The Geographies of Ancient Ephesus and the Artemision in Anatolia

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This study is a sedimentologic and geomorphologic analysis of ancient geographies of the floodplains and delta of the Küçük Menderes (ancient Cayster River) around the city of Ephesus and the Artemision in Aegean coastal Anatolia. The authors emphasize the interrelationship of archaeological dating and structure, and historical comment in interdisciplinary analysis of ancient geographies and their paleoenvironments. In some cases, the historical literature is specific and factual. In other cases, legend from prehistory may provide important clues to the reconstruction of ancient environments as related to archaeological and historical settings. Ephesus and the closely related Artemision, or Temple of Diana of the Ephesians, offer a chance to link the disciplines of geology, physical geography, archaeology, history, and epigraphy in a composite of paleoenvironmental/paleogeographical interpretations of geomorphology over the past three millennia. Holocene sea-level rise and marine transgression provide the raised paralic settings of the harbors of Ephesus and the Artemision. The settings of the harbors were altered by continuing progradation of the ancient Cayster River delta-floodplain over the past three millennia. This research shows how interdisciplinary research greatly enhances our understanding of the ancient geographies of Ephesus and the Artemision. © 2007 Wiley Periodicals, Inc.

INTRODUCTION

"... in his reply to a doubtless sarcastic enquiry by a man of Lampsacus as to whether the mountains surrounding that city would ever turn into sea; 'yes,' he said, 'provided that time does not fail.' "
ANAXAGORAS OF CLAZOMENE (~540–428 B.C.)

"... all things move and nothing remains still."
HERACLITUS OF EPHESUS (~542–480 B.C.)

"[He] compared reality to the flow of a river, ... one could not step twice into the same river."
HERACLITUS ON PLATO'S CRATYLUS 402A

"Egypt is the gift of the Nile."
HERODOTUS

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The integration of the scholarly disciplines of geology, geography, the classics, history, and even prehistoric legend results in highly synergistic interdisciplinary research (McDonald, 1991). Perhaps nowhere is this truer than in the delineation of long past geomorphologies and the rapidly changing sedimentary environments associated with coastal cities and archaeological and historical sites in the Mediterranean region. In many cases, geology provides the key to paleogeographic reconstruction, whereas in other cases archaeology and/or the written record are definitive. Legend from prehistory hints at, and sometimes dictates, ancient morphologies rarely. John Victor Luce's comments on Homeric landscape and environmental description clearly put an end to the idea that Homer was "a blind poet," although he may have been so in later life (Luce, 1998). We remain impressed by frequent correlation of facts, whether in the written record, the archaeological site record, and/or the sedimentary environmental and geomorphological record, let alone the correlative information from legend. Yet there is discordance and therein lie challenges.

> Paleogeographic and paleoenvironmental analyses are the essence of archaeological geology. We can relate geologists' work on paleogeographies to analogous modern problems of coastal transgression and regression, the nature of human occupancy of the coastal zone, projections of future land gain and losses, adaptations to ever-changing coastal landscapes, and the need to fortify or restructure our coastal cities. We can explain more precisely the reasons for the establishment and loci of ancient (and modern) cities and archaeological sites and their local and regional paleogeographies. We can also project where, why, (and how) to search for unknown or missing historical and legendary sites. Our studies must include an amalgam of 3-D analysis of sedimentary environmental lithosomes and geomorphologies, applications of many traditional and newly developed analytical techniques, a continuing attempt to fit our interpretations to concepts of world eustasy, and the complexity of climatological cycles and changes throughout the Holocene—all considered within the context of peoples and their occupation of Earth. (Kraft, 1994, p. 13)

In a sense, we deal in time travel. Yet ours is neither by esoteric quantum mechanics nor Einsteinian physics, but rather by judicious application of widely utilized techniques of sedimentary environmental lithosome correlation and projection. We follow the dictates of 19th-century Johannes Walther's law of correlation of (sedimentary) facies, and 20th-century logic and practice applied to sedimentology, geomorphology, paleo- and micro-paleontology, paleobotany, radiocarbon dating, and geophysical methodology. Our methods have been well discussed, rationalized, and widely utilized (Brückner et al., 2002, 2004, 2005, 2006; Brückner, 1997, 1998, 2003, 2005; Gifford, 1978; Jing & Rapp, 2003; Kayan, 1988, 1991, 1995, 1996, 1997; Kraft, 1972; Kraft & Aschenbrenner, 1977; Kraft, Kayan, & Erol, 1980; Kraft, Rapp, & Aschenbrenner, 1980; Kraft et al., 1975, 1977, 1982, 1987, 2003, 2005; Marriner & Morhange, 2005, 2006; Marriner et al., 2005, 2006; Morhange et al., 2000, 2003; Rapp et al., 1978; Soter & Katsonopoulou, 1998, 1999; Villas, 1983; Vött et al., 2006a, 2006b, 2006c, in press; Zangger, 1993; Zangger et al., 1997).

Herein, we present a summary of our collaborative research with our archaeologist, classicist, epigrapher, and historian colleagues of the Austrian Archaeological Institute (Österreichisches Archäologisches Institut) in Vienna on the delta-floodplain of the Küçük Menderes in Anatolia over the past 17 years. Here lie the partially excavated remains of the ancient cities of Ephesus and the Artemision or the Temple of Diana of the Ephesians, one of the Seven Wonders of the Ancient World. There are also a number of undiscovered features in this area, such as the not yet located first city of Ephesus established by Androclus and his Greek immigrants in the coastal landscape, then occupied in part by Lydian peoples, ~1000 B.C.

GEOLOGICAL SETTING

The Küçük Menderes (ancient Cayster River) delta-floodplain has prograded over 18 km seaward since mid-Holocene time. The surface morphology includes remnants of meandering river patterns, floodplains, and backswamps, and flanking colluvial and alluvial fans of tributary streams. The lower 4 km of the delta are dominated by barrier accretion ridges and ponded deltaic swamps with seasonal evaporative pans. Twentieth-century agricultural engineering includes a canal designed to drain the back swamps and provide water supply for irrigation. Smaller flanking embayments include bypassed lakes. Thus, we might readily identify the sediments, fauna and flora, and stratigraphic sequences resulting from the ever-changing aggrading and prograding river and delta sedimentary environments (Figure 1). Through surface and subsurface studies of the evolving deltaic sediments (Figure 2), we have been able to delineate coastal and harbor morphologies from the time of Ephesus's origin through its peak occupancy of greater than 200,000 people, to the decline and abandonment of the city.

Our subsurface drill core program shows marine and deltaic sediment infill of over 30 m during the Holocene delta progradation, while flanking alluvium rises up to 12 m above sea level (Figure 3). Thus, a reconstruction of the mid-Holocene Neolithic Early Bronze Age marine embayment, the ancestral Gulf of Ephesus, is possible (Figure 4). To date, we know of only two archaeological sites of mid-Holocene age. One, on a coastal promontory on the north side of the embayment, is essentially a shell midden of prehistoric occupancy; the southern site is a definitely Neolithic settlement. Both sites were located along or near the coast of a then clear-water marine embayment.

HISTORY, LEGEND, ARCHAEOLOGY, AND ANCIENT LANDSCAPES

Artemis and the Artemision

> To Artemis, Amazons, lovers of battle, set up a wooden image under an oak, in seaside Ephesos and Hippo offered a holy sacrifice to you; around the oak they danced you a war dance, Queen Oupis, first with shield and then a wide circle dance. . . . Afterward around that wooden image, wide foundations were built. Dawn sees nothing richer or more divine.
>
> CALLIMACHUS, HYMN III: TO ARTEMIS

> But all cities worship Artemis of Ephesus, and individuals hold her in honor above all the gods. The reason, in my view, is the renown of the Amazons, who traditionally dedicated the image, also the extreme antiquity of this sanctuary.
>
> PAUSANIAS 4, 31, 88

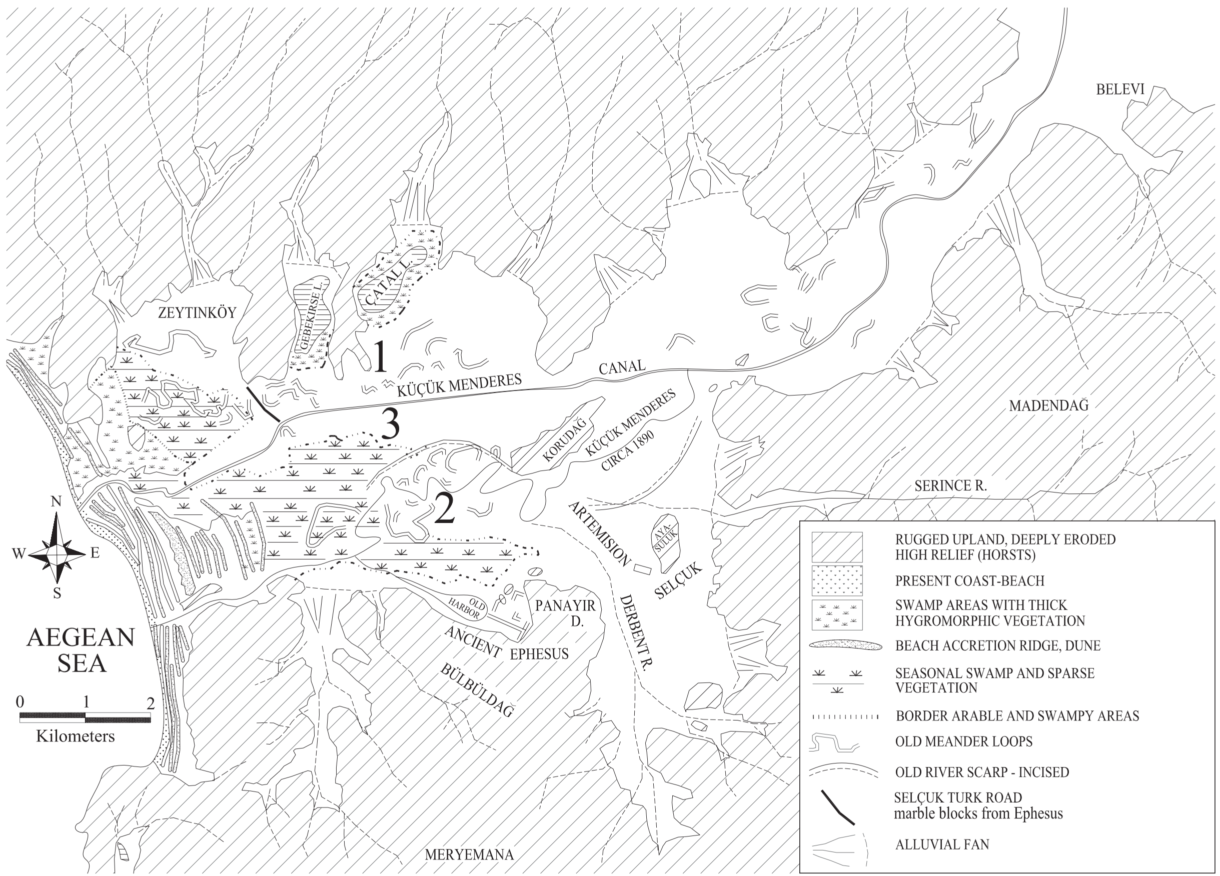

Figure 1. Geomorphology of the Küçük Menderes (ancient Cayster River) floodplain showing environments of deposition that, through progradation and aggradation, form definitive sedimentary sequences in vertical stratigraphic section. (1) Old river channel oxbows, (2) abandoned younger river channels of the early 20th century, and (3) modern drainage and irrigation canal. From air photo and satellite imagery by Dr. Ertug Öner.

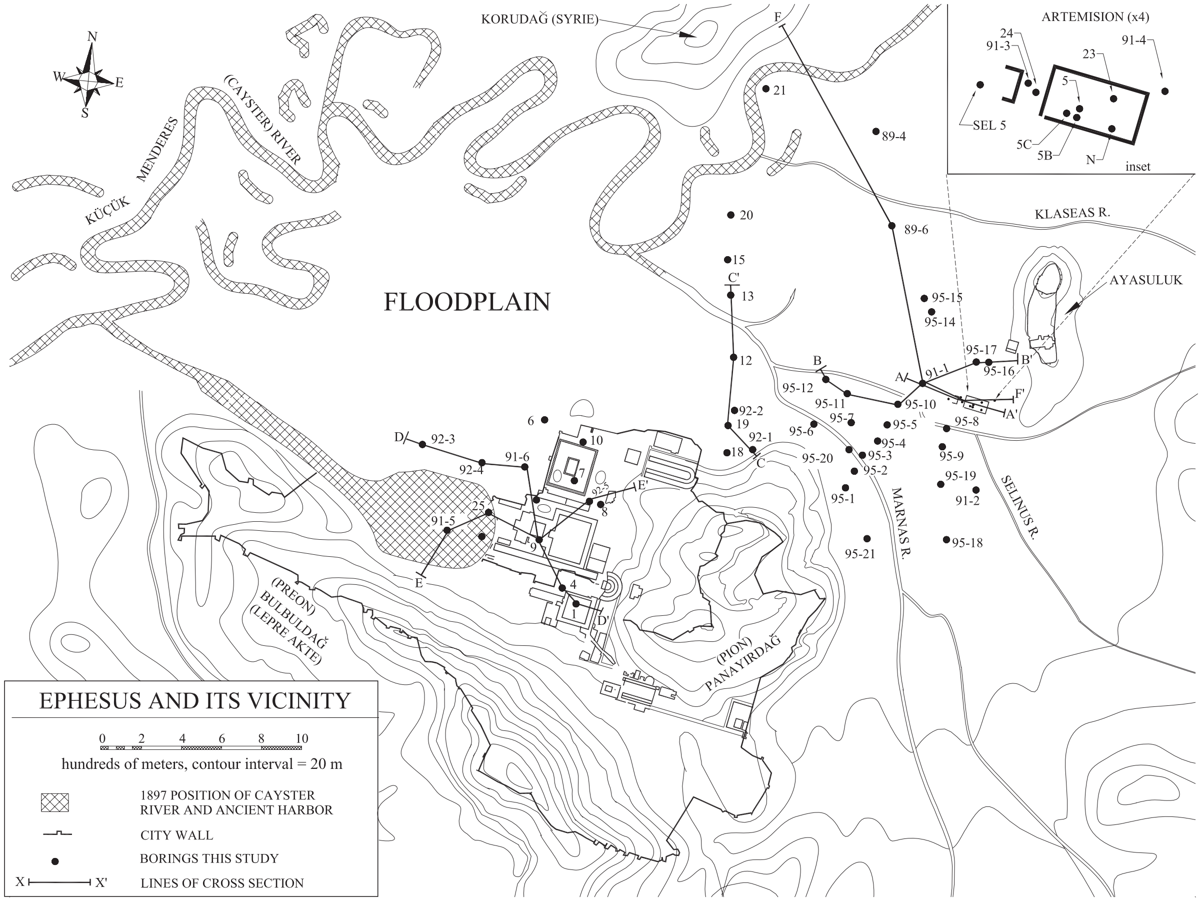

Figure 2. The vicinity of Ephesus and the Artemision in their 19th-century environmental settings showing the location of cross-sections and geological borings used in this study (based on a map by Schindler, 1906). The city walls of Lysimachus (early Hellenistic) are shown in relation to the flanking mountainous terrain.

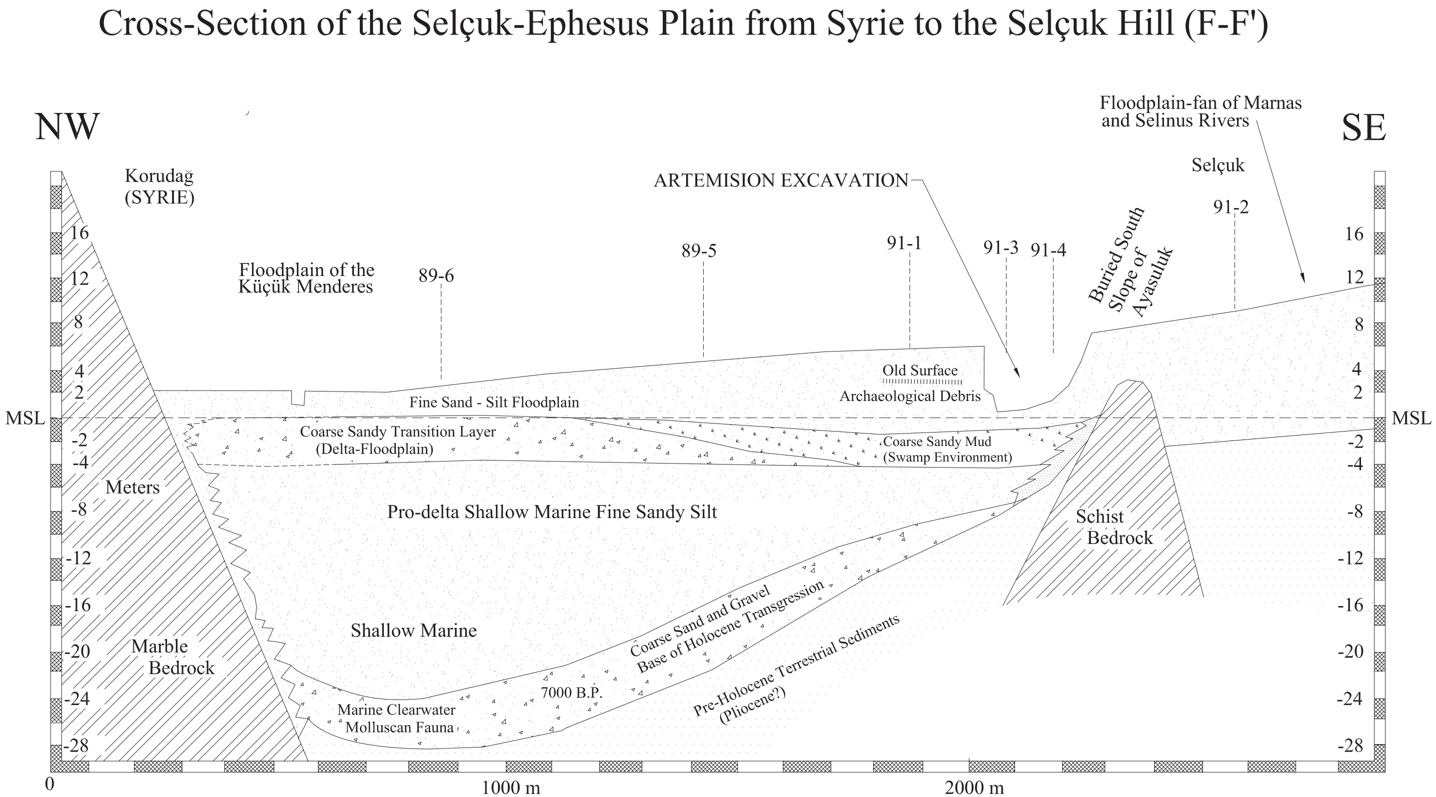

Figure 3. A geologic cross-section of the floodplains of the Küçük Menderes River from the vicinity of the Artemision and Ayasoluk hill to Korudag, the island of Syrie in antiquity. The alluvium in the vicinity of the Artemision is a composite of the Küçük Menderes (ancient Cayster River) alluvium and the torrential alluvium fan of the Derbent River tributary (ancient Selinus and Marnas Rivers). Shallow marine prodelta fine sandy silts underlain by basal transgressive marine sands and gravels with abundant clearwater molluscan fauna form the greater portion of Holocene Epoch sediment.

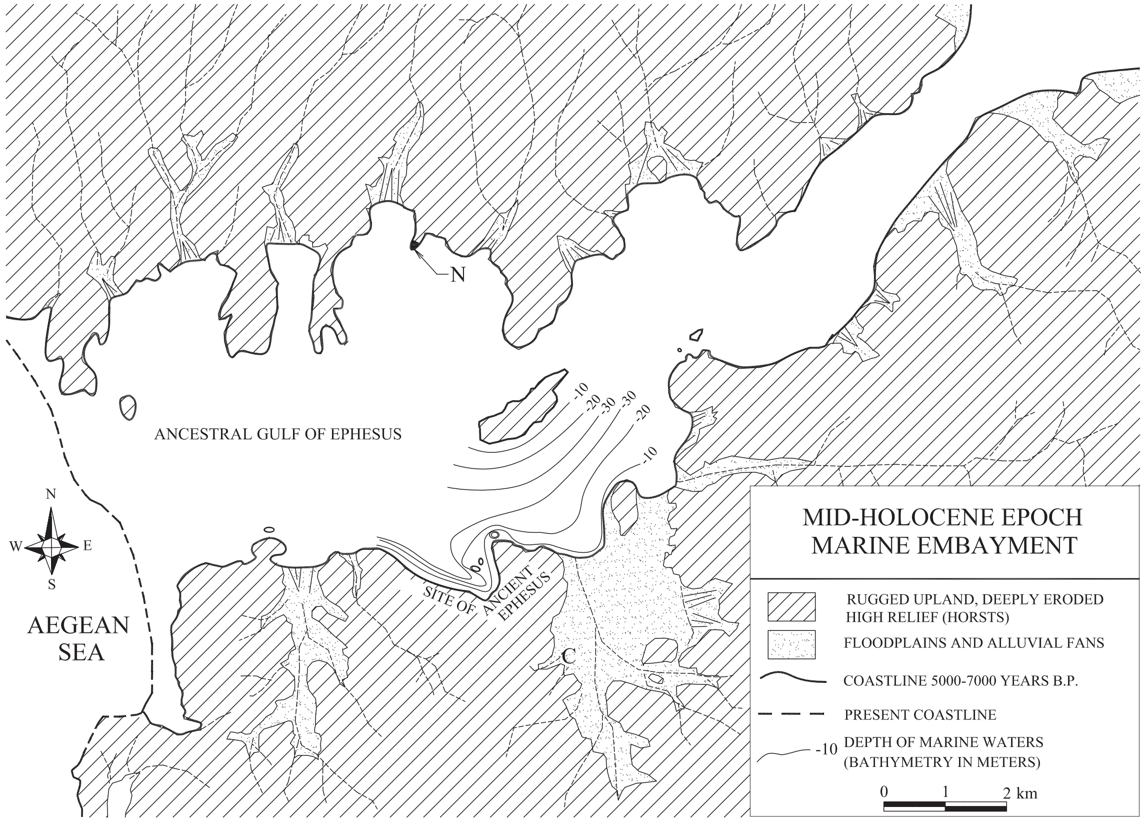

Figure 4. A map of the mid-Holocene ancestral Gulf of Ephesus, at peak marine transgression (~6000 yr B.P.). Only two archaeological sites are known from this time, the Neolithic site (N) on a Quaternary alluvium peninsula in the north, and a prehistoric site, possibly Chalcolithic (C), about 400 m southeast of the Magnesian Gate of the ancient city of Ephesus. The northern site is midden-like with shells and pottery at the immediate edge of the sea; whereas the southern site lies on a low hill in alluvium less than 1 km from a southerly extension of an arm of the sea. Water-depth contours are shown between the southern shoreline and limestone island-horst (ancient Syrie) in mid-bay.

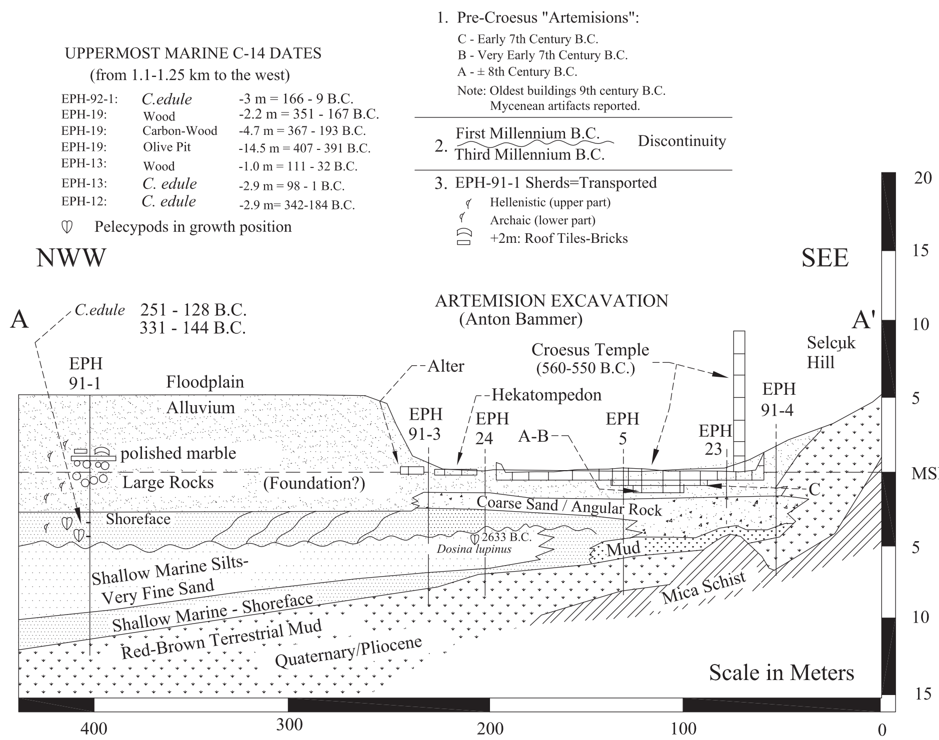

Figure 5. A stratigraphic cross-section through the Artemision excavations of A. Bammer, at the foot of the Selçuk Hill (Ayasoluk Hill). The foundations of the Croesus Artemision (mid-6th century B.C.) and earlier temples A, B, and C, dating to the 7th and 8th centuries B.C., are shown underlying alluvium of the ancient Selinus River torrential fan and overlying mid-Late Holocene shallow-marine sediments. A mid-Late Bronze age coastline immediately underlies the earliest sacred site and structures. In mid-Hellenistic time, the shoreline was still within 100 or more meters of the Artemision complex. Archaic–Classical Ephesus lay immediately adjacent, as dictated by Lydian King Croesus, until forcibly removed by early Hellenistic King Lysimachus in the early 3rd century B.C. Plundered by the Goths in 263 A.D., the Artemision was abandoned after 400 A.D. Subsequently, its marble was reused in the large Byzantine church of John, located above on Ayasoluk Hill, and later in the adjacent 12th-century Isa Bey Mosque.

Legend tells us that the Amazons (~1200 B.C.) first established the sacred site upon which later peoples worshiped the Goddess Artemis, Diana of the Ephesians, and constructed a series of ever more magnificent temples that we now know as the Artemision. In our geological research, we discovered that the earliest known temple to Artemis, ~9th century B.C., was indeed constructed on or by a beach at the edge of the ancestral Gulf of Ephesus. We determined this by a series of drill cores through the archaeological site and its environs (Kraft et al., 1999, 2000, 2001). Figure 5 is a schematic section presenting our evidence. Eventually, based on over two dozen cores, we delineated the coastline and showed that the Artemision was built on the deltaic shoreline of torrential alluvium of the tributary

Selinus River (Kraft et al., 2001). Indeed, the site experienced continual flooding by the Selinus River beginning as early as the 7th century B.C. and remained wet throughout antiquity. The present excavations require continuous pumping in the wet season, demonstrating the remarkable tenacity of the site's occupants (Bammer, 1984, 1993). As a consequence of its construction on torrential alluvium, the ruins were buried under 5 m of sediment and the locale of the Artemision was unknown until mid-19th century. However, there were many clues as to the locale in the ancient literature.

In the 1860s, John Wood, an engineer working in western Anatolia, initiated a search for the Artemision or Temple of Diana of the Ephesians. To that date, the Artemision was known only from history and not from actual site location or excavation. Over a number of years, Wood searched the vicinity of the ancient city of Ephesus by repeatedly digging trenches with a crew of workmen (Romer and Romer, 2000). After repeated failures, Wood discovered an inscription in marble near the location of the Theater of Ephesus in the Hellenistic Roman city of Ephesus. The inscription alluded to processions along the Sacred Way (Via Sacra) via the Magnesian Gate of the southeastern walls of the city of Ephesus and then across the plain to the Artemision. With this clue, Wood and his workmen proceeded to dig trenches along the edge of the marble paved roadway from the Magnesian Gate skirting around the base of Mount Pion and then to the Artemision (Figure 6). In this remarkable case of detective work, Wood "rediscovered" the foundations and remaining ruins of the Artemision. Disappointingly, there was much evidence of destruction of the Artemision's marble by local lime kilns. Later, it became evident that large portions of the marble from the destroyed Artemision (abandoned after 400 A.D.) were recycled into the construction of the Byzantine cathedral of St. John on the adjacent Ayasuluk hill, and later into the Isa Bey Mosque situated at the base of Ayasuluk hill near the Artemision. This is an example of the concentration or clustering of sacred sites from one religion to another in the same vicinity. In fact, Wood was following the Via Sacra of early Roman Imperial time. This sacred road extended from the Magnesian Gate around the eastern flank of Mount Pion to the Artemision and back to Ephesus along the northern flank of Mount Pion. Portions of this road were impassable in earlier Hellenistic times because of the marine waters that lay tight against the foot of the northern flanks of Mount Pion.

The poet Archestratus of Gela, who lived during the Hellenistic period, provides us with information on the brackish nature of the Selinus River that flows between the Artemision and the cliffs of Mount Pion to the west. Archestratus informs us that in the second half of the 4th century B.C., the gilthead bream (*Sparus aurata*), a marine fish which also frequents brackish waters of estuaries, lived in the Selinus River by the Artemision (Kraft et al., 2000). Xenophon in Anabasis 5, 3, 8, verifies that there were many fish and mussels in the Selinus River. This may seem like only a small clue; however, the reference is quite specific and there seems no reason to doubt a poet's details about a species of fish that frequented a portion of a small estuary near the Artemision several millennia before the present (Kraft et al., 2000).

We might, then, conclude that the earliest seaside temples of Artemis, established in a seaside locale in Croesus' time, had an immediately adjacent sacred harbor.

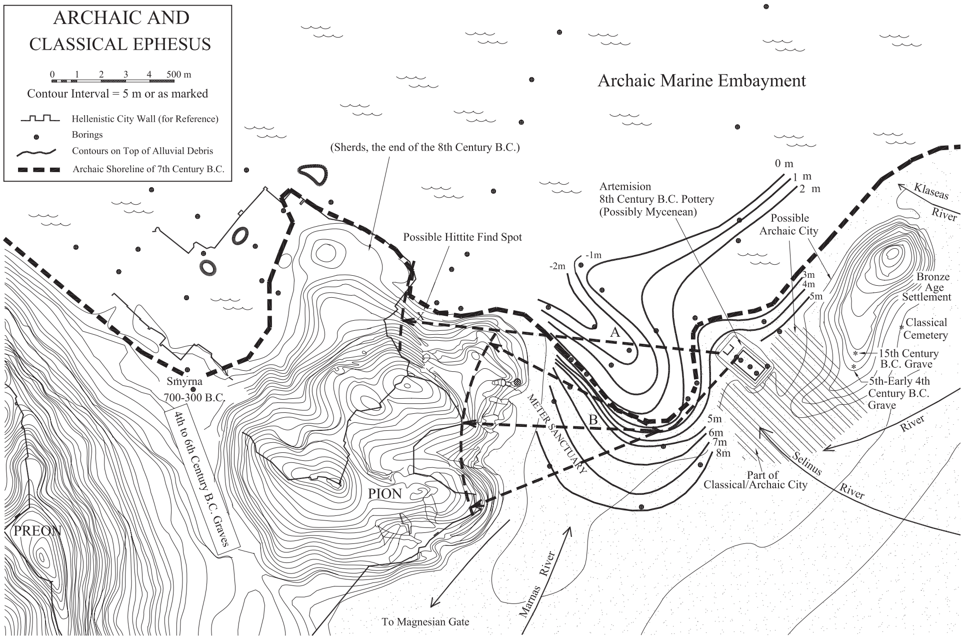

Figure 6. Paleogeographic map of Archaic and Classical times showing the coastline of the marine embayment along the base of Ayasoluk Hill, around the Artemision, and the foot of Panayirdag (Pion) and Bülbüdag (Preon/Lepre Ackte). The Artemision complex and its underlying earlier sacred buildings were constructed on a small alluvial fan of the ancient Selinus River, which projected into the marine waters of the ancestral Gulf of Ephesus. Herodotus (5th century B.C.) states that the settlement of the Ionian Greeks was located 7 stadia (about 1300 m) from the Artemision. Line A shows an arc of 7 stades "as the bird flies"; Line B shows an arc of 7 stades "as one would walk" around the shoreline of the sacred harbor. Thus we propose the as yet undiscovered Ionian Greek settlement of Androclus, ~1000 B.C., was located somewhere from the vicinity of the Meter Sanctuary southward toward the "Cave of the Seven Sleepers," or in the southeasterly flank of Mt. Pion or the adjacent alluvial plain of the ancient Marnas (and/or Selinus) River. Dots show drill core sites in this study (in part, based on I. Kayan's unpublished drill cores in 2001).

Present ^{14}C dates and micro- and macropaleontological evidence suggest that the Artemision remained in a harbor setting into Hellenistic time. However, the delta of the prograding Cayster River eventually bypassed the Artemision, forcing the citizens of Ephesus to move the sacred harbor progressively to the west along the northern flanks of Mount Pion until such time as it was no longer viable and the importance of the cult of Artemis was gone from the city of Ephesus. Figure 7 shows Edward Falkener's reconstruction of what has been referred to as a somewhat fanciful interpretation of the Artemision immediately adjacent to its sacred harbor. However, the water shown may be close to the reality of the time from Croesus in the 6th century B.C and later. Presently, there is no information about adjacent buildings other than the Alter Hecatompedos seaward of the Artemision or the concept illustrated in Figure 7, suggesting that ships could have docked against a sea wall immediately by the Artemision. Perhaps the 21st-century archaeology in the vicinity of the Artemision

Figure 7. A schematic illustration of the Temple of Artemis in a coastal harbor setting by E. Falkener (~1850). Many have correctly dismissed the diagram as "fanciful," yet our geological studies show the Artemision, and its smaller predecessors, to be on a coastline from the 9th century B.C. until bypassed by the prograding Cayster River delta ~100 B.C. A "lower" city partly surrounded the Artemision from Archaic to early Hellenistic times when Lysimachus forced its relocation to Mount Pion and the flank of Mount Prion (see Figures 6 and 12). Note that none of the other buildings shown are based on excavation and the then-unknown Altar and Hecatompedos, which lay seaward of the Croesus Temple, are not shown.

will clarify the early settings of the Artemesion and other buildings before the prograding delta of the Cayster River bypassed the shoreline location.

The City of Androclus—The First Greek City at Ephesus

According to Kreophylos, Androclus came to Ephesus and founded the Greek colony at the Koressos harbor ~1000 B.C.:

> Androclus had searched for a long time for a suitable place for a colony but had found nothing: he turned to the oracle of Apollo and there received the response that he should settle at the place a fish would show him and to which a wild boar would drive him. The oracle was fulfilled on a beautiful day when Androclus made a picnic at the shore. Fishermen were also resting there, and one had placed fish on the fire. A fish jumped from the coals, a flaming piece of vegetation (cabbage?) ignited a reed, and a wild boar saved itself from the burning reed by running onto a mountain flank. Androclus pursued the beast, killed it, and constructed his colony at that place. So goes the legend. The place at which the fishermen rested is described as follows: '. . . it is said the fishermen prepared their meal there, where the foundation [source] is that which Hypelaios called, and which [is] the sacred harbor.' (Kraft et al., 2000: 183)

Over the past several centuries, scholars have thought that the city of Androclus was located near the future stadium of Hellenistic-Roman Ephesus. This was based on a statement by Herodotus (mid-5th century B.C.) that the city of Androclus was located seven stadia (1300 m) from the Artemision. However, a seven-stadia arc drawn "as the crow flies" from the Artemision leads to an area with no archaeological evidence of occupation before 800 B.C. Our drill core evidence, on the other hand, shows that a marine embayment lay between the Artemision and Mount Pion. Therefore, we must look elsewhere in our search for the city of Androclus ~1000 B.C. as the ancient Greeks measured distance "as one would walk."

Englemann and Büyükolanci (1998) provide an important clue about the ancestral site sacred to the early Greek immigrants.

> The sanctuary of Meter and the sacred precinct of the ϊεοί πατϱώιοι was located on the northern slope of Mount Panayir (therein called Pion). Androclus had once settled at this slope: he had built the lower city at the Koressos harbor and the upper city on a mountain side above the harbor. Its two settlements existed for a long time: only King Croesus forced the resettlement to the upper city and forced the settlers to give up the Artemision. The oldest inscriptions in the temple precinct of the ύεοϊ πατϱώιοι occurred a few decades after Croesus forced resettlement (ca. 600 BC). The grandsons and great-grandsons of the colonists would have recalled their (ancestors') dedications and no doubt remembered that the old family associations had a religious sanctuary to the ύεοϊ πατϱώιοι, and their fathers had lived on the northern slope of Mount Panayir. (Kraft et al. 2000: 196, translating Englemann and Büyükolanci, 1998)

Figure 6 shows possible loci of the missing city of Androclus at seven stadia from the Artemision following the limitations of our newly established shoreline of the southern coast of the Gulf of Ephesus during Archaic and earlier times. Projection of detailed interpretations of historic/prehistoric events based on legend is not proof; however, it may serve as collaborative evidence when it correlates well with ancient landscape geometries as interpreted by geological–sedimentological means. Clearly the legend of Androclus is problematic if projected to the steep north flank of Mount Pion, which, in the time of Androclus, plunged abruptly into marine waters that were 8–20 m deep (Figure 4). This area is a questionable site for Androclus' colony, particularly as no archaeological evidence ~1000 B.C. has been found in the vicinity. Rather, if we take our geographical interpretations of the coastline of the marine embayment to the southwest of the Artemision and flanking the northeastern cliffs of Mount Pion, we can project the locale of Androclus' colony and the search for archaeological remains along the east flank of Mount Pion. Clearly, the Meter (Cybele) sanctuary was the locus of an important site to the early Greek peoples at Ephesus (Kraft et al., 1999, 2000, 2001). It may be further noted that the initial city of Androclus was referred to as Trachia, colloquially translated as "rough or broken rocks." Nowhere is this expression more appropriate than the vicinity of the eastern flank of Mount Pion immediately adjacent to our southerly projecting arm of the sea with its shattered rocky zone known as the "Cave of Seven Sleepers." According to legend, the "Seven Sleepers" site was an early Christian refuge established in the 2nd and 3rd centuries A.D. As noted by Engelmann and Büyükkolanci (1998), both the Meter sanctuary and the

Seven Sleepers' sites may be of import to the earliest prehistoric Greek occupancy areas. A sacred or religious site at one time may have been established upon, or in the immediate vicinity of, previously important sacred sites. The arc of seven stadia from the Artemision was noted by Herodotus, who admittedly was speaking over one half millennium after the original Greek colonists arrived at Ephesus. Further extension of the southward embayment of the sea into the Marnus River graben raises another issue: With a Greek "acropolis" dated to the early days of the so-called Ionian migration, on eastern Mount Pion, a lower city might have been located on the adjacent Marnus River alluvial plain. These are speculative statements by geologists/physical geographers not verified by excavation; however, they show the potential uses of paleogeographic reconstructions to suggest alternative locales in the search for an important yet unknown prehistoric site—the city of Androclus in 1000 B.C.

The Demise of the Sacred Harbor of the Artemision

In the 1990s, Dieter Knibbe and his associates of the Austrian Archaeological Institute opened a deep trench in the Feigengarten excavation at the immediate base of the steep slope of northern Mount Pion. Knibbe established the walls of the Damianos Stoa, a roofed arcade that extended along the Via Sacra from the northern gate of the city of Ephesus in a straight line to the Artemision (Knibbe et al., 1993; Knibbe and Thür, 1995). The Feigengarten excavations exposed a 2nd-century A.D. gladiator burial and successive layers of the Sacred Road to the Artemision as established ~1 A.D. Layer after layer of archaeological fill and sediment debris form the surface of a narrow (>5 m) terrace along the base of the north flank of Mount Pion (Figure 8). The final marble-block paved Roman road at the time of Septimius Severus was an extension of the road from the Magnesian Gate to the Artemision and back along the northern flank of Mount Pion into the city, and then in full circle to the theater in the lower city of Roman Ephesus.

Perhaps of more importance to geologists, Knibbe's excavation provided a 6-m-deep trench through the heavy construction debris of brick and marble blocks. Thus, we were able to make a 9-m boring through the base of the Knibbe excavation wherein we encountered 3 m of alluvium with sherds dating from the 1st century B.C. to 1st century A.D. underlain by a sharp disconformity into marine silts (Figure 8). At the top of the marine silts, we encountered a densely packed layer of the edible cockle, *Cerastoderma edule*, in living position, which dated to 89 B.C. with a range from 166 B.C. to 9 A.D. at the 68% confidence level. Near the bottom of our drill core we encountered vermetid tubes (marine gastropods—*Vermetus*) in the marine silts and seeds of *Vitis* (the grape) that dated from the 6th to 8th centuries B.C. Less than 50 m from the foot slope of the precipitous edges of the northern flank of Mount Pion, dated marine mollusks, in living position, established that marine waters of the ancestral Gulf of Ephesus lay tight against the talus slope of Mount Pion for three millennia until 89 B.C., Roman Senate time. It is for this reason that the lower city of Koressos and its harbor (the city of Androclus) could not have lain in this embayment at the foot of Mount Pion in the time of Androclus. As noted before, there is

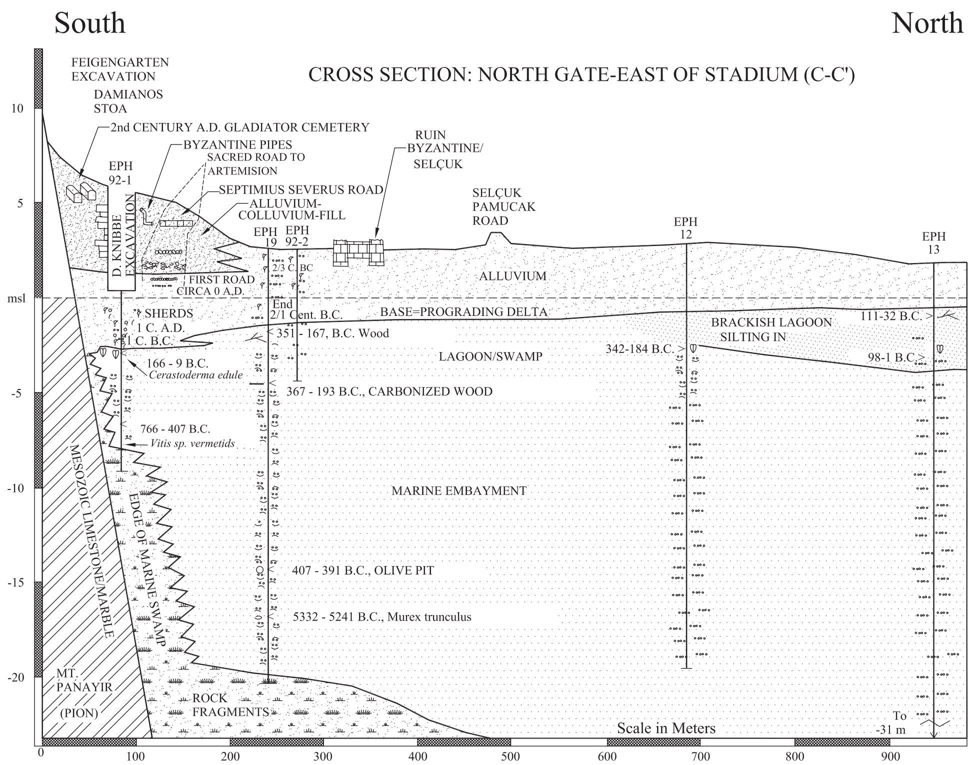

Figure 8. A stratigraphic cross-section extending northward, from the base of the hill Panayirdag (ancient Pion), from the northern gate of Ephesus at the Damianos Stoa, across a portion of the Cayster River floodplain. Here, Cayster River alluvium forms a thin veneer over a relatively thick section of marine fine sandy silt. D. Knibbe's archaeological excavations at Feigengarten (1993) show a composite fill with sherds from the 1st century B.C., an early gravel road ~A.D./B.C., a series of sacred roads (to the Artemision) to the later Roman heavy marble/limestone block road of Septimius Severus' time, along with large Byzantine terracotta pipes (for water and sewage), the rectangular foundation blocks and floor of the early Roman Imperial covered Damianos Stoa, and buried gladiator cemetery: All are immediately adjacent to the talus slope of Mount Pion. Radiocarbon dates with a 1-sigma error range at the 68% confidence level with intercept dates are shown. All corrections are made, including marine carbon correction for the $CaCO_3$ fossils. Marine silts date from the early 1st millennium B.C. to the 6th millennium B.C.

no evidence, artifact or structure, dating to the time of the so-called Ionian Greeks on the northern steep slopes of Mount Pion.

Thus, from geological and archaeological data, we can conclude that there was no road along the northern flank of Mount Pion to the Artemision until the end of the 1st century B.C., and that this is an unlikely locale for a projected site of the lower city of Koressos in the Archaic period (7th–6th centuries B.C.). Indeed, only 100 m to the north of the Knibbe excavation, another core (EPH-19) shows marine waters up to 20 m deep in mid-Holocene time (Figures 4 and 8). The Knibbe excavation was very important in establishing the geometry and depth of marine waters immediately adjacent to Mount Pion's steep slopes and their talus cover before the Hellenistic time. Further, the Via Sacra in pre-Hellenistic time, from the Magnesian Gate to the Artemision, must have extended around the southern and eastern base of Mount Pion and then across the alluvium skirting the margins of a narrow arm of the ancestral Gulf of Ephesus to the Artemision. The coastline of 300 B.C. still included shallow marine waters extending close to the Artemision. By the 1st century B.C., the sacred harbor was forcibly moved west to the vicinity of the later Damianos Stoa as excavated by Knibbe. After the Cayster River delta prograded westward, beyond the north flank of Mount Pion, a final sacred harbor may have been extant in a narrow shallow-marine reentrant until such time as Artemis was no longer worshiped by the Ephesians and the Artemision lay in ruins.

Hellenistic Times in the City of Lysimachus

Lysimachus, an early Hellenistic king, relocated the city of Ephesus from its Archaic Classical locale in the vicinity of the Artemision to the western flank of Mount Pion and northern flank of Mount Preon, where it became the site of the large Hellenistic–Roman city of Ephesus. Possibly, Lysimachus forced this major shift of the peoples of Ephesus and their city back to Mount Pion and the base of Mount Preon in what was thought to be a "vain" action in attempt to rename the city of Ephesus after his wife, Arsinoeia. In fact, Lysimachus was probably quite far-sighted and an excellent urban planner. He was certainly aware that the Cayster River delta was rapidly prograding into the vicinity of the Artemision and converting the formerly deep ancestral Gulf of Ephesus into shallow-marine prodelta waters. The final silting of flanking lagoons, potential harbor areas of the Artemision, on the north side of Mount Pion, did not produce a swampy floodplain until several centuries after Lysimachus. However, by moving the city and constructing huge city walls around Mount Pion and along the precipitous crest of Mount Preon, Lysimachus established a fortified city over 4 km long and 2 km wide. In later times, the city was to have an estimated population up to 250,000. Important to Lysimachus was the fact that the delta progradation had not yet reached the embayment between Mounts Preon and Pion, and thus the city of Lysimachus again had an excellent deep-water harbor. However, the inexorable progradation of the Cayster River delta and "running ahead" of the shallow-marine distal and proximal prodelta silts had a progressively negative impact on the harbor throughout Hellenistic and Roman Senata times, resulting in centuries of engineering efforts to keep it open to commercial and naval shipping.

Figures 9 and 10 are geologic cross-sections extending from the western base of Mount Pion seaward. Figure 9 is a cross-section from the Tetragonos Agora excavation of P. Scherrer (2000) to the northern levee of the Great Harbor of the city of Ephesus. For nearly five millennia, a sandy shore and adjacent talus slope occupied the coastal zone at the juncture between Mounts Pion and Preon. Here, at the time of the so-called Ionian Greek migration, in the early 1st millennium B.C., lay a small Carian city. At the foot of the slope of the adjacent limestone mountains, abundant fresh water could be obtained from the karstic topography.

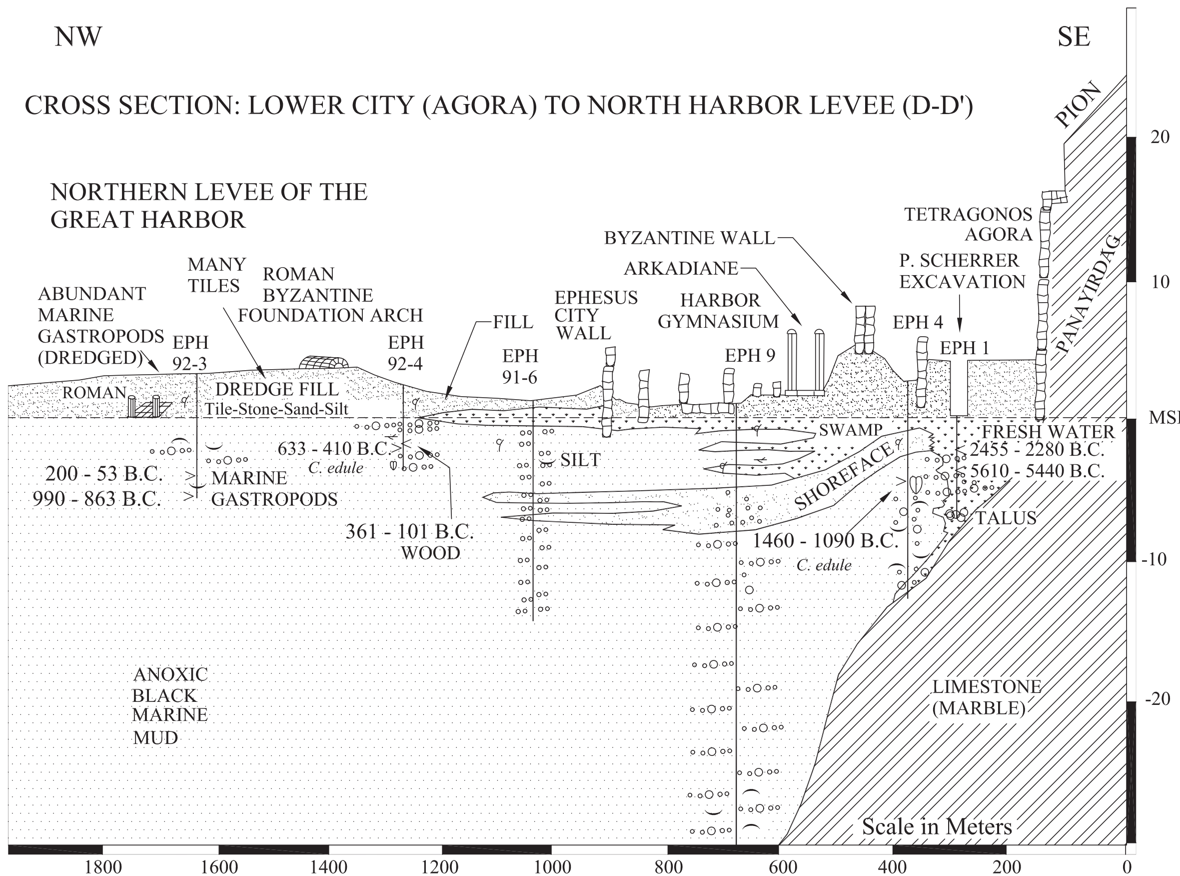

Figure 9. A geologic cross-section extending from the Tetragonus Agora excavations of P. Scherrer at the base of the junction of Mts. Bülbüdag (Preon) and Panayirdag (Pion), extending westward across the Roman city of Ephesus, which was built on the fill overlying swamp and coastal sediments and the prograding marine silts of the Cayster River. The section continues onto the large northern harbor mole of dredged fill and construction debris.

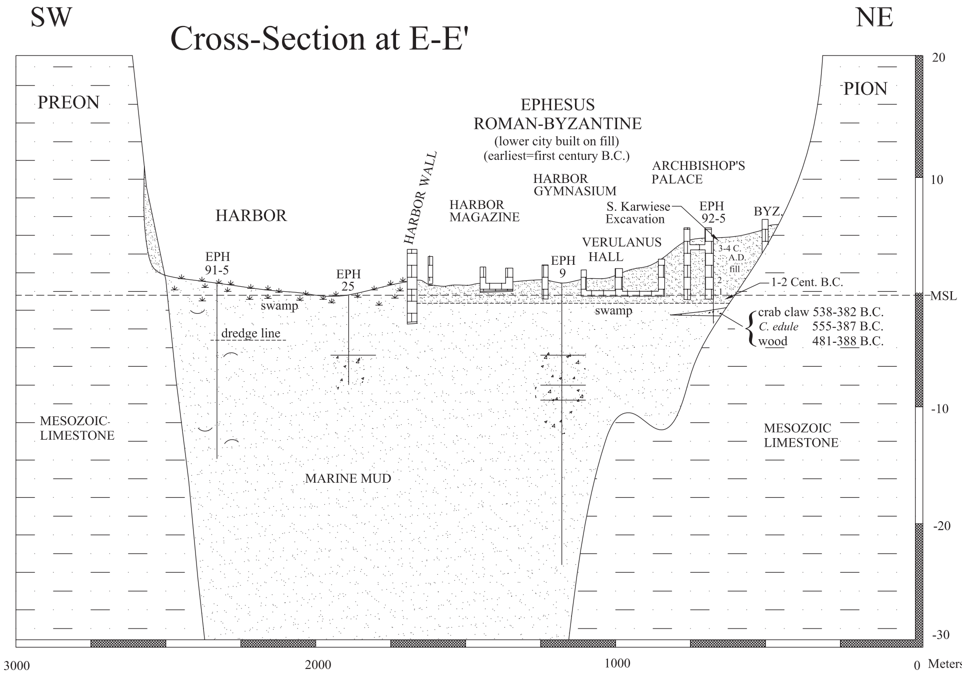

Figure 10. A geologic cross-section extending from a trench excavation by S. Karwiese along the wall of an Archbishop's Palace on fill into the previously shallow marine waters of Classical to Hellenistic times. The large buildings of the lower Roman City are built on fill over swamp and shallow-marine prodelta silts. A section of nearshore and beach sediments of Classical times was identified in a drill core under the base of Karwieses's trench (also see Figure 11).

Along the western foot of Mount Pion, a Classical-age coastline was identified and dated by ^{14}C dates of a crab claw, *Cerastoderma edule*, and wood debris. However, by Hellenistic time, prodelta silts of the ever-advancing Cayster River began to fill in the nearshore harbor of Lysimachus, both forcing movement of the Hellenistic harbor westward and leading to construction of the "lower" city of Ephesus over the infilled marine and swampy environments (Figure 10). Ultimately, Hellenistic engineers established a large northern mole to prevent the harbor from filling with the silts and sands of the Cayster River delta (Figure 9). Thus, from Hellenistic time to the last use of the harbor in Byzantine times, the peoples of Ephesus were continually fighting to maintain their "world-class harbor" and to protect it from the siltation of the adjacent prograding Cayster River delta.

Figure 11 is a composite diagram of an excavation through archaeological fill by S. Karwiese (1993) and our drill core (92-5) along the base of the foundation walls of a Roman archbishop's palace (also see Figure 10). Karwiese's excavation showed building foundations dating from the 2nd/1st century B.C. until Late Roman time ~500 A.D. Again using the deep trench of the archaeologists, we drilled and encountered

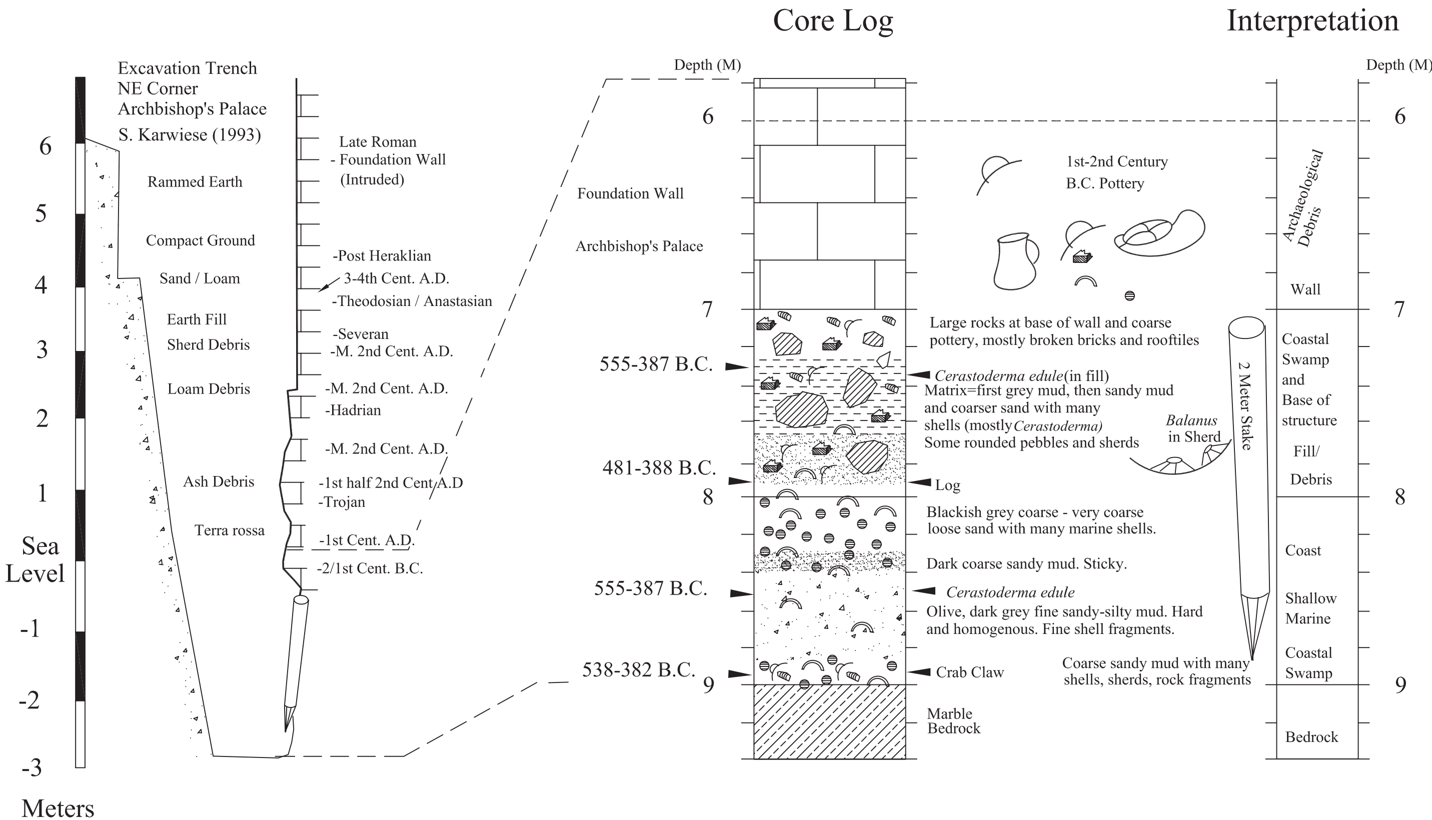

Figure 11. A schematic section of a drill core in an excavated archaeological trench. Details and ^{14}C dates of the edge of the Classical marine waters are shown. Archaeological excavation strata and Roman dates based on pottery and building structures are shown on the left (Karwiese, 1993).

construction debris and fill overlying a very coarse loose sand with many marine shells overlying a sandy shallow marine layer with abundant *Cerastoderma edule*. The marine environment at the base of Mount Preon, as shown in Figures 9, 10, and 11, lies within 10 m of the Neolithic to Archaic coastline of the ancestral Gulf of Ephesus. The initial coastal swamp present at about 430 B.C. was succeeded by shallow marine waters (~1–2 m deep), and then a thin layer of coastal sand overlain by building structures.

It is possible that Lysimachus recognized that his "great harbor" would have to be built seaward of the shallow coastal zone and planned to expand his city onto the newly created infilled area. However, we are not yet certain as to the precise dates at which the first buildings were built over the newly emerged land. Nevertheless, from mid-Hellenistic time onward we have an excellent written record accounting for various structures and measures taken to protect and extend the lifetime of the Great Harbor of Ephesus. In all cases, our drill cores through the lower city and through the mole along the northern flank of the harbor encountered a sand-silt swamp overlying shallow-marine prodelta silts. Thus, by the end of the 1st century B.C., buildings had already been extended up to 0.8 km seaward over the prodelta sediments and structural fill, which provided a foundation for the large public buildings of the lower city of Ephesus.

Five Centuries of Harbor Maintenance

By the end of the 1st century B.C., delta progradation had advanced as far as the Great Harbor. In fact, the writings of Hellenistic, Roman Senate, and Roman Imperial times tell us of a continual struggle to keep deltaic silts out of the Great Harbor to maintain deep-draft shipping access to this "world class" port of western Anatolia and capital of the Kingdom of Asia. Livy tells us of harbor entrance conditions ~190 B.C., when a Roman/Rhodian/Pergamene allied fleet attempted to attack the Ephesian fleet "bottled up" in the harbor of Ephesus.

> The Roman/Rhodian/Pergamene allied fleet tried to attack the fleet of the Seleucid king, Antiochus III, trapped in the harbor of Ephesus. The 'allied' fleet anchored for days on the high sea before the harbor of Ephesus. Finally the Roman commander lost patience and proposed to his allies to block the egress from the Ephesian harbor. That would be a simple venture: one had only to sink several heavily loaded cargo ships at the harbor outlet, and the harbor would be completely blocked, "because the mouth of the harbor was like a river: long and narrow and full of shoals" (. . . quod in fluminis modum longum et angustum et vaduosum ostium portus sit)
>
> Livy, 37, 14–15

It is clear from Livy's comment that access to the harbor of Ephesus was only via channels and that the mouth of the harbor was extremely narrow and full of shoals.

Strabo relates the story of King Attalus Philadelphus II of the mid-2nd century B.C.; the king's engineers designed a "solution" to the continuing silting problems that were beginning to restrict deep-draft merchant vessels from the harbor. This reference is one of the most frequently quoted of ancient writings alluding to failure to properly solve an environmental problem. The results of the Hellenistic king's actions to improve the harbor condition were exactly the reverse of the expected, as Attalus

Philadelphus II and his engineers had created an ideal settling basin into which silt could migrate but could not exit.

Strabo wrote at the time of Augustus, referring to the time of Attalus Philadelphus II (159–138 B.C.):

> The city has both an arsenal and a harbor. The mouth of the harbor was made narrower by the engineers, but they, along with the king who ordered it, were deceived as to the result. I mean Attalus Philadelphus; for he thought that the entrance would be deep enough for large merchant vessels—as also the harbor itself, which formerly had shallow places because of silt deposited by the Cayster River—if a mole were thrown up at the mouth, which was very wide, and therefore ordered that the mole should be built. But the result was the opposite, for as the silt, thus hemmed in, made the whole of the harbor, as far as the mouth, more shallow. Before this time the ebb and flow of the tides would carry away the silt and draw it to the sea outside.
>
> STRABO, 14, 1, 24

Figure 12 shows our interpretation of these mid-Late Hellenistic scenes from the literature. Clearly the northern mole had already been constructed; in addition, the city walls around the lower city blocked egress of the Cayster River into the lower-city region. However, shoaling continued at the mouth of the harbor, eventually leading into long tube-like extensions that later extended far westward. The allied fleet's actions tell us that already at that time, heavily loaded ships had difficulty in entering the harbor. However, the Hellenistic and Roman engineers were quite capable of dredging. During that time, Attalus II Philadelphus made a major effort to "permanently solve the problem." However, the clay- and silt-sized particles suspended in the prodelta currents were able to enter the harbor where they encountered settling-basin conditions and could no longer egress via the sluggish tidal action of the Mediterranean/Aegean Seas. Indeed, our drill cores into the harbor region show more than 20 m of black and anoxic marine mud. There was, in fact, very little that the Hellenistic and Roman engineers could do except to continue dredging and extend the mole westward in an attempt to protect shipping access to the harbor of this major metropolis on the Aegean coastline.

By Roman Imperial times, a continuing effort was made to keep the harbor clear by dredging and to extend the mole seaward. Eventually, the north mole protecting the channel access to the Great Harbor at Ephesus extended seaward for several kilometers (Figure 13). In the early 2nd century A.D., Hadrian (117–138 A.D.) attempted to divert the Cayster River with a large dam or barrage thus keeping the major flow of delta sediment further away from the harbor and its channel access. Hadrian Caesar undertook a forceful effort to protect the harbor of the city (129 A.D.):

> He diverted the Cayster and let a large dam [ohoma levee] store up [the sediment]. He made the harbor further accessible and diverted the River Cayster, which [had] caused serious damage to the harbor. The inscription comes from the year 129 AD and mentions several harbors. The Cayster River damaged all harbors of the city, not only the Great Harbor. Hadrian (117–138 AD) diverted the river in order to contain the damage which the Cayster incurred. The damages that occurred were the reason of his actions.
>
> The city of the Ephesians had erected a dam of 60 feet (=18 m) on the right bank of the Manthites River at the command of Caesar. The inscription was found when a lemon grove was being laid out on the street towards Zeytinköy, a few meters from where this street branches

off from the main thoroughfare of Selçuk-Izmir. The workers stated that the stone was found in situ, if true, Manthites was the ancient name of the river which comes down from the fiirince Valley, before it was named the Klaseas River (Kraft et al., 2000: 199).

Other than the construction of the dam, we do not know the magnitude of the attempts to divert the Cayster River. Indeed there is some discussion as to which river was being diverted. Some suggest that the dam may have been north of Ayasuluk hill in an attempt to divert the ancient Klaseas River (Figure 13). Because we have not located the precise site of this dam, it may be possible that Hadrian's engineers had much greater ambitions. For instance, if it were possible to divert the main river channel, the diversion of the Cayster River to the north of the midembayment island of Syrie would have been more effective. Regardless, by Roman Imperial times, it is probable that the natural diversion into multiple channels would have formed a complex of narrow distributary channels, broad swamps, coastal lagoons, and extremely shallow proximal- and distal-prodelta nearshore marine waters.

However, by Roman Imperial times, a more insidious problem had emerged. The citizens of Ephesus were causing their own environmental problems. The Ephesians were using the Great Harbor as a dump. Owing to the topography of the city of Ephesus, it had an excellent city drainage and sewer system, as all the sewage was diverted into the Great Harbor. In addition, the literature alludes to considerable dumping of "industrial debris" into the harbor. As much of the city was built of stone and brick, the materials dumped into the harbor included silt, sand, and coarser construction debris. During our drilling in the harbor, we encountered numbers of pottery sherds (all broken) suggesting deliberately discarded debris. An extensive list of attempts to dredge and clear the harbor is extant in the ancient literature (Kraft et al., 2000).

"1) Under Nero Caesar (54–68 AD) the *proconsul* Soranus tried to clear the Ephesian harbor (Tac. ann. 16, 23).

2) Around 100 AD, the *prytanis* C. Licinius Maximus Julianus gave gold for the further expansion of the harbor (IvE 3066, lines 14–15).

3) At the beginning of the second century AD, the archpriest T. Flavius Montanus paid 75,000 *denarii* for the enlargement of the harbor (IvE 2061).

4) In the middle of the second century AD the proconsul L. Antonius Albus prohibited the dumping of heavy loads from the bulkhead (sheet piling wall) of the harbor canal and sawing up building material and to throwing the emery and stone dust into the canal (IvE 23).

5) At the beginning of the third century AD, an archpriest gave 20,000 *denarii* in order to clean the harbor. . . . δόυτα καί έν τώ καϱώ τής άϱχιεϱωσύνης είς τήν άυακάθαϱσιυ τοϋ λιμένος δηναϱίων μυϱιάδας δύο. . . (IvE 3071).

6) In the middle of the third century AD, the politician Valerius Festus enlarged the harbor as [if] *Croesus himself had been able to do it*" (Kraft et al. 2000: 198–199).

The Slow Demise of the City of Ephesus in Late Roman/Byzantine Time

At the end of the second century AD the millionaire, sophist, and politician Titus Flavius Damianus constructed artificial islands in order that cargo ships could anchor safely in the 'island harbors' and transfer their cargo to the city.

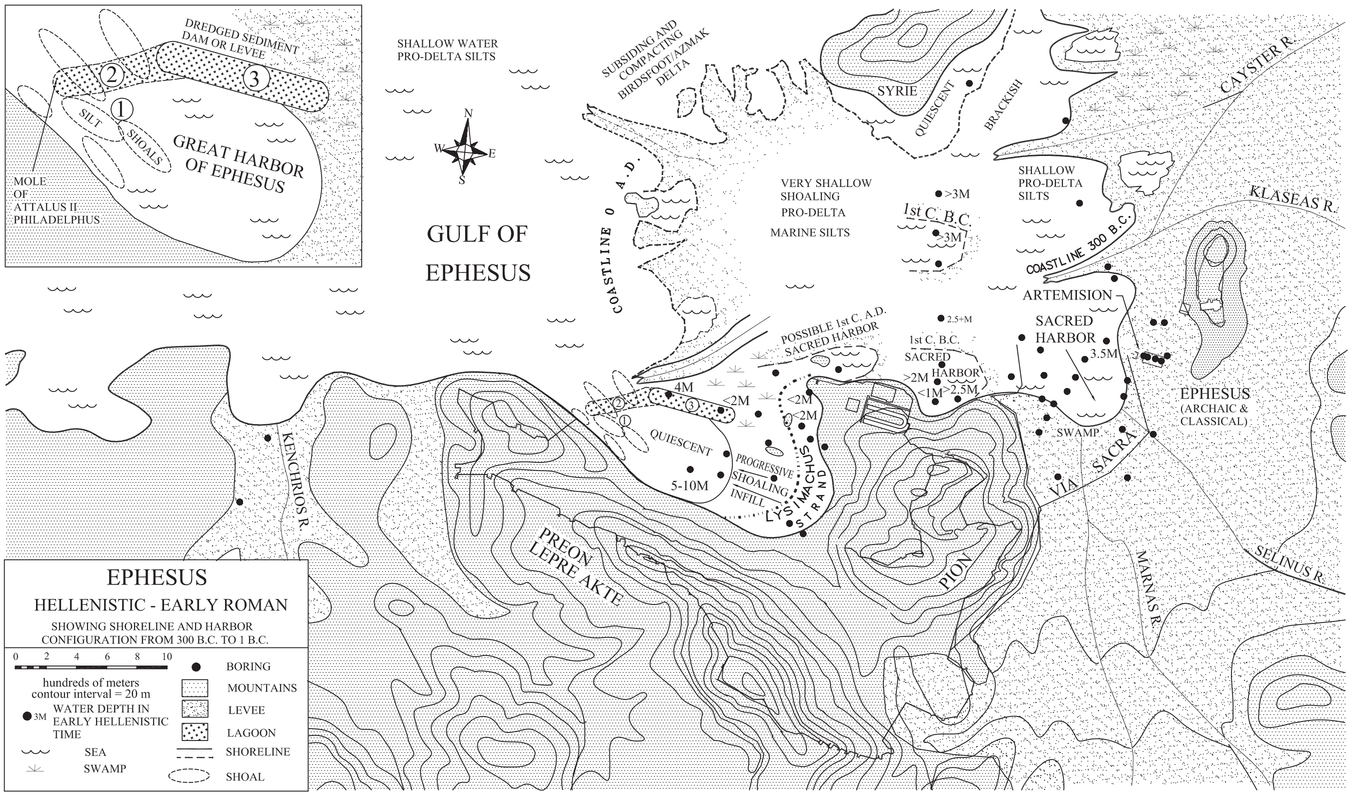

Figure 12. A paleogeographic map of the vicinity of Ephesus and the Artemision in Hellenistic times (300–1 B.C.). Selected depths of marine waters are shown, indicating possible marine access by ships. The Sacred Harbor of the Artemision is gradually "forced" westward as the Cayster River delta relentlessly progrades seaward. The coastline of Lysimachus' city "Arsinoeia" at the juncture of Mts. Pion and Preon was rapidly infilled by prodelta silts and man-made debris. A hypothesis about the Hellenistic harbor engineering of Attalus II Philadelphus is shown in the upper-left insert. However, harbor works of the middle-Hellenistic engineers may just as well lie to the east under the late Hellenistic/earliest Roman Imperial fill upon which the lower city was built. (1) Silt shoals in harbor; (2) construction of mole narrowing harbor entrance; and (3) large northern harbor mole, occupied in Roman times.

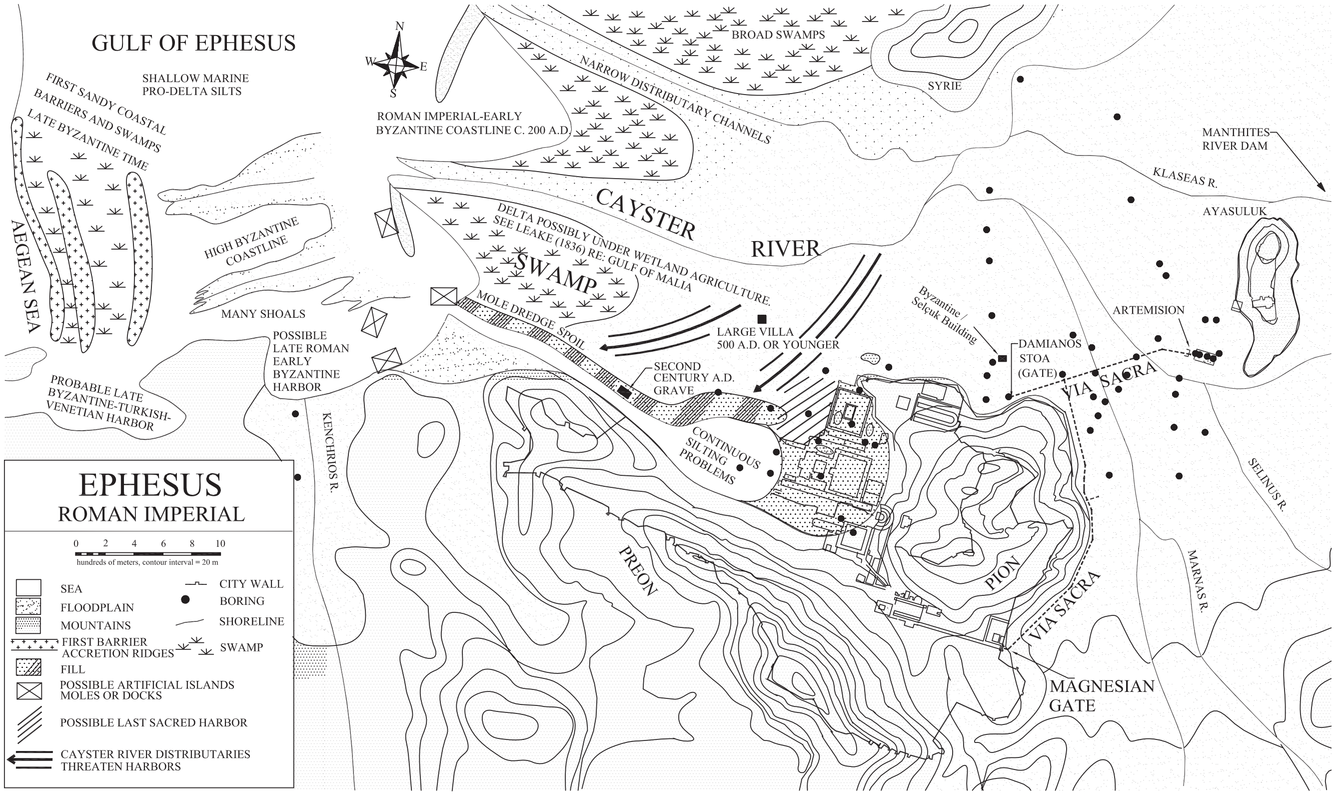

Figure 13. A paleogeographic map of ancient Ephesus in Roman Imperial and Byzantine times. The continually prograding Cayster River delta shown as a "birds-foot distributary" dominated the low-lying swampy coast of narrow ever-changing river channels. When the sands of the distributary mouths encountered increasing wave activity, a swampy barrier accretion plain formed from late Byzantine times to present. Note the continual dredging maintenance necessary from early Roman imperial to the end of the Great Harbor's use in late-Byzantine time. A few known archaeological sites in the lower delta alluvium suggest a possible heavy agricultural occupancy in antiquity, as noted by Leake (1835) in the lower Sperchios delta of 1790–1830 A.D. Note the large Roman buildings over the former harbor of Lysimachus' early Hellenistic times. The Via Sacra now extends over floodplain sediments overlying the former Hellenistic and earlier harbor areas.

> In the fifth century AD (431 AD), the harbor basin in the center of the city still was in operation, seaworthy ships went about, dropped anchor (outside the harbor), and loaded their cargo on barks that reached the inner city harbor above the runoff channel.
>
> The Coptic text quoting a Byzantine bishop says: “Because our ship could not travel inside the harbor, . . . I boarded a small boat [or barge]. . . .” (Kraft et al., 2000:199).

The ancient literature speaks of the construction of “artificial islands” to transfer cargo to ships that could navigate the shallow waters into the Great Harbor region of the city (see (Kraft et al., 2000). By the 5th century A.D., seagoing ships commonly anchored outside of the harbor and reshipped their cargo into the inner-city harbor by shallow draft boats (Figure 13).

In Late Roman–High Byzantine time, the Cayster River continued its progradation seaward. Although we obtained no evidence of linear barriers forming, it is possible that small barriers formed at the mouth of the distributaries. In Figure 13, we show a schematic reconstruction of the Roman Imperial–Byzantine coastlines ~200–1400 A.D. Precise delineation of the shoreline is almost impossible as the depositional geomorphic features are now partially buried, not distinct, and, more importantly, cannot be precisely dated. We believe that the birdsfoot-like distributary extensions, including many shallow-marine shoals, extended into the Middle Byzantine time. By Late Byzantine time, the Cayster River distributaries began to feed larger amounts of sand-size sediment into the mouth of the ever-seaward prograding river. At this time, the first linear barriers appear, as the Cayster River delta approached the open Aegean Sea and wave-driven littoral transport increased.

By the 7th or 8th century A.D., the population of Ephesus had sharply declined and a new series of walls was built from Mount Pion across the lower city to the harbor. The remainder of the formerly large city was no longer considered defensible. Also by this time, it is clear that attempts were made to keep harbors open still further seaward than the Great Harbor. Figure 13 shows two possible suggestions for bypassed, relatively deep-water bodies in the small flanking embayments of Mount Preon, possible Late Roman–Early Byzantine and Late Byzantine and even Turkish–Venetian harbors.

Little study has been made of settlement patterns on the actual floodplains of the Cayster River in antiquity. We have located a Byzantine or Selçuk building about 400 m north of the Feigengarten excavation (Figure 13). Recently, a large building (as yet unexcavated) has been located by archaeologists about 600 m north of the Great Harbor mole under 1 m of alluvium. This major structure on the low-lying Cayster floodplain is possibly a wealthy person’s farming villa occupied only in the dry season. Its presence suggests that intensive agriculture may have been practiced in the lower deltaic region in Late Roman and Byzantine times. Such agricultural emphasis in lower deltaic regions was extensive elsewhere in the Aegean region and in Late Antiquity (Kraft et al., 1987). Should such lower deltaic occupancy structures be found in the Cayster River’s lower deltaic regions in the future, they may indicate a wide agricultural support base for the city of Ephesus in Roman Imperial and possibly Early Byzantine times.

> When the Byzantine walls were built in the seventh or eighth century, the Harbor evidently still functioned, for the fortifications came down to its edge and included a town to protect the port.

> Writers of the time frequently mention Ephesus as a port, but by the early ninth century it was no longer adequate for the Byzantine fleet, which sailed instead from Phygela on the coast to the southwest. . . . After the ancient harbor fell into disuse, a new port was established three kilometers down the river. This site is well known from the fourteenth and fifteenth centuries when it was the commercial center of Ephesus and the base of the Italian merchants who frequented the area. . . . After the fifteenth century, this port also apparently succumbed to silting. . . . Ephesus lost all commercial importance. G. Hess (1989) reinforces the local of the outer harbor of Ephesus. (Panormus, of the eighth century AD) as located by A. Schindler's 1896 map, at the base of the Kenchrios valley, 2.5 km. west of Ephesus, based on the 723 AD visit of Willibald as documented by his biographer, Hugelburc in 778 AD. Other distances from the eighth century reference suggest that Phygela, the harbor for the ninth century Byzantine fleet, was either at the local of modern Kusadasi to the southwest or in the small, open Aegean Sea embayment at the modern resort of Pamucak due west of Ephesus on the Aegean coast (Kraft et al., 2000: 199–200).

Some of these harbors were located by Schindler in his carefully engineered 1896 map. However, it is not definite as to whether Schindler was following the dictates of earlier literature or proposing "logical or possible" small harbor-like embayments that may have extended along the flanks of the prograding Cayster River delta.

Foss (1979) summarizes, in detail, the extant literature on historic sites and their geographic settings in Late Byzantine, Selçuk, and Ottoman times. By the 14th century A.D., the Muslim city on Ayasuluk hill was still said to have one or more "harbors." Indeed, there is evidence of a road and causeway built with marble blocks extracted from the ruins of ancient Ephesus to allow vehicle and foot passage across the lower, very swampy deltaic plains and its many channels to the northwest corner of the Cayster-River delta (Figure 1). Thus, it is possible that a Selçuk Turkish fleet may have operated out of a harbor in the northwestern delta region in the early second millennium A.D.

Seven Millennia of Deposition in the Gulf of Ephesus

Figure 14 is a conceptual diagram showing relative changes in rates of deltaic sedimentation in the Gulf of Ephesus. The sharp increase in rates of deposition, as observed from Neolithic times to present, shows the impact of the approaching deltaic sediments of the Cayster River on sea-bottom topographies. As the land–sea interface (shoreline) moves seaward, alluviation begins and the potential for occupancy sites increases. It is possible (speculative) that the beginnings of coastal-barrier formation led to swamps and seasonal ponding with a negative impact on agricultural utilization of the fertile lower-deltaic regions by Late Byzantine time. The two lower-deltaic occupancy sites known to date may lead to the discovery of abundant occupation evidence of the delta-floodplain during antiquity. See Leake (1835) for a modern analogy of extensive agriculture and salt industry in the lower-deltaic coastal regions of the Gulf of Maliakos in Greece.

CONCLUSIONS

We have shown a series of paleogeographic reconstructions extending over the past 6000 years on the southern flank of the ancestral Gulf of Ephesus as related to

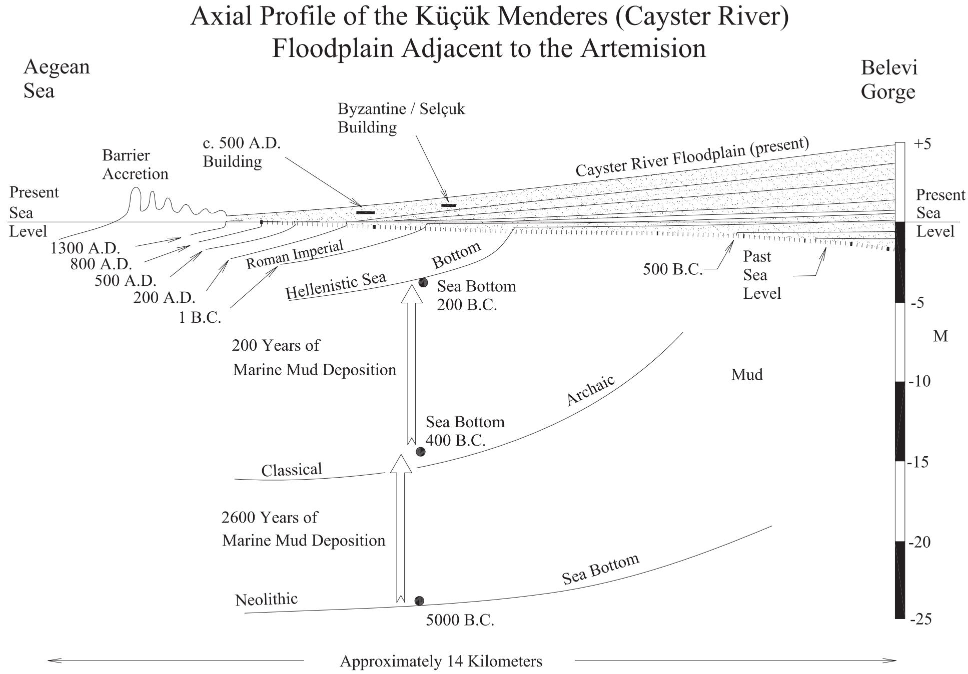

Figure 14. A schematic diagram of delta alluviation and coastal progradation of the ancient Cayster River (Küçük Menderes) as the deltaic environments moved ever westward past the sites of Ephesus and the Artemision. The marine embayment was primarily infilled by proximal and distal prodelta marine silts and sandy silts. The alluvium of river and delta cover the marine sediments with a relatively thin veneer. Note the change in deposition rates of distal pro-delta silts from 5000 to 400 B.C. to the more rapid deposition of proximal prodelta silts from 400 to 0 B.C. Historic comment frequently "notes" the rapid advance of the Cayster delta coastline as it bypasses the harbors of Ephesus and the Artemision. Deltaic foreset deposition was probably not common as the river silts were widely distributed throughout the marine embayment. Apparently, much of the coarser sediment load of the Küçük Menderes (ancient Cayster River) was deposited in the broad inland alluvial basin to the east of Belevi gorge (see Figure 1).

archaeological, historical, and legendary sites along the southern flank of the modern Küçük Menderes (ancient Cayster River) delta floodplain. Over the past six millennia, the Cayster River delta has prograded over 15 km seaward. By the 7th century B.C., there were clear indications of flooding problems at the Artemision. However, in Classical and Hellenistic times, an "environmental crisis" began and continued through Roman and Byzantine times, eventually leading to the long-term decline of the harbor and city of the ancient Ephesian peoples. Our identifications of sedimentary environments by geological and paleontological means are correlated with dated archaeological sites. In some cases, historically recorded events provide limiting parameters on reconstruction of ancient geographies. Pertinent legends may also provide valuable clues to ancient morphologies. In turn, interpretation of ancient paleogeographies allow us to better understand prehistoric locales.

This research was done under the auspices of the Austrian Archaeological Institute. We thank Friedrich Krinzinger, General Director and Director of the Ephesus Excavation for his encouragement and permission for us to publish the figures and results of our research as herein discussed. We thank the following Austrian archaeologists at Ephesus: Gerhard Langmann and Stefan Karwiese, past Directors of the Ephesus Excavation; and Anton Bammer, Michael Kerschner, Dieter Knibbe, Ulrike Muss, Ulrike Outschar, Peter Scherrer, Hilke Thür, Elisabeth Trinkl, and their many associates for countless courtesies and fruitful discussions over the years. The entire excavation staff welcomed us in our role as natural scientists, geologists, and geographers. Peter Scherrer provided a detailed listing of Archaic and Classical find spots. Aenne Ohnesorg kindly located Falkener's diagram showing the Artemision as a harbor site. Ertug Öner provided the photogeomorphologic map of the Küçük Menderes floodplain. R.E. Taylor of the University of California at Riverside provided many of the radiocarbon dates. Russell Rothe converted our hand-drawn maps into the completed computer drafted figures you see in this paper. Zhichun Jing helped edit the text as well as drawings.

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