

Quarrying at Notion: Urban Settlement and the Natural Environment



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The East Agora



Possible Quarry Area



Gray Carbonate



White Carbonate



Tan Carbonate



Conglomerate



Fault Breccia



Architectural Blocks at the Temple of Athena





(1) Tool marks



(3) Rock-cut corners



(2) Vertical faces



(4) Rock-cut pockets



(6) Cut faces w/flat terraces



(5) Separating trenches

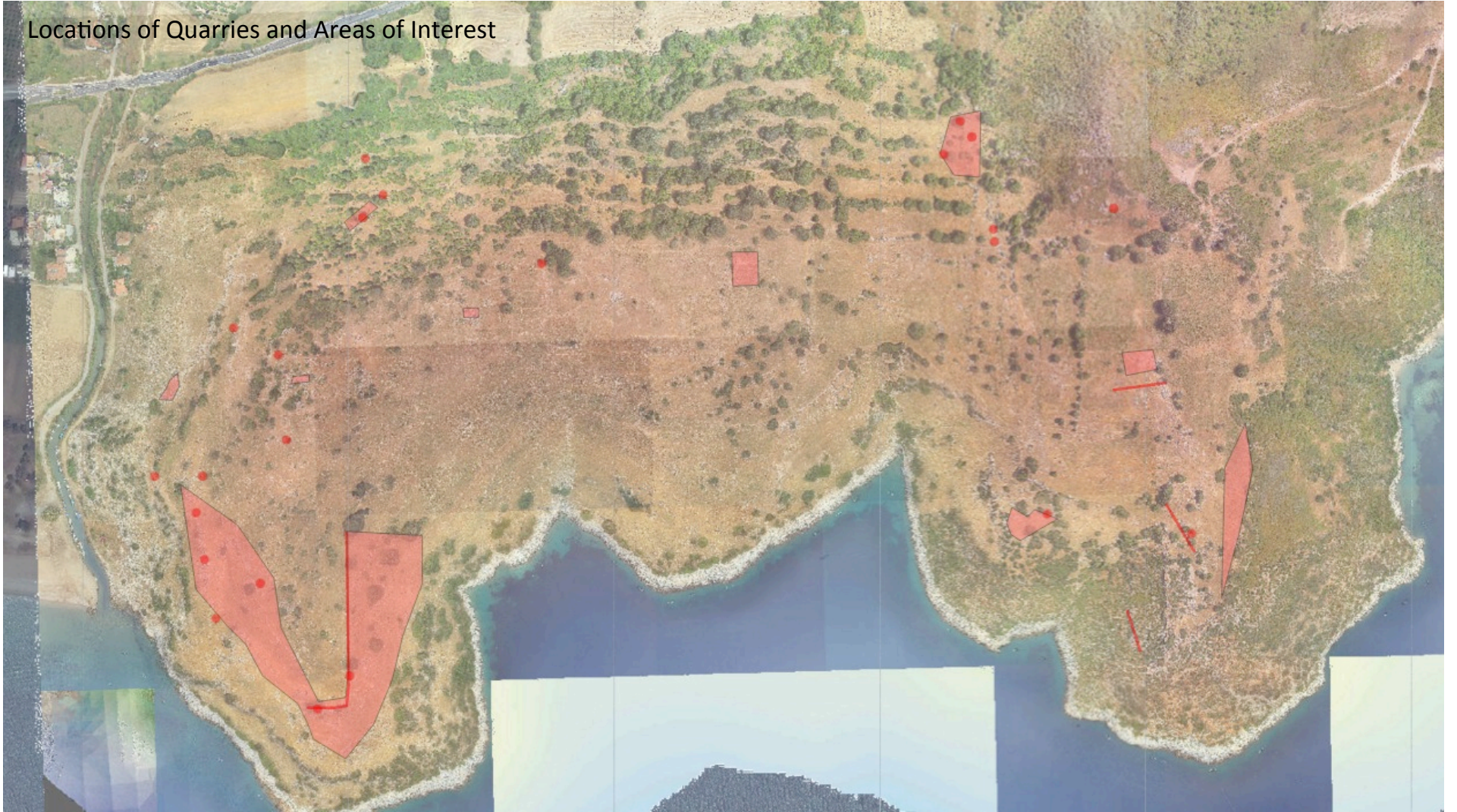
Quarry With Vertical Faces and Multiple Tiers



Linked Quarries on the Western Promontory



Locations of Quarries and Areas of Interest



Possible Conglomerate Quarry



Possible Off-Site Conglomerate Quarry



Section of Fortification Wall



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By now, you've heard about our overall program of research at Notion, and some of the strategies employed by the builders and residents of the coastal site to create a new home on this rocky promontory. One of the obvious needs for such a construction project was an adequate supply of stone—a material that Notion has in abundance beneath its very foundations. It was also necessary to negotiate the topography of the chosen site; either a level surface must have been built up, or the landscape itself would have needed to be modified. With steep slopes that descend to land or sea on all sides, Notion also shows abundant evidence for this landscape modification. This evidence includes the large, level Agora; other artificially leveled terraces; and a fortification wall that snakes down and around the edges of the site's craggy mass. The wall—the single largest building project on the site— would have required a minimum of roughly 27,000 m³ of stone.

Several broad, flattened areas of bedrock—including the Agora—and numerous craggy chunks missing from the landscape, suggest that Notion's builders took full advantage of local stone. Specifically, then, we are asking: Where did the vast quantity of stone used to build the city come from? How much of it was removed from on-site quarries? And how much was transported from elsewhere? **If** stone was brought from elsewhere, did this occur because there was no alternative type of stone on-site, or were there other motivations at play?

Our study of Notion's quarries will ultimately be divided into several parts: We will create a geological map of the site, we will identify how much of each type of stone used for construction may have come from on-site sources, and we will explore what we might learn of the organization of city-building from our architectural remains and related quarries.

To begin this project, our goals for the first season of quarry study were to identify any certain, or probable, sites of stone extraction, and then to characterize the stone at each location, measure the dimensions of the remaining stone, and plot the locations of quarries using a handheld GPS. This work was undertaken in partnership with Peter Knoop, a geologist and IT specialist from the University of Michigan.

In our reconnaissance of the quarries we identified six major rock types at the site: three of these were carbonate— white and tan varieties, and gray variety with thin,

resistant bands, all pictured here. We've refrained from classifying these as either limestones or marbles until we can inspect the rock further. The remaining rock types are schist, fault breccia, and a small amount of what we have termed 'conglomerate'. On closer inspection, we may very well conclude that the white, gray, and tan carbonates are three specimens of the same rock, in which case the major distinctions between on-site rocks would be limestone and schist. The conglomerate and the fault breccia are also somewhat similar to one another in appearance, but they're distinctly different in composition. To clarify this distinction: The conglomerate is formed by a random mix of clasts carried by water, some of which are angular and some more worn, but all generally encased in a reddish matrix. In contrast, the fault breccia consists of a white-to-reddish matrix and its clasts are made up of very angular chunks related to the rocks near its find spots; it was formed along the fault between two geologic boundaries, which runs through the site from roughly the northwest to the southeast.

Of the architectural blocks on site, the majority consist either of the conglomerate or of the gray and white carbonates. In addition, there are a few blocks that appear to be cut from the fault breccia, as well as tan carbonate, and what are probably off-site marbles and off-site basalt. We are particularly interested in exploring how much of each of these types of stone might have come from on-site quarries.

In identifying these quarries, we looked for the following diagnostic features: (1) tool-marks, here, (2) vertical faces, here, (3), rock-cut corners—which is a term we've given to locations where two vertical, cut planes intersect, as you can see on the slide, (4) rock-cut pockets—which are similar to the corners, but also have a third, horizontal, bottom plane, as in this picture, (5) separating trenches, which you can catch a glimpse of in this photo, and (6) cut faces with flat terraces, here. If areas either had unclear evidence of these characteristics, or looked as though stone had been removed to make room for construction, we identified them as 'areas of interest'. In our view, these represented possible sites of *ad hoc* or 'opportunistic' quarrying, where rock may have been used for construction as a result of removal for other purposes, such as clearing a level space for a foundation.

Vertical faces were the most prevalent of these characteristics, but we did find at least 1 instance of each of the 6 diagnostic features. It should be noted that, given the

erodible nature of many of the rocks on-site, we did not necessarily expect tool marks to be well-preserved above ground. Indeed, they're visible on the surface of very few quarry faces, and they're most clearly preserved on faces that have more recently been exposed by trenches dug for looting. Many of the quarries represented by vertical faces also appeared to have multiple tiers, and we found at least 6 of these locations. 12 of the quarries, and 2 of the areas of interest, appeared to have multiple visible faces that were likely part of the same extraction area. Additionally, on the ends of both promontories, the tiered leveling of the landscape suggests that several quarry faces may have actually linked up to form particularly large quarries.

On the western promontory, the quarry pictured here may have wrapped all the way around the southern tip; we estimated its size at a minimum of roughly 9,000m³. On the eastern promontory, another very long quarry appears to have been cut into the eastern-facing edge of the site. We are still working to estimate its original volume, but it was likely larger than its western counterpart. This means that with a combined minimum of roughly 18,000 m³, these quarries could have conceivably provided most, if not all, of the carbonate blocks used in the fortifications.

In total we identified 13 quarries, as well as 8 areas of interest for possible stone extraction which we will continue to evaluate.

Of the quarries, we classified 9 as gray carbonate, 2 as white carbonate, 1 as tan carbonate, and 1 as possible conglomerate. We expected a high number of carbonate quarries because we see many architectural blocks of this material on-site, and it is also the most prevalent rock we see simply walking around the site. We were surprised, however, and intrigued, by the lack of any significant conglomerate quarries. The single possible conglomerate outcropping that we did find, located within the fortification wall on the northern (landward) side of the site, has very little rock still visible.

Our estimates of the combined length and height of these conglomerate outcroppings did not exceed 10m. Even an optimistic estimate of potential volume for this quarry would not have been nearly enough stone to source the numerous conglomerate blocks found all over the site and throughout the fortification walls. The conglomerate appears to make up around 20-30% of the wall material, which would have been between 5,400 and 8,100 m³. Where then, did this stone come from? And why would conglomerate

rock have been brought to the site when the entire city sat on a ready supply of carbonate suitable for construction—and indeed, already used for just that purpose? Perhaps because the most accessible rock had been exhausted, or because the conglomerate was easier to extract?

Just as the original settlement of Notion may have been located at another site, however, so, too, may other quarries have been located in the surrounding landscape.

Within view of the site we have noted at least one area that might have been a possible source of stone, here. This, and another possible source of conglomerate down the modern road to the east, lie outside of our survey area, and so we have not yet been able to examine them in any detail. Their presence close to the current city site, however, does not solve the problem of transportation. The top of the city promontory is not so easily accessible from any side, and the task of moving stone blocks up its steep slopes would have been an arduous one. What would the motivation have been to haul rocks even a short distance over the surrounding river plain and up to the city walls? Were there aesthetic properties that made the conglomerate rock more appealing? Was it preferred by stonemasons for some reason? Or were there simply practical concerns related to quarrying a large volume of rock that made the conglomerate preferable? The stone is widely used at nearby Ephesos, and so the quarrying and transportation infrastructure were presumably already in place.

In identifying these quarries and building up a geological picture of the site, we have noted two challenging problems that we will grapple with. Each relates to a different component of our quarry study, and ultimately concerns the fortification walls. As Christopher Ratté has noted, the piecemeal construction of the walls involved the use of primarily two types of stone—carbonate and conglomerate. The first problem relates to quantities of stone and their origins. As I have shown, although conglomerate blocks are found in great numbers in the city walls and other buildings, we have only found 1 possible quarry for this rock on-site. Is it possible that we have found very little evidence of the conglomerate because it was quarried for construction so thoroughly? Is the roughly 10m-wide swathe we observed peeking out of other rock in the hillside all that remains? At the root of these issues, our question is: where is the conglomerate coming from?

The second problem relates to the construction of the walls themselves and the acquisition of stone as part of the organization of city-building. One of the overall questions posed by the survey project is how were the walls built—were they a collective effort by the city's populace, erected by various teams of masons in slightly different styles? If we add to this the question of sources for some of our rock—where was it coming from, and why was it worth moving up challenging terrain—then an even more interesting set of questions emerges. Can we explore the social life of stone at Notion? Who was participating in extraction, in transport, and in construction? What did it mean that the walls were built piecemeal, and that individual blocks were cut from different rocks? These are the questions we will address as we continue to study the quarries. Comparative evidence will, of course, be a crucial part of these interrogations, both nearby at Ephesos and farther afield, as will the integration of this work with our study of the fortifications and other architectural remains.