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31. Cosmogony and Uses of Geothermal Resources in Mesoamerica

Abstract: Many Mesoamerican cultures developed in the Mexican Volcanic Belt, which runs east-west across Southern Mexico. For thousands of years, this was a place particularly rich in active geothermal manifestations, where intense contacts between mankind and geothermal forces deeply influenced the material lives of Mesoamericans and played an important role in basic decisions, such as selecting where to live. Vapor baths, cooking in steam at fumaroles or on naturally hot rocks, crop irrigation, and therapeutic applications were all ways that the Earth's natural heat was used in Mesoamerica.

Mythical and religious interpretations of geothermal phenomena occurred early on, reflecting a profound respect toward terrestrial heat. People's relationships with geothermal resources were both beneficial and harmful, constructive and destructive. Volcanic explosions drove away populations, who then returned, drawn by the fertile soils, volcanoes, lakes, and natural heat. Mesoamerican peoples understood this duality, which deeply influenced their cosmic view.

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by
Mario César Suárez Arriaga
Raffaele Cataldi
Susan F. Hodgson

"Mexico has as many volcanoes as England does blackberries."
—10th International Geological Congress, Guadalajara, 1906

INTRODUCTION

COSMOGONY IS THE SCIENCE OF THE CREATION AND EVOLUTION of the universe. This chapter treats some aspects, recently discovered, of the close relationship that existed between the development of Mesoamerican cosmogony and geothermal resources.

When opening any book on the history of science, one rarely finds a chapter dealing with science in pre-Hispanic America. However, Mesoamerican cultures created not only original art but also hydraulics, architecture, and mathematics. They developed autonomously the concept of zero, an advanced numerical system, and they made astronomical calculations with astonishing precision. Today, we know that scientific knowledge was a daily reality for Mesoamerican peoples. Less well known is

their general concept of the world, how they questioned origin, being, and destiny. Their beliefs and knowledge originated from ideas about the cosmos. We want to demonstrate that their cosmogony arose, at least partially, from intense experiences with geothermal phenomena. To comprehend this vision, one must look at the natural environment, religion, and Mesoamerican mysticism.

For at least 4,000 years, human communities have resided in zones with geothermal manifestations throughout the Americas. Archaeological investigations show that stable settlements grew at the feet of all Mesoamerican volcanoes (Burgassi et al., 1992). We can infer that since remote times, humans coexisted with volcanoes, with geothermal manifestations, and with other phenomena related to the Earth's heat.

Being predominantly volcanic, Mesoamerica was a region that included earthquakes, thermal waters, fumaroles, boiling muds, steaming grounds, and volcanic eruptions. Surface geothermal manifestations and the energy of the Earth were well known to ancient Americans. For millennia since prehistoric times, people had close contact with the energy of the Earth. Therefore, geothermal resources, in the widest sense of the word, deeply influenced the material, spiritual, and cosmic development of the Mesoamerican people.

A religious attitude toward volcanoes was widespread among pre-Columbian populations. Because of their magnificence and eruptive natures, volcanoes were considered sacred cult objects, often because so many volcanoes were nearby.

We have classified into two groups the available information about geothermal development in Mesoamerica, and a faithful approach to describing influences of geothermal phenomena incorporates both. Information from the first group is scarce, for it is based on direct facts described rigorously and is seriously limited by not going beyond documented evidence. One important original source was the Náhuatl texts compiled by the Spanish historian, Fray Bernardino de Sahagún, who began in 1534 to transcribe narratives of Náhuatl elders reciting what they had learned in Aztec schools.

The second, more abundant type of information is subjective and indirect, based on myths, legends, and oral testimonies that possess meanings simultaneously poetic, mystical, and religious. These references, which cannot be demonstrated, are based on intuitive faith in the authenticity of a story that liberates the imagination.

This chapter is a preliminary outline, not an exhaustive treatment of the subject. Our survey has a double objective: to explore the influence exercised by geothermal resources on the material and spiritual development of Mesoamerica and on the relationship between humans and territory, and to emphasize the historical antiquity of the influences by geothermal phenomena on cognitive processes.

The history of geothermal resources in the Americas still needs to be written; this brief document sketches that possibility for the first time. The theme is left open for new studies, in hopes that a better understanding may develop of the ancient history of Mesoamerica. "The culture of the old Mexicans, suddenly annihilated, was one which humanity could have been proud to create.... From time to time, in the infinite of the whole and amid the enormous indifference of the world, some men assembled in society and invented something that surpassed them, a civilization. They were the creators of cultures. And the Indians of Anáhuac, at the feet of their volcanoes, at the shores of their lakes, could be counted among those men" (Soustelle, 1955).

FROM PREHISTORY THROUGH THE POSTCLASSIC PERIOD

THE ORIGIN OF PEOPLE IN THE AMERICAS APPARENTLY DOES NOT INTRODUCE ANY EPISTEMOLOGICAL problem, for researchers have not found human remains from predecessors of *homo sapiens* in the Americas, as they have in Africa, Asia, and Europe. Today, it is accepted that the proto-Americans came from Asia some 50,000 years ago, passing through the Bering Strait. The first immigrations could have been the "Amurians" or inhabitants of the Amur River shore in Siberia (Ruiz, 1987; Museo Nacional, 1996). A Mexican historian suggests these people could have come from southern zones in Central Russia (Sodi, 1992). The Cahuilla, Sioux, Tolteca, and the Teotihuacano have facial features resembling the Amurians. That first passage could have occurred during the Wisconsinan glaciation that lasted from 70,000 to 30,000 years B.C., a date that agrees with the oldest ages of human fossils found in America (Carmona, 1993). The Mongoloid immigration perhaps included the forerunners of the Olmecas and the Maya and probably occurred around the year 12,500 B.C., at the end of the Woodfordiense interglacial period.

The first contacts of proto-American *homo sapiens* with geothermal phenomena probably happened in Southwestern Alaska, with nomads passing through the northern portion of the

“Ring of Fire,” an area between the North American and the Pacific plates. As new populations advanced southward into the Cascade Range, they found numerous active volcanoes and other geothermal manifestations. Eventually, their slow expansion reached the imposing manifestations of what is today Yellowstone National Park and The Geysers Geothermal Field in the North-western United States. Continuing southward into the enormous deserts of Arizona, New Mexico, and Texas, some ancestral nomads arrived at the great morphotectonic depression between the Imperial and the Mexicali Valleys at the Mexican border with the United States. By now, familiarity with geothermal resources should have been high.

Archaeological evidence indicates that North American Indians lived near hot springs for over 10,000 years and that all kinds of geothermal manifestations were sacred places for them, sites of refuge for rest and recuperation from warfare, havens for the elderly, and areas for cooking (Lund, 1995). The Indians believed that the Great Spirit lived at geothermal sites, a being who provided heat and “the rejuvenating warmth of mother earth” (Lund, 1995). The breath of the Great Spirit was manifested through steam discharges and fumaroles.

In the remote and distant past, prehistoric peoples used volcanic rock, such as basalt, silica, and obsidian, to manufacture weapons and tools. Some 3,000 to 3,500 years ago, with the beginning of stable agricultural settlements, the first uses of natural heat arose. Tales and legends from pre-Hispanic sources tell of the use of thermal waters and mud to clean and cure the body, to temper arrows and lances for hunting and war (Suárez and Cataldi, 1993). Food was toasted or steamed by very hot stones. Ears of corn, potatoes, and meats were cooked this way.

The first archaic groups in North America spread slowly into the central and southern parts of Mexico, seeking improved soils and climates. Yarza de la Torre points out that volcanic activity in Mexico generally began about 62 to 63 million years ago in the Tertiary era, decreasing first in the Western Sierra Madre and lasting longer in the region between 18° and 22° latitude (Burgassi et al., 1992).

This region, called the Mexican Volcanic Belt, forms an east-west band across Southern Mexico. It is characterized by an imposing series of 3,000 volcanic phenomena, 10 of which are active today. The sector is particularly rich in active geothermal manifestations such as thermal springs, fumaroles, gas exhalations, mud lakes, and volcanoes, and in hydrothermal deposits such as kaolin, sulfur, and iron oxide. This temperate region, with an altitude of 1500 to 3000 meters, became a choice area for settlements (Ruiz, 1987). Here, in the heart of Mesoamerica,

a deep relationship grew between people and geothermal phenomena as civilizations evolved to high cultural levels through the centuries.

American civilizations developed apart from other influences, separated from Europe by the Atlantic Ocean and from Asia by the Pacific; they remained isolated for thousands of years from the discoveries and cultural mixtures of the Old World, and this separation made them unique.

Although many different cultures developed in Mesoamerica, one can speak of a Mesoamerican civilization because a uniformity developed, a shared cultural inheritance. All Mesoamerican peoples had a common mental horizon: similar religious beliefs, a theocratic-military social structure, and a shared general concept of the cosmos. Mesoamerican peoples revered the same gods but gave them different names. Their cult objects represented things captured by the senses: volcano, sun, moon, wind, fire, water, corn, and then death—the end of the sensate realm and the start of the abstract. Mesoamericans knew peak periods and decadence, ascent and destruction, with no break in global continuity of a civilization built in a universe deeply religious, recurrent, circular, where all returns to its origin and everything begins again, uninterrupted by the outside world (Paz, 1992).

The history of Mesoamerica begins with the Prehistoric period, 10,000 B.C. to 2000 B.C.

- Formative or Preclassic, from 2000 B.C. to 100 B.C.
- Classic, from 100 B.C. to 900 A.D.
- Postclassic or Historic, from 900 A.D. to August 13, 1521. On this day Tenochtitlán surrendered to the Spanish invaders and the great destruction began (Sodi, 1992).

Mesoamerican peoples settled into permanent communities once they began cultivating corn. They were outstanding painters, sculptors, artisans of gold and copper, architects, poets, and creators of feathered embroideries and codices.

Religion that included sacrifice formed a basis for all Mesoamerican cultures, and rigor and asceticism were underlying concepts. The Aztecs called their supreme god Ometeótl, the Lord of the Duality, with feminine and masculine aspects. The double divinity was the creative principle, the origin of all beings and of all things, and the infernal counterpart was the Lord and

Lady of Death. Such dualism is found at the base of Mesoamerican thought and is the root of Mesoamerican cosmology and ethics.

The relationship between humans and geothermal resources grew in America autonomously but more slowly than in other parts of the world (Cataldi et al., 1992a and 1992b). Investigations and archaeological discoveries prove that 3,000 years ago, communities existed in many areas with geothermal manifestations and at the feet of all volcanoes in Mesoamerica.

Thus we can infer that from very remote times, people established a fundamental—and sometimes dramatic—relationship with volcanoes, geothermal surface manifestations, and with geothermal phenomena in general. Investigators of two Costa Rican volcanoes, Arenal and Miravalles, showed that life in the first settlements was regulated by volcanic eruptions. The eruptions drove off populations, which then returned to rebuild, drawn by the rich soil and other attractions in geothermal areas (Burgassi et al., 1992).

Ceramics discovered at Miravalles indicate the presence of an agrarian population from the year 800 B.C. Sepulchral badges, shaped as very thin plaques, were extracted from laminar formations of volcanic rock and used by pre-Hispanic populations between 800 and 500 B.C. (Burgassi et al., 1992). The geothermal zone of La Primavera, Mexico, is in a volcanic caldera with multiple domes, hot springs, and fumaroles. One of the domes, named Colli, contained obsidian arrowheads, and the hill is consecrated to the god of fire (G. Tibon et al., 1967). A piece of obsidian was found that characterizes Iztlacoliuhqui, “the one twisted of obsidian,” the god of punishment.

Various indirect references link Mesoamerican peoples to geothermal resources. Most consist of names of places, gods, and narratives about religious myths (Suárez and Cataldi, 1993; Hodgson, 1995; Hernández et al., 1995). Some traditions and legends were transmitted orally and some were transcribed by Spanish friars. Many others, like most of the codices, were hopelessly lost. As an example, the indigenous informants of Sahagún, a Spanish historian, told him in about 1534 how travelers had arrived from remote regions, through the coasts of the Gulf of Mexico, coming to settle in a mythical place named Tamoanchán, where the Náhuatl culture first flourished:

“Here is the story that the old men used to tell:
‘In a certain time that no one can any longer recount,
and which now nobody can remember....”

Over the water, in their boats they came, in many groups,
And arrived at the edge of the water, on the north coast,
And where their boats were left, is called Panutla....
Off they went immediately following the water's edge,
Searching for the white and smoking mountains....”

Why did these people seek to settle near volcanoes? The informants never said. The story suggests a deliberate decision, typical of the relationship between mankind and geothermal phenomena in America.

Cooking with pots in steam began with the development and diffusion of pottery, probably starting from the Late Formative period from 800 to 100 B.C. The pots were placed upon boiling water, on spouts of vapor, or on hot ground—a method still used in the geothermal zone of Ixtlán de los Hervores in Central Mexico.

Cooking food with steam is a traditional use of natural heat in Mexican geothermal areas. The Náhuatl term *Atotonilco*, which means “place of the boiling waters” (*atl*, “water”; *totonil*, “hot”; *co*, “place”), is a word used throughout Mexico. Twenty-five ancient villages possess this name referring to thermal waters, to their healing, divine, and magical properties. We can infer that, at least a millennium before the Spanish Conquest, many human settlements grew up here because geothermal manifestations were nearby. In fact, geothermal resources were used for cooking and cures throughout Central America (Suárez and Cataldi, 1993).

From time immemorial, American peoples took vapor baths by throwing cold water on hot rocks taken from the mouths of hydrothermal manifestations. They socialized, enjoying the vapors. Eventually, hot springs and thermal muds were used medicinally at some towns with the name *Atotonilco* and throughout the Mexican Volcanic Belt.

With time, some Mexican peoples began to use a structure called the *temazcal* for religious purposes (González, 1991). The *temazcal*, a dome constructed with volcanic stone and mortar, was warmed from the outside by showering cold water on piled rocks, heated by fire. The narrow corridor at the entrance was adorned with an image of Teteo Innan, the great goddess of the Earth and of childbirth, and the *temazcal* was used by pregnant women and babies.

Soon thermal baths were used widely in Mesoamerica. There were hundreds, all assigned with medicinal and divine properties with thermal waters between 20° C and 40° C.

Mexico had four famous gardens before the Conquest, and the most grand and beautiful was Oaxtepec. Located south of Mexico City, in the valley of Cuautla, it was founded by the Olmecas and preserved by all successive conquerors, finally becoming the summer residence of Aztec kings and the foremost botanical garden on the continent. One Aztec ruler, King Moctezuma I, sent messengers throughout the empire with orders to fill the garden with the most beautiful and rarest of plants, trees, and medicinal herbs. By the reign of King Moctezuma II, Oaxtepec had reached its greatest splendor and the emperor built temples, rooms, gardens, pools, and many *temazcal* baths for his noblemen and warriors.

The garden had abundant sulfurous thermal waters at temperatures of about 25° C that Moctezuma's warriors used for healing. The waters made a strong impression on the Spanish when they saw them (Bernal, 1532). The thermal waters were used, as well, to irrigate the garden. Oaxtepec was the first pre-Hispanic garden cultivated in Mesoamerica by a method known today as geothermal hydroponics.

Many Aztec structures were built with blocks of volcanic rock, often basalt. The upper classes of Aztec society made their homes with *tezontle*, a hard volcanic rock extracted from stony ground in what is today southern Mexico City. Mesoamerican minerals related to geothermal processes were used for weapons and tools and held mythical and religious meanings. For example cinnabar, the principal ore of mercury often associated with geothermal regions, was used to redden the bones of important personages, providing them with heat in the afterlife. Tezcatlipoca, one of the more important divinities, was characterized by a sculpture in obsidian and given the name of "smoky mirror." Obsidian was associated with death, magic, war, and fertility.

MESOAMERICAN COSMOGONY AND CALENDAR

FOR THE NAHUAS, THE ORIGINAL SUPREME BEING WAS CIPÁCTLI, A FEMININE MONSTER THAT inhabited the sea. Two gods converted into serpents cut Cipáctli in two portions. From the first half they made the underground world and from the second, heaven. For the Maya, the cosmos was a structure formed by horizontal planes in which sacred powers lived who decided the destinies of all. For both cultures, the divine energies were land, corn, volcanoes, wind, rain, lightning, sun, and stars.

Two stable, visible bodies in the heavens are the sun and the Milky Way. For the Aztecs, Huitzilopochtli, the god of war born on Earth, represented the sun. His dismembered sister, the goddess Coyolxauhqui, characterized the Milky Way (Aguilera, 1979). This divine couple in the Aztec pantheon was considered the founder of the universe.

For the Nahuas, the Earth was a cylinder surrounded by water. The universe originated in the center of the Earth, in its navel where the god of terrestrial fire resided. From that navel, the four cardinal points were drawn. Above the Earth existed thirteen heavens and below were nine underground hells. Through the first heavens went the courses of the sun, moon, stars, and comets. The thirteenth heaven was the site of the divine duality, Ometéotl, the principle of generation and conservation for the cosmos, who controlled the universe with fire, earth, water, and air through the navel of the world.

Water was always related to the origin of Mesoamerican people, the basic element in one of the first epochs of their existence (León Portilla, 1992). At the horizon, the waters of the Earth joined the waters of heaven to envelop the world. That world was called *Cemanahuac*, “that which is surrounded by water.” The cosmic meaning of water was so important that in the Náhuatl language, *atl* (“water”) came to represent the phoneme “a.” Tláloc, the god of rain, was worshiped throughout Mesoamerica, called “Chac” by the Maya, “Cocijo” by the Mixtecas, and “Tajín” by the Totonacas. In Náhuatl, “city” is translated as *atl in tepetl*, literally, “water-mountain” (León Portilla, 1992). Pilgrimages were made to volcanoes for several festivals marking dates on the solar calendar. The existence of lakes in craters of some old volcanoes reinforced the belief in the relationship volcano-water, which implicitly contains the idea that the mountains are large water reservoirs, kept by the gods of rain.

“All the high mounts, where the clouds join to make rain, are gods.
To each one of them an image is made....
Like the image of the volcano Popocatépetl (‘smoky mountain’)
Or of her whose name is Iztaccíhuatl (‘white woman’),
Or the image of the mount Poyauhtécatl (‘that which is from the region
of the fog’)....”

—From the Florentine Codex

Ancient Mesoamericans believed that man and woman were necessary collaborators in the living universe. Both depended on nature in the same way that nature depended on them. Heat was the force that sustained life. Heat was equal to life; cold was equal to death.

In many chronicles, in the oral tradition, in indigenous manuscripts, and on reliefs of pre-Hispanic monuments, the idea is found that our era was preceded by four prior eras—named suns by the Aztecs. Each era ended with the destruction of the world by different, terrible cataclysm generated from the energy of the Earth. The bygone eras were those of *atl* (“water”), *ocelotl* (“jaguar”), *quiahuatl* (“rain”), and *ehecatl* (“wind”) (León Portilla, 1961). Each era had great mythical importance, and the meaning and the reason for the end of each follow.



The five suns, or eras, in the center of the Aztec calendar. Reprinted with permission from Geotermia, Revista Mexicana de Geoenergía, vol. 9, p. 33, published by the Comisión Federal de Electricidad, Mexico

Atl-Tonatiuh (“Water Sun”). The first people were made from ashes. In the first catastrophe, humanity was destroyed by water in the form of floods, and people were converted into fish.

Ocelotl-Tonatiuh (“Jaguar Sun”). In the second era, the sun stopped at noon, interrupting its path. Suddenly night appeared and heaven was oppressed. Now giants lived, who, in spite of great corpulence, were weak. When they fell by accident, they fell forever.

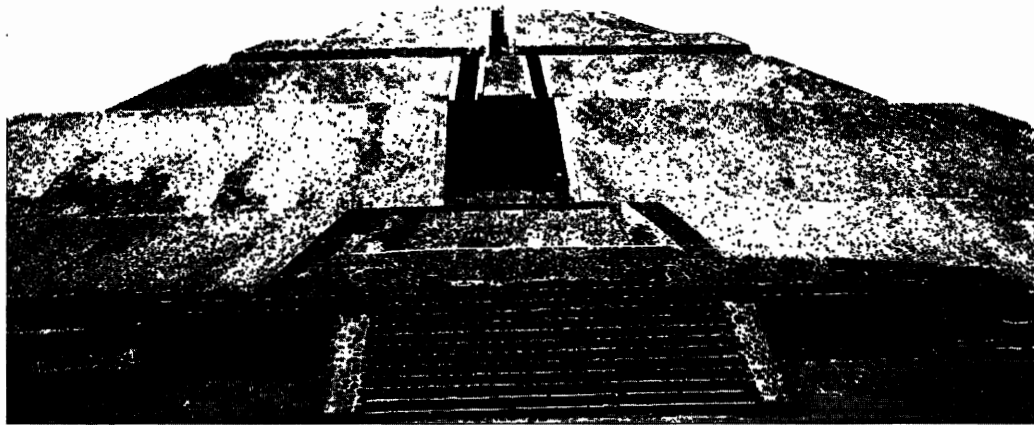
Quiahuatl-Tonatiuh (“Rain of Fire Sun”). In the third era, the rock boiled, burning the people in a rain of fire streaming down from volcanic eruptions (Tlequiahuatl) that destroyed the world. People in this era met a tragic end, changed into turkeys. The date 4-Quiahuatl, which records

Hieroglyphic of Fire

In the Aztec hieroglyphic for the third era, the “Rain of Fire Sun,” the god of volcanic fire, elegantly arrayed and with lava pouring from his mouth, falls face downward between adjacent volcanic slopes outlined in escaping tongues of lava. He will envelop in flame a man and woman sitting beneath him in the protective circle of their home, still unaware of his descent. Turkeys fly around the couple, presaging the end of the third era when mankind is changed into turkeys.

the end of this time, is placed under the protection of Tláloc, god of rain. He was also the god of fire, which fell from the sky as lightning rays and as volcanic eruptions (León Portilla, 1983).

Ehecail-Tonatiuh (“Wind Sun”). During this era, everything was destroyed by the wind in the form of terrible hurricanes, snowfalls, and glaciers. Humans were converted into monkeys and scattered through the mountains. At the end of the fourth era, the gods met in Teotihuacán to recreate the world. With the sacrifice of one god, who flung himself into the fire of an active volcano, the Fifth Sun emerged.



Pyramid of the Sun, Teotihuacán, Mexico. *M. C. Suárez Arriaga*

Ollin-Tonatiuh (“Movement Sun”). This was the last of the eras, the era of the Fifth Sun in which we live and one that will be devastated by earthquakes. The divinity of the Fifth Sun is Xiuhtecutli, god of fire, who links the heat of the Earth with that of the heavens.

Our era is represented on the Aztec calendar by the date 4-Ollin, which means “movement and earthquake.” The date 4-Quiahuitl, “end of the Rain Sun,” is placed under the protection of Tláloc, god of rain. The third era ends in a rain of fire; Tláloc is not only the god of rain, but also the god of fire falling from the sky in the

Ages or Suns That Have Existed

It was related so, it was said
that 4 lives came before,
And that this is the Fifth Age.
Just as the old men knew it, in the Year 1-Rabbit
The Earth and the Heavens were founded.
And they knew it thus,
That when the Earth and Heavens were founded,
Four kinds of men had existed,
Four kinds of lives.

They also knew that each one of them
Had existed in a sun (in an age).
And they said that their god made the first men,
He forged them from ash.
This they attributed to Quetzalcóatl,
Whose sign is 7-Wind, he made them, he invented them.

The First Sun (Age) that was made,
Its sign was 4-Water and it was called the Sun of Water.
In it happened that water carried everything away.
The people became fish.

Then the Second Sun was made.
Its sign was 4-Jaguar, it was called the Sun of Jaguar.
In it happened that the heavens were weighed down,
The sun did not follow its course.
When the sun arrived at noon,
It then became night, and when it was dark

cont....

The jaguars ate people.
And giants lived in this sun.
The old men said that the giants greeted them thusly:
“Don’t fall,”
because he who fell, fell forever.

Then the Third Sun was made.
Its sign was 4-Rain.
It was called the Sun of Rain (of Fire).
It happened that fire rained during it.
Those who lived in it were burned.
And during it sand also rained
And they said that in it
The little pebbles rained that we see
And that the *tezontle* stone boiled
And then the rocks turned red.

Its sign was 4-Wind, and the Fourth Sun was made.
It was called the Sun of Wind.
During it everything was carried away by the wind.
Everyone became monkeys.
They spread themselves through the mountains,
The ape men went away to live.

The Fifth Sun, 4-Movement its sign.
It is called the Sun of Movement,
Because it moves, it follows its course.
And as the old men say,
And in it will be earthquakes,
There will be famine and so we will perish.

In the Year 13-Reed, it is said that it came to exist,
The sun was born that exists now.
Then was when it illuminated, when it dawned,
The sun of movement that exists now.
4-Movement is its sign.
This is the Fifth Sun that was formed,
In it will be the movement of the Earth,
In it there will be famines.
This sun, its name 4-Movement,
This is our sun in which we live now,
And here is its trace
As the sun fell in the fire,
In the divine fire-box there in Teotihuacán.
Equally this was the sun
Of our prince in Tula,
That is to say, Quetzalcóatl.

English translation by M. C. Suárez Arriaga and S. Hodgson, from the Spanish translation by León Portilla in 1983, one of 11 Spanish translations of the poem. Transcribed in Náhuatl in 1558. (The dates in the poem correspond to the Aztec calendar.)

form of lightning and volcanic eruptions, equal to Tlequiahuitl, the rain of fire. Thus in four attempts, the world was born and destroyed from gigantic catastrophes, and this will happen once again.

In Mesoamerica the origin, existence, and development of the universe were the efforts of divine beings and came from divine energy in action. Therefore, religious understanding formed the basis of reality and Mesoamerican beliefs about geothermal manifestations were filled with fervent religious meaning with positive and negative dualities: both beneficent and harmful, constructive and destructive. The characteristics of three geothermal divinities illustrate this paradox.

Huehuetéotl was one of the principal gods, the oldest one, father of the other gods. He was the divinity who controlled fire, living in the “navel of the world,” that is to say, at the center of the Earth. At the same time, he was the nearest



Top view of the basalt Coronation Stone of Moctezuma II, Stone of the Five Suns. The stone is remarkable for its colossal size (55.9 x 66 x 22.9 cm), technical refinement, and iconographic complexity. The Aztecs believed that four imperfect eras of the universe, each named after its destruction date, had preceded the present age. Located at the stone's four corners and read counterclockwise from the lower right, they are 4-Jaguar, 4-Wind, 4-Rain, and 4-Water. The name of the present era, 4-Movement, represented by the carved X at center, predicts a cataclysmic end by earthquakes.

Encased in a square cartouche below the 4-Movement sign, the year 11-Reed corresponds to the year 1503, while the 1-Crocodile carved above the sign corresponds to July 15, together the coronation day of Moctezuma II, the last Aztec ruler before the Spanish arrival.

From Tenochtitlán, Mexico, Aztec culture, c. 1503. Major Acquisitions Centennial Endowment, 1990.21. Photograph by Robert Hashimoto. ©1996, The Art Institute of Chicago, all rights reserved



The underside of the Coronation Stone of Moctezuma II, Stone of the Five Suns, proclaiming the ruler's title to the Earth. The figure on the base represents 1-Rabbit, the mythical date marking the beginning of the present era in the Aztec calendar. The stone's dimensions are 55.9 x 66 x 22.9 cm.

From Tenochtitlán, Mexico, Aztec culture, c. 1503. Major Acquisitions Centennial Endowment, 1990.21.
Photograph by Robert Hashimoto. ©1996, The Art Institute of Chicago, all rights reserved

to humans, *Tloque Nahuaque*, “sir of the neighboring vicinity,” of the immediate present, who lived directly with people.

To the Aztecs, Huehuetéotl was fire itself, which came from volcanoes, the heat of terrestrial origin and the oldest principal generator of life who resided in the center of the Earth. The representation of Huehuetéotl as an old man suggests the antiquity of the mountains and the volcanoes. The age of this god underlines the importance given by the Mesoamericans to geothermal heat.



Huehuetéotl, the old god of fire, one of the most ancient deities in Mesoamerica. During ceremonies, fire was kindled in the brazier on his head. The volcanic stone sculpture, 19 inches high, is from Teotihuacán, Mexico, 250–750 A.D. *Natural History Museum of Los Angeles County*

“Mother of the gods, father of the gods, the old god,
The one that is in the navel of fire,
The one who is confined in turquoise.”

—*From Náhuatl elders, León Portilla, 1956*

Huehuetéotl was also the god of time. The museum of the great temple in Mexico City has basalt sculptures of the god, characterized in a similar manner by the Aztecs and the Teotihuacanos. The two snails on the head are located above streams of water, clearly related to Tláloc, god of rain and volcanic eruptions.

Tláloc was at the same time malevolent and beneficent: he enriched the soil with water but brought floods and disasters from hail, thunder, lightning, and volcanic eruptions. He represented a rain of water or a rain of fire. Chalchiuhtlicue was his feminine part, the goddess of running waters.

Tlazoltéotl was the Aztec goddess of carnal love and birth but also the goddess of vapor baths and confessions of illicit relationships. She was the goddess of refuse, lewdness, and spiritual

impurities; she also was named *Cihuacóatl* (“woman-serpent”), a form of the goddess of the Earth presiding over part of the underworld, the world of the dead, the sower, and childbirth.

Mesoamericans were obsessed by the flow of time and the oldest known writings of the Zapoteca and Maya (600 to 400 B.C.) are closely related to the calendar (Joyce, 1979). The Mesoamerican calendar has existed since 700 B.C., structured as a complex measuring system based on the idea of time as flow. The Aztecs called time *Cáhuítl*, “that which is leaving us” (León Portilla, 1961). Time began outside of human scope, at the beginning of the universe when vital activities of the gods created this world. The order in which the mythical actions occurred gave birth to the calendar, and every new being is named for the day it was created (López, 1990).

Cosmology is defined as a study of the philosophy of the universe as an ordered whole. Given the terrestrial nature of the oldest gods and the worldly origin of the sun and Earth, the symbols of the Aztec calendar representing days, months, years, and centuries reflect the influences of geothermal phenomena.

The calendar’s cycles were of distinct dimensions and significance. The major cycle of 52 years was attached to the Pleides constellation, at whose completion was celebrated the festival of New Fire. It was related to terrestrial heat and probably represented periodical eruptions or earthquakes. This cycle was divided into four groups of 13 years each. The ritual activities corresponded to the agricultural cycles and, given that the calendar was based on the solar year, the principal function of the religious cult was to regulate social and economic life.

The premier ring of 20 days shows the importance ancient Mesoamericans placed on concepts related to geothermal processes: rain (water, fire, or eruptions), movement (earthquake), and serpents (related to the Earth and to things beneath it). Most surprising is the concept related to water (*atl*), essential in all forms and whose patron saint was the god of fire, Xiuhtecutli (González, 1991). The Aztecs used the words *atl tlachinolli* to say “water in fire,” for which the geothermal relationship is evident.

The millennia of experience and wisdom accumulated by the Mesoamericans led them to a balanced existence between their societies and nature. Because of this, they revered water, corn, the volcano, the serpent, and the hummingbird. Thus Mesoamerican peoples studied and

developed natural phenomena, including geothermal resources. Natural heat and its by-products, plus close observations of geothermal phenomena, influenced the shape of their cultural, ethical, religious, and social structures.

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The Authors:

Mario César Suárez Arriaga
Mexican Geothermal Association
Michoacán University
E-mail: msuarez@zeus.ccu.umich.mx

Raffaele Cataldi
55, Via del Borghetto
56124 Pisa, Italy
Telephone/Fax: 39.050.59.81.07
E-mail: rafcat@tin.it

Susan F. Hodgson
Ca. Dept. of Conservation
Division of Oil, Gas,
and Geothermal Resources
801 K Street, MS 20-20
Sacramento, CA 95814-3530 USA
Telephone: 916.445.9686
Fax: 916.323.0424
E-mail: shodgson@consrv.ca.gov



Basalt sculpture from Mexico of a female deity reflected in an Aztec obsidian mirror with a wooden frame, 10 1/4" in diameter. *Courtesy Department of Library Services, American Museum of Natural History (neg. 323348; photograph by L. Boltin, October 1953)*
