

A paradise went under – The unique hydrology of the Atlas Basin recorded in the Pyramid Texts

Abstract

The Pyramid Texts portray a detailed, specific, and vivid scene of akhification (spiritual rebirth), including the positions, shapes, depths, colors, temperatures, inundation events, vegetation, and salinity of the bodies of water as well as the human activities of religion, irrigation, farming, and ferry around the Akhet. This paper reveals that this scene was an actual environment in the Atlas Basin right before the end of the green Sahara. All the above details exactly describe the characteristics of the two terminal megalakes of the basin, based on the water cycle of the green Sahara. The Akhet located at the outlet of the canal connecting these two lakes was a continuation of Atlantis. Most importantly, the Pyramid Texts tell us that, with advanced hydraulic and agricultural technologies, Atlanteans unknowingly triggered the water cycle collapse in the Atlas Basin and inflicted a breach to the green Sahara.

Keywords: Pyramid Texts, green Sahara, Akhet, Atlantis, paradise, Plato, hydrology, water cycle, Atlas Basin, inundation

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Abbreviations: AB, Atlas Basin; PT, Pyramid Texts

Introduction

Based on water cycle stability and paleoclimate data, Zhang (2019) reconstructed the desertification process of the green Sahara.^{1,2} The breach point of the green Sahara is the Atlas Basin (AB), which is in the rain shadow area of the Atlas Mountain range in today's East Algeria and South Tunisia. About 5700 years ago, the water cycle in this standalone catchment collapsed. The terminal megalakes shrank rapidly, and the precipitation decreased sharply. Due to the low evaporation, the strong rain shadow effect of the Atlas Mountain became fully active. Desert formed immediately in AB and gradually expanded to the south and east, spreading like wildfire powered by the westerlies and trade winds. This chain reaction includes the synchronous desertification and aridification in West Asia and the Mediterranean region. The Sahara expansion forced people in North Africa into the Nile Valley. The population shift gave birth to the dynastic Egyptian civilization shortly after the end of the green Sahara.

This understanding of the hydrology and water cycle stability in AB led to the identification of the Atlantis location at the outlet of the canal connecting the two terminal megalakes in the basin.^{3,4,5} The geographical features in AB, the climate change timelines, and the suggested Atlantis inundation scenario match perfectly with Plato's account on Atlantis in his Dialogues *Timaeus*⁶ and *Critias*.⁷ Besides Plato's Atlantis story, there are numerous fragments in ancient literatures implying relationships between the Egyptian, Mediterranean, and Atlantic civilizations, such as Diodorus of Sicily's *Library of History*, Apollonius Rhodius's *Argonautica*, Herodotus's *Histories*, and the epic poems of Homer and Hesiod.

This paper presents the direct, detailed, and precise evidence preserved in the Pyramid Texts for the Egyptian religious lineage to AB and Atlantis. The Pyramid Texts (PT) are the earliest known ancient Egyptian religious documents about the afterlife. They were carved onto the subterranean walls and sarcophagi of pyramids at Saqqara in Lower Egypt. The Texts laid the foundation and core for the Egyptian religion, which later evolved and had far-reaching influences. The quotes in this paper are all from JP Allen's *The Ancient Egyptian Pyramid Texts* using the volume titles and section numbers

in the first edition,⁸ cross-checked with the second edition.⁹ Allen's book includes translations of PT found in the pyramids of Unis, Teti, Pepi I, Merenre, Pepi II, and Neith, spanning from ca.2353 to 2152 BC. Many of the recitations are repeated and appear in more than one of these volumes. They are sacred, accurate, and can corroborate with each other and supplement for damages.

The place where the gods are born

The Akhet

The hieroglyph Akhet (symbol shown in Figure 1) is usually translated as 'horizon' or 'the place where the sun rises' associated with recreation and rebirth. Akhet also represents inundation, the first season of ancient Egypt from mid-July to mid-November, corresponding to the Nile River flooding time. Obviously, the Akhet is the centerpiece of the ancient Egyptian religion. It is the one and foremost sacred place mentioned in the Pyramid Texts (PT) more than 300 times.⁸ It is the place where the gods are born and take their throne. It is also the place where the deceased is reborn with the gods after purification. The deceased becomes akh with the Sun god Atum, and this akhification is commanded by Anubis the Jackal god (Pepi I 31). Then, his akh will rise from the Akhet with gods to the sky (Unis 150). This process is a journey to the west to join the gods of the West. The most prominent gods of the West are the Ennead including Atum (Sun god), Shu, Tefnut, Geb, Nut, Osiris, Isis, Seth, and Nephthys (sometimes also including Horus). Osiris is called the Foremost of Westerners. Shu's equivalent in Greek mythology is Atlas.



Figure 1 The Akhet icon.

This paper reveals that the Akhet is an actual place located at the outlet of the canal joining the two terminal megalakes in the Atlas

Basin (AB). It is exactly the location identified by Zhang in 2021 for the legendary Atlantis.^{3,4,5} The Akhet was also called ‘the Great Immersion,’ ‘the Inundation,’ or ‘the Great Inundation’ in PT (Unis 222). Figure 2 shows the layout of the bodies of water in AB and their names used in PT. Water from the Jackal Lake flowed to the Stork

Lake, which further discharged to the Mediterranean Sea if there was a surplus. The two megalakes were also generally named Shu’s Lakes or god’s lakes. Individually, they have multiple specific names defining their properties. This is also true for the canals.

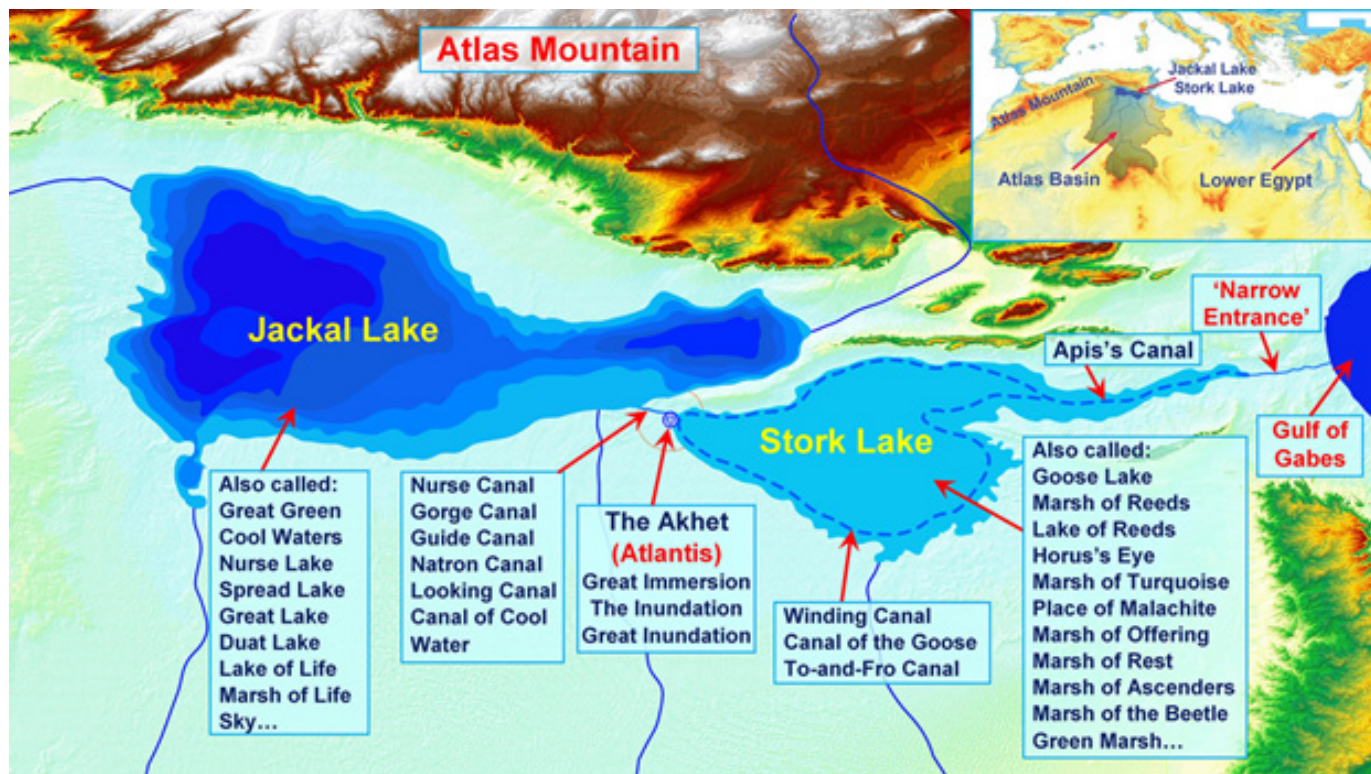


Figure 2 Locations and names of water bodies surrounding the Akhet.

The akhification process was conducted in the Big Enclosure, which is AB (Unis 175). The Big Enclosure had two pillars (Teti 9). The basin was also called Great Land, where “the name of Osiris is firm” (Pepi I 582). The deceased was first welcomed by Osiris at the inlet of the Big Enclosure (the river outlet):

The marshes fill for you, the shores flood for you, as a king-given offering. Foremost of Westerners (Osiris) takes your arm upon the lip of the bowed mountain (Atlas Mountain): (this is) Osiris’s reward that he gives you for linen. (Menehre 367)

Then, the deceased will be ferried to the Akhet for rebirth:

The Nurse Lake (Jackal Lake) is opened up, the Winding Canal becomes inundated, the Marshes of Reeds have filled, so that I might be truly ferried to that eastern side of the sky (the Akhet), to the place where the gods are born, and I am born there in my birth with them as Horus, as him of the Akhet. (Pepi I 320)

Jackal Lake

Table 1 lists the names used in PT for the western megalake and their attributes. The name Jackal Lake is due to its shape, which resembles a jackal head if one stands on the high rising Atlas Mountain and looks at it from the north. In the Egyptian pantheon, the jackal god Anubis is one of the most frequently depicted and mentioned gods, but no relevant myth involved him. He must be the personification of the Jackal Lake for its purification, protection, and guidance in the afterlife of the deceased.

The Jackal Lake was called the Great Green, which was most likely the origin of Osiris’s body color. The Egyptian term ‘green’ covers a spectrum from green to blue. Contrasting to the Marsh of Turquoise (a name for the very shallow Stork Lake) on the east, this green-to-blue color spectrum reflects a water depth change from its shallow edge to its deeper central area with a depth of about 70 meters. When the water from this deeper Jackal Lake flowed into the shallow Stork Lake, people would feel the sharp coolness of the current. Therefore, the Jackal Lake got the name Cool Waters. It was called the Nurse Lake, because it provided the nurturing water to the Marsh of Reeds, which was later converted to farmland. The Jackal Lake was for purification and joining the gods in the sky:

You become clean in the Jackal Lake and are purged (of impurity) in the Duat Lake. Come in peace to the Dual Ennead! The eastern doorleaf of the sky is opened to you by Fixed of Kas (Sun god). (Pepi II 564).

Table 1 Names and corresponding properties of the western megalake

Name	Characteristics
Jackal Lake	Like a jackal head if viewed from the northern mountain top.
Great Green	The Egyptian term ‘green’ covers a spectrum from green to blue. This name reflects water depth change from shoreline to the center.
Cool Waters	Its outflowing water is cooler than the shallow water in the Stork Lake.

Table Continued...

Name	Characteristics
Nurse Lake	It provided nurturing water to the farmland in the Place of Malachite.
Lake of Life	The place to become clean and receive rebirth.
Marsh of Life	Same.
Spread Lake	It spreads out from east to west.
Great Lake	Bigger than the Stork Lake, which later became farmland.
Duat Lake	The place to become clean and rise with gods.
Sky	The place gods will go after rising on its eastern side (the Akhet).
Shu's Lake	Lake of Atlas.
God's Lake	Sacred lake, for purification and rebirth.

Stork Lake

Table 2 lists the names used in PT for the eastern megalake and their attributes. This lake was called the Stork Lake, since its shape looked like a stork. The outgoing canal resembles the long neck, head, and beak of a stork. The unique shape and traits of this lake were likely the original inspirations for the bird deity Bennu (depicted as heron) associated with sun, recreation, and rebirth. It appears in all the illustrations of the Marsh of Reeds in the Book of the Dead. Also due to its shape, this lake was sometimes called the Goose Lake.

Table 2 Names and corresponding properties of the eastern megalake

Name	Characteristics
Stork Lake	Its shape resembles a stork or heron.
Goose Lake	Its shape resembles a goose.
Marsh of Reeds	Shallow water with flourishing reeds.
Lake of Reeds	Same.
Horus's Eye	Shape of an eye, related to Horus's lost eye in his fight with Seth.
Marsh of Turquoise	Reflects color of the shallow water.
Place of Malachite	Color of farmland plots and shallow lakes.
Marsh of Offering	Place to receive supplies and offerings.
Marsh of Rest	Place for rejuvenation.
Marsh of Ascenders	Place to prepare rising with the gods.
Marsh of the Beetle	Associated with sunrise.
Green Marsh	Color of vegetation.
Shu's Lake	Lake of Atlas
God's Lake	Purifying and life-giving

The water in the Stork Lake was very shallow and gave a turquoise color. The lakebed is extremely flat as shown by recent satellite measurement. When the water was drained lower at the later stage, reeds flourished and spread widely across the lake. Therefore, it was called the Marsh of Turquoise and the Marsh of Reeds. It is a place where the deceased get supplies and rejuvenation before rising with the gods. Therefore, it was also called the Marsh of Rest, the Marsh of Offering, and the Marsh of Ascenders. Other variants, such as the Marsh of the Beetle, the Place of Malachite, and Horus's Eye were also used. The Marsh of Reeds was also a place for purification with the Cool Waters from the Jackal Lake. In PT, frequent recitations go like these:

The sky's door is opened, the Cool Waters' door is pulled open, for eastern Horus at daybreak, that he might descend and become clean in the Marsh of Reeds. The sky's doorway is opened, the Cool Waters' door is pulled open, for me at daybreak, that I might descend and become clean in the Marsh of Reeds. (Pepi I 449)

The Winding Canal floods, the Marsh of Reeds fills with water, and I descend to the Akhet among the gods of the Akhet. (Pepi I 355).

Horus's Eye

The Stork Lake was frequently called Horus's Eye, since its shape vividly resembled a human eye. This lake must be the original inspiration of Horus's Eye with a long lateral canthus, one of the most popular Egyptian amulets. It is a motif representing well-being, healing, and protection in ancient Egyptian religion. Based on PT, the original Horus's Eye symbolizes cleaning (Tei 194, Pepi I 472), provision (Pepi I 319, Neith 16), endurance (Unis 134), offering (Pepi II 22), and censing (Neith 16). It was also called the Eastern Eye of Horus (Pepi I 471) reflecting its location on the east side of the Duat Lake. The following recitation from Neith 16 lists some of the benefits the deceased receives from Horus's Eye as a flourishing farmland:

Osiris Neith, accept Horus's eye: provide yourself with it. Horus has censed himself with his eye. Ho, Neith! Cense yourself with Horus's eye, natron-cleanse yourself with Horus's eye. Provide yourself with Horus's eye and it will provide you as a god to your opponent forever.

Nurse Canal

The canal connecting the Jackal Lake and the Stork Lake was called the Nurse Canal, since it released nurturing water from the Nurse Lake to the Marsh of Reeds. It was the drinking place of every akh (Merenre 260). It was also called the Gorge Canal since the canal was narrow and deep at the lower peak of the ridge (the present day Draa el Djerid Ridge) between the two megalakes. A water gate was set at this narrow gorge to control the water flow (Pepi I 467). This must have been a very impressive hydraulic structure at the time, which could regulate the water flow to smooth inundation, and provide water for irrigation and ferry.

Table 3 Names and corresponding properties of the Nurse Canal

Name	Characteristics
Nurse Canal	Releases nurturing cool water from the Nurse Lake.
Gorge Canal	Narrow and deep at the ridge.
Natron Canal	Purification water and may reflect salinity change.
Looking Canal	Magnificent view of sunrise at the east end of the canal.
Guide Canal	Guides the way to the sky, guides the nurturing water to the Akhet.
Canal of Cool Water	Flows cool water from the Jackal Lake to the Marsh of Reeds.

The name Natron Canal for this watercourse might reflect the water salinity increase due to the water cycle collapse in AB. The name Looking Canal must reflect the magnificent view of sunrise from the east end of the canal, where the Akhet is located. A person standing at the narrow gorge would see a sunrise exactly like the motif shown in Figure 1. This must be the original representation of the Akhet symbol. The canal was also called the Guide Canal or the canal of cool water (Table 3). One of the most frequent recitations in PT is the declaration of the water release from the Jackal Lake:

The Nurse Canal opens up, the Marsh of Reeds fills, and the Winding Canal floods, so that my ferrying might be ferried to the Akhet, where Horus of the Akhet is. (Pepi I 481)

Winding Canal

The canal around the Marsh of Reeds was called the Winding Canal (or Curved Canal¹⁰). Since the water in the Marsh of Reeds was very shallow, a canal was excavated off the shoreline to enable

ferry and irrigation. Later, this canal must have been dug deeper to drain the water from the Marsh of Reeds to form farmland (Unis 165). As shown in Figure 3a, the Winding Canal had two branches – the south and north routes. They split at the Akhet at the west end and merged on the east side to the Apis's Canal, which further flowed to the Mediterranean Sea. The Winding Canal was sometimes called the Canal of the Goose for it was around the Goose Lake (Merenre 353). It was also called the To-and-Fro Canal. A boat could ferry from the entrance at the Gulf of Gabes to the Akhet following the north route and return via the south route (or vice versa). One could also "sail around the Marsh of Reeds and moor in the Marsh of Turquoise (Merenre 260)." The Winding Canal was also symbolized as a mouth and the Akhet was located on its lips (Pepi I 551, Pepi I 486). The name of Apis's Canal was likely due to its shape of an Apis bull horn.

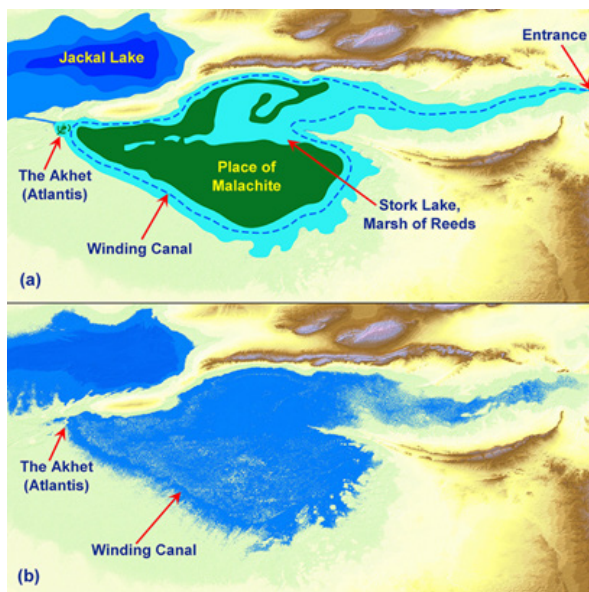


Figure 3 Winding Canal and Place of Malachite: (a) Stork Lake before end of the green Sahara; (b) current profile showing the Winding Canal around the Stork Lake.

These canals were dug and maintained to meet the seasonal water needs of the farmland in the Marsh of Reeds. The water gate at the narrow gorge of the Nurse Canal controlled the water flow from the Jackal Lake to the Stork Lake. The water gate at the Apis's Canal outlet could restrict the water discharge from the lake. The following repetitive recitation clearly depicts the landscape around the Akhet:

Greetings, you at the fore of the Inundation, who guard nourishment and sit at the fore of the Green Marsh at the shoulder of the lord of sunlight! May you let me eat of grain, and I will become thereby like Osiris on the Great Immersion. (Pepi I 376)

Both 'the Inundation' and 'the Great Immersion' refer to the Akhet. 'The lord of sunlight' is the Sun god Atum. 'The shoulder of the lord of sunlight' is the ridge cut by the Gorge Canal (Figure 1). The 'nourishment' is the Cool Water from the Jackal Lake. The 'Green Marsh' is the Stork Lake. Both the Akhet and Stork Lake are downstream of the water gate located at the ridge.

Figure 3b shows the surface profile of the current lakebed of the Stork Lake with the areas below 24 meter (above sea level) painted blue. After about 5700 years' weathering, the area along the shoreline is still clearly showing a lower profile, indicating an ancient man-made canal around the Stork Lake. At the Akhet location, the crescent shaped external isle is still visible. The close-up image in Figure 4

of Zhang (2021)⁵ shows a clear round profile having the exact same diameter of the Atlantis citadel detailed in Plato's *Critias*.

Rebirth at the Akhet

According to PT, akhification is a process of rebirth with gods and becoming akh (Peip II 84). It involves activities across the areas shown in Figure 2. The deceased receives his abundant provisions from the Marsh of Reeds (Pepi I 31, Pepi II 349), becomes clean with the Cool Water from the Jackal Lake (Unis 155, 157), and is given a new birth at the Akhet as described in the following recitations:

The Nurse Lake is opened up, the Winding Canal is inundated, the Marshes of Reeds fill with water, and my ferrying might be ferried on them to that eastern side of the sky (the Akhet), to the place where the gods give me birth, and I am fully reborn there, new and rejuvenated. (Teti 187)

I have come to my canals in the flood-shore in the Great Immersion (the Akhet), to the place of rest with green marshes in the Akhet, that I might make green the vegetation on the Akhet's shores, that I might get the faience of the great eye (Horus's Eye) in the marsh's midst, that I might receive my seat that is in the Akhet. (Unis 222)

The positioning of these activities is precise and detailed, fitting perfectly to the environment shown in Figure 2.

The Pyramid Texts (PT) were originally reserved only for the pharaoh (and queen) and were not illustrated. Their use was extended to the elites during the Middle and New Kingdoms of Ancient Egypt, and illustrations were developed. Figure 4 is a typical depiction of the paradise the deceased would enter after passing judgment. He is shown greeting various gods and paddling his own boat in the top register, which is labeled as 'Marsh of Offerings.' In the second register, he harvests emmer (or barley) and drives oxen over a threshing floor, and he is plowing with oxen in the third, which is labeled as the 'Marsh of Reeds.' At the bottom, the gods' throne is located on the lower island (the Akhet, where the gods are born). Passing the narrow canal two boats are ready for him to join the Sun god in the sky (the Duat Lake). The essence of akhification described in PT was still well preserved in this episode of the Book of the Dead about one thousand years later.



Figure 4 Life in the paradise (Tomb of Ani, 19th Dynasty; The British Museum).

Akhet is Atlantis

The Atlantis city inundation occurred around 11,000 years ago according to Plato's account.³ The immersion was catastrophic for the island city but had almost no effect on the countryside. People must have relocated, and the Atlantic civilization continued to advance to

new heights. The environment described in PT corresponds to the time right before the desertification started about 5700 years ago.¹ There were about five thousand years in between these two events. During this interval, many interactions and transitions could have occurred, many kings and heroes would have gone by, many traditions and technologies would have evolved. Worshiping the creator Sun god was certainly developed in the Atlas Basin (AB). The landscape and water bodies around the Akhet must have been the natural setting for this inspiration. The sun rose every morning from ‘the eastern side of the sky’ (a synonym of the Akhet) as a new creation. It set every evening into the west Duat Lake (Jackal Lake), where the vast and calm water surface mirrored the starry sky to form a crystal dreamy view during the night. A deceased would join the gods and become one of the ‘Imperishable Stars’ in the Duat Lake.’ The Akhet was the sure ‘ladder’ to ascend with the gods. Its shape symbolized the sun, and it had immersed and risen again in its own history. Clearly, the Akhet and Atlantis were the same sacred city as reflected in their physical profiles, hydrological environment, and anthropological relationships.

Location and profile

Plato’s Atlantis was a circular island city encircled by a man-made canal which ran from the sea. Its geometrical features are well known, and here we only need to show the corresponding profiles of the Akhet described in PT. As shown in Figure 3a, the Akhet was located on the lips of the Stork Lake and at the outlet of the Nurse Canal, which connected to the Great Lake (Pepi I 324, Merenre 260). The recitation in Teti 198 (also in Merenre 206 and Pepi I 49) is a description of its resemblance to Atlantis:

Your sisters Isis and Nephthys have come to you, making you sound – very black in your identity of the Great Black Wall, very green in your identity of the Great Green. Look, you have become great and round, as the Great Round. Look, you have become encircled and round, as the circuit that surrounds the External Isles. Look, you have become round and big, as him who surrounds the Big Waters That Perish (Destroy).

The ‘Great Black Wall’ reflects one of the three stone colors (black, white, and red) mentioned in Plato’s *Critias* on Atlantis. The ‘Great Green’ (Great Lake, Jackal Lake) is the Atlantic Sea for Atlantis. The ‘Great Round’ (‘encircled and round’) is the circular Atlantis citadel. ‘The circuit that surrounds the External Isles’ is the circular canal around the city, a unique feature of Atlantis. As shown in Figure 3a, the ‘External Isles’ are the remains of the Atlantis ring islands. After the ‘Great Immersion,’ the river broke into the ring structure of the citadel, and the long-time water flow eroded it into isolated isles. The ‘Big Waters That Perish’ must refer to the Great Immersion that destroyed Atlantis as described by Plato. The location is clearly identified in Pepi I 553: “...you may drink the waters of the Inundation (the Akhet, Atlantis) that are in the circular canal on the lips of the Winding Canal.”

Great Immersion

Now we know that the inundation meaning of the Akhet was originally from the Atlas Basin. Specifically, it traces back to the inundation of Atlantis about 11,000 years ago. This historical event must have been deeply engraved in the Atlantean memory. Therefore, the Akhet got its commonly used synonyms: the ‘Great Immersion’ (Pepi I 379, 449), the ‘Great Inundation’ (Pepi I 297), or simply the ‘Inundation’ as recorded in PT (Pepi I 297; Pepi II 22, 513; Neith 253).

Zhang (2021) suggests that the Atlantis inundation was due to an earthquake, which caused a landslide at the ‘narrow entrance’

blocking the water outflow.³ The blockage and the continuous upstream inflow quickly raised the water level of the lakes to a height, which submerged the island city Atlantis. The following recitation in PT seems to reflect the memory of this event:

The sky speaks, the earth trembles, Geb quakes, the god’s two cultivations yell, the earth is hacked... I cross the Basin and travel across the fierce lake, one that topples Shu’s walls. (Pepi I 462)

Geb represents earth, and ‘Geb quakes’ implies an earthquake. Due to the surge of the ‘fierce lake,’ the Atlas City (‘Shu’s walls’), namely Atlantis, was destroyed.

A common sacred land

The Akhet is the place where the gods are born. In Egyptian religion, Atum the Sun god created Shu (Atlas) and Tefnut who produced the other gods. This agrees with Plato’s account on Atlantis from where Atlas ruled his kingdom. In his *Library of History* Book III, Diodorus of Sicily recorded a tale about the Atlanteans as¹¹

...the most civilized men among the inhabitants of those regions, who dwelt in a prosperous country and possessed great cities; it was among them, we are told, that mythology places the birth of the gods, in the regions which lie along the shore of the ocean (Shu’s Lakes), in this respect agreeing with those among the Greeks.

The Elysian Fields for afterlife in Greek religion clearly corresponds to the Marsh of Reeds. According to Homer, the Elysian Fields was located on the western edge of the Earth by the stream of Oceanus. Hesiod also calls it the ‘Fortunate Isles’ or the ‘Isles of the Blessed,’ which must be the Akhet. *The Argonautica* by Apollonius of Rhodes tells a story that the Argo was driven to west Libya by a fierce storm.¹² Jason and his comrades “came to the sacred plain where Ladon, the serpent of the land, till yesterday kept watch over the golden apples in the garden of Atlas.” This must be the Garden of Hesperides, from where Heracles stole the golden apples as his eleventh labor.

Plato’s *Critias* tells us that there were two temples at the center of Atlantis, a private one for Cleito and Poseidon and a bigger one for Poseidon himself. They may correspond to the Dual Shrines at the Akhet frequently mentioned in PT. The ‘two pillars of the Big Enclosure’ (Teti 9) may be related to the Pillars of Heracles mentioned by Plato.

A paradise went under

Marsh drained for farming

Atlanteans were skillful hydrologists, as demonstrated in their constructions of the Atlantis aqueducts and irrigation network on the ‘Fairest Plain’ in the Atlas Basin (AB).⁷ After the Atlantis inundation, they advanced their hydraulic technologies to even higher levels. They learned how to use canals and water gates to regulate flash floods, to provide irrigation for farming, and to maintain a navigable canal system for ferry. The Pyramid Texts (PT) Unis 165 portrays a vivid scene of sailing to the Akhet from the basin entrance. The water outflow had to be blocked to elevate the canal water level so that boats could ferry on it:

The earth is completely dammed up, for the mountain ranges on either side of the river have been joined and the two banks have been united... The boat’s rope has been pulled, the Beaten Path crossed, and the ball struck at the mouth of the Apis’s canal. ...excavating a plot for me in the Marsh of Reeds; and establishing my farmland in the Marsh of Offerings.

Toward end of the green Sahara, Atlanteans started to convert the vast, fertile Marsh of Reeds into farmland by draining the water from this area. This was accomplished by digging the Apis's Canal deeper. The farmland on the Marsh of Reeds was irrigated using the Cool Water from the Jackal Lake according to seasonal needs. Water gates (or dams) were used to control the water flows into or out of this area. A canal network might have been excavated across the Marsh of Reeds for irrigation and ferry, like that on the 'Fairest Plain' described in Plato's *Critias*. This seemed to be a marvelous hydraulic project, and this area must have given unprecedented agricultural productivity due to the rich lakebed sediment and surface water control. The abundant green farmland and the surrounding turquoise shallow waters were viewed as a field of malachite (Teti 164), and Horus was honored as the lord of malachite:

I am now off to my place of malachite and my food is now in the marshes of rest and the lakes of turquoise. (Pepi II 32)

The sky's door is opened to me, the Cool Waters' door is pulled open for me. I shall set course to the Marsh of Reeds, where I will farm emmer, reap barley, and make my yearly supplies from them like Horus, Atum's son. (Merenre 284)

Water cycle collapse

The Atlas Mountain range has a strong rain shadow effect, which creates desert if not compensated.¹ The water surface area of the Jackal Lake and the Stork Lake together was about 30,000 km² during the Atlantis' time, roughly the size of Belgium. This giant water surface area plus the surrounding vegetation could generate water vapor more than enough to eliminate the rain shadow effect of the Atlas Mountain and maintain the green Sahara. The Atlas Basin (AB) is a standalone catchment and has its own water cycle dictated by the non-linear relationship between precipitation and evaporation. When precipitation is higher than evaporation, there is a runoff surplus flowing out to the Mediterranean Sea, and the ecosystem is healthy. However, if precipitation decreases below evaporation, the lake level will drop. The smaller lake surface area gives lower local relative humidity and further reduces precipitation. The water cycle will get into a self-propelled destabilizing process, and quickly move to a desert condition.

When Atlanteans converted the Marsh of Reeds into farmland by draining water to the Mediterranean Sea, they significantly reduced the water surface area. Through this hydrological endeavor, they were unknowingly making a deadly mistake – triggering a collapse of the water cycle over AB. The water cycle collapse led to a rapid desertification in the basin over a very short time, probably less than 50 years.¹ Because of its leading position for the westerlies and trade winds, the AB desertification inflicted a breach to the green Sahara and caused deterioration of all downwind areas including North Africa, West Asia, and the Mediterranean region.

The 'Fairest Plain' became desert

The Pyramid Texts give signs of desertification around the Akhet. The lakes were called the 'leaking basins' (Neith 272). This is a clear indication of desertification and freshwater deterioration. People must have noticed that rivers flowed into the lakes, but there was no rising water level or discharge into the Mediterranean Sea. They were probably unaware of the huge water loss due to high evaporation. They might have thought that the lakes were leaking water at the bottom. A recitation in Pepi I 452 reflects the vegetation change:

Thornbush, remove yourself from my path, that I may attain the southern part of the Marsh of Reeds.

Thornbush is a typical vegetation in dry land. In the same section, the water in the Jackal Lake was called natron-water, which might reflect the water salinity increase. In Pepi I 484, the name Natron Canal was used for the Nurse Canal:

...you might become cleansed with natron-water; that have been filled to the brim for you from the Natron Canal (Nurse Canal)...

The land near the lakes was called the 'Swept Land' in Pepi I 523, probably because of the rapid desert spreading. The rivers across the 'Fairest Plain' on the south side of the megalakes must have dried first and the desert formed on the plain rapidly. The runoffs from the Atlas Mountain on the north side probably kept flowing longer. The agricultural activities on the Marsh of Reeds likely lasted for another 100 years until the soil salinity became too high to cultivate. This desertification process is clearly shown by the dust flux changes obtained by deMenocal et al.¹³ and McGee et al.¹⁴ from the marine cores extracted at four locations close to northwest Africa coast from 19°N to 27°N.⁵

The dispersion of Atlanteans in this desertification process was an unprecedented Exodus about 5600 years ago. On the north side, they likely found a foothold on some Mediterranean islands and the Atlantic façade of Europe. On the southeast side, Atlanteans must have followed the retreat of the green Sahara.³ A big group of Atlanteans must have relocated to Lower Egypt and built Heliopolis, the great Sun City, as a rebirth in the east. The fond memory of their sweet homeland was faithfully preserved in religious traditions.

Conclusions

The understanding of the unique hydrology and water cycle of the Atlas Basin has pinned Plato's Atlantis and the Akhet depicted in the Pyramid Texts together to the same location at the outlet of the canal connecting the two terminal megalakes of the basin. This finding:

- I. Confirms the lineage of the Egyptian and European civilizations to the Atlantic civilization,
- II. Reveals how Atlanteans helped breach the green Sahara through farming on the Marsh of Reeds,
- III. And hence opens remedies for the Sahara¹⁵ and other broken water cycle systems.¹

History met science, the loop has closed, and the door is open.

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Conflicts of interest

The author declares no conflict of interest.

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