

Is Atlantis related to the green Sahara?

Abstract

Most scholars take Atlantis as Plato's invention to promote his political ideal articulated in his masterwork *The Republic*. This paper points out that the green Sahara period encompasses the time of Atlantis according to Plato's records. The transitions between the green Sahara and desert Sahara were controlled by the water cycle stability in the Atlas Basin, an area fitting all the features of the Atlas Empire as described in Plato's *Timaeus* and *Critias*. The historical account of Atlantis by Plato is compared with the newly identified site, the timelines of climate changes, a likely hydrological process, and the geographical profiles in the Atlas Basin.

Keywords: green Sahara, Atlantis, Plato, water cycle stability, rain shadow effect, Atlas Basin, Atlas Empire, inundation

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Abbreviations: AB, Atlas Basin; BP, calendar year before 1950 AD; *E*, evapotranspiration; GDEM, global digital elevation model; GSP, green Sahara period; ka, 1000 calendar years; km, kilometer; m, meter; masl, meter above sea level; *P*, precipitation; YD, Younger Dryas

Introduction

Atlantis is commonly viewed as a fictional island mentioned in an allegory on the hubris of nations in Plato's works *Timaeus* and *Critias*, wherein it represents the antagonist naval power that besieges ancient Athens, the pseudo-historic embodiment of Plato's ideal state in *The Republic*.¹ The Atlantis story has many connections with the Mediterranean (especially Greek) myths and Egyptian cultures. In the early days of Egyptology it was thought that Egypt was simply a gift of the Nile. After the 1980s, archaeological excavations in Egypt's Western Desert began to clearly identify the 'Saharan affinities' of the Pre-dynastic Egyptians. Friedman² believes that Egypt and Nubia were also 'gifts of the desert.' Plato describes Atlantis to have ruled Libya as far as to the borders of Egypt.³ That means Atlantis must have been located west of Libya, and Libya itself must already have been part of the Atlantean territory. Based on water cycle stability and paleoclimate data, Zhang⁴ reconstructed the desertification process in North Africa following the green Sahara – an abrupt dry out in the Atlas Basin and a gradual desert expansion afterward powered by trade winds and westerlies. With the gradual desert expansion from northwest to southeast, people living in the Sahara were squeezed to the Nile valley. The population conglomeration gave birth to the dynastic Egyptian civilization which started about 5000 years ago, shortly after the end of the last green Sahara.

Rapisarda⁵ examined the coincidence between the period of the alleged foundation of Egypt (according to traditional Egyptian sources) and some remarkable events that characterized the end of the Ice Age. He suggests that the memory of these events might have inspired Plato and there might be some truth in the Atlantis story. Egypt had divine rulers and confederations of kings with one supreme sovereign and many other smaller kings (governors) bound by a covenant. Herodotus states that at that time Egypt was divided into twelve districts with twelve kings over them. The kings concerted ritual action by pouring libations together and making a sacrifice. Herodotus locates this in the temple of Hephaestus (Ptah), though he adds that the kings met also in all the temples. There are

so many similarities between Egypt and Atlantis as portrayed by Plato that Egyptologist Griffiths⁶ believed that Plato invented the Atlantis story based on Herodotus' writing on Egypt. There are some other historical notes reflecting the relationship between Egypt and Atlantis.⁷ Orpheus, a Greek philosopher, wrote: "In Chaldea the twin sister of Egypt, daughter of Poseidon, King of the lands beyond the sea and Libya." Herodotus mentioned: "The Egyptians boasted that their ancestors in the lands of the West, were the oldest men on earth." Diodorus informed us: "The Egyptians themselves claimed that their ancestors were strangers who in very remote times settled on the bank of the Nile, bringing with themselves the civilization of their mother country, the art of writing and a polished language. They had come from the direction of the Setting Sun and that they were the most ancient of men."

Is the Atlantis account a pure fiction, a credible history, or a mixture? Plato himself claimed the story as fact and gave a clear thread.⁸ The records on Atlantis were meticulously kept and handed down through many generations in Egypt. It was a very old priest in the city of Saïs who told the Atlantis story to Solon, an Athenian lawmaker and one of the Seven Sages. In his book 'Life of Solon', Plutarch says that Solon spent some time in intellectual converse with Psenophis the Heliopolitan and Sonkhis the Saïte, who were very learned priests.⁶ In fact, Plato did not portray Atlantis as a wicked power but described it as a great and wonderful empire. He praised many virtues of the Atlanteans and suggested that it was the weakening of the divine element that brought about lack of moral balance which led to decline. However, the allegorical theory of Atlantis is inconsistent with Plato's records. According to the statement in his *Timaeus*, Athens suffered the same fate as Atlantis.³

Borchardt, a German archaeologist, claimed to have located Atlantis between the Chotts and the Gulf of Gabes in Tunisia.⁹ He believed he had discovered Atlantean ruins at Qabes, but these ruins were later found to be of Roman origin. He informed us that Chott Djerid had also been known locally as Bahr Atala (Sea of Atlas). Hofmann¹⁰ supports the idea of Atlantis as a Bronze Age city located in North Africa. He believes that the Chotts in what are today Algeria and Tunisia originally constituted the lake Tritonis of Greek legend and was also known as the Atlantic Sea and connected to the Mediterranean at the Gulf of Gabes, where the 'Pillars of Heracles' were situated. Zhang¹¹ identified a site between the Chott Melrhir and Chott Djerid perfectly fitting with Plato's description of Atlantis.

This paper will review the climate research findings clearly defining the start and end of the last green Sahara, which include the Atlas Empire era according to Plato. The water cycle stability in the Atlas Basin will be explained for the abruptness of these transitions. The geographical features will be compared with Plato's account and a possible inundation process will be explored.

Water cycle stability

Climate background

After the Last Glacial Maximum started receding around 20,000 BP, the Younger Dryas (YD, c.12,900-11,700 BP) temporarily

reversed the gradual climatic warming. Corresponding to the short-term global cooling, the Sahara experienced a rapid desertification. Around 12,000 years ago, the Sahara quickly turned to green and lasted about six thousand years until 5700 years ago. Figure 1 shows the dust flux (normalized with low dust flux between 6-8 ka) changes obtained by McGee et al.¹² and deMenocal et al.¹³ from the marine cores extracted at four different locations very close to northwest Africa coast from 19°N to 27°N. As shown in Figure 2, these locations are right in the (trade wind) downwind area of the Atlas Basin (AB). Therefore, the dust accumulation rate on the sea floor clearly reflects the environmental conditions in and around AB.

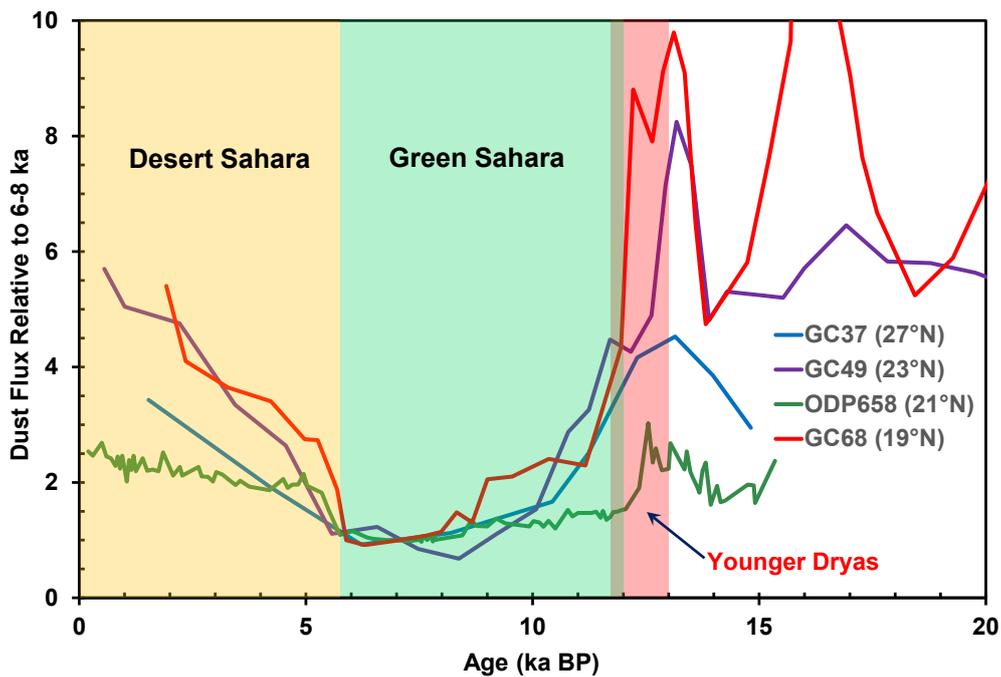


Figure 1 Dust flux changes (normalized with low average between 6-8 ka) reflect environmental conditions in the Atlas Basin.^{12,13}





Figure 2 (a) North Africa and the Mediterranean during YD, (b) North Africa and the Mediterranean during GSP.

From c.13,500 to 12,000 BP, there was a dust flux peak, about 3 to 9 times higher than the lower dust flux level during the green Sahara period (GSP) from c.11,700 to 5650 BP. This high dust flux level indicates a desert condition in northwest Africa. It is debatable whether the GSP started earlier or at the same time of the YD ending. It is possible that the Sahara desertification and greening were leading the YD. After c.12,000 BP and YD, the temperature continued to rise. Being in the leeward area of the Atlas Mountain range, AB became warmer first, and the water cycle quickly switched from a desert condition to a green condition. Climate data show that both flips from desert to green and from green to desert were abrupt, taking only several decades.¹² According to Plato, Poseidon, the forefather of the Atlas Empire, was probably one of the first emigrants into AB after the area turned to green. Plato's *Timaeus* gives a very brief but accurate description about the location and size of the Atlas Empire: "...there was an island situated in front of the straits which are by you called the Pillars of Heracles; the island was larger than Libya and Asia put together, and was the way to other islands, and from these you might pass to the whole of the opposite continent which surrounded the true ocean; for this sea which is within the Straits of Heracles is only a harbor, having a narrow entrance, but that other is a real sea, and the surrounding land may be most truly called a boundless continent."³

In Figure 2, (a) shows the desert extent during YD time, and (b) shows the environmental condition of North Africa and the Mediterranean areas during GSP. In recent history, the 'Pillars of Heracles' refer to the promontories that flank the entrance to the Strait of Gibraltar (GSP). However, Apollonius of Rhodes (c.270 BC) located the 'Straits of Heracles' in the Gulf of Gabes. The 'Straits of Heracles' was the ~100 km waterway connecting the 'Atlantic Sea' (the present day Chotts area) to the Mediterranean Sea. The strait is confined by mountain ranges on the north and south sides (Figure 4). Aristotle (385-322 BC) writes that "outside the pillars of Heracles the sea is shallow owing to the mud, but calm, for it lies in a hollow."¹⁴ This is not a description of the Atlantic that we know, which is not shallow,

calm or lying in a hollow and which he refers to as a 'sea,' not an 'ocean.' Therefore, the 'Pillars of Heracles' must be the first highest mountain the Greeks and Egyptians saw when they looked to the west. The Atlas Mountain was regarded as the pillar of heaven.

About the size of the Atlas Empire, many scholars think Plato's description as an exaggeration when he says that Atlantis was an island "larger than Libya and Asia." Asia originally was just a name for the east bank of the Aegean Sea, an area known to the Hittites as Assuwa. Indeed, the area of the Atlas Empire was larger than Libya and Asia put together. It is surrounded by the Atlantic Ocean on the west side and the Mediterranean Sea on the north and east sides. This part of the African continent was likely viewed by the Athenians and Egyptians as an island or peninsula in prehistoric time. The empire was the way to other islands in the 'true ocean' we now call the Atlantic Ocean. Comparably, the 'Atlantic Sea' within the 'Straits of Heracles' was 'only a harbor, having a narrow entrance,' and 'the other (Atlantic Ocean) was a real ocean.' This 'narrow entrance' detail is very important to the fate of Atlantis, which will be explained later. The land (Africa and America) surrounding the Atlantic Ocean was said to be 'boundless.' All these descriptions are very accurate even by today's standards with satellite mapping.

Plato's *Timaeus* says "...in those days the Atlantic was navigable," which must mean that the Atlantic became unnavigable at a later time. The Atlantic Ocean as we know today has always been navigable. Therefore, the 'Atlantic Ocean' in *Timaeus* was actually the Chotts Megalake in AB. When its water level was high enough to discharge to the Mediterranean, the east to west length was about 190 miles (300 km) and north to south width was about 75 miles (120 km). The water surface area was about 26,000 km². Standing on the high ridge, one would have seen boundless water stretching to the horizon and would likely have thought he was looking at an ocean. Knowing that the Mediterranean Sea lay to the north may have created the illusion that the land was surrounded by water like an island.¹⁵

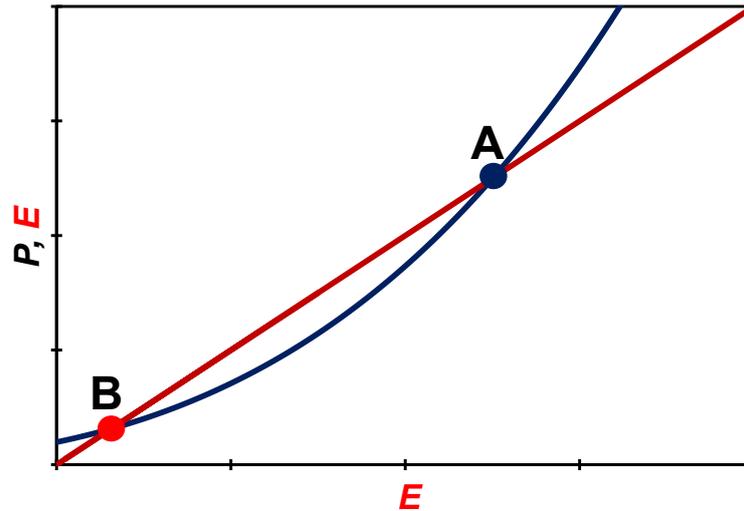


Figure 3 Nonlinear relationship between precipitation and evaporation in Atlas Basin.

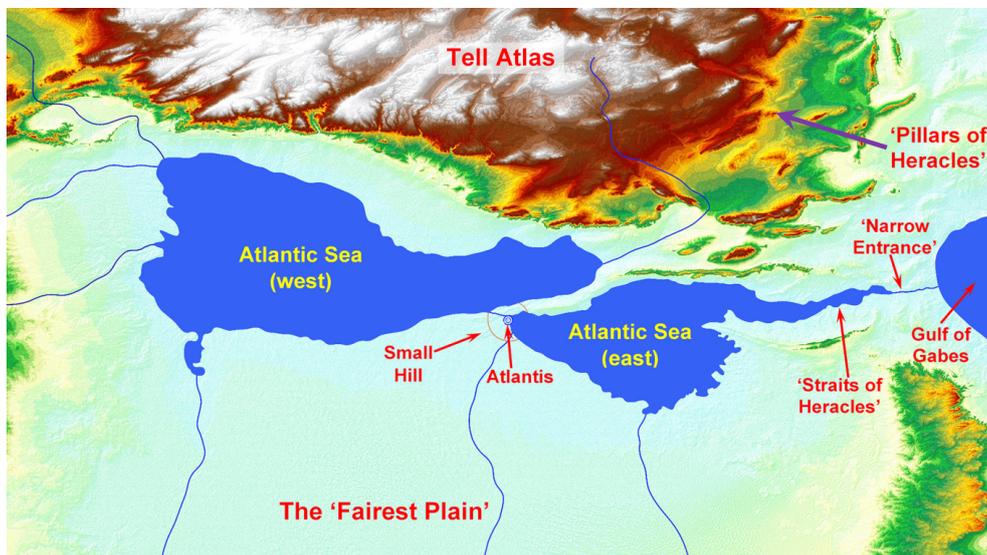


Figure 4 The likely twin Atlantic Sea and Atlantis site.

Water cycle stability in Atlas Basin

The main control of the transitions between desert and green is the local water cycle stability which is controlled by surface conditions and atmospheric circulation. Most of the airborne moisture is in the lower layer of the troposphere. Transition is a result of instability when a perturbation triggers the system to change from one status to another. The breach point of the Sahara is the Atlas Basin (AB), which is a standalone catchment and has its own water cycle. Because of the rain shadow effect of the Atlas Mountain, this area is the most vulnerable spot of Afro-Eurasia. Also, because of its leading position for the westerlies and trade winds, once the water cycle in this area is broken, it causes the downfall of the downwind areas including North Africa, West Asia, and the Mediterranean. Inside AB, the terminal Chotts Megalake plays an important role in stabilizing the water cycle with its huge water volume and surface area. Therefore, the ending of the green Sahara was caused by the drying up of the Chotts Megalake, triggered by a drought event superimposed on the southward shift of the monsoon belt due to the Earth's precession.⁴

There is a non-linear relationship between the mean precipitation (P) and the mean evaporation (or evapotranspiration, E). We can use

Figure 3 to illustrate this relationship between P and E in the Atlas Basin. P increases with increase of E from low to high, first slowly and then rapidly. When both P and E pass the critical point 'A', P will be higher than E , and there will be runoff surplus in the system. This water surplus must be discharged from AB, which is the flow from the Chotts Megalake to the Gulf of Gabes. If P is kept at a level higher than E , the water cycle is stabilized, and the AB ecosystem is maintained at a healthy, 'affluent' condition. However, the critical point 'A' is an unstable threshold. If P drops lower than this value, E will be higher than P , and the lake level will drop. The smaller water surface area will reduce the local relative humidity and further decrease P . The water cycle will get into a self-propelled destabilizing process, quickly move away from point 'A', and finally stabilize at point 'B', which corresponds to a desert condition.⁴

Location and inundation

Atlantis site?

The descriptions of Atlantis in Plato's *Timaeus* and *Critias* completely match the climate process and the geographical features in the Atlas Basin (AB). Then, did Atlantis actually exist, and if so,

can we identify its exact location? Plato's *Critias* gives this direction: "Looking towards the sea, but in the center of the whole island, there was a plain which is said to have been the fairest of all plains and very fertile. Near the plain again, and also in the center of the island at a distance of about fifty stadia, there was a mountain not very high on any side." On Google Earth, I looked for the small hill and circular features along the south side shoreline of the Chotts

Megalake (Atlantic Sea) corresponding to the water level at Atlantis' time. It only took about 20 minutes before I saw a crescent mark, part of the signature ring shape of Atlantis, perfectly matching Plato's description in size and layout as shown in Figure 5(a). The exact position is 33°49'45"N, 7°43'50"E.¹⁶ This location makes perfect sense to everything we know about Atlantis.

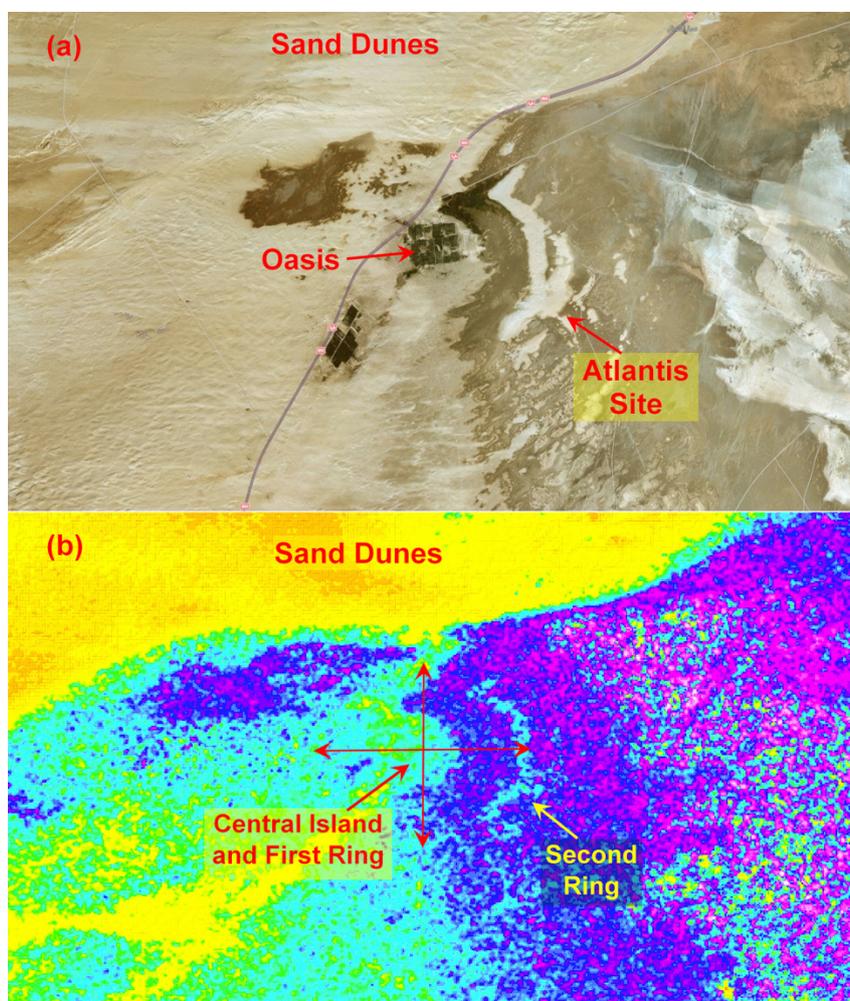


Figure 5 Surface profile around the likely Atlantis site (The arrow marked diameter is 3696 m).

Let us take Plato's Atlantis as fact and apply it to this newly identified site. Figure 4 shows the Atlantis location on shore of the Atlantic Sea, which has two megalakes (west sea and east sea) connected through a canal passing the moat of Atlantis. The surplus water from the west sea flowed to the east sea which further discharged to the Mediterranean Sea if there was an overflow. South of the twin Atlantic Sea was the 'fairest plain'. The Atlantis citadel was located on the south bank of the man-made canal and to the northeast side of the 'small hill.' It occupied a very important strategic position, controlling the water transportation and trade between the areas around these two seas. Near the south coast of the east Atlantic Sea, apparently the marshes were dredged as a navigable canal for ship sailing and access. Atlantis served as the central hub for water transportation between the 'fairest plain' and the north side of the sea and beyond to the Mediterranean Sea. On land, Atlantis was also at the central point between west and east of the basin. This unique location was the key for Atlantis' prosperity.

In Figure 5, (a) is the aerial image of the Atlantis site today from Zoom Earth, and (b) is the ground profile for the same area based on the Global Digital Elevation Model (GDEM). Amazingly, after more than ten thousand years of water and wind erosion, the surface profile of the citadel is still clearly visible, although partially buried under sand dunes. It is apparent that the water way between the outer circular zone and the inner circular zone became part of the canal connecting the west sea and east sea after the inundation. The land contours were severely eroded by water flow and dredging. The central island is still clearly recognizable.

The inundation

According to Plato's Dialogues, the Atlantis inundation occurred around 11,000 BP, about 1000 years after the green Sahara started. Occasional heavy rainfall in AB could raise the water level of the Atlantic Sea to submerge Atlantis in one day and one night if the

narrow outlet of the Atlantic Sea to the Mediterranean was blocked by a landslide. About the event and aftermath, Plato's *Timaeus* gives this description: "...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. For which reason the sea in those parts is impassable and impenetrable, because there is a shoal of mud in the way; and this was caused by the subsidence of the island."

The European and African tectonic plates collide across AB and the Mediterranean area. The collision accumulates a great amount of energy, and this energy is released through earthquakes from time to time. This was likely the cause of the 'misfortune' for both Atlantis and Athens about 11,000 years ago. A powerful earthquake could have caused widespread structure collapse and massive casualties in the Mediterranean area. The consequent high Tsunami would submerge the coastal areas of Athens and other nearby countries, claiming more damages and human lives. This same earthquake could also

have triggered a landslide at the 'narrow entrance' and blocked the water outflow (Figure 4). The 'narrow entrance' is a small gorge at the Atlantic Sea outlet formed by water erosion and dredging, about 30 meter deep. The blockage and the continuous inflow would quickly raise the water level of the Atlantic Sea to a height to submerge the island city Atlantis. The water level rise was likely accelerated by floods from upstream rivers due to heavy rainfalls. The water level rise was probably 5 to 7 meters. Figure 6(a) shows the land and water surface area around a prosperous Atlantis corresponding to water level 24 masl (meter above sea level) based on the present Earth surface profile. Figure 6(b) shows the same area flooded and Atlantis submerged by a water level of 30 masl. After the inundation, the area became a muddy shoal only several feet below the water surface, making the area "impassable and impenetrable." This water area was the connection between the west sea and the east sea. The subsidence of the debris blocked the waterways in and out of this area, making it difficult to identify a navigable path.

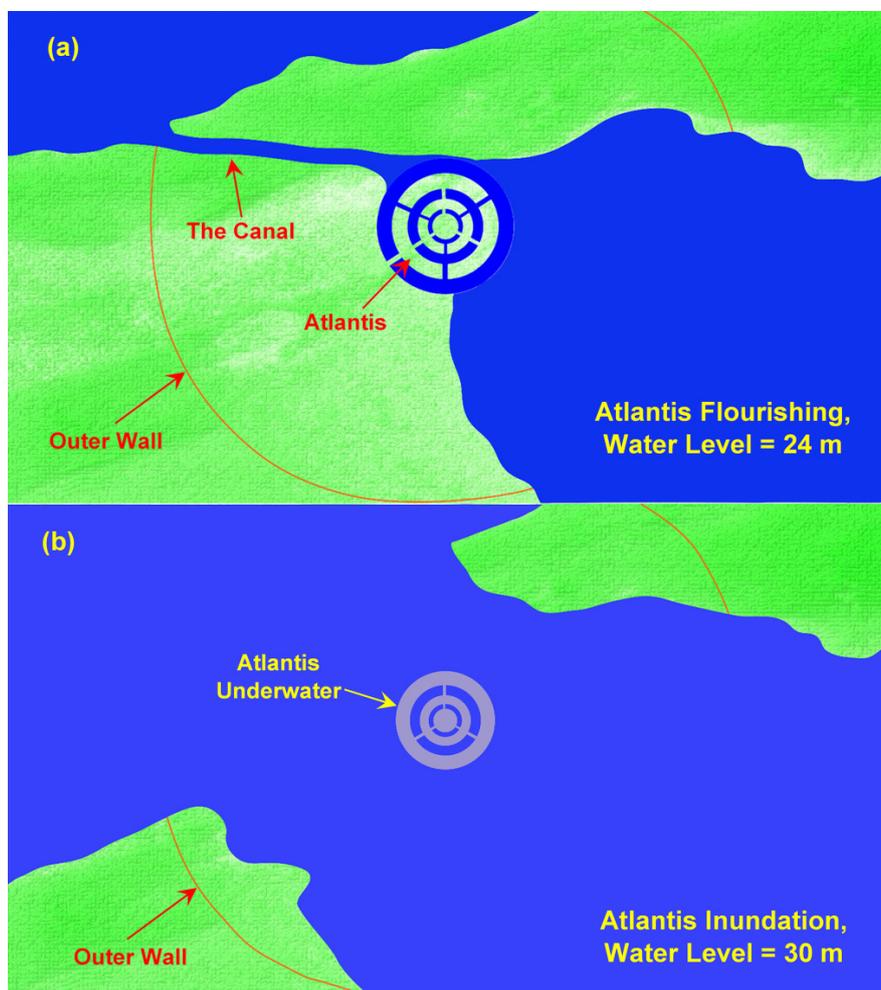


Figure 6 Atlantis before and after the inundation.

Profile and hydrology

The citadel

For measuring distance, Plato must have used the Olympic stadium (or stadion), which is 176 meters (m). Based on the detailed records given in Plato's *Critias*, the diameter of the Atlantis citadel is 3696 m, with a surrounding moat 528 m wide. Stones of white, black, and red

colors were used for building walls to please the eye. Satellite images show that the stone colors at the identified site indeed include white, black and red. In Southern Tunisia, the sedimentary outcrop belongs to six different geological periods.¹⁷ This type of outcrop usually provides good quality building stones with different colors including white, yellow, black and red. Plato's *Critias* also informs us that two springs of water were brought up "from beneath the earth, one of warm

water and the other of cold.” On the site shown in Figure 5(a), springs are still providing water for the oasis. Some nearby spring mounds are up to 25 or 30 m high due to long-time mineral deposition.¹⁸ The spring percolating from a deeper aquifer gives higher temperature than that from a shallower aquifer.

The ‘fairest plain’

In Plato’s *Critias*, the descriptions of the land profiles around the Atlantic Sea perfectly match the land profiles we see in AB. On the north side the ‘very lofty and precipitous’ area is the south slope of the Tell Atlas mountain. On the south side, “...the country immediately about and surrounding the city was a level plain, itself surrounded by mountains which descended towards the sea; it was smooth and even, and of an oblong shape, extending in one direction three thousand stadia, but across the center inland it was two thousand stadia. This part of the island looked towards the south, and was sheltered from the north.”

As shown in Figure 7, the shape and dimension of the plain within AB from GDEM are exactly the same as the above descriptions. The length of the plain in the north-south direction is about 528 km,

equivalent to three thousand stadia. The width of the plain in the west-east direction is about 352 km, equivalent to two thousand stadia. The plain is sheltered by the Tell Atlas mountain from the north side. Plato’s *Critias* says that the plain “was fashioned by nature and by the labors of many generations of kings through long ages.” ‘By nature’ means that the plain is flat with a running down slope of about 6.5 cm per 100 m, perfect for water flow, transportation and, at the same time, to avoid waterlogging and soil erosion. ‘By labors’ means that the magnificent canal network system was the result of continuous building up over many generations, implying a long-lasting green period.

Plato’s *Critias* gives detailed information about the ditch around the plain: “falling out of the straight line followed the circular ditch... it was carried round the whole of the plain, and was ten thousand stadia in length.” In Figure 7 the purple line marks the peripheral ditch. Its total length is indeed about 1760 km, equivalent to 10,000 stadia. After many thousand years’ erosion and deposition, this ditch is still clearly visible, which laterally cuts the runoffs from the mountain sides. The naturally formed gullies never go lateral and always wind down from top to bottom and merge with other streams to form a river.

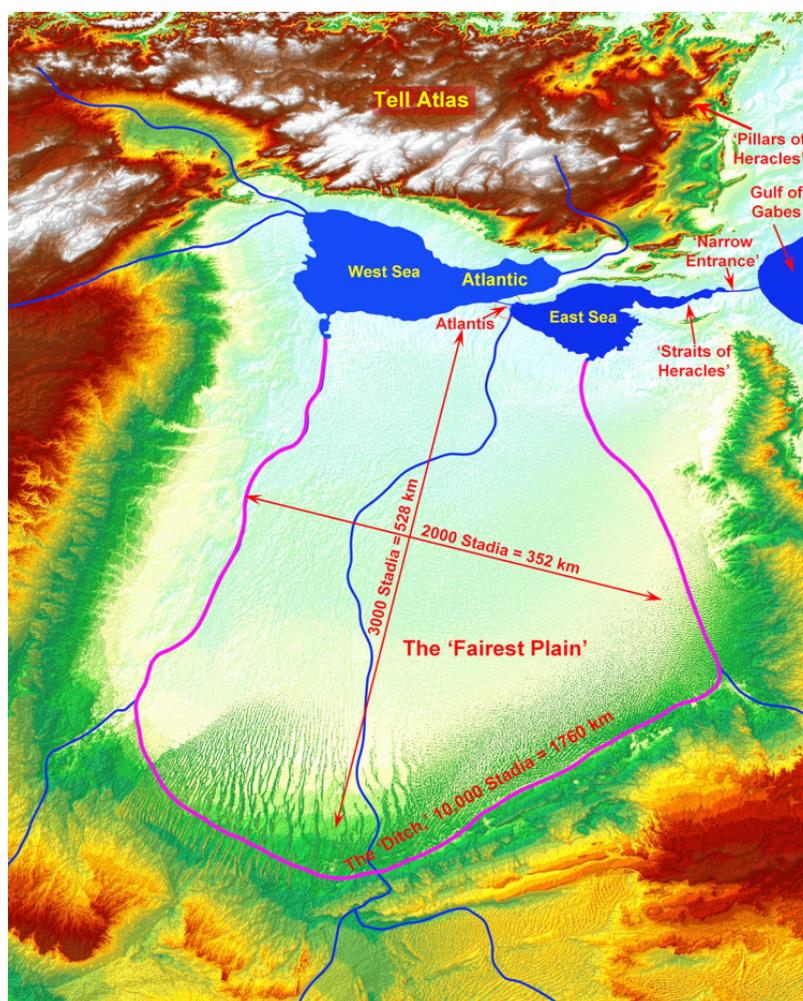


Figure 7 The ‘fairest plain’ and the surrounding ‘ditch’.

Besides ship transport on water, AB was an ideal place to use chariots for land transportation and war purposes. The wide distribution of chariot paintings and engravings around the basin

clearly agrees with the mentioning of chariot deployment in Plato’s *Critias*. Anderson¹⁹ examined about 1200 depictions of painted and engraved chariots in Saharan rock art. Most of them are distributed in

the mountains around AB. Drawn by different animals, the extent and abundance of chariot imagery indicates the vehicle had a considerable importance to a wide-ranging network of cultural groups.

The green Sahara

During the green Sahara period, the environment in AB was warm and lush. Many rivers flowed from the surrounding mountain ranges to the Atlantic Sea and further discharged into the Mediterranean. The water evaporation from this area was more than enough to eliminate the rain shadow effect of the Atlas Mountain range. Due to its upwind leading position, this area further provided stability for the giant water cycle system over North Africa, West Asia, and the Mediterranean areas. The entire region was a wonderland for animals and hunter-gatherers. Plato's *Critias* tells that "...there were a great number of elephants in the island; for as there was provision for all other sorts of animals, both for those which live in lakes and marshes and rivers, and also for those which live in mountains and on plains, so there was for the animal which is the largest and most voracious of all." Numerous engravings and paintings of big animals have been found in mountains around AB including elephant, rhino, hippo, and giraffe. The great altitude difference from the basin to the mountains suits wide varieties of animals and different species of plants. Even at a much later time, elephants were a key part of the Carthaginian forces throughout the Punic Wars. Animal domestication is the most frequent portrait in the Sahara rock arts.

Conclusion

More and more paleoclimate data and archeological findings depict a lush green Sahara from 12,000 to 5700 years ago. Then, the green Sahara suddenly began to wither from the Atlas Basin, which is in the rain shadow area of the Atlas Mountain range in today's Northeast Algeria and South Tunisia. When the water cycle stability in this standalone catchment was broken, the Chotts Megalake (Atlantic Sea) dried up rapidly and the strong rain shadow effect of the Atlas Mountain became fully active. Desert formed immediately in this area and gradually expanded to the south and east, like a spreading wildfire powered by the prevailing winds. This led to desertification and aridification in North Africa, West Asia, and the Mediterranean synchronously until this day. This timeline spans most of human history as we know it, including the rise and fall of Egypt, the prosperity and desolation of Mesopotamia, and the civilization shifts from east to west across the Mediterranean and the Atlantic. This paper discusses the relationship between the green Sahara and the Atlas Empire described in Plato's *Timaeus* and *Critias* and provides correspondent timelines and explanations based on climate data and water cycle stability theory. The geographical features in the Atlas Basin are compared with Plato's account on Atlantis with a perfect match. This new insight is of great importance for the understanding of the climate change mechanism of the Sahara and its surrounding areas and begs further investigations and archeological excavations.

Acknowledgments

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Conflicts of interest

The author declares no conflict of interest.

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