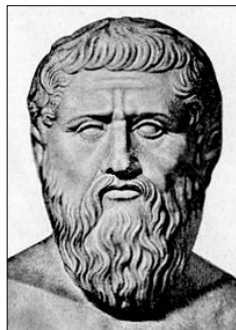
## Abstract

The large island, Atlantis, supposedly sank in the Atlantic Ocean nearly twelve thousand years ago. For some, the story is only myth. The Atlantis legend might have stayed merely fiction without a modern understanding of geology. Right where Plato said the fabled island once stood are the plate tectonic properties for building mountains and thus islands. Not only do we have evidence of tectonic damage in this region, but the damage from the proposed coming and going of Atlantis seems to have been far more widespread.

Keywords: Atlantis, geology, science, plate tectonics, subduction, mountain building, myth, Plato

## Plato's Lost Island

Plato (c. 428–348 BCE) was a Greek philosopher, mathematician and writer. Along with Socrates (his teacher) and Aristotle (his pupil), he helped to shape the culture and ideas of Western civilization.



A bust of Plato. (Wikipedia)

Scholars are relatively certain that Plato's dialogues *Timaeus* and *Critias* were written near the end of his

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lifetime, circa 360 BCE. These conversations are the source of the story of Atlantis as we know it. All other references to an island by that name depend on these two dialogues.

The story of Atlantis was related by one Critias who had heard it from his grandfather, also by the same name, who had in turn heard it from Solon (c. 638–558 BCE), the great Athenian statesman. Solon had picked up the story from an elder priest in the former Egyptian capital of Saïs in the Nile Delta region.

The priest told Solon that the story of Atlantis took place "nine thousand years ago." A great battle had been fought between Atlantis and Athens after which both nations were overcome by great floods and

earthquakes, and Atlantis was swallowed by the sea. Estimating that Solon heard the story approximately 600 BCE, Atlantis met its end roughly 9600 BCE.

There are many skeptics of the Atlantis story. Some have found it hard to believe the date, preferring to think that the Egyptian priest meant nine thousand *months* instead of *years*. Others have suggested that there was a "factor-of-ten" error and that the priest really said "900," not "9,000."

While these excuses for changing Plato's meaning may seem clever to some, they ignore other details in the original dialogues that reaffirm the original meaning. For instance, the priest also told Solon that current Egyptian history started "8,000" years earlier — "1,000" years after the great battle between Atlantis and Athens. If these numbers were really "800" and "100," then Egyptian history would have started approximately 1400 BCE.

Anyone familiar with Egyptian history will immediately see the problem here. If Plato was off by a factor of ten, then the Egyptian priest would have been admitting to ignorance of nearly two thousand years of his own history — dynasties about which we have long known. At first glance, the argument for recalculating Plato's dates is weak at best. With this understanding of the dates' relation to Egyptian history, the recalculated dates seem entirely unsatisfactory.

There has also been much debate about the site of Plato's lost island. Many prefer not to believe the Greek philosopher regarding the location. In my article, "Atlantis Everywhere" (available at [www.MissionAtlantis.Com](http://www.MissionAtlantis.Com)), I address this controversy in detail. The inescapable conclusion is that Atlantis, as defined by Plato, was outside the Strait of Gibraltar from the Mediterranean, stretching

from there toward the mid-Atlantic Ridge. The exact size is unknown, but based on the wording of Plato in his dialogues, an educated estimate gives us between one and two times the size of Texas (the largest state of the contiguous United States of America). The nearest part of Atlantis to Europe faced a region called "Gadira" located in south-western Spain, centered on the modern city of Cádiz (the oldest European city on the Atlantic coast). To the Carthaginians the city was "Gadir," to the Romans it was "Gades," and to the Moors it was "Qādis."



Santa Catalina garita, Cádiz, Spain. (Wikipedia)

From the location and estimates of size, Atlantis, if it existed, would likely have included the Azores underwater plateau and possibly part of the mid-Atlantic ridge.

### The Big "What If"

To many, "Atlantis" means the hope of discovering something profound from our mysterious past — perhaps hidden treasure or ancient technology. The lost island empire and fabled city have become the source of an industry, giving its name to vacation resorts, video games, motion pictures and more. And one of America's space shuttles was named for the legendary island.

To some, Atlantis is merely a fantasy created by a passionate Greek philosopher.

What if Atlantis was real, though? What if a rare and massive tectonic collapse really did occur at the end of the last Ice Age? What evidence would we look for?

While doing background research for a novel ([www.EdgeOfRemembrance.Com](http://www.EdgeOfRemembrance.Com)) I made many discoveries, several of which support the idea that Atlantis was not only

geologically possible, but that it may have left evidence of its creation and destruction across a globally wide area.

## An Expectation of Evidence

If a massive tectonic collapse did occur when Plato says Atlantis subsided, what kind of evidence would such an event leave behind? Perhaps the most obvious effect would be that of a wave. Such a collapse could have created a megatsunami as much as 1–3 kilometers high. Could such a nightmare wave really have occurred?

The Lituya Bay megatsunami of 1958 was 524 meters high, and that was produced from only 90 million tonnes of rock and ice sliding into the bay. Ward and Day point to active volcano, Cubre Vieja (La Palma, Canary Islands) as a possible future source of a megatsunami. The possible collapse of Cumbre Vieja could create a wave with an initial height of 1,000 meters (1 kilometer) — from 1.5 trillion ( $1.5 \times 10^{12}$ ) tonnes sliding into the Atlantic. And Cumbre Vieja is far smaller than Atlantis might have been.

A wave like this could possibly have affected climate worldwide. Such a collapse would also likely have been associated with a volcanic event, forcing perhaps at least one eruption. And the removal of such a large body of land from the ocean would have caused sea levels to fall by a measurable amount.

We have proof of these effects — climate change, volcanic activity and sea level drop. In my article, "Proof that Something Big Happened" (available at [www.MissionAtlantis.Com](http://www.MissionAtlantis.Com)), three items of scientific evidence prove that something very, very big happened at the same time that Plato's Atlantis was swallowed by the sea. Though these do not prove Atlantis

directly, they go a long way toward establishing the validity of such a catastrophic event.

More than coinciding with the date of Atlantis's destruction, these three items of evidence — each from a different scientific discipline — support the idea of a major tectonic subsidence somewhere in the oceans of our world. The mutual date of these events makes us look a little closer at Atlantis as the likely culprit.

Over time, I developed a geological hypothesis for Atlantis compatible with modern earth science. This involved evidence from the mid-Atlantic ridge to the Arabian Peninsula (spanning thousands of miles) and involved evidence from the early Eocene epoch to the beginning of the modern, Holocene epoch (spanning more than fifty million years).

## More What if!

What if the current "history" of humanity is only an *island* of contiguous culture rather than a *continent* of such? What if another island of "history" lay six thousand years before the current one began? The elder priest of Saïs, Egypt hinted at these "islands" when he related the story of Atlantis to Solon, the Greek statesman from Athens, suggesting that humanity had suffered several history stopping disasters.

We cannot say with any credibility that Atlantis was real, because we do not have irrefutable proof of that. Also, we cannot say with any credibility that Atlantis was *not* real. Both sides of this argument need to practice restraint and to look for more evidence.

If Atlantis was a real place, then it would have to have had a geological foundation. There would need to be something in the science of geology that would explain how Atlantis appeared and ultimately disappeared.

## Early Ideas

Some have proposed that Atlantis lay at the mid-Atlantic ridge. Perhaps the first to suggest this was Ignatius Donnelly in his highly popular, nineteenth century work, *Atlantis: The Antediluvian World*. What mechanism would have lifted the fresh, new ocean floor above sea level to create an island? Certainly Iceland is a relatively large island and it sits right on the mid-Atlantic ridge. Could that Scandinavian island one day become the new Atlantis? Is it in danger of subsiding?



Ignatius Donnelly  
American congressman  
and author. Picture courtesy  
Wikipedia.org.

Another idea involves plate tectonics and the fact that the Atlantic Ocean did not exist much beyond 200 Mya (million years ago). Like the Great Rift Valley of East Africa, two plates separated, forming new land from the mantle of Earth. With the split that formed the Atlantic, the valley floor eventually subsided to form an oceanic basin. Will the Great Rift valley floor one day become a new sea?

Was Atlantis a holdover from the valley floor in the split of the ancient super-continent of Pangaea? This is an interesting idea, but it seems unlikely that an island would form in this manner, especially one containing the mountainous terrain Plato described for Atlantis.

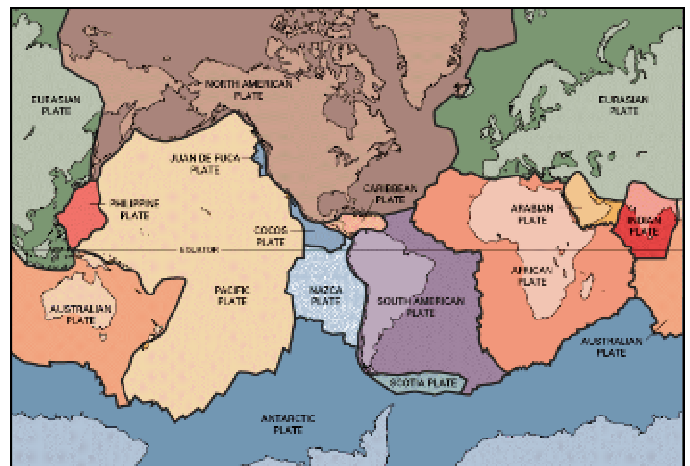
Could basaltic crust, temporarily held aloft, have later subsided because of its greater density — greater than the density of the surrounding continental granite?

These fanciful ideas have very little to support them — no pun intended. As possible explanations of Atlantis they fall far short of the mark. We need something which offers not

only an explanation for how Atlantis was destroyed, but also a plausible method for its initial creation. And without more knowledge about the science of geology, we are left with more questions than answers.

## Geology 101

Current knowledge of the Earth's surface structure involves something called tectonic plates. In a way, these are like the patches of leather sewn together on the outside of a baseball. Instead of two, thin, interlocking pieces of leather, there are, at current count, 20 semi-rigid spherical caps of rock (12 major and 8 minor plates) that form the continents and ocean basins.

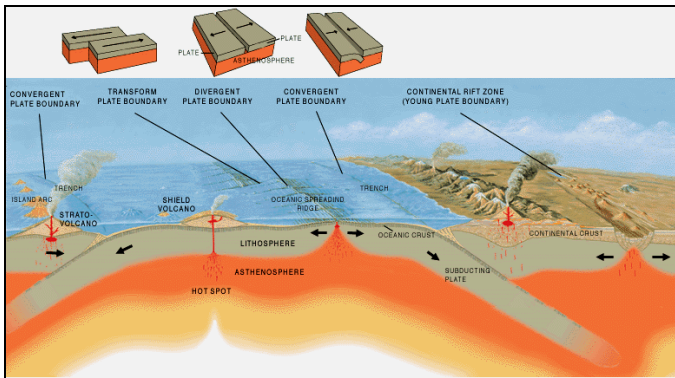


The tectonic plates of planet Earth (courtesy USGS).

Each of these plates is in motion relative to its neighbors. At any one point on the mutual boundary between two plates there are four possible states:

1. **Motionless** (and none of the plate boundaries currently seem to have this characteristic to any significant degree).
2. **Transform** — where two plates are sliding by one another.
3. **Convergent** — where two plates are moving toward each other. One plate will slide under another in an action called "subduction." If such sliding becomes

impossible, compression results. Mountains are usually formed near a convergent boundary, from crustal folding, volcanism or both.



The three main types of plate boundaries — transform, divergent and convergent (Wikipedia).

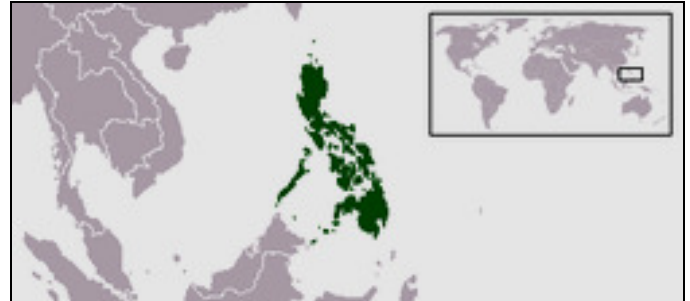
4. **Divergent** — where two plates are moving away from each other. This is typically called a "ridge" or "spreading center." This is where new material from the Earth's mantle rises to form new crust.

What interests us most here is the convergent type of boundary. Currently, the Africa-Eurasia tectonic plate boundary west of Gibraltar is mostly non-convergent in nature. There are some indications, however, that this boundary may have been heavily convergent in the distant past.

Why is this important? A convergent boundary is where most mountains are made. Some examples are the Andes of South America, the Sierra Nevadas of North America, the Alps and Carpathians of Europe, and the Himalayas of Asia. Each of these mountain ranges sits at the edge of a tectonic plate that had been or is being subducted or compressed. Certainly all of these are along continental margins, but even an oceanic subducted boundary could yield crustal folding (mountain building) given sufficient impediment to that subduction.

Wikipedia.org, puts the matter rather succinctly: "Convergent boundaries (or active

margins) occur where two plates slide towards each other commonly forming either a subduction zone (if one plate moves underneath the other) or an orogenic belt (if the two simply collide and compress)."



Philippine Islands, Asia (Wikipedia).

The Philippine archipelago is an example of a magmatic arc — the product of volcanism at the convergent oceanic boundary of two plates in the Western Pacific. The arc of Costa Rica in Central America is a similar formation between the Caribbean and Cocos plates.



Costa Rica, Central America (Wikipedia).

What could cause crustal folding at the oceanic boundaries of two plates? Usually such subduction merely creates volcanic islands as with the Philippines previously mentioned. Obviously, rock rubbing against rock creates friction and that friction would tend to yield some crustal folding, albeit minor for oceanic boundaries.

Jeremy McCreary in "Earth at Work," tells us that thicker, crustal material is not easily subducted (returned to the Earth's mantle). "The larger bumps don't always go down easily at subduction zones, particularly if they

contain a lot of buoyant arc-generated or continental crust."

Was an old continental fragment caught in the subduction of the Africa plate underneath the Eurasia in the vicinity of the present-day Azores plateau? This is certainly an intriguing idea, but it seems unlikely that such a scrap of continental material could have found its way so far from the continental margins. Older continental crust does not "swim" through newer oceanic crust.

Subduction in the North Atlantic may not have choked on a bit of continental "bone." Something else may have happened to create crustal folding where the Azores currently sits. We will come back to that idea shortly.

### Breaking Up

Approximately 240 Mya, the mega-continent, Pangaea, began splitting along the North Atlantic spreading center. The ocean did not exist at that time, but there may have been lakes or an inland sea there.

Over millions of years the split expanded, formed of basalt — denser than the surrounding continental crust. As the basaltic region broadened, it would seem natural for it to tend to sag both from the greater density and from extensional forces (the stretching caused by the separation).

Inevitably, the split found connection to the external oceans and flooded, forming a new, fledgling ocean. The weight of all that water would contribute to further sagging, similar to the continental subsidence experienced from Ice Age glaciation.

Several million years later, the future South America split from future Africa, forming the South Atlantic.



Pangaea supercontinent, circa 250 Mya. (Wikipedia)

Gradually, Africa rotated away from South America and toward Eurasia, closing up the ancient Tethys Sea, eventually forming the Mediterranean.

Perhaps in the range of fifty million years ago, Africa began colliding with Eurasia after millions of years of oceanic crust subduction.

### Gloria Fracture Zone

From the mid-Atlantic ridge (MAR), which separates the North America plate from the Eurasia and Africa, the boundary separating the Eurasia from the Africa is sometimes called the Gloria Fracture Zone. It is also called the Azores-Gibraltar boundary.

Jimenez-Munt, *et al*, in an abstract for their 2001 article on the Azores-Gibraltar boundary, speaking of the nature of the boundary, indicate that "the eastern segment is not so well defined and deformation spreads over a much broader area."

Silveira, *et al*, also speak of this indistinct quality. "While the boundary between the American and the Eurasian and African plates is well established by the MAR, the location and nature of the eastern branch of the Azores Triple Junction is still controversial."

What could cause such a poorly-defined plate boundary? Has the plate boundary been damaged? If so, when was it damaged and by what process?

## Terceira Ridge

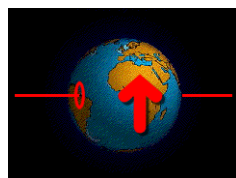
Roughly from Santa Maria Island in the Azores to the mid-Atlantic ridge, the Africa-Eurasia plate boundary turns toward the northwest to form what has been characterized as an ultra-slow spreading center or ridge, called the Terceira Rift. Searle indicated that the rift began about 36 Mya.

Why did the plate boundary change thirty-six million years ago?

## Tectonic Plate Movement

Because all plates move within the spherical surface of the Earth, all plate movement relative to another plate is going to have a "pole" of rotation. These are called Euler poles, named after the eighteenth century Swiss mathematician, Leonhard Euler, who developed the concept.

If the motion of a plate is linear within the sphere of the Earth (its physical center has a path along a "great circle"), its Euler pole will stand ninety degrees from the plate's path.



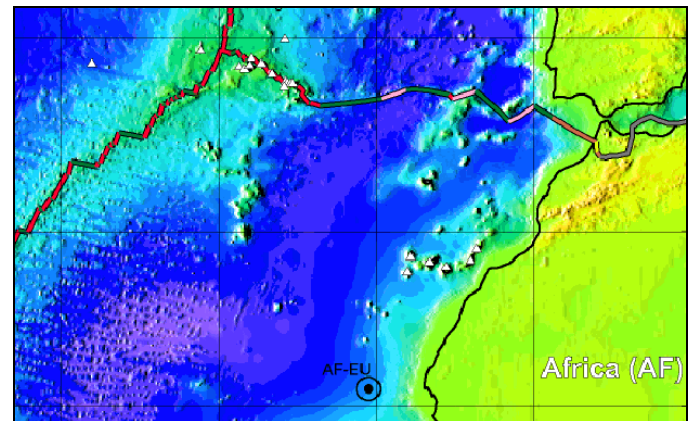
Hypothetical northward motion of Africa plate with respect to Eurasia and the associated Euler pole.

Changes in the Euler pole can occur when continents collide as did the Africa with the Eurasia, circa 50 Mya. Mehmet Keskin (2005)

mentions this collision, between the future Arabia (which did not exist as a separate plate for another 20-30 million years) and the Eurasia. "Previous studies have shown that the future Arabian plate made its initial contact with the Eurasian plate during the Late Eocene. The region underwent compressional tectonic evolution subsequently, but most of it lay beneath sea level during a period between the Late Eocene (~50 Ma) and Serravalian (~13 Ma)."

## Current Euler Pole

The rotation of the Africa plate with respect to the Eurasia has a Euler pole at approximately 20° 29' West and 21° 0' North. This is about 1,840 kilometers (roughly 1,140 miles) south of the Africa-Eurasia boundary and mostly south (only slightly east) of the Terceira bend in the boundary (Peter Bird, 2003).



North Atlantic west of Africa and Gibraltar showing the current Africa-Eurasia Euler pole and the plate boundaries between Africa, Eurasia and North America (Bird, 2003).

The Euler poles are far from permanent. Changes in plate movement have occurred throughout the history of Earth. The breakup of Pangaea was one such change. Another change can occur when one plate's continental mass collides with that of another, as did the African continent against the Eurasian several million years ago.

If the Euler pole had shifted as Africa approached Eurasia, this could have created stresses at the plate boundaries. Changes in direction could create shear or compression forces.

If compression forces were created at the triple junction where the Africa, Eurasia and North America plates meet, crustal folding might have occurred perpendicular to the Africa-Eurasia plate boundary. This folded crust could then have created an impediment to subduction of the Africa underneath the Eurasia. This may well have created enough of a "bone" on which subduction there could choke.

If an impediment to subduction is large enough, it might stop tectonic movement altogether at the point of the blockage. All of the northward movement of Africa against Eurasia would then have been converted to crustal folding locally. If such folding occurred over an extended period of tens of millions of years, then the folded crust might have protruded above the ocean's surface, creating one or more islands.

Do we have evidence of this blockage?



Some islands can form from crustal folding or volcanic events. (Wikipedia)

## Azores Plateau

Navarro, *et al* (10/2003) inform us that "The nature and location of the present EUR/AFR boundary configuration in the Azores region is controversial and, in particular, the pattern of the present day deformation associated with plate boundary processes, is still unknown."

One oft-repeated theory for the volcanic activity of the Azores is that of the mantle plume. Yet, this theory is not universally accepted. Perhaps the classic mantle plume "hot spot" is that theorized to exist underneath the Hawaii chain of islands. There the islands exhibit a progression of ages away from the theorized "hot spot."

The Azores, on the other hand, do not exhibit a gradation of ages, but instead have ages which are haphazardly arranged around the Azores underwater plateau. Intraña challenges the mantle plume ("hot spot") hypothesis in general, opting for alternative mechanisms to explain the observed phenomena.

Ritsema and Allen discuss in detail the methods needed for verifying the existence of mantle plumes. They admit that though the "mantle plume is a well-established geological structure in computer modeling and laboratory experiments [...] an undisputed seismic detection of one has yet to be made."

It seems clear, though, that some kind of damage allowed magma to move upward in the region of the Azores, giving rise to the volcanoes which make up the archipelago, today. This also created a persistent bulge known as the Azores underwater plateau.

What actually caused the Azores underwater plateau and gave rise to the Azores archipelago?

**Hypothesis**

Approximately 50–60 Mya, mountain building got a boost at the Africa-Eurasia border in the North Atlantic. This created an impediment to the subduction underway by the Africa underneath the Eurasia. The result was plate compression locally.

The exact cause of this impediment can only be conjectured, but as already stated, such might have been created from compressional stress against the North Atlantic triple junction, where the boundaries of the North America, Eurasia and Africa plates meet.

After millions of years, crustal folding from plate compression resulted in an island or islands. This was the future Atlantis. But such compression could not continue forever.

Then, about 36 Mya (Searle), the Terceira Ridge was started. It is hypothesized that this was a result of plate rotation initiated because compression could no longer proceed, locally. While subduction continued farther East with relative ease, the only possible result was a change in the plate's Euler pole, rotating Africa in a new direction relative to the Eurasia.



Something caused the Eurasia to choke on the Africa plate, locally.



Mountain building can only extend so far. Picture courtesy Wikipedia.org.



Currently, the Africa-Eurasia plate boundary across the Mediterranean is largely convergent (lavender), including subduction zones (blue). Green=transform, red=divergent. Original map courtesy Wikipedia.org.

**A Pattern of Rotation**

Navarro, et al (2003) note that from preliminary findings restricted to the Western Terceira Island, the boundary locally is "exhibiting a clockwise rotation of about 8° per million years."

The overall pattern, from plate boundary divergence in the West to strong convergence in the East, proves to be one of rotation. The current Euler pole, already mentioned, is a product of this rotation.



Blocked movement at the new Atlantis, but continued convergence farther East, resulted in new plate rotation.

**Saharan Stretch Marks**

When a landmass has been moving in one direction and suddenly changes direction, that landmass will likely experience stress fractures.

If the Africa plate had been committed to northward movement, then changed to one of rotation, certain sheering forces were bound to have impacted the plate. Some features in the Sahara Desert include fractures or faulting dated to approximately 35 Mya. Conveniently, this dates to one million years after Searle's start of the Terceira Ridge and the change in Africa plate rotation. One must use caution, however, because dates have a tendency to change as new data is achieved from different researchers or techniques. For now, it appears there may have been a cause-and-effect relationship between the change in plate rotation as signaled by the initiation of the Terceira Ridge, and some of the fracturing and volcanic features in the Sahara.

But the sheering forces did not stop there.



Between 30–23 Mya, the Africa plate suffered the loss of the Arabia. This was the start of the Great Rift Valley, which continues to form even today.

## Tearing off a Corner

The website, Answers.com, tells us that the Arabia plate was split off from the Africa approximately 20 Mya when the Red Sea was formed. Earlier sources placed the date closer to 30 Mya. Wikipedia puts the formation of the Arabia plate in the Oligocene epoch (36-25 Mya), with the start of Red Sea rifting occurring in the previous epoch (the Eocene, 58-36 Mya).

The Africa plate loss of Arabia might be an extension of the shearing forces from the plate's change in direction after the more perfect blockage at Atlantis. Part of the plate was committed to northward movement, but another part was being forced to rotate around the new Euler pole, and the new rotation won.

## Messinian Salinity Crisis

Based on the work of Hsü and others, starting about 5.96 Mya, the Mediterranean became an isolated body of water as the Strait

of Gibraltar became blocked. A number of factors, including hot Mediterranean sun, and Ice Age reduction in precipitation and reduction in river runoff, resulted in the near-complete desiccation of the Mediterranean basin. There were occasional episodes of flooding and re-desiccation. Finally, about 5.33 Mya (the end of the Messinian Age of the Miocene Epoch), the Mediterranean flooded completely and has not dried significantly since then.



For nearly 600,000 years, the Mediterranean was a mile-deep desert.

During the height of the crisis, temperatures at the lowest levels might have reached as high as 80°C (176 °F).

What actually happened to the Strait of Gibraltar? How did it become blocked? And what mechanism unblocked it?

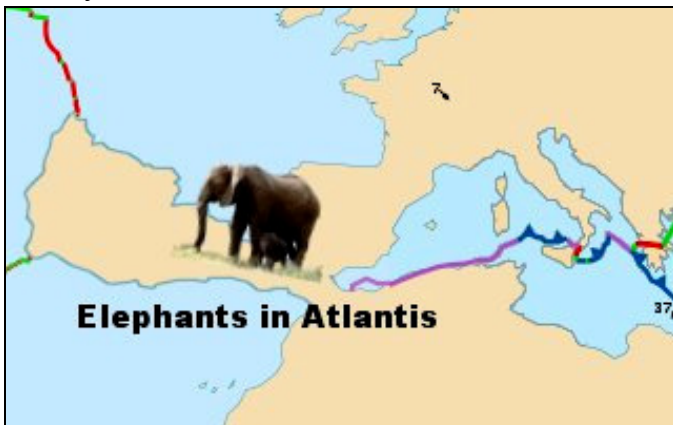
Shortly after the Messinian Salinity Crisis, and a little more than 5.2 Mya, the Madeira Island was formed. According to MadeiraNature.com, the island subsequently sank and was reformed during two subsequent eruptive phases — 4.07–2.55 Mya and 2.19–1.62 Mya.

Could the mechanism which closed off the Mediterranean be related to the mechanism which later opened it up and even later gave birth to the Madeiras?

Similar to a paper jam in a printer, the Africa plate, jammed at Atlantis, was now being forced to rotate around the new Euler pole. Subduction adjacent to Atlantis would cause more crustal folding (crumpling) which

would become a new source of impediment. This would result in the area of damage growing toward Gibraltar.

From Searle's 36 Mya to the start of the Messinian Salinity Crisis about 5.9 Mya, the damage had been growing toward Gibraltar. And for close to 600,000 years, Atlantis was a peninsula of Africa-Eurasia. Perhaps this is how Plato's Atlantis got its elephants: they merely walked there.

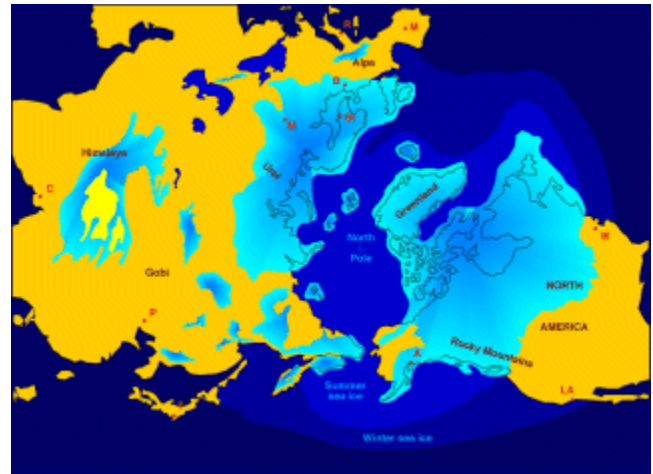


The land bridge formed along the tectonic plate boundary allowed Atlantis to receive many immigrants.

## Post-Glacial Rebound

During an Ice Age, like the one that ended twelve thousand years ago, millions of tons of ice cover large areas of land. This immense weight depresses the Earth's crust causing the land underneath to be lower than it would normally be.

When all that ice melts, the land rebounds toward its normal elevation. In a relatively closed system such as the Earth's interior, when some parts go up, other parts must go down to compensate. The term "post-glacial rebound" is slowly being replaced with the more appropriate "glacial isostatic adjustment" because more than upward movement is produced by the post-Ice Age meltdown.



Thick sheets of ice covered much of Europe and North America. Map courtesy Wikipedia.org.

The greatest change realized by this adjustment effect was felt toward the end of the last Ice Age — about the time Atlantis supposedly subsided. This was the "elastic" phase, when Earth experienced the greatest rates of change.



Before they melted, the great ice sheets of North America and Europe were as much as a mile thick. Picture courtesy wikipedia.org.

The rebound or adjustment continues even today, but at a much slower rate, the forces diminishing over time. This more gradual change is referred to as "slow viscous flow" and may continue for another ten thousand years.

One example of both effects (up and down) involves Great Britain. Wikipedia, in its article on Post-glacial rebound, tells us that while

northern Great Britain experiences continuing rebound, the southern half of the island is experiencing a corresponding subsidence. Combined with rising sea levels from global warming, London is threatened by increased flooding.

The Great Lakes of Canada and the United States give us another example of this effect. Southern shorelines experience rising water levels while the northern shores witness falling levels.



Atlantis may have suffered the brunt of "post-glacial rebound" at the end of the last Ice Age.

Could Atlantis have suffered from the effect of rebound compensation? Could it have been "sucked" down to make up for the crustal rise in North America and Northern Europe?

If Atlantis had already been weakened by the extensional forces of gravity and rotation around the initial region of plate boundary damage, then rebound compensation could have accelerated the weakening and ultimate collapse. Atlantis may have been the weakest link, globally. With two regions of energetic uplift on both sides of the Atlantic, Atlantis in between likely suffered the brunt of the required compensation for the American and European rebounds.

## **Geological Evidence**

The 1980 compilation by Corliss includes several enigmas that support the past possibility of Atlantis. One such report (p.282) details fragments of shallow water limestone found in the Vema Fracture Zone in the middle of the Atlantic, far from Africa and South America. Some of the shallow water fossils included in the samples imply formation in water less than thirty meters deep. The work of the scientists was reported in *New Scientist*, 66:540, 1975, and *Earth and Planetary Science Letters*, vol. 26, p. 8.

Corliss also mentions recrystallization discovered in the limestone. "Oxygen- and carbon-isotope ratios prove conclusively that this process must have taken place subaerially 'through the action of meteoric water enriched in light carbon while passing through a soil zone...' A pitted limestone sample bears evidence of tidal action." In other words, the limestone had, in its past, been exposed to the open air.

Another report (*ibid*, p.219) filed in *Scientific American*, 221:54, July 1969, raises the possibility that there may be oil-bearing formations in the abyssal depths of the ocean. "Seismic-reflection records made by the research ship *Kane* last July [from July 1969] disclosed the existence of geologic structures resembling salt domes in sedimentary layers of the ocean bottom at a depth of 15,000 feet northwest of the Cape Verde Islands. Salt domes are widely associated with oil deposits on land, in shallow seas and on continental shelves. The Cape Verde structures also resemble an oil-bearing salt dome discovered at oceanic depth in the Gulf of Mexico last summer by the deep-drilling ship *Glomar*

*Challenger*." Such discoveries were sobering surprises for geologists.

Corliss includes another eye-opener (p.368), from *Geological Society of America Bulletin*, 65:1261, 1954, concerning seamounts in the North Atlantic. "The Atlantis, Cruiser and Great Meteor seamounts rise from a broad ridge or plateau which extends from the Mid-Atlantic Ridge at 37° N. 32° W. southeast to Great Meteor Seamount at 30° N. 28° W.... About a ton of flat pteropod limestone cobbles was dredged from the summit area [of the Atlantis Seamount]. One of the cobbles gave an apparent radiocarbon age of 12,000 years ± 900 (J. L. Kulp). The state of lithification of the limestone suggests that it may have been lithified under subaerial conditions and that the seamount may have been an island within the past 12,000 years.

R. Cedric Leonard, on his Atlantis Quest website, offers several thought-provoking items of geological evidence concerning land in the middle of the Atlantic that subsided several thousand years ago. Nearly all of these reports come from respected journals. A small, but vital portion has been included here:

In 1948 Dr. Ewing, one of the bitter opponents of Atlantis, sailed up and down the Mid-Atlantic Ridge during the Woods Hole Oceanographic Expeditions to the Mid-Atlantic Ridge. Numerous samples of tremolite asbestos were brought up. Ewing made this significant comment: "Such rock is generally considered typical of continents and not of ocean basins" (Ewing, 1948).

Important also was the discovery of "beachlike terraces" beneath two miles of ocean water. Ewing cautiously observed: "It is, of course, extremely radical speculation to identify these level stretches more than two miles below the sea surface as former beaches. Such a theory would require the obvious but almost incredible conclusion that the land has subsided two miles or else the sea has

risen by that amount" (Ewing, 1948). However, subsequent expeditions only strengthened the "incredible."

According to Ewing, long flat stretches were detected 2 to 20 miles wide and hundreds of miles long. These beach-like areas were always covered with thick sediments, indicating a long period of deposition, although occasionally separated by mountainous "higher ground" exhibiting no such sediments. (The Central Highland of the Ridge occasionally approaches four-fifths of a mile from the sea surface.) Ewing observed that deep ocean basins never have thick sediments—which are the result of surf action and river deposition—it is actually *shorelines* that display thick sediments. More evidence of just how recently such a landmass existed turned up during an expedition the following year.

The follow-up expedition in 1949 turned up numerous core samples from these terraces. These cores contained two different strata of beach sand: the older estimated to be 225,000–325,000 years of age, and the younger 20,000–100,000 years old (Ewing, 1949). Another significant fact is that the deposits were found to be well-sorted by surf action into the usual pattern of shoreline beaches familiar to geologists (Miller & Scholten, 1966). His conclusion was that: "Sometime in the distant past this sand found deep beneath the ocean must have been located on a beach, at or near the surface of the sea" (Ewing, 1949).

During this second Woods Hole Mid-Atlantic Ridge Expedition Dr. Ewing once again dredged up continental type rocks. Sample after sample containing large masses of sial were brought up all along the Mid-Atlantic Ridge. It became obvious that granite and sedimentary rocks "which originally must have been part of a continent" were abundant (Ewing, 1949). Dr. Bruce Heezen, oceanographer with the Lamont-Doherty Geological Observatory, observed that this type of rock indicates "possible sunken land masses" (Heezen, Tharp & Ewing, 1959).

Geologists have short memories when it comes to Atlantis. A geologist reviewed the Woods Hole

expeditions of 1948-1949 barely ten years later and wrote a report on the findings (Cifelli, 1970). I read his report, word for word and cover to cover: *not a word was written concerning the numerous findings of continental material (sial) along the Mid-Atlantic Ridge*. Dr. Ewing was puzzled, even dismayed, by these particular discoveries; yet he was honest enough to report them. Why were these astounding facts not included in Richard Cifelli's review? Can professional geologists be this one-sided?

Still another oceanographic expedition, Swedish Deep-Sea Expedition of 1947-1948, yielded core samples containing sand from the Romanche Deep along the Mid-Atlantic Ridge. Dr. Otto Mellis did not publish these findings until ten years later (Mellis, 1958). Other geologists have guardedly admitted that the Azore Islands (Central Atlantic) are composed chiefly of continental material, some even conceding that there might be enough continental material (sial) in the mid-Atlantic to make up a landmass the size of Spain (de Camp, 1970). This is not much smaller than the size I have been proposing for the island of Atlantis.

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### Analysis

We know that the Azores have existed for several million years, and that this archipelago sits atop an underwater plateau. As we have

seen, there appears to be a great deal of geological evidence in support of the possibility past existence of Atlantis. Here we review some of those facts, look at the hypotheses based on those facts, and discuss the implications.

**Fact:** The area between the Azores and the Strait of Gibraltar has suffered a great deal of geological damage.

**Fact:** The tectonic plate boundary from Gibraltar to the Azores (the Gloria Fracture Zone) is broken up and indistinct.

**Fact:** There is a large bend in the boundary at the eastern end of the Azores archipelago. Up to this point from the East, the Africa-Eurasia boundary is largely East-West in its direction. From this bend toward the mid-Atlantic ridge, the boundary becomes Northwest-Southeast.

**Fact:** There is a large underwater plateau on which the bulk of the Azores chain sits.

**Fact:** There is a spreading center along that Northwest trending bend in the plate boundary called the Terceira Ridge. This means the boundary is divergent in that region.

**Fact:** Between the Terceira Ridge and Gibraltar, the boundary is transform or only slightly or intermittently convergent.

**Fact:** Across most of the Med, the boundary is strongly convergent.

**Fact:** The pattern of plate motion along the entire Africa-Eurasia boundary is one of rotation. In fact, the Africa-Eurasia Euler Pole is almost exactly due south of the Terceira bend, approximately 1,840 km (1,140 miles) south of the plate boundary.

**Fact:** There is a strongly-supported hypothesis that Africa once nestled against South America and that the two land masses broke apart approximately 200 Mya.

**Discussion:** How can we treat a hypothesis as fact? Certainly, this weakens any argument, but all "laws" of science are subject to amendment, revision, or outright repeal. For all intents and purposes, such a "working hypothesis" acts as a surrogate law.

When a preponderance of data suggests that an assertion is true, we can treat that assertion as true for the purposes of investigating other more minor hypotheses. Here we deal with relative truths, not absolutes. For every Newton there may come some day an Einstein to say, "You almost had it right." And Newton's laws of motion work well up until one reaches near-light velocities. Then, Einstein's relativity takes over.

**Fact:** That same strongly-supported hypothesis warrants that Africa moved northward toward the Eurasia, closing up what would one day become the Mediterranean.

**Premise:** The northward movement of the Africa plate included subduction (plate convergence) along the Gloria Fracture Zone.

**Discussion:** At this point, the ocean floor crust that was to become the Azores underwater plateau did not exist as such. That future crust was still in the Earth's mantle awaiting its birth at the mid-Atlantic ridge (spreading center).

**Fact:** Most mountains are found near convergent tectonic plate boundaries, formed from the actions of subduction, friction from impediments, or convergent compression, and the resultant crustal folding, or they are formed from subduction-related volcanism.

**Premise:** The current damaged state of the region from Gibraltar to the Azores was caused by crustal folding and subsequent tectonic collapse.

**Premise:** Atlantic Ocean subduction of the Africa under the Eurasia met with sufficient impediment to cause complete blockage at one point on the Africa-Eurasia boundary.

**Discussion:** Complete blockage from impediments to subduction could have converted all northward motion of the Africa plate with regard to the Eurasia into crustal folding locally, i.e. mountain building. This may have started with the deflection of the plate boundary toward the Northwest, perhaps as much as 60 Mya. However, subduction would have continued farther east of the area of damage.

**Premise:** This impediment to subduction resulted in sufficient mountain building to create an island in the middle of the North Atlantic east of the mid-Atlantic ridge.

**Premise:** Circa 36 Mya (date given by Searle, 1980, for the start of the Terceira Ridge), northward movement of the Africa against the impediment to subduction could no longer proceed and local mountain building ceased, deflecting motion around the area of blockage. This initiated the current pattern of rotation and established the current location of the Africa-Eurasia Euler Pole.

**Premise:** Deflected movement of the Africa plate meant decreased support for the folded crust in this region, opening the door for eventual subsidence from the effects of gravity, extensional spreading and post-glacial adjustment.

**Fact:** Approximately 5.9 Mya to 5.33 Mya, the Strait of Gibraltar was blocked, leading to the desiccation of the Med and to the Messinian Salinity Crisis (Hsü, 1983).

**Premise:** Continued subduction adjacent to the area of crustal folding led to boundary damage creeping along the boundary toward Gibraltar.

**Discussion:** This is like a paper jam in a printer. Crumpling of paper at the point of obstruction leads to crumpling more distant from that point of obstruction, which in turn becomes a new point of obstruction. With continued subduction, the spread of this "disease" eastward was inevitable.

**Premise:** The blockage at the Strait of Gibraltar was the result of 30 million years of boundary damage creep, connecting the continents with the former island.

**Fact:** Plato states that Atlantis contained many elephants.

**Fact:** Elephants existed in Europe and Africa as far back as 10 Mya, perhaps even longer ago.

**Premise:** Elephants from Africa and/or Eurasia merely walked across the Atlantis peninsula while Gibraltar was blocked.

**Premise:** The subsidence of the Atlantis landmass could have started as early as the initiation of plate rotation around the current Africa-Eurasia Euler Pole.

**Premise:** The reopening of the Strait of Gibraltar was the result of this ongoing weakening of this raised sea floor and from the continued rotation of the Africa around the current Africa-Eurasia Euler Pole.

**Fact:** North Africa suffered from faulting, the Hoggar (Ahaggar) bulge and volcanism circa 35 Mya (Liégeois).

**Fact:** The Africa plate suffered a major fracture and the loss of what is now the Arabia Plate circa 30–23 Mya.

**Fact:** The Great Rift Valley of East Africa is an extension of the Arabia plate break off. It is an incomplete spreading center that is in the process of creating another tectonic plate (currently the Somalia Sub-plate).

**Premise:** The rotation of the Africa plate around the current Euler Pole was sufficient

change in plate motion to cause the stresses observed in North Africa and along the Great Rift Valley, and these resulted from the impediment to subduction at the uplifted sea floor (Atlantis).

**Fact:** The Younger Dryas (YD) was a 1,300-year return to Ice Age conditions which abruptly started about 10,900 BCE, and just as abruptly ended about 9620 BCE.

**Fact:** A popular hypothesis has the YD caused by the sudden flooding of the North Atlantic with several cubic kilometers of fresh water from prehistoric Lake Agassiz. A critical ocean current, part of the thermohaline cycle, was cut off by this pulse of fresh water. This plunged the world into what has been called, the "Big Freeze."

**Fact:** Something broke the freshwater cap on the North Atlantic that had stopped the thermohaline circulation of the world's oceans, and this abruptly ended the Younger Dryas at about 9620 BCE.

**Fact:** A moderately large volcanic trace was deposited in Greenland 9620.77 BCE. Another, smaller trace was deposited two years later.

**Fact:** The 1989 chart of sea level rise by Fairbanks (*Nature* magazine) shows a 2-meter drop at the end of the Younger Dryas (now dated at about 9620 BCE).

**Premise:** This 2-meter drop was a proxy for a real event.

**Discussion:** If this 2-meter drop on the graph is a proxy for a real event, then a massive tectonic subsidence likely occurred. The only other realistic way to remove that much water from the world's oceans would be to precipitate out that amount as ice and snow, deposited in the far North or far South. Yet, such abrupt loss could not have been achieved by the effects of weather. That process is too

slow. The abrupt drop in sea levels worldwide could only have been achieved by the tectonic collapse of a landmass roughly equal in volume to an area the size of Texas and down approximately 1,000 meters (3,280 feet).

**Fact:** The melting of thousands of cubic miles of ice from North America and Northern Europe resulted in an effect known as "post-glacial rebound" or "glacial isostatic adjustment" (uplift or subsidence).

**Premise:** Continued weakening of the uplifted sea floor from Africa plate rotation and post-glacial adjustment caused the final subsidence of Atlantis at about 9620 BCE. And the effects of this one-day collapse included a megatsunami which broke the freshwater cap on the thermohaline cycle. This abrupt collapse also produced volcanic events, the debris of which found its way to Greenland. And the evacuation of the Atlantis landmass from the North Atlantic left a void which, when filled, lowered ocean levels worldwide by roughly two meters.

**Fact:** Plato tells us that the Greeks concurrently lost their homeland from earthquakes and massive flooding which removed their rich topsoil.

**Premise:** The megatsunami produced by the collapse of Atlantis overwhelmed the Strait of Gibraltar, traversed the length of the Mediterranean and flooded the Greek homeland.

**Fact:** Greece is near the same tectonic plate boundary which ran through Atlantis.

**Premise:** The violent tectonic collapse of Atlantis produced effects not seen for earthquakes lower on the Richter scale. These effects produced earthquakes in Greece which added to the destruction produced by the megatsunami flooding.

**Fact:** Plato mentions that the Egyptian civilization of the priest who talked to Solon (and gave us the story of Atlantis), began 1,000 years after the destruction of Atlantis. Therefore, the Egyptian civilization which suffered the attack by Atlantis was an earlier civilization.

**Premise:** The prior Egyptian civilization was also destroyed by the megatsunami and earthquakes produced by the collapse of Atlantis.

## Conclusion

Atlantis was geologically possible at the location given by Plato. Admittedly, much work is needed to prove this hypothesis.

Atlantis, if it existed, was likely rare, and possibly unique in the geological history of Earth. Convergent compression at an ocean-to-ocean plate boundary may have happened rarely. With such a rare occurrence, would today's professional geologist really know what to look for? Would they recognize the signs of such a sequence of events?

There are many unsolved puzzles in the region Plato gives us for Atlantis. The indistinct nature of the Azores-Gibraltar plate boundary is one. The source mechanism for the Azores archipelago and its underlying plateau is another. And the cause of the Terceira Ridge is yet another.

The fact that these puzzles exist right where Plato's Atlantis supposedly stood is far from proof of anything in the matter of this mythical island. This hypothesis is only one possible solution to these puzzles.

## Beyond Geology

According to Plato, Atlantis had colonies in the Mediterranean and across the Great

Ocean (Atlantic), on the opposing, unnamed continent (America?) and its islands (Caribbean?).

As sea levels were far lower 9600 BCE, the remains of those colonies might be just off the coast in those locations. Careful study of past conditions (old rivers, natural harbors, etc.) might lead researchers to prime sites for investigation. Thousands of years of silt may cover ancient ruins left by Atlantis.

Such locations would be far easier to investigate than the homeland itself. The capital of Atlantis, if indeed it existed, might be as much as three kilometers under water.

We have a great body of evidence that suggests that the refugees of Atlantis were related to the Basques, some Native Americans, the Suomi (Finns), the Etruscans and possibly the Sumerians, Georgians, Dravidians and Mon-Khmer.

We also have linguistic and cultural data which suggests that the latter-day Atlanteans and their refugees were matriarchal.

For more information on these aspects of the Atlantis story, see "Myth and Atlantis," and "Refugees of Atlantis," available at [www.MissionAtlantis.Com](http://www.MissionAtlantis.Com)).

## Glossary

Atlantis — the legendary island that Plato mentioned in his dialogues *Timaeus* and *Critias*. The island, according to Plato, was the size of Ancient Libya and Asia Minor combined, and located outside the Strait of Gibraltar, the nearest portion facing Gadir (Cádiz), Spain.

Azores — An archipelago in the North Atlantic straddling the Mid-Atlantic Ridge and adjacent to the boundary between the Africa and Eurasia tectonic plates.

BCE — Before Common Era. Secular equivalent to B.C.

BP — Before "present" (1950).

CE — Common Era. Secular equivalent to A.D.

convergent — one of the types of tectonic plate boundaries, this one characterized by both plates approaching each other and one sliding underneath the other in an action known as "subduction."

*Critias* — One of three dialogues by Plato which included the story of Atlantis. *Hermocrates*, the third dialogue in the series, was never written and *Critias* was left incomplete. *Timaeus* was the first in the series.

divergent — one of the types of tectonic plate boundaries, this one characterized by both plates moving away from each other, creating new crust from the rising mantle material.

glacial rebound — post-glacial rebound or, more recently, glacial isostatic adjustment. Land depressed by the great weight of Ice Age glaciers rebounds when that ice melts. Farther from the region of glacial coverage, land tends to subside in compensation for the areas of rebound. In other words, some land goes up and some goes down to compensate.

km — Kilometer, a measure of distance.

Literally "1,000 meters." This is equivalent to approximately 0.62 standard miles. km<sup>2</sup> (square kilometers) is a measure of area and km<sup>3</sup> (cubic kilometers) is a measure of volume.

kya — thousands (represented by the prefix, "kilo") of years ago.

lithify — to convert into stone; e.g. limestone from biological sedimentation.

mantle — an interior portion of the Earth's structure consisting of semi-molten rock under high pressure.

Mya — millions of years ago.

Plato — A Greek philosopher of the fourth century BCE (c. 428–348 BCE). His mentor was the equally famous philosopher, Socrates while one of his students, Aristotle, was the tutor of Alexander the Great.

post-glacial rebound — see "glacial rebound."

subaerial — under air rather than under water.

subduction — the action of one tectonic plate sliding underneath the edge of another plate. This occurs at what is called a convergent boundary.

*Timaeus* — The first of three dialogues by Plato which included the story of Atlantis. *Hermocrates*, the third dialogue in the series, apparently was never written and *Critias* was left incomplete.

transform — one of the types of tectonic plate boundaries, this one characterized by one plate sliding past another one, but neither converging nor diverging.

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