ARCHAEOLOGICAL RESEARCH AT WARM MINERAL SPRINGS, FLORIDA

Wilburn A. Cockrell
Warm Mineral Springs Archaeological Research Project
Department of Anthropology
Florida State University
121-35 Dorado Drive
Warm Mineral Springs, FLORIDA 34287 U.S.A.

The Warm Mineral Springs archaeological site is comprised of terrestrial and underwater deposits in and around an anaerobic spring-fed 70m deep sinkhole in Sarasota County, Florida. Interdisciplinary research during the past eighteen years has produced a wealth of data about human activity and environmental change over the past 11,000 radiocarbon years. Analysis of the current field season's recoveries has added significantly to existing knowledge of the site and to an understanding of its place in the archaeological record.

ENVIRONMENTAL AND PALEOENVIRONMENTAL BACKGROUND

Warm Mineral Springs is a significant archaeological site, not only for the scientific data that it has produced over the past two decades, but also for the technological applications that have been developed and the approaches to method that have been refined there. Aside from questions of technique and method, however, the site provides a look through time back through the last approximately 30,000 years. An understanding of the cultural aspects of Warm Mineral Springs must have as its background an understanding of the physical aspects of Warm Mineral Springs, including the geology, hydrology, and the paleoenvironmental data.

Geologically, Warm Mineral Springs is a solution hole in a karst plateau. Peninsular Florida is underlain by highly porous limestone and many areas are characterized by sinkholes, most of which are shallower in nature (l to 4 m deep). In the area of Warm Mineral Springs the karst topographic manifestations are quite distinctive, and an aerial view will demonstrate hundreds of shallow and seasonally dry sinkholes that opened up in a time of lowered water table, associated with a lowered sea level. Today in Florida sinkholes are opening up in central Florida where the ground water is being depleted, but in prehistoric times they would open up at times of extreme drought or, principally, through a lowering of sea level. It is hypothesized that Warm Mineral Springs and Little Salt Spring (only 4 km away) opened up at a time of lowered sea level during the terminal Pleistocene, perhaps as early as 30,000 years BP, but certainly by approximately 11,000 BP (Cockrell, 1989).

At Warm Mineral Springs, the cavity itself is today 72 m across (from bank to bank) and is filled with spring-fed water (Figure 1). At 30 m below the surface of today's water, it is only 36 m wide. At the base of the cavity, some 70 m below the surface, it is approximately 70 m wide. Stratigraphically the surrounding terrestrial column from the surface, at approximately 3 meters above sea level, begins with 1 - 2 m post-Pleistocene deposited sand. Underlying the sand is a marine shell marl, the Caloosahatchee Marl, which is approximately 1 m thick and dates from the middle Pleistocene. There is underneath the Caloosahatchee Marl an unconformity from the early Pleistocene back to the Miocene, with the Pliocene being completely absent. The top of the Miocene is the well known Hawthorn Formation, and the Hawthorn Formation occurs all the way through the remainder of the column; it is highly porous and eroded in the walls of the *cenoté.*

The areas above 30 m below the present day water surface were dry for a sufficiently long period of time to allow for the growth of a number of large dripstone formations, principally stalactites and stalagmites, although we also have flowstone occurring as well. The lowest of these dripstones is at 30 m below the surface. We see no speleothem evidence deeper than 30 m below surface to indicate that the water level was ever any lower than that. It is estimated that some of the formations in the band about 13 m below the surface would have taken thousands of years to form by the mechanism of fresh water seep springs dripping down the walls, depositing calcium carbonate over the millennia. In addition to the dripstone formations, there is another significant mineral deposit at Warm Mineral Springs, called tufa, which grows underwater as a result of precipitation of calcium carbonate out of calcium carbonate-charged water that has come into contact with bubbles of trapped CO2. The tufa formations grow principally on the 13 m ledge, in and above the dry deposited sediments, and are a factor to be considered during excavation.

The hydrology of Warm Mineral Springs is critical to understanding the human utilization of the springs in past times as well as the preservation of the materials up to this time. The water in Warm Mineral Springs occurs in three zones today (Cockrell, 1988). The upper zone, or Zone I, extends from the surface down to 7 m below the surface and is generally between 30 to 31 degrees C. It contains a large supply of dissolved oxygen due to the occurrence of aquatic weeds and algaes down to the 7m below surface depth. Zone II of the water extends from 7 m below the surface down to 58 m below the surface. This Zone II normally maintains a temperature of 30 degrees C and is essentially anaerobic in nature. Although there is an oxygen gradient, there is insufficient oxygen in Zone II to allow for any aquatic weeds or marine life to exist. Zone III occurs from 58 m down to the base at 70 + m. This water is normally 31 to 33 degrees C and emanates from a cave at the north side of the springs, which goes approximately 30 m toward the north, being only about 3 m wide and 1 m high. The principal water source for Warm Mineral Springs is this cave which terminates at a small crack at the rear of the cave; it is from the crack that the approximately 20 million gallons of anaerobic saline mineralized water a day find their way into Warm Mineral Springs. There are multiple water sources at Warm Mineral Springs - this 20 million gallon a day water source is the principal one (Rosenau *et al.,* 1977). There is a smaller cool fresh water spring on the northeast side that has not been measured as to volume, and there are numerous small seep springs all around the base of the circumference of the diameter of the springs, over the top of the cone of debris on the bottom, and there are fresh water seep springs around the shallower part of Warm Mineral Springs approximately 3 m below surface, primarily as a result of rain water runoff. Additionally, at various places around the wall from 3 m below surface down to 30 m there is clear evidence of interchange with the surrounding ground water. Indeed, given the fact that there is in excess of 20 million gallons a day coming in and only 5 to 8 million gallons a day flowing out the overflow at the southwestern edge of the pool, it is clearly evident that the remaining gallons are seeping out into the highly permeable Miocene limestone that is the matrix of Warm Mineral Springs.

The hydrological column in the surrounding terrestrial strata consists of the surface and ground water which is perched atop the Caloosahatchee Marl, then continues down wherever there are cavities in the limestone to approximately 1,000 meters. At 300 to 1,000 m below surface, the upper zone of the Floridan Aquifer, the water is fresh. Below approximately 1,000 m lies the Boulder Zone of the Floridan Aquifer, and the Boulder Zone contains geothermally heated mineral water. The Boulder Zone produces the approximately 20 million gallons a day of warm saline water that flows into the Springs, and the upper portion of the Floridan Aquifer produces the fresher water, and as noted, the groundwater and rainwater also mixes in. The principal waters, those from the Boulder Zone, contain virtually no dissolved oxygen. The lack of oxygen denies access to aerobic bacteria, and this is the major contributing factor to the unusual preservation of submerged organic remains in the springs. Studies by USGS hydrologist Fran Kohout in the 1970's also demonstrated that no traces of radiocarbon activity could be found in this Boulder Zone water, leading him to estimate that this water had been trapped underneath the earth for more than 60,000 years (Kohout, personal communication).

There are two principal theories as to the origin of this geothermally heated water. One theory is that this water is connate water, ancient sea water that was trapped beneath the Miocene deposits, which would therefore be older than 30,000,000 to 35,000,000 years (Stringfield, 1966). A more recent theory holds that, while the water is indeed ancient, the aquifer is being recharged from far off-shore in the Gulf of Mexico and in the Atlantic Ocean, and that the sea water is migrating laterally to underneath the Florida peninsula; then geothermal heating and great pressure cause the water to rise to the surface through fissures (Kohout *et al.*, 19 77). Regardless of origin, the water is essentially anaerobic and this anaerobic condition has led to the preservation of the paleoenvironmental remains, the archaeological remains, and even the dripstone formations in principally the areas below Zone I of the water, or what is today 7 m below the present water surface.

An understanding of sea level change at the end of the Pleistocene is critical to understanding Warm Mineral Springs, as the piezometric surface is directly related to the sea level. As sea level rises, so does the piezometric surface; as sea level falls, so does the piezometric surface. With the dripstone formations demonstrating that the water in Warm Mineral Springs was down at least 30 m below present surface it is possible to speculate that the low stand of the sinkhole's water would relate to the low stand of the sea level during the Pleistocene, and that the rising of the post-Pleistocene sea level to its present day status at approximately 6,000 BP would have positively correlated with the rise of the water in Warm

Mineral Springs, to cause the water to flow over the top at an estimated 6,000 BP (Cockrell, 1989).

Florida is a highly porous limestone peninsula. Today, the surface pores, or sinkholes, when they occur near sea level, tend to be water-filled. During a time of lowered sea level, peninsular Florida would have been topographically much like today's peninsular Yucatan, with virtually no surface drainage; all drainage would be sub-surface. Additionally, it is important to remember that whereas today Warm Mineral Springs is only 20 km from the seacoast, in a time of lowered sea level the Gulf coast would have been approximately 200 km further west. So, Warm Mineral Springs, at the time of lowest sea level stand in the Pleistocene, would have been in the center of the Florida peninsula instead of near the coast, and would have been approximately 100 m above sea level rather than 3 m above sea level. This would not only have resulted in surficial topographic changes, but would have also quite probably contributed to shifts in wind pattern and other climatological events. Other aspects of environmental change would of course relate to the poorly understood causes of the glaciations themselves.

When viewed grossly the sea level change curve seems to be somewhat smooth, but of course it was not smooth at all. Any minor or major fluctuations in sea level, given the porosity of the limestones of the Florida peninsula, would have directly or indirectly correlated with rises and falls of the water in Warm Mineral Springs.

An understanding of the paleohydrological situation when the first humans arrived at Warm Mineral Springs is important. As the people and the plant and animal remains we have recovered would have required at least some fresh water, it is evident that some fresh water was available. The principal water source at Warm Mineral Springs today is not considered potable due to the high concentration of minerals in it. However, in past times, assuming the saline inflow still occurred, the water that was coming in flowed out the porous walls of Warm Mineral Springs, rather than overflowing as it does today (Kohout, personal communication). The fact that this could have occurred is again demonstrated by the fact that nearly 20 million gallons of saline mineral water a day come in, but only 5 to 8 million flow over the top. The surrounding matrix is obviously highly porous and can absorb and diffuse millions of gallons of water a day. At a time of lowered sea level the porous strata around Warm Mineral Springs could have easily absorbed and diffused the entire 20 million gallons a day. The fact that the water was not flowing out of the top is again witnessed by the yet undated dripstone formations and the dated dry-deposited paleoenvironmental remains, as well as the dated intentional human burial on the 13 m ledge. It is clear that the water level was down.

It becomes increasingly obvious, as a result of the interdisciplinary studies we are doing, that there was a fresh water lens in Warm Mineral Springs. Bullfrog bones are found extensively in the 13 m ledge deposits, and no modern bullfrogs can live in saline water; it is assumed that such was the case at the end of the Pleistocene. I believe that when the water level was below the rim of the *cenoté* there was a lens of lighter fresh water overlying the denser saline water. The fact is that we do have bullfrog bones on the 13 m ledge in the 7,000 to 11,000 BP strata and there are no bullfrogs at Warm Mineral Springs today.

Kohout insisted that the inflow of the saline water would have been somewhat constant through time, given the recharge mechanism. The origin of the fresh water, as it is commonly held that the Florida peninsula was arid at this time, is a problem. The dripstone formations are *prima facie* evidence that there was fresh water dripping down at a time of lower water table. Additionally, work by paleobotanists at the Springs demonstrates unquestionably that there were eastern deciduous forest elements present at the Springs at the terminal Pleistocene. There are also deep (40m to 70m) fresh water springs at the bottom of the sinkhole; these springs originate in the upper layers of the Floridan Aquifer, *ca.* 300m down.The 7m to 10m below present surface dripstone formations, which may have taken thousands of years to grow, were formed by the mechanism of fresh water dripping down the walls. This water would have come primarily from rainfall. As noted in the comment on stratigraphic column, the Caloosahatchee Marl occurs about 2 m below the surface. The Caloosahatchee Marl is impermeable, and any rainfall at all would have remained perched on top of the marl, and would have found its way into the Springs. This water would have been principally responsible for the formation of the dripstone formations in the 7m to 10m area. The deepest dripstones are at ca. 30m below surface, and are also undated (an attempt was made to date a dripstone formation through McMaster University in the 1970's, but the formation was too porous to be dated).

The fact is that there was fresh water on the surface of Warm Mineral Springs when the water level in the Springs was lower in past millennia, and there was probably fresh water inflowing at the bottom; additionally, fresh water formed the dripstones. This is critical to understanding the attraction that this site would have had for humans and human food resources. At a time of lowered sea level, when there were no surface rivers, and when there was very little surface water aside from that in deep sinks and caves, this area would have been a source of plant and animal food, as well as fresh water, for these prehistoric peoples. This would have been so even if the era was as arid as some have proposed, although the existence of the 7 to 11 thousand year old well-preserved oak and hickory remains implies considerable available water.

Geohydrological events would have allowed the fresh water lens to continue to float on the saline waters from Paleo-Indian times throughout most of the Archaic, but the fresh water would have ceased being available to both humans and animals once the sea level reached its present day optimum, at about 6,000 years before present. At approximately 6,000 years before present, then, given the interrelationship of the water level at Warm Mineral Springs and sea level, it can be postulated that Warm Mineral Springs waters started flowing over the top. At that time the fresh water lens on the surface would have disappeared and the water at Warm Mineral Springs would have ceased being potable. Interestingly enough, we find very few remains from the Formative Stage, which begins approximately 3000 BP.

In a terminal Pleistocene landscape then, Warm Mineral Springs and the adjacent Little Salt Spring would have been oases of fresh water. Paleoenvironmental studies suggest that at the terminus of the Pleistocene, at approximately the time the first humans came to Warm Mineral Springs, Florida was somewhat more arid than it is today and that there would have been large areas of grasslands. Warm Mineral Springs, as witnessed by the paleoenvironmental data, was surrounded by oak and hickory trees, remnants of an eastern deciduous forest; this does not mean that the entire area was covered by eastern deciduous forest. Warm Mineral Springs may have been an oasis surrounded by a small pocket of eastern deciduous forest. These sites, Warm Mineral Springs and Little Salt Spring, as seen by the remains recovered, were frequented by a wide spectrum of Pleistocene fauna, and the terminal Pleistocene flora is well represented.

The vertebrate paleontological studies and zooarchaeological analyses have demonstrated the existence of Pleistocene fauna at Warm Mineral Springs (McDonald, this volume). Recovered faunal remains include proboscideans, llama, saber cat, giant ground sloth, wolf, deer, panther, raccoon, opossum, fox, numerous rodents, reptiles, amphibians, and invertebrates.

Botanical studies both from macrobotanical and pollen remains have demonstrated that Warm Mineral Springs at the earlier human horizons was surrounded by oak and hickory, as well as a number of other plant species. The topography and environment at Warm Mineral Springs influenced the decision of early scattered small bands, or simply nuclear families, to utilize the site, probably for subsistence at first, and at some point these early peoples began using the site for interment as well.

ARCHAEOLOGICAL RESEARCH

Archaeologically speaking, the earliest radiocarbon date of human material, an isolated mandible, from Warm Mineral Springs is in a stratum dated at 10,980 +/- 40 BP from the Zone 3 area on the ledge. There has been intermittent human utilization of the site from at least that early through to the present. Prehistorically, Warm Mineral Springs should be viewed as a three-component site. The earliest component, the Paleo-Indian component, thus far has as its early date the 10,980 BP date from the Zone 3 ledge deposits, from which a human mandible was recovered in 1976. Over the years we have found archaeological evidence dating through time up through the Archaic Stage, which at Warm Mineral Springs we are estimating to begin at *ca.* 7,000 BP, and then upward to the Formative Stage, where we recently recovered a bone awl, or possibly a fid, from sediments dated at 2,200 BP. Additionally, we have material on up through the historic period, and into modern times. Material has been falling in Warm Mineral Springs daily for an estimated 30,000 years: on most days, of course, the material falling in would be pollen, which rains constantly down on the surface and then sinks; on other days, Pleistocene megafauna, perhaps even humans, fell into the *cenoté* and were unable to get out.

The estimated age of the opening is based upon information about past sea level changes as well as an estimate that the 30 m thick deposition on the bottom of Warm Mineral Springs is deposited at the rate of about 1,000 years per meter, based on recent radiocarbon analysis of materials from the sediments.

The site contains material from the time of some of the earliest Native American entries into Florida through to modern times. In addition to the three cultural stages, the site has three physical components; that is, the surrounding land area that consists of sandy, acidic well-drained soil that contains very little in the way of preserved material. On land excavations surrounding Warm Mineral Springs we have found *débitage* and a stone tool estimated to be from the Paleo-Indian Stage, along with fossil remains of horse and llama. We have additionally on the land surface found Archaic Stage remains, again consisting of *débitage* and a broken Archaic triangular stemmed point, similar to the Newnan type. We have found no Formative Stage archaeological remains on the surface, but our site records contain a mention that a geologist from the University of Florida collected a piece of pottery from there in the 1950's; this would probably not pre-date 3,000BP. The fact is that there is some scattered cultural material on the surface, but poor preservation has left very little in the way of remains.

The second physical component of the site is that of the 13 m below surface ledge. This 13 m ledge was dry from at least 11,000 BP to approximately 7,200 years BP as witnessed by radiocarbon dating of the dry laid sediments on the ledge. These sediments have produced cultural materials dating around 10,000 to 11,000 BP thus far.

The third physical component of the site is the debris cone on the bottom of the hourglass-shaped sinkhole. The debris cone is estimated to be approximately 30 m in thickness and is approximately 70 + m in diameter. This cone at the bottom of the *cenoté* has been built up by material falling in over the millennia. It is not known at this time whether the actual base of the *cenoté* itself is concave, flat or convex. This debris cone is being excavated currently with the technology described in other papers in this volume. The debris cone has produced human skeletal material, artifacts, and a wealth of paleoenvironmental data. Excavations thus far have proceeded down to 3.3 m in depth, and the deposits are found to be accumulating at approximately 1 m every thousand years.

Human utilization of the site during the Paleo-Indian Stage was, as noted earlier, apparently for subsistence and burial by early gatherer-hunters. Burial Number One, which was radiocarbon dated at 10,240 +/- 80 years BP, was found to contain a spearthrower spur made of carved shell. It is unfortunate that the actual spearthrower itself was not found, but the interment had occurred at 10,240 +/- and the rising springs water did not cover that area until approximately 7200 BP. It can be seen that there was an approximately 3,000 year time period for decomposition to occur and for small rodents to disrupt the area. The burial site was protected by a rockfall from the surface which was dated to *ca.* 8,000 BP. The rockfall created a situation in which three boulders sealed off the burial area until it was opened up in 1972. These early gatherer-hunters, on the land component, had left *débitage* and a tool made from a type of fossil coral which occurs around the Tampa Bay area. There was no cortex material associated with it, indicating that blanks had been brought to this area from elsewhere. An earlier human was found in the 11,000 year old strata, but this time only represented by a male mandible, and it is uncertain as to how it was deposited there, whether intentionally or not, but it was clearly from the *ca.* 11,000 BP stratum. A recently recovered human calcaneum on the 13 m ledge has been dated to 10,260 +/- 70 BP. Untrained collectors since the 1950's have uncovered uncounted numbers of burials, but we were only able to account for about a score of burials by working with one of the people who had extensively looted the site. I have excavated remains of portions of several other individuals over the past two decades. The 13 m below surface ledge was clearly used for disposal of the dead. Burial Number One was intentionally interred in a crevice and sealed with broken dripstones.

The past field season produced two significant artifacts from the ledge, but there is no evidence that they were associated with burial ceremonialism. A worked split fossil shark's tooth was dated at 10,550 +/- 80 BP, and a nearby finely worked bone pin was dated at 10,340 +/- 70 BP.

Additionally, in the 1970's I recovered a human long bone from stratified deposits of organic layered materials in an erosion gully in the debris cone some 60 m below present day surface. There are a number of erosion gullies in the debris cone as a result of sand being dumped in by the truckload over the last three decades in order to provide wading beaches for the bathers; the constant moving of the present day bathers in the water causes the sand to precipitate over the edge and it forms grooves in the limestone walls and erosion channels in the debris cone at the base. One such channel exposed human remains. It is quite possible that the debris cone contains a number of humans who were disposed of by dropping in the sinkhole. This is not an unknown type of burial practice in the southeast. While a student research assistant at the Alabama Museum of Natural History in 1962, I was part of a team that examined a collection of some approximately 200 skeletons that had been cast down a sinkhole, which had a pool of water at the bottom, during the Archaic Stage in the Tennessee River Valley; the practice of casting bodies into cavities in the earth is not unknown in the southeastern United States. Of course, the remains we found on the bottom of Warm Mineral Springs could have possibly been the remains of drowning victims, but I feel that once excavations proceed on the debris cone, there is a great possibility that we will encounter Archaic and Paleo-Indian dead deposited there.

RESEARCH POTENTIAL

The paleotopography, the general paleoenvironment, and the cultural decisions made by Paleo-Indian, Archaic, and Formative Stage peoples would have governed and regulated the materials that we find in the archaeological record. An understanding of past topography and other past environmental conditions factored in with current understanding of human behavior at these various stages will allow us to postulate where other areas may be examined, where other potential site locations might be found, and where within those loci we would look to find the cultural materials.

A study based on Warm Mineral Springs, Little Salt Spring, and other possible sites, and negative data from other sinkholes which do not have cultural components, will allow the development of a predictive model for predicting other similar related sites either on-shore or off-shore, and the development of a model for the exploration, excavation and study of these sites. In order to construct and test such a model it will be necessary to examine cultural data about particularly settlement and subsistence behavior. It will be necessary to compare the three archaeological stages with which we are concerned here against specific archaeological data from specifically known sites, and then compare those data to provide an indication of where to look for further such sites. Sites such as this can provide invaluably significant data on little known aspects of human prehistory. We know very little about Paleo-Indian behavior, particularly coastal Paleo-Indian behavior in the Florida area; we know virtually nothing about early and middle Archaic coastal behavior in the Florida area. This is primarily because these sites have been drowned and with rare exception have never been located. The utilization of existing data from the preserved sites such as Warm Mineral Springs will provide information for locating these. These sites would be submerged, thus more protected from looters, and protected in some degree from biological destruction as well as weathering and erosion. They would provide a class of data hitherto unavailable, particularly about Paleo-Indian and Archaic Stage peoples.

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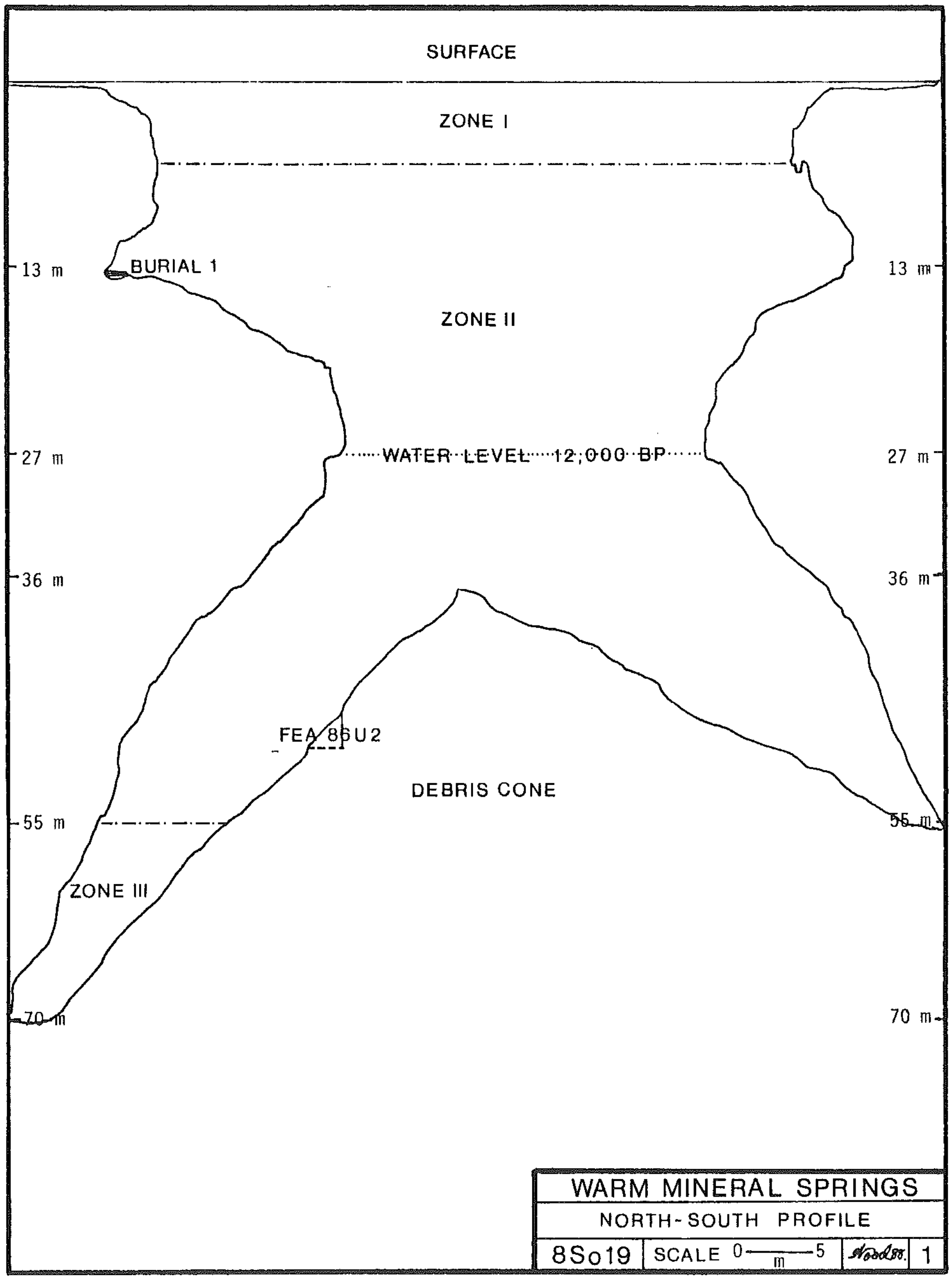
SURFACE
ZONE I
13 m
BURIAL 1
ZONE II
13 m
27 m
WATER LEVEL 12,000 BP
27 m
36 m
36 m
FEA 86U2
DEBRIS CONE
55 m
55 m
ZONE III
70 m
70 m
WARM MINERAL SPRINGS
NORTH-SOUTH PROFILE
8So19
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1

Figure 1.

DIVING FOR SCIENCE...1990

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PROCEEDINGS OF THE

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WALTER C. JAAP
EDITOR

American Academy of Underwater Sciences
947 Newhall Street, Costa Mesa, California 92627 USA

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INTRODUCTION

The *Proceedings of the Tenth Annual DIVING FOR SCIENCE. . .1990* contains 40 papers presented at the American Academy of Underwater Sciences Symposium, October 4–7, 1990, St. Petersburg, Florida. The Academy hosts these symposia to disseminate information and to stimulate discussion on the advancement of undersea science and technology. Diving safety is also an important research and operational criterion of the Academy.

The American Academy of Underwater Sciences is recognized as an authority on scientific diving and undersea technology. As such, it has a responsibility to disseminate new information in a published format. The Academy's publications include the proceedings of the annual symposia; special workshop proceedings; *Diving Computers* (1988); *Safe Ascents* (1989); technical manuals; diving standards; and a newsletter, the SLATE. In 1991 the Academy will sponsor a special workshop on multiple-day repetitive diving, and the papers and recommendations will be published in a "proceedings" format. The aforementioned publications are marketed through the American Academy of Underwater Sciences and other commercial vendors; and the publications list may be obtained from AAUS, 947 Newhall Street, Costa Mesa, CA 92627. This *Proceedings* contains papers on diving, scientific results, human impacts, archaeology, and physiology. We are pleased that several presenters this year traveled from outside the United States to attend the symposium.

The symposium was hosted by the Diving Program at the Florida Marine Research Institute with assistance from the Florida Institute of Oceanography, the U.S. Geological Survey, and the Committee (AAUS) for Southeast Region Scientific Diving Coordination. Special thanks to the coordinating team: Hector Cruz-Lopez, Kelly Boomer Donnelly, Dan Marelli, Jeanne Hoyt, Jerry Fountain, Jennifer Wheaton, and E.A. Shinn. Principal proceedings editor was Walter Jaap. The session editors included Joe Kimmel, Edwin Hayashi, Steve Gittings, Dennis Hanisak, Dan Marelli, Wilburn Cockrell, and Gregg Stanton. Word processing was done by Marjorie Myers. Gerry Bruger was instrumental in resolving computer-disk incompatibility problems. We are grateful to the University of South Florida for their gracious hospitality in allowing us to use their facilities, and we especially thank Sudsy Tschiderer, Dean Winston Bridges, and Herm Brames. We thank the Florida Marine Research Institute for generously supporting the program. For time, talent, and treasure, we thank Tom Perkins and Karen Steidinger. We appreciate the support given by Florida Sea Grant in publishing these Proceedings, and we especially thank William Seaman and Lorri Kell for their interest and help.

Walter C. Jaap
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