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A Geomythological Excursion and Experience

WHAT IS GEOMYTHOLOGY?

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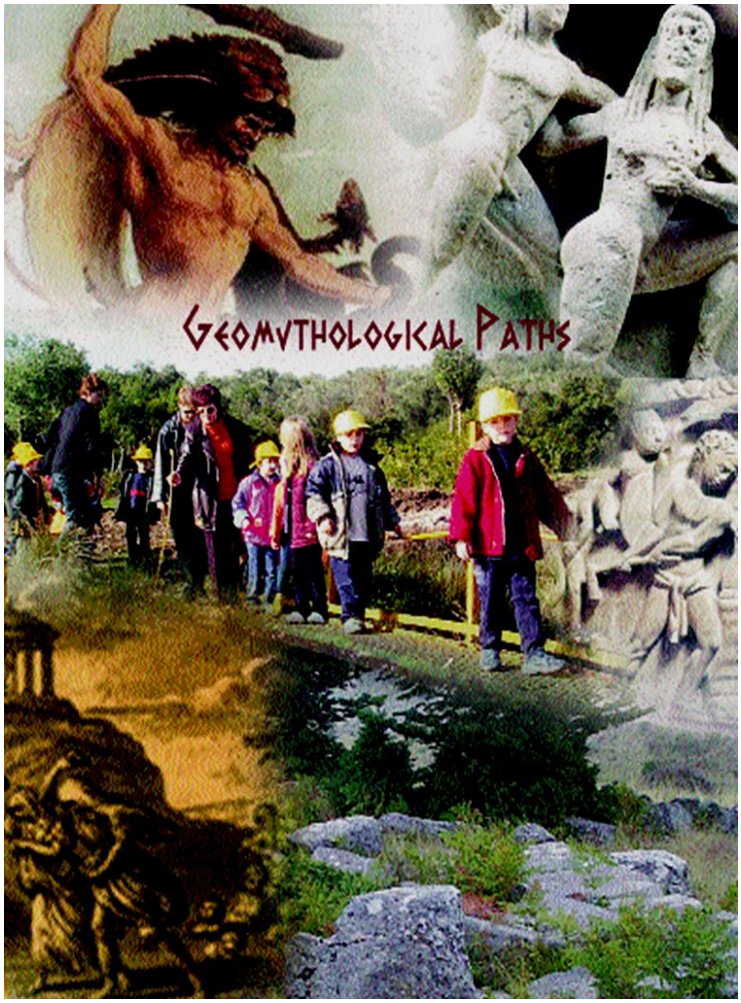
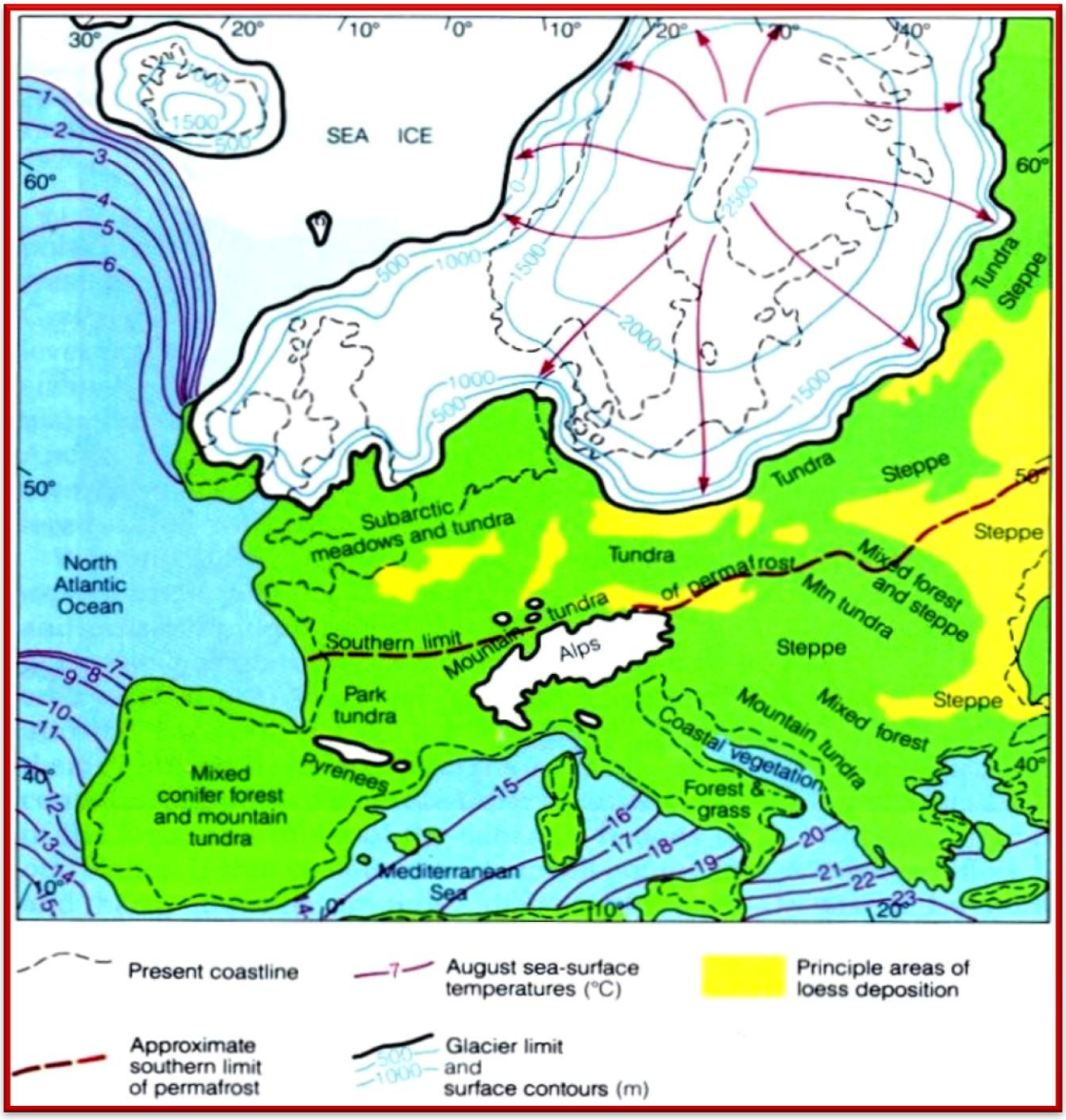


Geomythology is the branch of geo-sciences that aims to discover the relationship between various ancient people's myths and the geological environments where their early civilizations developed.

The long history of the human being is divided into two long periods: the historic period that starts with the invention of writing and the prehistoric one. For the purposes of geomythology, the prehistoric period should be further divided into two subperiods, specifically, when Homo sapiens is n the hunting-and-gathering stage (a food gatherer) and a later one, when Homo sapiens is a food producer, that is, after the initiation of agriculture and mainly after the cultivation of wheat.

The mythological period is the prehistoric period that refers to the acts of gods, deities, and heroes. These acts may not have been recorded in writing but have remained in the memory of different people, either through tradition or as they were later recorded by various authors. These texts constitute the different mythologies. Such characteristic texts are the "Gilgamesh epic," which refers to the people of the prehistoric Mesopotamia, and Hesiod's "Theogony," which represents the mythology of the Ancient Greeks.

The environment is changing…



Most people believe that the modern geoenvironment of a place, particularly of a coastal area, remains almost invariable, meaning that whatever landscape contemporary people see around them, no matter on which place on Earth they live nowadays, is the same as that seen by their prehistoric predecessors.

This point of view is inaccurate, because the geoenvironment does not remain the same, but constantly changes. In fact, the geoenvironment that we can see around us was created in approximately 5,000 to 6,000 years BP (before the present). This period is known as "Holocene Climatic Optimum."

Before that period, everything was different, especially in higher latitudes where the paleogeographic conditions were totally different in land areas as well as in coastal areas. On the contrary, in lower latitudes, the paleogeographic changes were very important, mainly in coastal areas, while at continental and intercontinental areas, the changes are of lesser importance, even though they still exist.

Examples from different parts of the Earth exist where these geographical-relief morphology

changes are so drastic that the present-day picture is totally different compared to prehistory.
For example: The Persian Gulf did not exist until 12,000 BP.

The Sahara area became a desert just after the 5th millennium. Before this period, the climate in Sahara was more favorable for the prehistoric inhabitants of the area, as a great number of hydrotopes and even lakes existed between 4,500 and 8,500 BP.

GODS

Prehistoric people created gods directly connected to their geoenvironment. In the Scandinavian mythology, for example, ice is often related to the myth, while ice is nonexistent in the synchronous mythologies of the people of tropical Africa. Some gods, however, were common in almost all ancient mythologies. For example, the sun and the moon have been deified by nearly all prehistoric people. In most ancient religions, the sun belongs to the early generations of gods; in Greek mythology, the sun belongs to the fourth generation of gods but not to an older one.

CLIMATIC CHANGES

The main physical and geological factors related to the ancient mythologies are some geodynamic phenomena, especially volcanoes and earthquakes. Another factor is the climate, mainly the climatic fluctuation during the last 18,000 years. The impacts of the climatic changes are various, but the ones that played a major role in the cultural development of Homo sapiens are:
The variation of the extent of land covered by glaciers
The sea level changes
The shoreline displacements
All three consequences are connected to the fact that water, under the climatic conditions of our planet, is presented in three different forms:
as gas (clouds, vapor, H2,O[g]) as solid (ice, snow,H20[s])
as liquid (saline water surface or ground water, H20[l])
The total quantities of the chemical compound H2O that are bound in each phase are directly connected to the mean global air temperature of the Earth atmosphere during a particular time period.
On the other hand, it is accepted that the total quantities of water on our planet are stable, at least during the Cenozoic era (last 65 m.a.). This means that under different climatic conditions, while the quantities of the partial phases may vary, the sum of these three phases remains constant:

H2O(s) + Hp (g) + H2O (1) - constant, whereas H2O(s) / H2O (g) / H2O (1) - variable
But we know that the climate changes periodically, connected primarily to astronomical causes. According to the Milankovitch theory, the Earth's climate depends on the solar radiation received by the planet, which in turn depends on the Earth's orbiting movement around itself and around the sun. So, finally, the quantity of solar radiation reaching the Earth depends on the precession of the Earth axis, the obliquity (the change in axial tilt), and the eccentricity. Because these parameters are not constant but present a periodicity, the climate changes also present a similar periodicity, which is the combined result of the partial ones.
These geoenvironmental changes were so important that they have forged the religious conscience of the prehistoric people during the most critical time of their evolution, which is the period of the transition from the food-gathering stage to food production stage.
The relationship between the myths of a people and its geoenvironment is in some cases direct and in others indirect.

Direct Relationship, between Gods and Geoenvironmental factors

The relationship is direct when a god, a semi-god, or a hero is identified with a geological phenomenon. A characteristic example of such a case is God Hephaestus of the Greek mythology or Vulcan of the Roman mythology, who are the gods of volcanoes and volcanic activity in general. In this particular case, the relevant geological phenomena concerning the upsurge of magma toward the surface of the Earth have also been named after these gods.
The responsible deity for earthquakes in Greek mythology was initially a giant, Enceladus, who later was replaced by Poseidon, who was at the same time the god of water. This replacement took place after the Gigantomachy, when the generation of giants was defeated by the generation of Zeus.

Indirect Relationship between Gods and the Geoenvironment

Tales of various mythologies do not correspond to reality but are inventions of the minds of the human beings who lived during this distant era. These views are probably connected to the fact that we have not yet realized the great changes that took place in the geoenvironment between 18,000 BP and 6,000 BP, especially at regions bordering the sea and along coastlines in higher latitudes.
During the Late Paleolithic, the Mesolithic, and almost the whole Neolithic Eras, the coast geomorphology of the entire planet changed so much that it is impossible now to recognize the original coastal geomorphology. The most striking examples are the Aegean Sea (Hellas), the Persian Gulf, the region of Australia, and the coasts of Polynesia.
In the Aegean Sea 18,000 years ago, for example, both the number and the shape of the islands were entirely different, while the present Persian Gulf did not even exist, as the Indian Ocean extended up to the Straits of Hourmouz. These occurred because the sea level dropped at least 125 m during the glacial period, mainly due to climatic-eustatic movements.
After a gradual rise in temperature and the commencement of glacier melting, water flowed from the glaciers into the oceans and caused the gradual rise of the sea. Coastal areas were inundated. This physical-geological regime, which commenced around 18,000 BP, continued until 6,000 BP. This means that the inhabitants of the planet's coastal areas watched the land on which they lived being engulfed by the sea, either rapidly or slowly but continuously for 12,000 years. During the same time period, earthquakes, volcanic activity, tsunamis, and other natural phenomena caused disasters from time to time.
We also have to take into account that, during the same period of time, Homo sapiens performed a great cultural, economic, and social revolution by inventing agriculture. The climatic change of 18,000 BP commenced when Homo sapiens was a food gatherer and hunter and ceased when man

became not only a farmer but also developed navigation, trade, ceramics, and metallurgy
To be able to realize the social-psychological reaction of the people of the era under flooding, we must imagine how our society would react if the residents of Manhattan, Shanghai, Bangkok, or Piraeus ascertained that the sea level had begun to rise slowly and steadily for many years, for thousands of years, accompanied by all the consequences
Moreover in some other cases, as for example in Greece, in Indonesia, and in Japan, in addition to this sea level rise, volcanoes, earthquakes, tsunamis happened from time to time. This is how dwellers near the sea formulated many of their myths during this era. For the inhabitants of the regions of higher latitudes, such as Northern Europe and the Northern America, or people who lived on high altitude areas, such as the Alps, the retreat of the glaciers was accompanied by the migration of the inhabitants from the south to the north, in the first case, and from lower to higher altitude areas, in the second. This was the physical-geological scenery when the humans of this prehistoric era gradually formulated many of their myths, depending on the geographical environment they lived in and its local physical-geological peculiarities.
Geotnythology tries to discover the connection that is hidden behind each myth with the paleoenvironment of a period.
Because some of the earliest and most important human civilizations have been developed in areas around the East Mediterranean Sea and the Persian Gulf, we shall use these areas as striking examples of events described in the mythologies of these people.

The Destruction of Eridu

The Sumerians were the first ones to settle Mesopotamia in the middle of the 5th millennium BC. Sumerians invented cuneiform script and believed in life after death. Two of the most important gods to the Sumerians were Enki, who was the god of water, and Enlil, who was the god of wind. The oldest city of Mesopotamia was Eridu, which is located at the southeastern part of the area, out of the Euphrates River. Some other well-known cities of this time are Ur and Uruk. Every city had its own protector god. The protector god of Eridu was Enki.
The myth says that Inanna, the goddess of love, was concerned about a new town, named Uruk, although it had neither the power nor the prestige of other new towns. During a symposium of the gods, Inanna seduced the god Enki, a philanderer who was drunk. At some moment and in exchange for her love.
Inanna asked Enki to reveal the location of the “one hundred divine powers” that protected Eridu. As soon as Enki revealed the secret to her, Inanna escaped and took the one hundred divine powers from Eridu to Uruk. Enki never managed to save Eridu from decadence since that time, while Uruk gradually became one of the most powerful towns. Enlil, the god of wind, took Enki’s position. Enlil continued to be more powerful than Enki, and thus according to the Sumerians’ mythology, the city of Eridu has been without any trace of human life since, due to the desertification that followed the era of climatic optimum of the Holocene. In the same era, we have observed a similar change of climate toward arid conditions in other areas of the Earth, with a prime example being the Sahara desert.
The study of recent continental sediments, such as lacustrine deposits, paleosoilsm and aeolian deposits found in the driest parts of the modern Sahara desert, has shown a succession of dry and wet climatic phases. According to Petit-Maire, at the end of Pleistocene, a phase of intense drought took place that reached its peak around 18,000 BP. It appears that the paleoclimate in Central Europe, follows a different course from the Sahara one, the Dead Sea, and Mesopotamia. While in central Europe, the climate was dry, in the Sahara, the Dead Sea, and Mesopotamia, a humid phase began that lasted from about 9,000 BP up to 4,500 BP (2,500 BC). It appears that the most favorable period in the region is temporally extended up to 4,500 years ago. During this wet phase, archaeological settlements have been discovered, dated between 8,200 and 6,800 BP, when the lakes reached their greatest extent. Since then, a dry period begins that extended up to 4,500 BP (2,500 BC). The conditions in the Sahara became unfavorable to the prehistoric inhabitants, the settlements

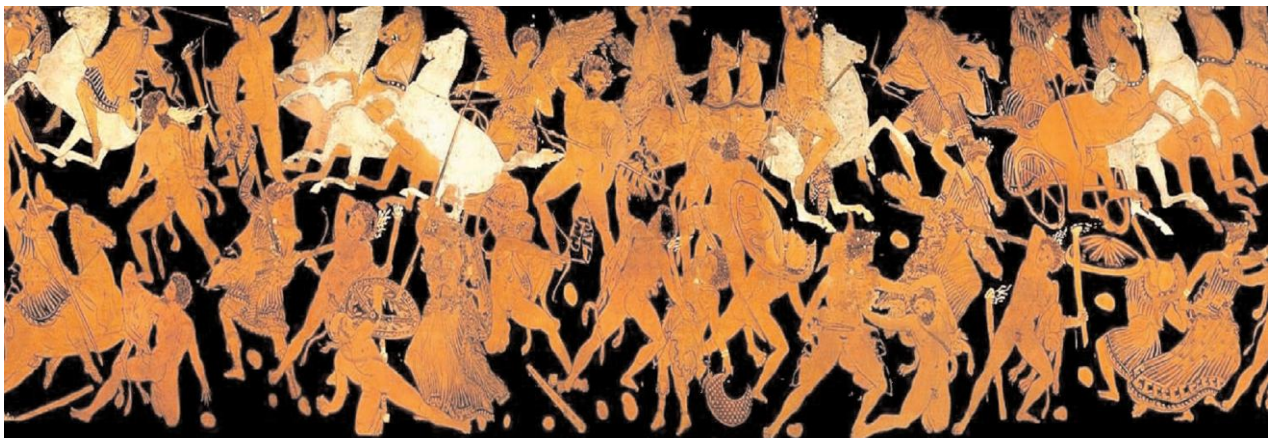
were abandoned, and there are no similar archaeological findings since then.
Humans lived in this region for a relatively small time interval. The first settlements dated to 6,980 + 320 years BP, while the last ones around 5,700 ± 100 BP. Consequently, the conditions in the Sahara were favorable, or relatively favorable, for the humans only during this period. As similar climatic conditions should happen in Mesopotamia during the same time period, the replacement of Enki, the god of water, by Enlil, the god of the wind, in Eridu is directly connected to the change of the climatic conditions of Eridu area.

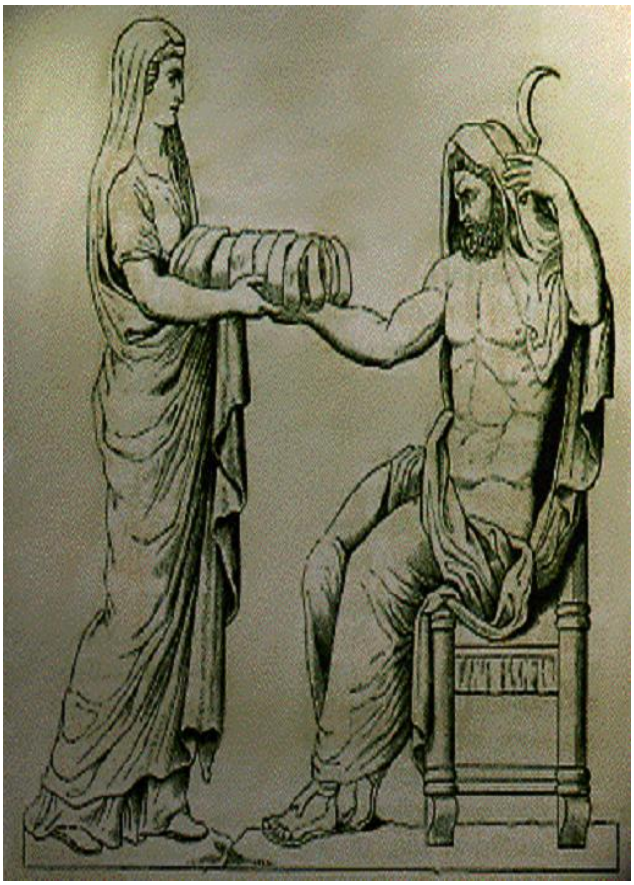
Sodom and Gomorrah

The description of the total destruction of Sodom and Gomorrah is given in the Bible (Genesis 19:25). The precise position of the city of Sodom is not known, but some suggest it may be near Mount Sodom, on the east of the southern basin of the Dead Sea.
The Dead Sea, is an active tectonic graben, which is bound by two roughly parallel faults. The faults are part of the central segment of the major north-south trending crustal rift separating the Arabian lithospheric subplate, on the east, from the Sinai, on the west. The Arabian subplate has been moving north continuously since the Miocene. The many faults in the Dead Sea region show continued seismic activity with a maximum earthquake magnitude of 6.9 (Richter scale) in the time period from 1909 to 1993.
Some geological evidences of a left-lateral fault movement and a great subsidence of the sediment filled basin and some others indicate that it was most likely a great earthquake that destroyed Sodom and Gomorrah

The Struggle between Greek Mythological Gods

The oldest and greatest poets of ancient Greece- Hesiod and Homer-wrote of the struggle between generations of gods or between gods of the same generation. This struggle sometimes resulted in the extinction or disappearance of whole god generations (for example, Titans or Giants), and some later used the struggles as an excuse to accuse the gods of the ancient Greeks of being immoral, cunning liars and criminals.
The struggles of these ancient gods, however, described in Greek mythology through the works of Hesiod, Homer, and others, reflect the physical and geological evolution of areas of the Aegean during the time between 18,000 and 6,000 BP
The Greeks, considered Heaven and Earth as the first generation and parents of Gaia (Gaea) or Mother Earth, whom they considered the oldest of their deities and the primary creator, born of Chaos itself. According to the myth. Earth brought forth Uranus (the Heavens) to be Gaia's mate, and the couple gave birth to the third generation of gods that included, among others, the Giants and twelve Titans.





The first struggle recounted in Greek mythology takes place when Cronus, a third-generation god and leader of the Titans, tried to overturn his father Uranus s power through assassination. Cronus did not succeed.
Gaia stood by Uranus during this difficult time and through her contribution, the Giants were born. Gaia and Uranus's son, Cronus, with another Titan, Rhea, parented the first six Olympian gods, among them Poseidon and Zeus. Cronus feared that his sons would eventually take over his power and, as he did with all his sons, he tried to eat Poseidon and Zeus at birth. Their mother Rhea protected them by deceiving Cronus. When Poseidon was born, Rhea told Cronus that she had not given birth to a child but to a small horse. In the case of Zeus, Rhea replaced the infant with a large stone, which she gave to Cronus to eat.
Subsequently, the children of Cronus and Rhea, which now made up the fourth generation of gods referred to as the Olympians, competed initially against the Titans in a battle known as Titanomachy (Titanomachia). The third-generation Giants assisted the Olympians in their battle against the Titans. Then the tables turned, and, in a second battle known as the Gigantomachy or Gigantomachia, the Giants fought the Olympians.
Through these battles, the Olympians exterminated the Titans and Giants and began their own period of dominance. Their reign was not without difficulties: the struggle of Zeus and Poseidon, Poseidon and Apollo (Delphi and Korinthos), Poseidon and Athena (for the protection of the city of Athens), Demeter and Hades, and others. In most of the battles, Gaia played a primary rote, and the elder brother, Poseidon, was gradually defeated by his younger brother, Zeus, as well as by Apollo and Athena, who are gods of a younger generation. By these struggles, the older generations of gods have been replaced by younger ones.
From a geological perspective, the struggles of the generations of gods should have occurred during the time period of about 18,000 and 4,000 years BP. This time coincides with changes of the physical and geological regime in the Saronic Gulf, the Aegean, and circum-Aegean areas.
The physical-geological evolution of this period follows. The last interglacial period begins at approximately 18,000 BP and spans to our times 18,000 years ago, the sea level was around 125 m lower than the present shoreline. Between 18,000 BP and 6,000 BP, the sea level rose from 125 m to 2 m. Scientists have estimated that the rising rates varied from 1 cm/y-5 cm/y. The rising of the sea resulted in a relative subsidence of the coastal areas, that is, a transgression of the land and permanent flooding of several coastal areas.

The rate of this transgression was different from place to place, depending on the slope of the landscape and varied from some meters a year rise to many hundreds of meters a year.
The result was a new physical-geological regime- permanent flooding conditions of several coastal areas-that replaced the older regime when the global air temperature remained more or less stable for many thousands of years. Evidently, the inhabitants of these areas suffered, and the catastrophes were enormous. In addition to the flooding conditions, earthquakes, tsunamis, and volcanic activity were continuously present, as Greece, from a geotectonic point of view, is a seismically and tectonically active arc.

Paleogeografic evolution of Evoea island -18.000 years BP (Before Present) till today.- Ilias Mariolakos- Yiannis Mpantekas

The upper Paleolithic and Neolithic Homo sapiens, who were living in areas under the flooding regime, believed that very strong gods were responsible for all these disasters and general catastrophic phenomena, some primitive, some evil, gods who were active throughout the period of the climatic changes

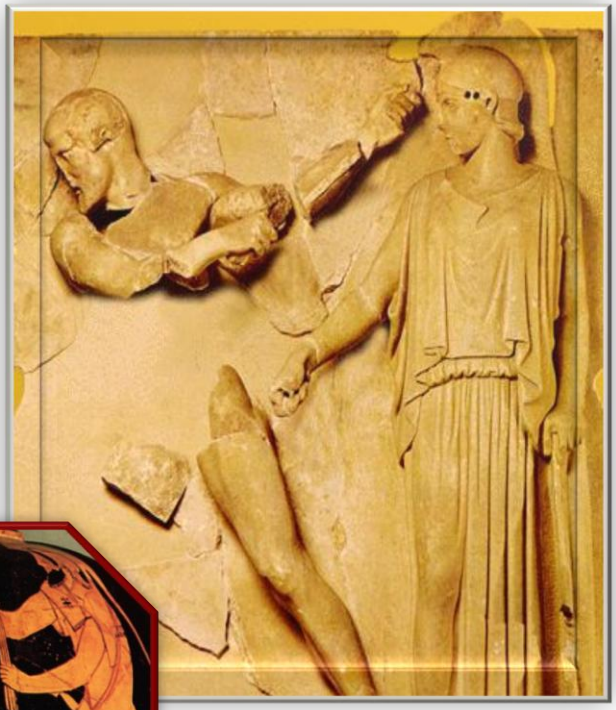
During the same period, the upper Paleolithic inhabitants of the Aegean area needed to pray to benevolent gods to save them from the disasters caused by the primitive gods, so they created the fourth-generation gods Poseidon, Zeus, and so on. After the climatic stabilization (around 6,000 years BP), the evil gods were defeated by the benevolent gods. Thereafter, the struggle among the Olympians concerns a rearrangement of jurisdictions. As the new climatic regime required more water and a god who could regulate precipitation was more important than Poseidon, Zeus replaced him.


N
W
E
S
10 km
CORINTHIAN GULF
COASTLINES DURING THE PERIODS:
18.000 BP (-125m)
12.000 BP (-70m)
ELEFSIS
MEGARA
KIHREA LAKE
ATHENS
PIREUS
CORINTH
SALAMIS
DIAPORIA
MYCINAE
EPIDAURUS PALEOLAKE
AEGINA
AGISTRI
EPIDAURUS
ARGOS
SARONIC GULF
SOUNION
METHANA
NAFPLION
POROS
Ag. GEORGIOS
DOKOS
HYDRA
Coastlines 18.000 BP (-125 m.)
Coastlines 12.000 BP (-70 m.)
Today coastline

Hercules and the Lernean Hydra

In ancient Greek mythology, Hercules is one of the most famous heroes, known primarily for his labors, most having to do with fresh water and land reclamation. Water came either from karstic springs, such as that in the Labor of Lernean Hydra near Argos (Peloponnesus), or from lakes, such as in the Labor of Extinguishing the Birds in Stymphalia Lake (Central Peloponnesus), or from rivers, such as in near Olympia. Apart from these labors, there are more, but not so well-known, such as those that relate to other rivers, thermal springs, or the destruction of draining sites. The myth of extinguishing the Lernean Hydra is one characteristic example of a myth coinciding with the hydrogeological conditions of the area. The essence of this myth follows. A repulsive snake-formed beast (the Lernean Hydra) lived in Argos, a region near Lorna Lake in eastern Greece. It had an enormous serpentine body ending in several snaky tresses with a head at each edge. The beast's breath was poisonous, and often it would spit out fire, even while asleep, which would destroy everything in the plain, including crops, animals, and even people.

The Labor of Cleaning the Stables of Augias



Descriptions of the number of the Hydra's heads varied.
On a reddish jug of 480–470 BC and on other representations as well, Hydra is shown with 12 heads.

- According to the ancient authors Alkaios and Apollodoros, Hydra had 9 heads.
- On clasps of the geometric period. Hydra is depicted with 5 or 6 heads.
- According to another author, Simonides, Hydra had 50 heads.
- According to Euripides, Hydra had 100 heads.

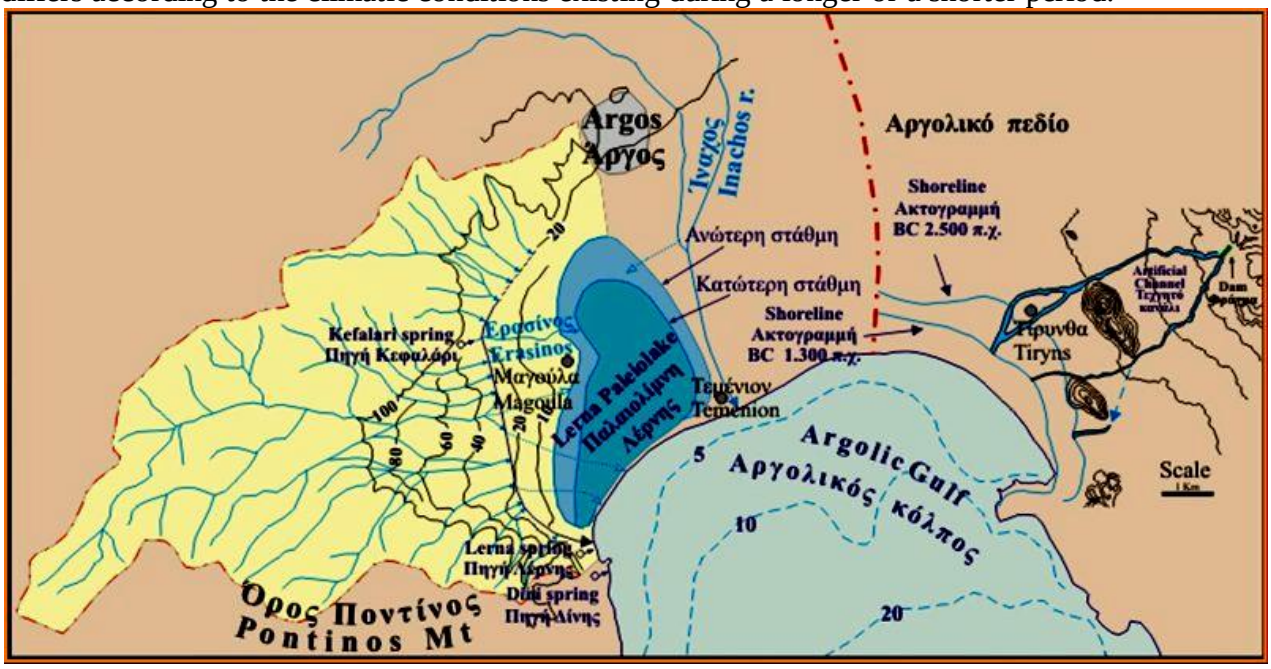
However many heads were presented, all agreed that Hydra's central head was immortal. In addition, the myth informs us that Hercules faced Hydra with The spring Lerna is a typical karstic spring, hydraulically connected to some sinkholes located at the bottom of a mountainous karstic basin. The connection between the myth and the geoenvironmental conditions is not obvious, but when we know the hydrogeological condition of the area, the geomythological interpretation is relatively easy.
Some of the hydrogeological characteristics of Lerna include.

- The discharge of the spring's system occurred at several points.
- The altitude is at 0.50 m - l m, above the present sea level.
- In 1965, the mean annual yield of the main Lerna

spring was about 60 by 106 m^3year.

•While the annual discharge is relatively lower compared to some other karstic springs located close to it, the central spring has never been known to be dry.

The number of points where the karstic aquifer is being discharged differs during the year, as we might expect, depending on the season, the mean annual height of the atmospheric precipitation at the regional area, and the duration of the climatic period, that is, if the wet period is a 100-, 500-, or even 2,000-year cycle, hi this way, we may interpret the differences in the numbers of the Hydra's heads, because each head can represent a point of discharge of the karstic aquifer and this number differs according to the climatic conditions existing during a longer or a shorter period.



The myth recounts Hercules's attempts to exterminate the Lernean Hydra by cutting off the beast's heads, one by one. This may symbolically represent a spring's discharge at a karstic point that may become possible by placing a rock at the point where the water discharges to prevent its exit or to force it to follow .mother route.

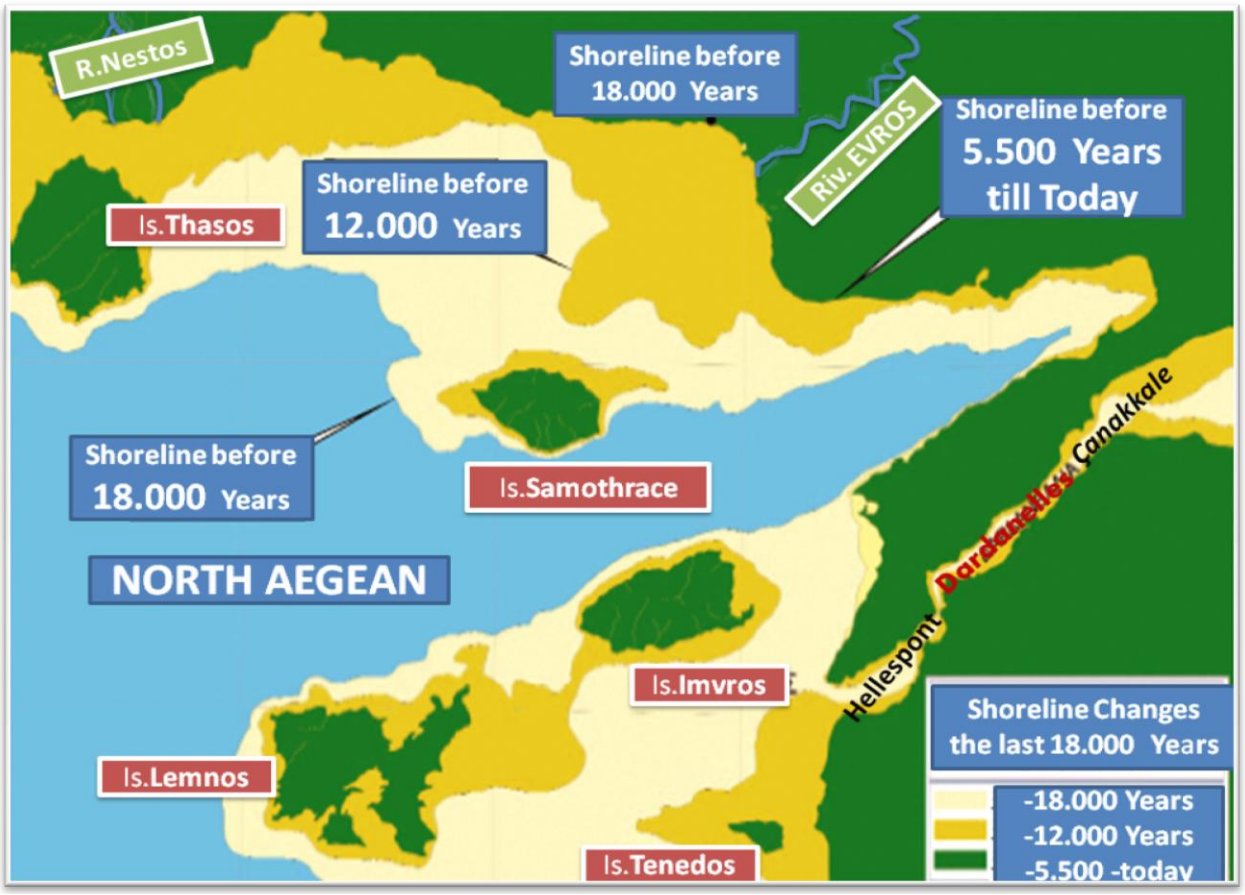
Geologists know well that the karstified rock body, through which the underground water circulates on its way to the spring, represents a complex system of underground intercommunicating erosion pipes or ducts. In addition, the tectonic discontinuities, even if the karstification is not very intense, are also permeable. Consequently, if we place a rock in front of the mouth of a karstic spring, the water will come out from two other or more side points. This corresponds with the Hydra's heads: each that Hercules cut off became two new heads. Hercules should have used the sword to cut the thick vegetation that usually exists in the swamp in front of a spring. It is easy to imagine that the vegetation of this hydrobiotope (Wetland) of prehistoric Lerna would have been quite rich and, without fail, richer than that of the present period, especially during the period of the climatic optimum, when the sea level was a little higher than today. Hercules probably used the cudgel to smash the limestone at the spring mouth, and Iolaus, Hercules's nephew and assistant, used the sickle to cut the vegetation and facilitate Hercules's way to the spring, that is, the heads or the central head, as well as to facilitate the flow of water to the sea to dry up the swamp or lake.

DARDANOS' FLOOD AND A DATING ATTEMPT

We believe that many events that are mentioned in the Greek Mythology are not just nice tales for the young and the old, but represent physicogeological phenomena that engaged the prehistoric man and his society. Among the most interesting phenomena are floods or cataclysms. In the following we attempt to date one of the three floods that are mentioned in the Greek Mythology and more specifically the Dardanos Flood.

The dating attempt is based on: i) its detailed description provided by the ancient authors and mainly that of Diodorus Sikeliotis (90 - 30 B.C.), ii) the conclusions of the recent paleoclimatic research iii) the recent research that took place in the Black Sea, and iv) to the diagrams of climatic-eustatic changes of the global sea during the last 18.000 years.

Based on the aforementioned and with the condition that all the data drawn by the Greek Mythology reflect the reality, something that we accept, then the flood that took place during the Dardanos period must have taken place before the period of Younger Dryas, that is before 12500 BP



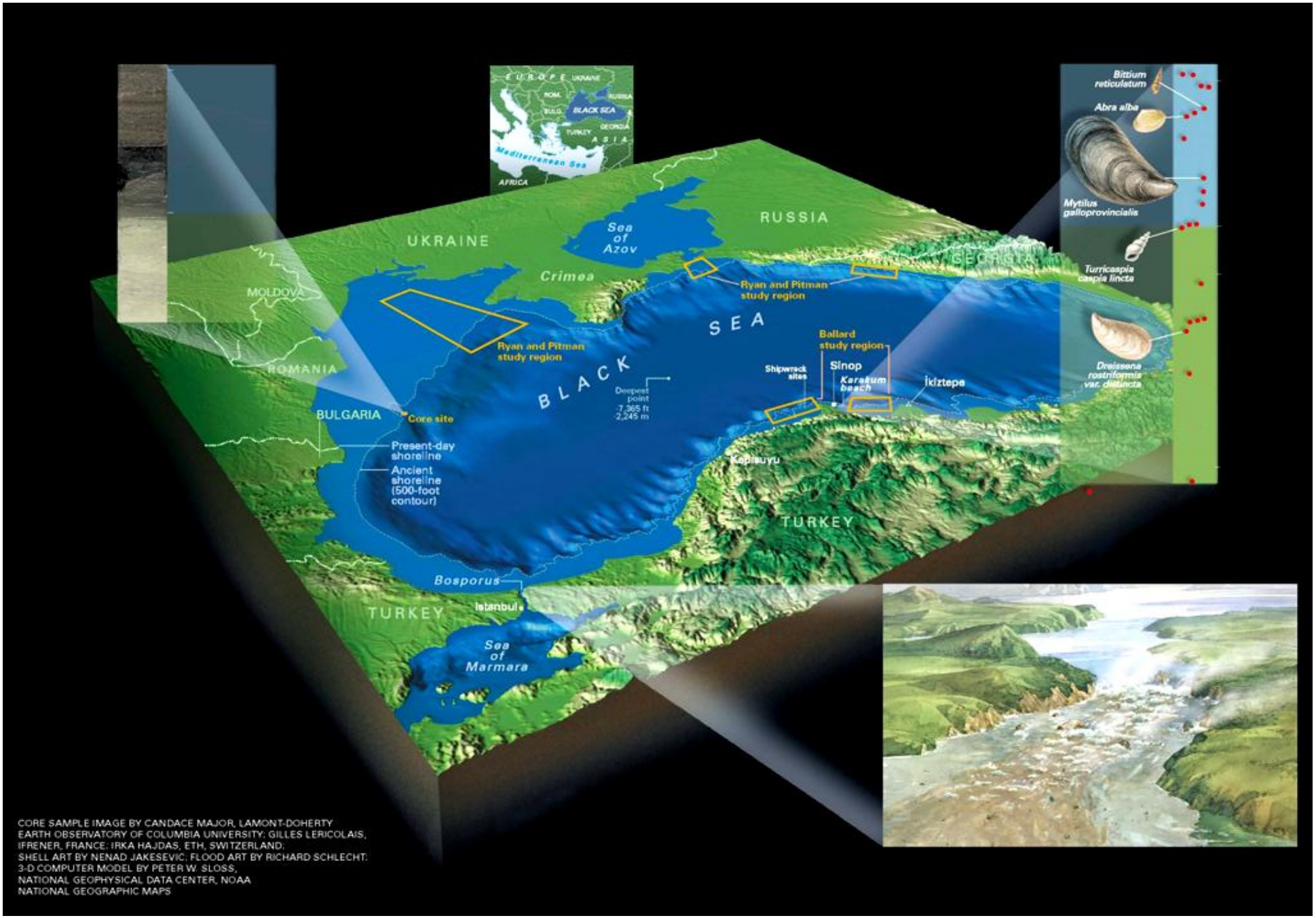
Shoreline ⇓ before 18.000 Years

Shoreline ⇓ before 12.000 Years

Shoreline ⇓ before 5.500 Years till Today

If this aspect is not rejected by future research, then the Dardanos Flood precedes, by many thousand years, the other known floods such as that of Ogygis, Deukalion, Noah, Siousourda and many others that are mentioned in the mythologies of various people.

Dr. rer. Nat. Ilias D. Mariolakos



CORE SAMPLE IMAGE BY CANDACE MAJOR, LAMONT-DOHERTY EARTH OBSERVATORY OF COLUMBIA UNIVERSITY; GILLES LERICOLAIS, IFREMER, FRANCE; IRKA HAJDAS, ETH, SWITZERLAND.
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3-D COMPUTER MODEL BY PETER W. SLOSS, NATIONAL GEOPHYSICAL DATA CENTER, NOAA
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