

**The Organization of Ancient Societies in Relation to Landscapes:
Perspectives Gained from the Analysis of Remotely Sensed Data
Collected from Aerial and Satellite Platforms**

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Aerial and satellite remote sensing provides a highly informative perspective on the organization of ancient societies. It can be used not only to identify the locations and types of archaeological sites, but also natural features, and the latter can suggest the basic structure of past environmental conditions. A synoptic view is inherent in the application of aerial and satellite remote sensing to archaeological landscapes, one that suggests why ancient populations occupied certain places, how they changed the landscape, and how those changes might have been a catalyst for increased or reduced social complexity.

I will give two examples here. The first informs us about a dramatic change to the economic and social structure of the Kingdom of Nabataea, located in present-day Jordan. The Nabataeans are perhaps best known as the builders of the World Heritage Site of Petra. Broad changes to Nabataean culture were brought about by the Roman expansion into Arabia. This expansion of the Roman Empire to the east culminated with the annexation of what the Romans called Arabia Felix by the emperor Trajan in 106 AD. The second example comes from the Southern Channel Islands just off the coast of southern California and deals with the ways that the humans who populated those islands were knit together in a common society. Those who are interested in learning more about these two examples can find chapters dealing with each in the book called *Mapping Archaeological Landscapes from Space* (Springer, 2013). I edited this book with Prof. Michael Harrower of the Johns Hopkins University. It contains many chapters written by or co-authored with NASA personnel, and is meant to be a primer on the use aerial and satellite remote sensing, especially by archaeologists. Chapter 7 is entitled “Petra and the Paradox of a Great City Built by Nomads,” Chapter 13 is “The Influence of Viewshed on Prehistoric Archaeological Site Patterning at San Clemente Island as Suggested by Analysis of Synthetic Aperture Radar Images.”

The Kingdom of Nabataea

Petra emerged as a city renowned in the ancient world sometime around the beginning of the Common Era, about 2,000 years ago. For many centuries before this the Nabataeans who inhabited the dramatic valley in which the city of Petra came to be located, with its steep, colorful sandstone walls, had amassed great wealth by controlling the trade in precious commodities through the Arabian Peninsula. Among these were spices, incense, frankincense, myrrh, gold, silver, pearls, and silk. Caravans of camels carried their valuable cargo from what is now Yemen and Oman to Petra and from there to the Mediterranean and thence by ship to the cities that ringed the Mediterranean. To this day, the inhabitants of the region strongly associate such treasures with Petra. It is a commonly held belief among the Bedouin there that the Three Wise Men who brought gifts to the Christ Child came from Petra.

Diodorus Siculus in his *Universal History*, written in the first century B.C., tells us that one of Alexander the Great’s generals, Antigonus Monophthalmus, attacked Petra twice in 312 B.C. The Nabataeans were well known for their wealth at that time, but Antigonus found nothing except a few bars of silver. The Nabateans, being entirely nomadic at the time, had fled, taking their wealth with them. Diodorus Siculus

tells us that the Nabataeans were forbidden to build houses or engage in agriculture on pain of death. Being completely mobile served them well as traders in precious commodities.

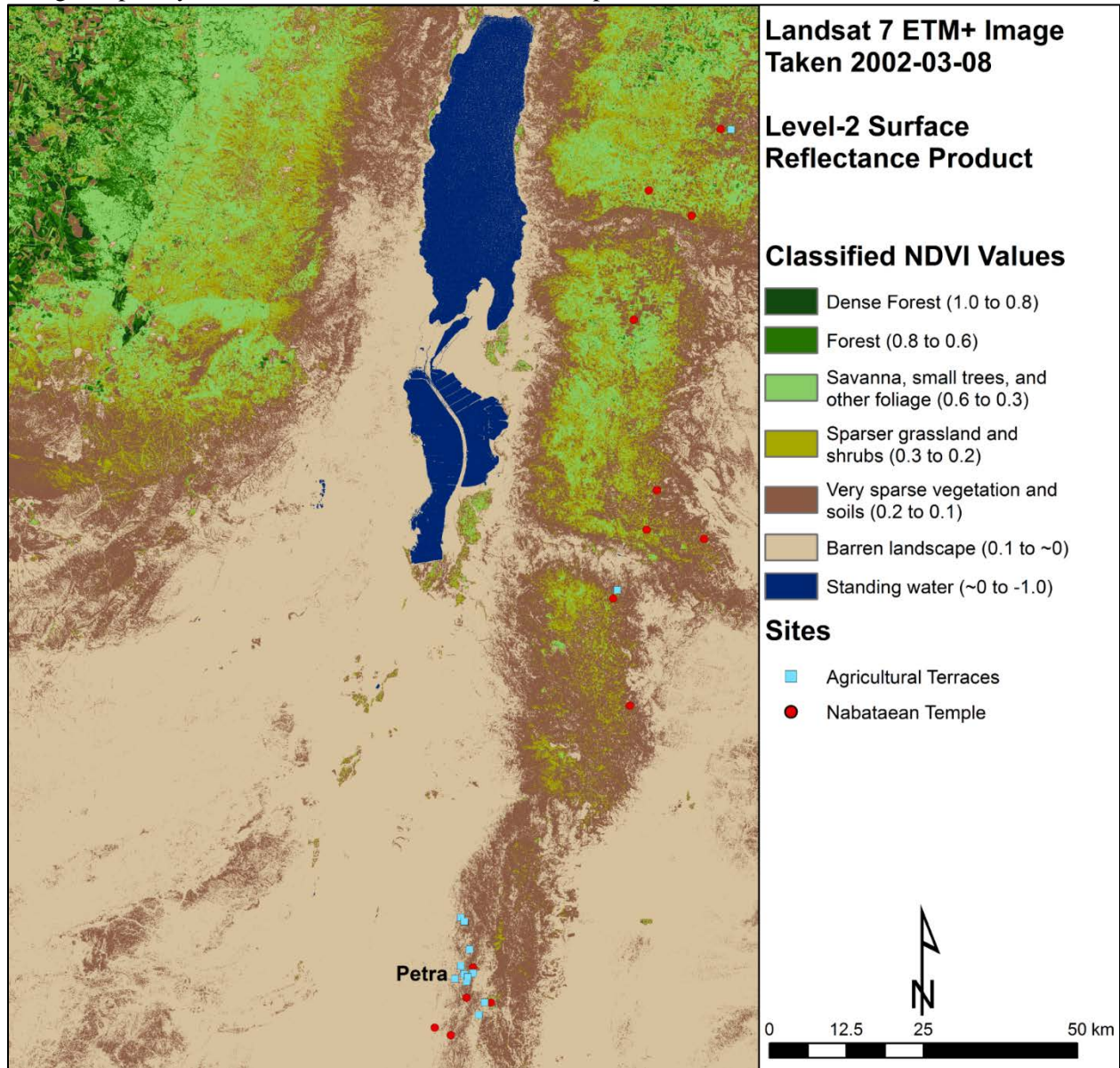


Figure 1: Locations of Nabataean temples and agricultural terraces that appeared in the First and Second centuries AD; for hundreds of years before they did not exist. They can be found only in places where agriculture is possible.

By the first century A.D., however the great urban center in the valley of Petra had been constructed. It boasted temples, baths, a

colonnaded street, a nymphaeum, and even a water garden, called a *paradesio*. How did nomads come to construct such a place?

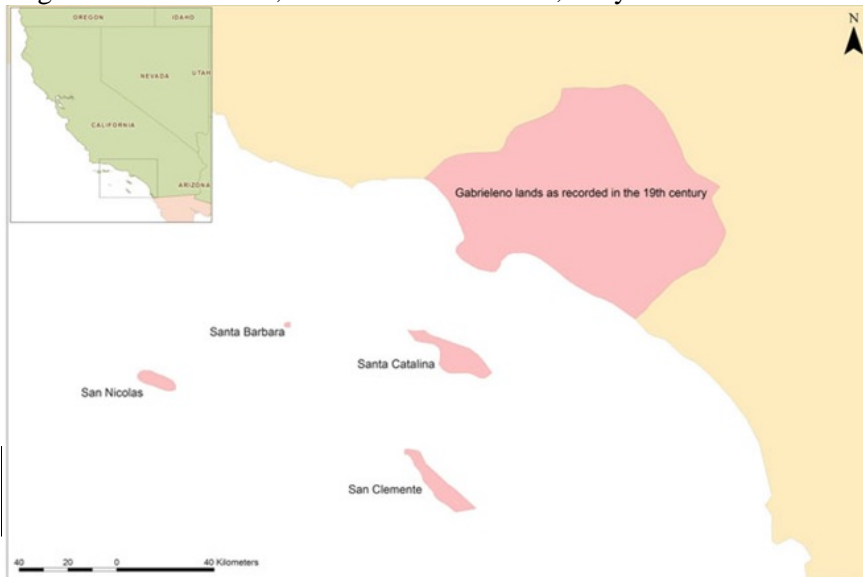
The great Roman general Pompey had cleared the Mediterranean of pirates in 66 BC. From that time onward the Mediterranean was a “Roman lake.” Rome then began establishing overland trade routes from the Mediterranean to the Arabian Sea, ultimately replacing Petra as key node in the system with Palmyra,

now in Syria. They also removed pirates from the Red Sea. Many of these Red Sea Pirates were Nabataean, who had been intent upon ensuring that the monopoly that Nabataea held on trade through the Empty Quarter of the Arabian Peninsula would be maintained. By the time of Christ, precious commodities could be safely moved north by ship on the Red Sea to Egypt, and then from Alexandria to the Mediterranean ports. Even before Rome formally annexed Felix Arabia, Rome took control of trade in the region.

This meant that the Nabataeans had to find a new source of income. And so they embraced with enthusiasm with they had distained for centuries: agriculture. Figure 1 is an NDVI image generated from Landsat data with Petra in the extreme south and the Dead Sea on the north. To the west of the Dead Sea is current day Israel, with arable land colored shades of green and light brown in the image. Here there had been small farmsteads for thousands of years. To the east of the Dead Sea is present day Jordan, generally more arid, but regions where agriculture is possible are also seen as green and light brown. Temples and terracing for agriculture suddenly appear in these areas in the first and second centuries AD. Such structures and the places where they are found indicate a sea-change in Nabataean culture.

The Southern Channel Islands

San Clemente Island is one of four Southern Channel Islands; the others are Santa Catalina Island, Santa Barbara Island, and San Nicholas Island. All of these islands and the Palos Verdes Peninsula, where Los Angeles is now located, were home for about 3,000 years to the Gabrielino-Tongva Tribe (see Figure 2)



Sailing from the Palos Verde Peninsula to the islands one crosses water thousands of feet in depth; the Southern Channel Islands are volcanic, they have never been a part of the mainland. Nonetheless the Gabrielino-Tongva Tribe was a cohesive social unit with a common language. The interdependence of each geographically separate unit was beneficial to each of them. San Clemente Island, with half the rainfall and not nearly as densely populated as Santa Catalina Island, was

in an especially rich area of the ocean. Sea mammals were especially important resources to the tribe. They provided many more calories per pound than most fish. They also supplied materials (skin, bones, and teeth) that were used in making tools, shelters, and boats. Together, the islands and peninsula comprised a social and economic network. This network was one was linked to other Native American tribes by trade: soapstone bowls and talisman made on Santa Catalina Island were traded with Native American groups as far east as current-day Arizona.

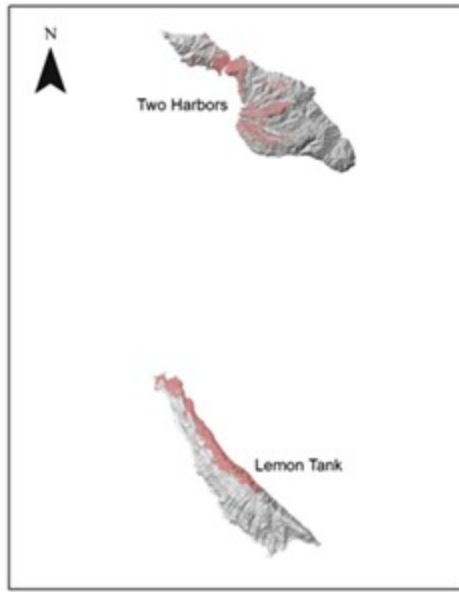


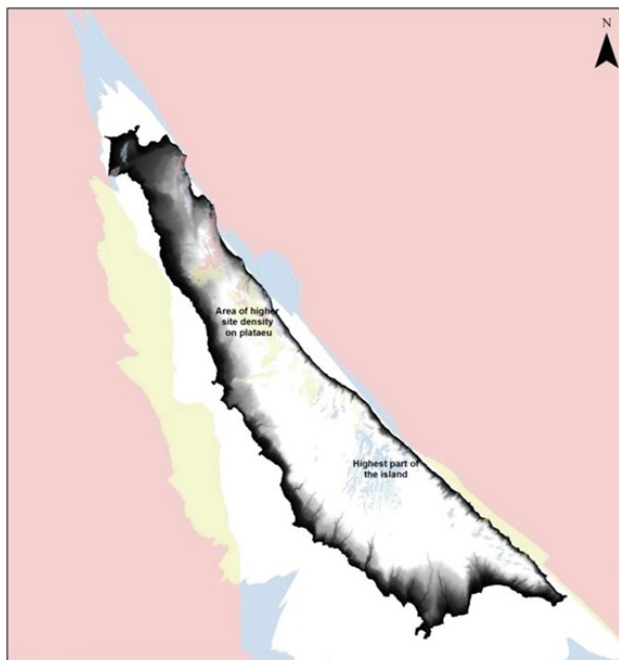
Figure 3: Areas of inter-visibility on Santa Catalina Island (to the north) and San Clemente Island (to the south).

But how was this network formed and maintained? A digital elevation model generated from synthetic aperture radar (SAR) data collected by an airborne NASA platform identified areas of inter-visibility on San Clemente and Santa Catalina Islands (see Figure 3). In just these places, early California histories tell us that rituals were held. Friar Geronimo Boscana in 1846 noted that perhaps the most important of these was the Chinigchinich ritual. The Gabrielino-Tongva Tribe held this to ask the common ancestors of the tribe to return. The ritual areas as described were a circular dance floor of hard packed earth surrounded by pits in which sacrifices (among them foxes and eagles) were placed. Because of the highly organic soils at these ritual sites, many of these can be seen in false color infrared images of an area on San Clemente Island known as Lemon Tank (see Figure 4). During these rituals, fires were lit that could be seen from one island to the next. This reinforced the cultural and social relationships between the two islands.

Viewshed played another essential role on Clemente Island.

Life on San Clemente Island was dependent upon harvesting sea mammals. To do this, it was necessary to surveil the ocean constantly. When pods of sea mammals were observed, signals would be sent to shoreline settlements. People from those settlements would immediately go into the ocean in water vessels, surround the pods of the mammals, and drive them into coves. Other groups were directed to those coves by signals from high points on the island. When the pods of sea mammals were driven into coves, these groups of people would harvest them. Figure 4 shows a

dense grouping of habitation sites at a high point on the island where not only can great expanses of ocean be seen, but from which signals could be given to settlements along the shoreline.



Legend
 Not Visible from either area
 Visible only from area of higher site density on plateau
 Visible only from highest part of the island
 Visible from both the area of higher site density and the highest part

4 2 0 4 Kilometers

Figure 4 shows a dense grouping of habitation sites at a high point on the island where not only can great expanses of ocean be seen, but from which signals could be given to settlements along the shoreline.

These are just two examples of how the synoptic perspective that is so much a part of the analysis of remotely sensed data collected from aerial and satellite platforms is transforming archaeology. This perspective encourages interpretation that is relevant to the ongoing dialectic between human groups and the landscape. One is greatly influenced by the other and so each is constantly changing, a change that becomes more intense as the human population grows.

Figure 4: Dense grouping of habitation sites in locations that provide a wide view of the ocean and the island shoreline.

Taken From

Comer, Douglas C. and Michael J. Harrower, eds., 2013, *Mapping Archaeological Landscapes from Space*, New York: Springer Press.