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8. Human Rapport with Hypogeal Waters and Geothermal Manifestations in Italian Prehistory

by
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Abstract: Humans established relationships with hypogeal waters and geothermal manifestations during the Neolithic and Metal Ages in Italy, including cults and therapeutic uses. Some geothermal by-products were used as well: obsidian for tools and weapons, volcanic rocks for millstones, pumice and fine-grained pyroclastics for tempering and grinding materials for ceramic finishes, and sulfur for pigment and ointment mixtures.

A General Look at the Problem

The study of the relationships formed in Italy between prehistoric people and various types of underground waters, particularly thermal waters, depends on the availability of data. In certain instances, significant evidence can be found on cultic practices related to lake, river, and superficial spring waters, as well as to hypogeal waters: cavern waters flowing, dripping, or in lakes. In other instances, solid evidence is lacking, and one must hypothesize about the existence of cultic practices related to hypogeal waters and about the use of thermal waters for therapeutic purposes. Localities with natural manifestations may have direct or indirect indications to suggest that these manifestations were frequented by people for some purpose; however, it is hard to establish if people visited these sites for cultic and/or therapeutic practices. It is much easier, of course, to identify and study volcanic and hydrothermal products used by the
early Italian populations to form artifacts and tools for their daily activities. These products are discussed in the last section of the chapter.

Concerning cults, an intrinsic difficulty lies in defining the concept and in the meaning that cultic phenomena may have held for prehistoric and ancient peoples in different regions of the Mediterranean. Too many times such a delicate subject has been approached with different methodologies, and the term “cultic object” itself has been applied to any type of prehistoric finding or archaeological complex that cannot be explained in terms of functional use (Grifoni Cremonesi, 1994; Di Fraia and Grifoni Cremonesi, 1996).

In Italy, prehistoric artifacts and ruins have been found that are certainly related to the spiritual sphere and the ritual practices of the people, especially for the Neolithic and the Metal Ages: they are mainly circular pits dug on the floors of some caverns and stone circles laid down on the floors of other caverns. Vases or other votive objects were methodically deposited inside the pits and circles. These circular features and the objects inside them probably represent symbols for funerary rituals.

Upside-down vases (perhaps the position represented a way people could connect with the dead and with the chthonian world of dead and underground divinities), pieces of broken vases (“ritual fragmentation”) accurately piled up, or piles of vases were also found in some caves; these findings, too, are interpreted in terms of funerary rituals (Radmilli, 1975; Cremonesi, 1976 and 1985-90; Grifoni Cremonesi, 1986 and 1994; Di Fraia and Grifoni Cremonesi, 1996).

Less frequent are Neolithic remnants of true monuments, among which two “altars” of stone drywalls in Apulia, Southeastern Italy, are worthy of mention. For the Copper and Bronze Ages, more evolved and complex remnants of hypogeal and megalithic monuments exist. Many of these are difficult to interpret: they are generally related to agricultural rituals, but they could also refer to both agricultural and funerary rituals. In this latter case, the cult probably aimed at linking the most significant moments of human life: birth, growth, and death.

A different type of cultic phenomenon is related to water and water circulation: cold or warm springs emerging in underground cavities frequented by people, natural manifestations with fluids at more or less anomalous temperatures, hot and ambient-temperature springs outflowing at the surface. Water-related cults did not involve just water; they also involved some of the effects
produced by water circulation, such as “solid water” (stalactites and stalagmites), bubbles of gas released in certain water pools, waterfalls and cascades inside caves, and pools or pits formed at the bases of waterfalls (Whitehouse, 1990 and 1992; Di Fraia and Grifoni Cremonesi, 1996). Other phenomena associated with water circulation, such as those resulting from hydrothermal circulation (travertine, chalcedony, and sulfur), relate to functional uses.

The symbolic value of water has been universally recognized and permeates on a global scale the cultural background of religions and popular traditions. Water is considered the origin and blood of any form of life, a symbol of rebirth and regeneration, a fertility element, a magical fluid, and the therapeutic substance par excellence (Eliade, 1966). Cults devoted to springs, rivers, lakes, and thermal sources are almost universal, and their persistence is reflected in the traditions and cultures of most peoples on Earth. Writing on this subject is substantial. Concerning Christianity, forms of cults for saints directly or indirectly related to water date back many centuries and still exist today.

**Prehistoric Cults and Ritual Practices Related to Hypogeal Waters**

Without being too detailed, this section briefly reviews the information available for Italy on prehistoric cults. Regarding the Paleolithic, Bahn (1978) has suggested a connection between some artistic expressions of the Upper Paleolithic and the presence of water in caves. However, no concrete evidence as yet exists for this period.

**Evidence for the Neolithic**

Abundant and reliable data are available for the Neolithic, beginning in Italy about 5200 B.C. This period is characterized by the arrival, from the Near Middle East to the Italian peninsula, of animal husbandry and agriculture that small communities in permanent settlements began to practice. New life styles and ways of thinking, also originating in the Near Middle East, started taking root among the Italian peoples in the same period. According to opinions of scholars in this field, organized forms of religion began, and cultic rituals, mostly related to agrarian activities, started gradually to take shape and consolidate during the Neolithic. These religions and practices focused on the figure of a female divinity called the “Mother Goddess” (Cauvin, 1994).
All evidence gathered comes from caves or branches of caves, which now, and presumably during the Neolithic, are difficult to access. Unsuitable for frequent visits, these caves probably were used as places for ritual and/or funerary practices or as cultic sites. One must remember that during the Neolithic, caves were no longer regarded as temporary shelters for individuals or small communities, as they were during the Paleolithic and Mesolithic. It is no wonder, then, that the most inaccessible caves were frequented only occasionally for ritual, cultic, and/or funerary practices.

The function of caves as sacred and mysterious places has been extensively debated to try to understand their use in prehistoric, ancient, and even recent times. Relationships have been proved or hypothesized with underworld entities, with the goddess “Mother Earth,” with esoteric and initiation rituals, and with incubation practices. For relatively recent times, psychoanalytic implications have been suggested for people frequenting underground or obscure recesses.

All of these relationships are basically the result of the mysterious atmosphere and the sense of fear aroused in people’s imaginations by deep caves and lack of light, even today. Mention should also be made of cults for saints, such as St. Michael, related somehow to the underground world, cults for “miraculous” waters flowing from natural cavities, and some popular beliefs regarding imaginary beings who guarded fabulous treasures in underground recesses (Di Fraia and Grifoni Cremonesi, 1996; Grifoni Cremonesi, 1996).

Italian caves with Neolithic evidence of cultic practices related to hypogeal waters are Grotta Scaloria Bassa, Apulia; Grotta dei Meri and Pozzi della Piana, Latium; Grotta Zinzulusa, Apulia; and, probably, Grotta Verde, Sardinia.

Grotta Scaloria Bassa. Discovered in 1967, this cave is the lower chamber of the Grotta Scaloria proper. It is a wide, concretion-rich chamber, with a small lake at the bottom. Inside the chamber, Neolithic people placed vases around stalagmites and upon the trunks of stalagmites intentionally truncated; they also dug a rectangular pit (90 cm x 50 cm) to a depth of 15 cm on the calcareous floor of this chamber. Near the pit, a human skull and other human bones were found in a small lateral branch of the chamber, and near this branch was a hearth with charred animal bones.

Some 60 vases attributed to a culture named “painted pottery with red strips,” the predominant culture in Southern Italy during the first half of the 4th millennium B.C., were also discovered in 118
Map of main archaeological sites with ascertained relations between prehistoric people and hypogeal waters or natural manifestations.

(1) Grotta di Re Tiberio, Iron Age; (2) Pozzo della Panighina, Copper Age; (3) Buca del Rospo, Copper Age, and Grotta dell’Orso, Bronze Age; (4) Pozzi della Piana, Neolithic; (5) Grotta Nuova and Grotta Misa, Bronze Age; (6) Caverna dell’Acqua, Bronze Age to Roman times; (7) Grotta dei Meri, Neolithic; (8) Grotta dello Sventatoio, Bronze Age; (9) Lago delle Colonnelle, Bronze Age to Roman times; (10) Lago del Monsignore, Bronze Age to Roman times; (11) Palmarola, Neolithic; (12) Grotta Verde, Neolithic; (13) Monte Arci, Neolithic; (14) Grotta Pertosa, Bronze Age; (15) Grotta Scaloria, Neolithic; (16) Grotte di Latronico, Bronze Age; (17) Grotta Zinzulusa, Neolithic; (18) Panarea, Bronze Age; (19) Lipari, Neolithic; (20) Tholos di San Calogero, Bronze Age; (21) Stufe di San Calogero, Copper Age.
this cave. All vases are painted with large red stripes, edged with narrow brown stripes, and made with a particular decoration technique called "in negative." They are especially valuable compared to the pottery normally produced in Southern Italy at that time. The vases are mainly shaped as bowls, cups, jars of different sizes, jugs, and pots, with subordinate flasks; they were all used to collect dripping water (Tiné, 1975; Tiné and Isetti, 1975-1980).

However, since most of the vases have an open shape, and considering the cave's very difficult access, it is hard to imagine that they were used to transport water outside of the cave; therefore, the water must have been collected for use inside the cave. Furthermore, the locations of vases on the truncated stalagmites suggest that the true interest of the Neolithic people lay in collecting the water dripping from the ceiling or from the stalactites. The fragments of the truncated stalagmites also may have had a cultic function. The subject of the cultic function of mineral and calcareous concretions is widely debated. Important examples of the practice were found by Mellaart (1967) in the Neolithic village of Çatal Hüyük in Western Anatolia, Turkey. Here in an area labeled VI.B.44, fragments of stalactites have been found together with stone statuettes and offerings of cereals. A concretion has been unearthed in another area with one extremity carved in the shape of a human head.

While it is impossible to establish with certainty whether the water in Grotta Scaloria Bassa was collected for cultic, magical, and/or therapeutic purposes, many European caves have numerous stalactites and carbonate concretions from which CaCO₃-saturated, opalescent water slowly drips and forms mammary-shaped concretions. Since the color of the whitish waterdrops resembles milk, these concretions are often referred to as pocce lattaie ("nursing mammaries"). Because of the resemblance to milk, milkless women used to drink it, frequently in the past and still today in some rural areas (Corrain et al., 1967). Indeed, until a few decades ago, devotees of the cult of St. Michael gathered the milky waters from caves because the waters were believed to have therapeutic properties and were reputed to cure some stomach disorders.

Considering that these popular beliefs and practices have persisted until the present, it is very easy to argue that such waters attracted the interest of prehistoric people for cultic and/or magical and therapeutic applications. Significantly, Neolithic people did not place water-gathering vases by the small lake at the bottom of the Scaloria Bassa cave. Many such vases were put only at the stalactitic-stalagmitic complex. Apparently, Neolithic people visited the cave exclusively to collect the water dripping from the stalactites or the ceiling and not for the water from the small lake.
Grotta dei Meri and Pozzi della Piana. Vases in the Grotta dei Meri and the Pozzi della Piana date from the same period of those of Scaloria Bassa, but they belong to a different culture, known as “pottery with engraved lines,” which developed in Latium and Tuscany. Both caverns are large, characterized by very difficult accesses and long labyrinthine passages through winding areas.

In the Grotta dei Meri, a jar was found near the final part of the cave in a place where several narrow passages merge. The jar was located beneath a continual slow drip, which is rather difficult to reach, suggesting that the water was not collected for practical uses.

In the Pozzi della Piana cave, which develops over three levels at different elevations, Passeri (1970) has documented a more complex situation. Stone and pottery objects were located on the various chamber floors, inside small cavities formed around fracture planes, and on some of the rock wall overhangs. In particular, a number of inverted cups 5-7 cm high were deposited carefully inside fracture cavities around a natural, relatively large water pool surrounded by stalagmites and stalactites. Flask-shaped vases were also left in a small natural pool formed under concretionary overhangs. The location and position of these artifacts indicate a ritual or cultic purpose.

Other evidence of cultic practices includes a circular pit (40 cm in diameter and 50 cm deep) dug in the calcareous floor of the cave and filled with ochre clods. A few small millstones were also found in the cave. The presence of these millstones—some left on the ground, others deposited inside pits of caves used for burials—has been highlighted by Di Fraia and Grifoni Cremonesi (1996).

Grotta Zinzulusa. The finds at Grotta Zinzulusa date back to the Late Apulian Neolithic, about the end of the 4th/beginning of the 3rd millennium B. C. This concretionary-rich cave yielded 11 vases, including bowls and flasks; they were all placed along the shores of a small lake located near the most distant and darkest part of the cavern, many hundreds of meters from the entrance (Zezza, 1984). The development of the cave is controlled by a set of subvertical faults, but its path is winding, with an up-and-down labyrinthine course, starting from a rather difficult access now located a few meters above sea level.

Grotta Verde. The access for Grotta Verde is at 75 m, but the cavity quickly deepens down a 45° slope to a small lake of brackish water at sea level. Near the lake, a hole 6 meters deep
leads to a small stalagmitic-rich site where human bones were found. From here, a very narrow passage leads to a large flooded chamber at 10 meters below sea level. Marine water is at the bottom, with a 2-6 m thick layer of fresh water floating on it. Many vases, “impressed” pottery, were deposited in the access passage and in the chamber; most are flasks dating to the Lower Neolithic (6th millennium B.C.). Cave visitations continued throughout the Neolithic (Tanda, 1978; Lo Schiavo, 1987).

It is hard to determine whether or not the vases were used to collect drinking water or for some ritual practice; however, considering the extremely difficult access to the chamber, the latter is the most reliable hypothesis.

During the Neolithic, the deposition of vases close to water pools or below dripping water occurred in Italy solely in caves with very difficult access and a labyrinthine development. In many instances, the vases were particularly valuable. All this indicates that the water was not collected simply for daily use but for ritual practices. However, no human remains have been found nor offerings of cereals or other objects, as occurs with ritual forms known for Neolithic sites outside caves, with the exception of Pozzi della Piana. Here, vases filled with wheat were placed along the shores of a small underground stream and the situation resembles that of the Trou Arnaud cave in France, where Late Neolithic vases were found filled with wheat (Blanc, 1976).

**Evidence for the Metal Ages**

Gathering dripping water in caverns is a custom which continued in Italy until the end of the Copper/beginning of the Bronze Age, as is indicated by the findings in the Buca del Rospo (“Toad’s Hole”) cave, located on the slopes of Mt. Cetona in Tuscany. Here, two vases were discovered in an area of sustained dripping water, partially embedded inside a stalagmitic concretion (Zanini, 1988). The site is at the very end of the cave, beyond a deep hole that makes reaching it extremely difficult. This situation differs greatly from that of French caves where the vases deposited during the Copper Age were mostly large with large orifices, thought to have been used to collect fresh water for daily use.

In the Bronze Age during the 2nd millennium B.C., the tradition of placing vases below dripping water in Italian caves persisted, but new forms of vase deposition began, with a tendency to favor running waters in caves with easy access and waters at the surface in rivers and lakes.
During the Middle Bronze Age (16th-14th centuries B.C.), vase deposition became frequent along underground streams or in the vicinity of subterranean springs. These vases often contained cereals, seeds, and fruits; other times vegetables were left in small heaps on the ground. In some locations, human bones were placed near the vases. The following are some significant examples.

_Grotta Nuova._ In the Grotta Nuova cave, Latium, vases were deposited inside the small stream flowing at its bottom. Some of the vases contained wheat and flat beans, and others were placed in an overturned position (Poggiani Keller, 1978; Negroni Catacchio et al., 1989-90).

_Grotta Misa._ Located in the same area as Grotta Nuova, Grotta Misa has a stream at its bottom, along which many vases and some ravaged burial sites were found. A hearth was also preserved with ashes accurately positioned to form a ring, inside which small heaps of wheat, millet, beans, and flour were carefully arranged (Negroni Catacchio et al., 1989-90).

_Grotta dell'Orso._ In the Grotta dell'Orso ("Bear Cave"), Tuscany, in the same territory of Buca del Rospo, a number of Bronze Age vases with wheat offerings were found in various chambers of the large cave (Grifoni, 1967; Cremonesi, 1968).

_Caverna dell'Acqua._ Inside the Caverna dell'Acqua (also called "Cave of the Votive Offerings"), Latium, a spring exists that was used for cultic purposes until Roman times. The most ancient findings in this cave date to the Middle Bronze Age (Rellini, 1920; Guidi, 1991-92).

_Grotta Pertosa._ The cave with the most abundant and important findings of the Bronze Age is Grotta Pertosa, Campania. It is very large, rich in concretions, and crossed by a stream originating from springs and waterfalls located at the very end of the cave. During the Middle Bronze Age, two pile-dwellings were constructed inside, and many vases were deposited along the shores of the subterranean watercourse. In addition, 324 miniaturized vases were deposited, methodically arranged, and piled up in a narrow branch of the cave near its innermost part; they are interpreted as important votive offerings (Carucci, 1907; Trucco, 1991-92). Another smaller votive offering of the same period was left near the entrance of the cave, on a small overhang of the rock wall on the left riverbank.

_Grotta di Re Tiberio._ More than 600 Iron Age II miniaturized vases were found in the cave Grotta di Re Tiberio, Romagna, left near a spring flowing out from the inner portion. Miniature
vases used for cultic purposes date to Neolithic times, but the practice spread during the Bronze Age, continued to persist for centuries, and assumed a special form of veneration during the Iron Age. For a review of Italian caves where cultic practices occurred, see the papers by Peroni (1989), Guidi (1991-1992), Bernabei and Grifoni Cremonesi (1995-1996), and Di Fraia and Grifoni Cremonesi (1996).

It is clear that a notable increase occurred in the depositions of votive vases on the shores of hypogean waters during the Middle Bronze Age. However, the offering of vases in this period was not related solely to cultic practices, as it was during the Neolithic, but mainly to agrarian rituals and sometimes to funerary rituals. Vase deposition practices in the Middle Bronze Age shifted from dripping waters and small lakes inside labyrinthine caves with very difficult access to underground watercourses in relatively large caves with easy access.

The custom of vase dedication during the Bronze Age also involved open-air waters (rivers and lakes), as is the case with Monsignore Lake in Latium. Here, the practice of placing votive vases near the spring tributaries of the lake started in about the 15th century B.C. and lasted until early Roman times in the 6th century B.C. (Guidi, 1980).

All of these examples refer to caves and localities in Central and Southern Italy. In Northern Italy, different forms of rituals took place during the Middle and Late Bronze Ages when bronze objects—mostly swords—were offered in rivers, streams, and lakes.

CULTS, RITUAL PRACTICES, AND USE OF THERMAL AND MINERAL WATERS

CULTS AND RITES

Due to their peculiarities, the external manifestations of terrestrial heat—thermal and mineral springs, fumaroles, volcanic eruptions, sulfurous springs, and gas releases—could hardly pass unnoticed by prehistoric people. In addition to water-related cults in caverns with hypogean waters, other forms of cults and rituals related to these manifestations started to appear in about the 3rd millennium B.C.

In the Stufe di San Calogero, Sicily, big vases of the Malpasso culture, dating to the Copper Age (3rd millennium B.C.), were found in natural tunnels from which sulfurous vapor flows out.
at 39° C. Burials were also found inside these tunnels, and the contemporaneous presence of vases and burials is a puzzle. These finds suggest that the vases were offerings to an underworld divinity that had manifested its presence suddenly, through terrifying phenomena. This may have been an earthquake causing fractures to open through which sulfurous vapors flowed near the end of the Copper Age. Now tunnels used since the Lower Neolithic could be entered no longer (Guidi et al., 1979). However, available data are not sufficient to prove this hypothesis (Maggi, 1976-77; Tiné, 1979).

A. Guidi (1991-92) has provided interesting information about the Grotta dello Sventatoio near Latium. This is a deep cave, 30 m below sea level, consisting of four chambers interconnected by narrow passages. It is classified as a “thermal cave” because warm air continuously flows from the cave and condenses outside, especially during winter. Fragments of 400 Lower and Middle Bronze Age vases associated with food remnants (an entire flat loaf was found near one of them!) were found in this cave, and many vases contained wheat, barley, and flat beans. Pig, sheep, and cattle bones were found in different places, as well as three charred children’s skulls.

Since the cave is all but suitable for habitation, the presence of so many artifacts suggests that the “vapor” flowing from the cave may have attracted the attention of people, resulting eventually in customary offerings of vases, food, animals—and perhaps also children—to divinities of the underworld.

Calcarà di Panarea is a group of pits located near the shores of an island in the Aeolian archipelago north of Sicily. Archaeologists attribute them to the Capo Graziano culture, dating back to the Lower Bronze Age.

Because of very recent volcanic activity, strong fumaroles spread over a large area around the pits, and even the nearby marine belt displays many releases of hot fluids rising from below the sea floor. People probably did not settle at this site or in its proximity (Bernabò Brea, 1968). Panarea, however, is a small island inhabited since Neolithic times, so the site must have been known to and occasionally visited by the island people. Archaeological evidence indicates human presence at the site since the Late Neolithic.

The pits were dug during the Bronze Age, probably in a period of relatively low fumarolic activity. They were lined with volcanic pebbles and gravels, bound together by a mortar of mud and products of hydrothermal alteration, such as kaolin, alunite, and sulfur obtained from nearby
manifestations. No significant objects were left inside or near the pits, and due to the high temperatures, no functional use can be imagined for these constructions. Perhaps their excavation was motivated by a form of cultic or ritualistic practice dedicated to the chthonian world.

The geological and geothermal conditions in the area of the small Lago delle Colonnelle, Latium, differ from those of the Calcara di Panarea. The sulfur content of the hypothermal water of this
small lake is probably related to a secondary branch of the hydrothermal circuit that, in recent
geological times, caused the thick travertine deposit to form near Tivoli (the renowned lapis
*titurtinus* of the ancient Romans). Because of a haze and the bad smell rising from the small
lake, no people settled in its vicinity. Nonetheless, the site was probably frequented for cultic or
ritualistic purposes during the entire Bronze Age, as numerous vases were found on the lake
shores (Guidi, 1986).

Grotte di Latronico, Lucania, is located at a distance from sulfurous thermal springs. The cave
was frequented during the Bronze Age, as confirmed by archaeological evidence from an
expedition conducted almost a century ago (Rellini, 1916): vases full of cereals and fruits were
unearthed, and Rellini suggested that they had been left in the cave as votive offerings to “heal-
ing waters.” Modern excavations of the 1970s and 1980s confirm that the cave was used
mostly as permanent shelter by people from the Mesolithic (7000-5500 B.C.) through the
Bronze Age (Cremonesi, 1978; Bianco, 1984). Unfortunately, the first excavation did not
consider the stratigraphic position and the location of the artifacts, so that a possible connection
between the deposition of vases and the thermal springs of the area cannot be established.

**USE OF THERMAL AND MINERAL WATERS**

The use of thermal and mineral waters for balneology and for curing stomach
disorders probably started in Italy in Neolithic times, or possibly even before. Concrete evi-
dence of these uses dates only from the Bronze Age onwards.

A significant example is the San Calogero *tholos* on the island of Lipari north of Sicily, which
was constructed by Mycenaean colonists during the Bronze Age. This *tholos* probably repre-
sents the oldest and best documented case of an organized use of hot waters for therapeutic
purposes in the Western Mediterranean. It is a building constructed of rows of large jutting
blocks enclosing a room saturated with hot vapor (*sudatorium*). The water was gathered from
a high-temperature spring in the vicinity and channeled through a stone-lined canal to a pond by
the *tholos*, which was probably used for thermal bathing. From this pool, the water was
channeled into the *tholos* by a smaller canal through the main entrance, which is finished with a
robust architrave. The *tholos* was constructed during the period of the Capo Graziano culture,
before 1430 B.C. (Bernabò Brea, 1991-92; Bernabò Brea and Cavalier, 1996). Thus the
islands of the Aeolian volcanic archipelago were the sites of both therapeutic and religious
practices related to geothermal manifestations (see section on Calcara di Panarea).
The *tholos* di San Calogero, Bronze Age, used as *sudatorium*: (above) entrance to the *tholos*; (below) pond by the *tholos*, probably used as a thermal pool. *Bernabò Brea and Cavalier, 1968, with permission*
The Phlegraean Fields near Naples is another area rich in geothermal manifestations, including fumaroles, hot springs, and hydrothermal activity. For this area, however, no significant archaeological findings exist to indicate therapeutic uses of the thermo-mineral waters in prehistoric epochs. This is because intense volcanic activity affected the area during recent geological times, resulting in the destruction or burial of Neolithic settlements and making the area periodically unsuitable for human habitation (Albore Livadie, 1986).

Ancient authors provide stimulating information on Sicily and Sardinia, the two largest islands of Italy, particularly when describing situations and life styles of the Sican and Sicilian peoples of Sicily and the Protosardinians of Sardinia. These works mention some popular customs of visiting thermal and mineral springs for cures and other purposes. These customs probably took root in prehistoric epochs and persisted for many centuries (or, perhaps, for several millennia) until ancient times (Lilliu, 1988).

For the Nuraghic period in Sardinia (2nd millennium B.C.), cases are reported of sacred places near thermal springs with healing properties. These are the fonte de los malavidos ("spring of the ill people") and funtana de is dolus ("spring of the pains"), whose waters were particularly sought for the treatment of rheumatism and other maladies. Near these springs during the Middle Bronze Age, people left vases in gratitude for their cures. At Santa Lucia di Bonorva (Sassari), a wide enclosure dating from the Nuraghic period can be seen surrounding an area with many releases of effervescent water. Most commonly, however, water-related sacred places in Sardinia were wells near sanctuaries. Indeed, all types of waters were considered a divine gift and were thus objects of cults (Lilliu, 1988).

For the Protosardinians, ancient writers mentioned a kind of ordeal (popular trial) celebrated at the site of some springs with warm caustic water; the divinities of these waters established the guilt or innocence of people accused of some fault (Lilliu, 1988). Macrobius, grammarian and philosopher of the 5th century A.D., reported similar activity in Sicily. Ordeals were held at the sites of special thermal springs issuing acidic water and gas; Macrobius wrote that the punishment for the people judged guilty consisted of exposing them at length to the noxious blasts of the springs, until they were blind.

Monticchio sul Vulture, on the slopes of the Vulture volcano in Lucania, has some caustic springs near which a stipis ("votive offering") was found at the end of the 19th century. It was a pile of miniaturized Iron Age vases and is interpreted as a sign of gratitude for the healing waters (Rellini, 1916).
Another example of a functional use of the water is a well, Pozzo della Panighina in Romagna. It was excavated toward the end of the Copper Age and was equipped with wooden pipes. Many flasks and two-handled vases were found inside this well, together with the remains of ropes that prove that the vases were lowered into the well to collect the chloride water and exploit its
therapeutic properties (Santarelli, 1902; Pigorini, 1908; Morico, 1988). Well use continued through the Bronze Age. A number of vases were also found at the surface around the well mouth, suggesting a cult of curative waters.

**USE OF GEOTHERMAL BY-PRODUCTS: AN OUTLINE**

The exploitation of volcanic and hydrothermal products is an extremely interesting branch of prehistorical research, which recently has attracted increased interest by archaeologists, historians, geologists, geographers, and scholars of the history of science and technology. Many works dealing with interdisciplinary investigations on this subject have enriched recent literature. However, I shall limit myself to a few references from Central and Southern Italy.

One of the most desired by-products of geothermal energy in prehistoric times was obsidian. Its systematic use in Italy dates to the Lower Neolithic. Italian obsidian is found on the two volcanic islands of the Tyrrhenian Sea—Lipari in the Aeolian archipelago and Palmarola in the Pontine archipelago—and at Monte Arci, an extinct volcano in the northwestern sector of Sardinia’s Campidano graben (an area of subsided land). Obsidian was traded as a raw material on the Italian mainland, Corsica, and the Mediterranean coasts of France. In Northeastern Italy, obsidian also was imported from the Carpathians (Ferrari and Pessina, 1996). In recent years, obsidian has become an important tool to reconstruct the prehistoric cultural relationships among various areas of Southern Europe.

As for hydrothermal products, prehistoric people at Panarea used kaolin, sulfur, and associated compounds of fumarolic activity to prepare a mortar binding pebbles and gravels together to strengthen the walls of the ritual pits. Very likely, kaolin was also used as a component in pottery making.

Data are not yet available regarding the use of native sulfur to prepare ointments and as a component of pigments in prehistoric epochs, but usage can be inferred because this mineral outcropped in a number of areas with fumarolic activity in Tuscany, the Phlegraean Fields, and the Aeolian archipelago. It could hardly pass unnoticed by early Italian peoples. The remains of a sulfur-melting furnace in a Lower Bronze Age settlement was discovered a few years ago in the Monte Grande area, near Agrigento in Sicily (Castellana, 1996). The furnace suggests that the use of hydrothermal sulfur was an established custom by the beginning of the 2nd millennium.
B.C., although the use of sulfur might have started much earlier. The size of the furnace suggests that its production capacity exceeded the demands of the local market, and it perhaps served external markets as well, in particular that of ancient Greece. If so, the furnace at Monte Grande would have provided one of the most important trading materials between Southern Italy and ancient Greece during the 16th and 15th centuries B.C., the Late Elladic period I-II.

Among the hydrothermal minerals, alunite and iron oxides, often associated with kaolin and sulfur, were probably used locally in areas of Central and Southern Italy to process textiles and/or to prepare pigments during prehistoric times predating the Bronze Age; however, specific evidence of this use is not yet available.

Volcanic materials, such as trachyte and other hard igneous rocks, were used frequently in prehistory for millstones. Volcanic products, such as fine-grained pyroclastics and pumice, were used for tempering, grinding, and degreasing pottery. Lipari Island had large deposits of pumice, and its exploitation was probably important for the local economy, at least since the Bronze Age.

In addition to obsidian, all of these raw volcanic materials have become important archaeological tools in the last few decades, helping researchers retrace and highlight cultural relations established in prehistory between different and often distant European populations.

**Conclusions**

The data available so far, even though scanty or unclear in some cases, are sufficient to highlight the interest that prehistoric Italians gave hypogeal waters, thermal springs, high-temperature geothermal manifestations, and by-products of the Earth's energy, beginning several thousand years before the Christian era. From that time, this interest resulted in the formation of cults, rituals, and customs related to the presence of water in caves, water springs of different natures and temperatures, and the emergence of effluents from the subsoil.

All of these elements were involved in the spiritual lives and behaviors of prehistoric people; they evolved and strengthened with time, continued to persist in ancient epochs, and, in a number of cases, influenced present-day cults, rituals, and popular beliefs.
Parallel to the magical and religious aspects, other pragmatic aspects related to the use of fresh water and thermo-mineral springs, high-temperature geothermal manifestations, and by-products of the Earth’s energy took root in prehistory. They were gradually refined and enriched through hundreds of generations into a valuable heritage of ancient and modern peoples.

Together, all of these elements contributed significantly to the development of aspects of Italian civilization in prehistoric and ancient times.

**CITED AND SELECTED REFERENCES**


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Plato described in detail the configuration of this fantastic city-state of the imaginary continent with the same name—the famous "lost continent." Among many other features, Plato recounted that within the inner citadel thermal springs existed, supplying the royal palaces with hot water. However fictitious Plato's account may be, it highlights the importance the ancient Greeks attached to lands with thermal springs.