

# ‘Finding Old Sikyon’, 2015

## *A preliminary report*

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### **In memory of Anastasios Orlandos and Serapheim Charitonidis**

The project ‘Finding Old Sikyon’ is a cooperation between the Ephorate of Antiquities of Corinth, the National Museum of Denmark, the Danish Institute at Athens and the Institute of Geoscience of the Christian Albrechts University of Kiel.<sup>1</sup> It is planned as a five-year project, the actual running permit covering the first two years. The project was conceived by former Director of the Danish Institute at Athens Rune Frederiksen with the aim of identifying the exact location and major features of the city, prior to its relocation in 303 BC to the plateau of Vasiliko by Demetrios Poliorketes. The project studies the topography of the pre-Hellenistic city and its surrounding landscape, hoping to identify the course of the city walls, the location of the harbour, major public spaces, monumental architecture and dwelling quarters with houses, streets etc. Rescue excavations of the Archaeological Service and the Archaeological Society at Athens have already brought significant evidence to light, and the project intends to conduct a systematic search for the city in order to understand its main elements, material, size, form and topography. This, however, is intended to serve the greater purpose of answering general questions of Archaic and Classical urbanism, as it is a very rare case

that a major Archaic and Classical polis was given up at a clearly defined date and never built over afterwards, either by later ancient or larger medieval or modern settlements. Old Sikyon will thus – as one of the rare examples in the Greek motherland – allow us to study in detail the genesis and processes of development of an important city between natural growth and systematic planning. Moreover, the archaeological investigation of Old Sikyon will allow us to mirror the accounts of the written sources on this very active centre of art in seizable archaeological remains and thus to evaluate their reliability. Finally, it will inform us about the structure and organization of a famous centre of art and culture in comparison with other such centres like Corinth and Athens.

The five-week field season during the summer of 2015 was directed by Dr. Rune Frederiksen (now Ny Carlsberg Glyptotek, Copenhagen). With the assistance of Giorgos Giannakopoulos, Dr. Kristina Winther-Jacobsen (now Director of the Danish Institute at Athens) directed the intensive systematic survey with the participation of twenty students from the Universities of Copenhagen, Aarhus and Southern Denmark, as well as two students from the National and Kapodistrian University of Athens. Vasilis Oikonomou directed the finds registration. Geophysical survey was carried out by the research team ‘Archeo-Geophysics’ of the Institute of Geoscience,

<sup>1</sup> The project obtained authorization for 2015 and 2016 with a Ministerial Decree (ΥΠΟΠΙΑΙΘ/ΤΔΑΠΚ/ΔΙΠΚΑ/ΤΕΕΑΕΙ/68688/379/29.06.2015). The synergasia is directed by Dr. Konstantinos Kissas, Director of the Ephorate of Antiquities of Corinth and Dr. Silke Müth of the National Museum, Denmark.

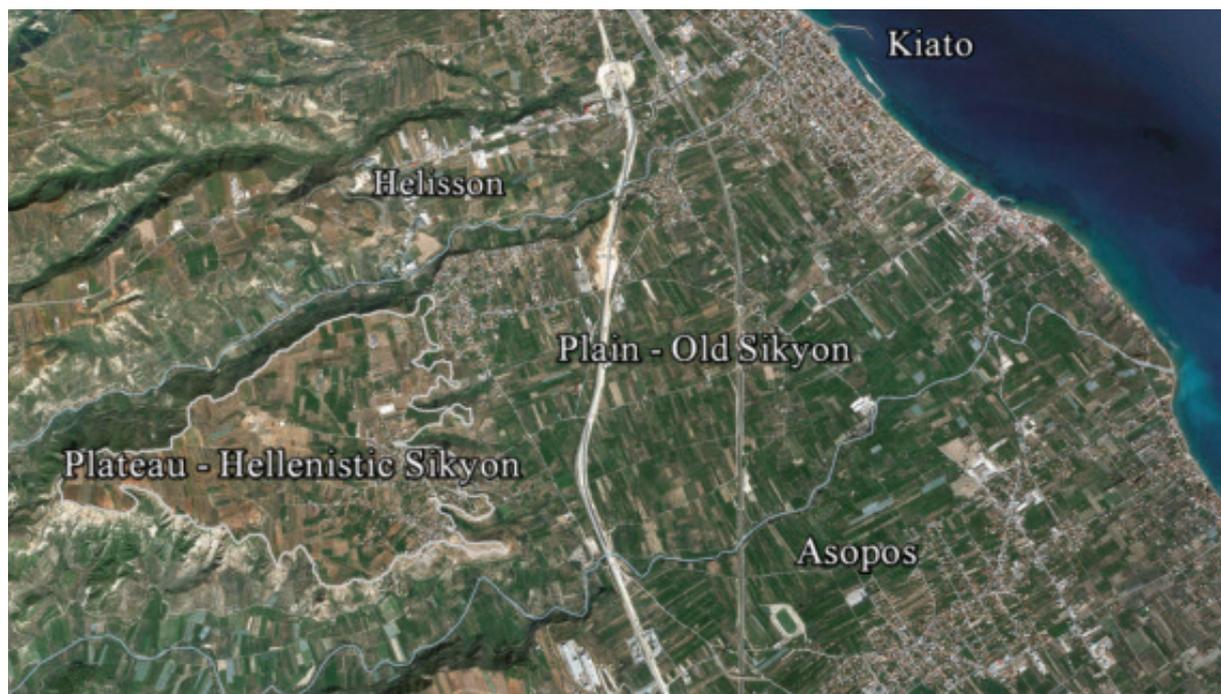


Fig. 1. GIS map of the research area with the rivers and plateau.

Christian Albrechts University of Kiel under the direction of Prof. Wolfgang Rabbel, and Eastern Atlas GmbH & Co, Berlin under the direction of Burkart Ullrich. Dr. Jamieson Donati of the Institute for Mediterranean Studies applied remote sensing methods to the project area.

The area under examination is located in the marine plain of Kiato and is defined by the Asopos river towards the south, the Helisson river towards the north, the east slopes of the plateau of Hellenistic Sikyon towards the west and the sea towards the east (Fig. 1). Several archaeological sites identified since the 1960s are located within the project area, such as Ayios Konstantinos, Ayios Nikolaos, Moulki, Syriona, Chtiri, Palaiochori, Dragatsoula and Merkouri (Fig. 1).<sup>2</sup>

In 2011 Yannis Lolos published his synthesizing study of Sikyonia in *Hesperia Supplements*, but systematic archaeological research in Sikyon has up to now focused mainly on the Hellenistic city. The American School of

Classical Studies excavated major parts of the theatre between 1896 and 1898, and during the 20<sup>th</sup> century excavations conducted by the Archaeological Society at Athens brought additional monumental structures to light, i.e. the temple, the gymnasium-palaistra, the long stoa and parts of the theatre's koilon.<sup>3</sup> From 2004 until 2008 a survey took place on the Hellenistic plateau under the cooperation of the Ephorate of Antiquities, the University of Thessaly, the Institute for Mediterranean Studies at Rethymnon and the University of York.<sup>4</sup>

The mission of the Archaeological Service in the area goes back to the 1960s, producing important knowledge for the topography of pre-Hellenistic Sikyon. During the emergency excavations for the suburban railway (2003-7) and the national highway Corinth-Patras (since 2008), residential structures, workshops, cemeteries and ancient roads have come to light.

<sup>2</sup> ΦΕΚ 282/Β/26.04.1969, ΥΑ 9309/18.04.1969.

<sup>3</sup> Brownson & Young 1893, Earle 1889a; 1889b; 1893; Fiechter 1931; Fossum 1905; Krystalli-Votsi 1984; 1988; 1991a; 1991b; McMurtry 1889; Orlandos 1933; 1934; 1935; 1936; 1937; 1938; 1939; 1940; 1947; 1952; 1954; 1955; 1956; Petrakos 1989; Philadelphus 1926.

<sup>4</sup> Lolos et al. 2007; 2012.

## Systematic Intensive Survey

The aim of the systematic intensive survey is to understand the settlement pattern in the plain of Kiato from a diachronic perspective. The survey area – approximately 8 square km – occupies the western part of the Vocho marine plain, which spreads from Corinth to Kiato and consists of three marine terraces with only minor altitude variations between them. The highest altitude of 121 m is found on the eastern slopes of the Hellenistic plateau. Generally, the landscape appears homogeneous except for the hills of Palaiochori and Tragana.

Apart from Asopos and Helisson, the two rivers constituting the southern and northern boundaries of the project's area, the landscape is highly hydrogenous due to many streams, as well as artificial channels for watering the fields. The northeast of the area is occupied by the town of Kiato and the northwest by the modern settlement of Moulki, with secondary settlements at Palaiochori and Tragana. The area is intensely cultivated, the crops consisting mainly of apricot trees, citrus trees and vineyards, as well as olive trees and vegetables.

Very few structures are recorded in situ on the surface in the area included in the permit, and recent as well as current emergency excavations at the railroad and the national highway have demonstrated that part of the survey area is covered with a layer of alluvial sedimentation up to 1.5 m thick. This sedimentation complicates the interpretation of the results of both the side-by-side and the geophysical survey. The remote sensing survey also documents the strong morphological forces at work in the survey area (see below).

The survey area was subdivided into zones according to existing toponyms: Ayios Konstantinos, Ayios Nikolaos, Kamaratiza, Moulki, Syriona, Merkouri, Chtiri, Zogeri, Dragatsoula, Palaiochori, Tragana-Dourvationa, Lakkos, Valtos and Ayios Ioannis (Fig. 1). Supported by local knowledge, natural and cultural features, such as changing elevations and roads, were used to define the boundaries of the zones. Initially, the ambition of the 2015 campaign was focused on the area immediately north of Asopos and east of the plateau of Hellenistic Sikyon, where the emergency excavations of the Archaeological Service and the Archaeological Society at Athens have

revealed the in situ remains of Classical habitation (Ayios Konstantinos, Kamaratiza and Syriona, see also below). However, due to the complications of the thick sedimentation and poor visibility in general we chose to prioritize survey units with high visibility within the entire survey area. Consequently, the survey results give a patchy image, but we have managed to sample all the zones during the first season.

## Methodology

The systematic intensive methodology and research strategy was adapted for the conditions in the Plain of Kiato by Kristina Winther-Jacobsen, based on experiences from *The Troodos Archaeological and Environmental Survey Project*, *The Dzarylgac Survey Project*, and the *Where East meets West* project.<sup>5</sup> Four teams carried out the fieldwork and the daily processing of the finds, supervised by Vasilis Oikonomou. Each team worked as an individual unit of four people supervised by a team leader.

Initially the aim was only to survey ploughed or harrowed fields with 75-100% visibility. However, visibility proved to be the great challenge, because more fields than expected were covered with thick vegetation. Visibility was recorded in ranges of 25%. Visibilities over 75% were recorded in 47% of the units surveyed.

Field boundaries were used to delimit the survey units, and the research area is characterized by fields of greatly varying sizes. In order to achieve sufficient spatial resolution the survey units were never larger than 60 x 50 m, but the majority of fields were much smaller. When fields were larger than 60 x 50 m, they were subdivided into multiple units. In fact, the mean size of the survey units is approximately 1165 m<sup>2</sup>. The 50 m limit was determined by the size of the team and the spacing of the field walkers (see below). When fields were shorter than 50 m, a smaller area was surveyed with fewer people, with 4 field walkers along a 40 m line and so on (Fig. 2).

Two approaches to the surveying were employed:

1. A fully quantitative method consisting of intensive survey with field walkers spaced at 10 m intervals.

<sup>5</sup> Given et al. 2013a–b; Bilde, Attema & Winther-Jacobsen 2012; Winther-Jacobsen 2015. See also Bekker-Nielsen & Winther-Jacobsen, this volume. Extensive literature on the issues of planning a survey is referred to in these studies.



Fig. 2. Archaeological surveying on the plain (Photo: Kristina Winther-Jacobsen).

According to this method, the field walkers cross the survey unit, collecting all finds larger than a thumbnail (a so-called total collection) in a 1 m transect line, thereby producing a quantitative sample from a 10% coverage of the total surface.

2. In areas of significantly high density of finds we employed a qualitative survey method, collecting diagnostic sherds over the entire surface after the systematic, intensive survey.

As an experiment we developed a new method for fields with poor visibility, which involved raking the 1 m transect lines. The raking produced conditions of 100% visibility, allowing us to collect all the finds from 10% of the surface. Of course the raking displaced the finds, but with two people working together, one could dedicate their attention exclusively to looking for finds. Although the data produced by this method are quantitative, we will treat them separately in the analysis.

Architectural fragments and remains of structures, as well as some unquantified ceramic assemblages, were recorded as *Places of Special Interest* with coordinates.

The finds were recorded according to the chronotypological system, which entails creating a hierarchical classification according to fabric, manufacture, surface treatment, function and period.<sup>6</sup> The advantage of the chronotypological system is that it facilitates the mapping of finds' densities quantitatively according to different periods. Chronotypes range from very precisely dated, well-researched types of pottery such as *Tableware*, *Bell-crater*, *Handle*, *Classical period*, which would be abbreviated TWBCH-Cl. At the opposite range are generic chronotypes consisting of finds lumped together based on observations of broader physical characteristics. Such chronotypes may be assigned to multiple periods, e.g. the *Mud stone group* (Msg-), defined by a characteristic inclusion. The *Mud stone group* is an endemic group and more research is required to date it and locate its exact prove-



**Fig. 3.** GIS map of the units surveyed and PO-SIs recorded in 2015 with the zones indicated.

nance, but based on morphology the fabric was probably used to produce pottery over an extended period of time.

The advantage of the chronotypological system is that function is at the heart of the classification system, and since we are mapping functions all finds are important.<sup>7</sup> No finds are discarded; all finds are analyzed and finally become part of the interpretation.

For spatial mapping of the finds' densities, the data are exported from the Access database to a Geographical Information System (GIS) in order to create spatially coherent density maps. For the density maps, total densities are extrapolated from the 10% coverage, then multiplied by 10 and divided by square metres. The project applies two ways of correcting for visibility: 1) maps with extrapolated visibilities, and 2) maps with uncorrected visibility, where units in which visibility should affect the densities are marked by a signature.

## Results

During the 2015 campaign we surveyed 578 survey units covering an area of 0.79 square km (Fig. 3). Distribution according to zones is as follows: 30 SU in Ayios Konstantinos, 29 SU in Ayios Nikolaos, 35 SU in Kamaratiza, 72 SU in Moulki, 32 SU in Syriona, 49 SU in Merkouri, 81 SU in Chtiri, 32 SU in Zogeri, 60 SU in Dragatsoula, 38 SU in Palaiochori, 31 SU in Tragana-Dourvationa, 43 SU in Lakkos, 35 SU in Valtos and 11 SU in Ayios Ioannis.

A total number of 52,326 pottery fragments and 17 lithics, as well as 85 architectural artefacts were collected, washed, counted and described; the most important specimens were drawn and photographed. A pottery inventory was created, consisting of 328 sherds after the first season. This inventory works as a reference collection of the chronotypes for future seasons.

All the data are entered into the database, but we have only made preliminary studies of the material, and a detailed study of chronology awaits the 2016 season. We may, however, present the following preliminary observations. First of all the surface revealed far richer traces of the buried past than we had dared to hope for, based on our knowledge of the geomorphology of the landscape of Sikyon. The finds date from the Late Neolithic/Early Bronze Age to the present day, but material from the Classical period is predominant.

The density map including the pottery of all the periods is characterized by a high degree of heterogeneity (Fig. 4). Even accounting for visibility, highly variable densities have been recorded in adjoining fields, which may be interpreted in two ways: either the settlement was not contiguous, or post-depositional disturbance has been highly heterogeneous. Densities over 1 per square metre were recorded in 23% of the units. The highest densities, 5 to 6.8 sherds per square metre, which is approximately equivalent to the second highest category in the urban survey on the Hellenistic plateau, where the plough zone is

<sup>7</sup> Winther-Jacobsen 2010, 67-70.



Fig. 4. GIS raw density map with the zones indicated.



Fig. 5. GIS density map corrected for visibility with the zones indicated.



Fig. 6. GIS raw density map of Ayios Konstantinos, Ayios Nikolaos and Kamaratiza.

relatively thin, were recorded in 3 units.<sup>8</sup> Due to the lack of continuity between the fields surveyed, we cannot at present say anything conclusive about the diffusion of finds, whether it represents a contiguous pattern or many separate settlements. All the zones investigated yielded finds, although numbers dropped as we moved north towards Moulki and east towards Kiato, where modern activity is also more intense. The slopes immediately east of the plateau yielded the highest densities as well as the largest and best preserved fragments, indicating that the buried structures from which the finds originate are well-preserved. Although this is an intensely farmed area, a few structures were even preserved in situ on the surface. In this area the finds date from the Bronze Age to the present day, but finds of the Classical period are ever predominant.

The preliminary overview of the entire survey area appears to confirm existing theories on the location of the pre-Hellenistic city, based on emergency excavations. Elevated densities are recorded predominantly on the second and third marine terraces directly north of Aso-pos. Towards the north this area includes Kamaratiza and Zogeri. The distribution within the area is not homogeneous, but densities of more than 1 sherd per square metre are very rare outside this area. Correcting for visibilities does flatten the data, but cannot explain the heterogeneity on its own (Fig. 5).<sup>9</sup> Apart from extending the areas of relatively higher densities in the individual zones, at this poor chronological resolution the corrected visibilities do not seem to affect the overall distribution pattern (see individual zones below). This is also the area where emergency excavations have revealed architectural remains of habitation. Additionally, graves seem to line up along the edge of the second marine terrace, which actually cuts directly through the area with elevated densities.

*Places Of Special Interest* (POSI) from 2015 consist of remains of seven structures in situ, 53 architectural fragments and some pottery assemblages (Fig. 3). Three wells/cisterns were identified at the edge of Ayios Konstantinos close together (see below). The other four structures are wall remains located at Ayios Konstantinos, Chtiri and Kamaratiza. The architectural fragments



Fig. 7. Well at Ayios Konstantinos (Photo: Kristina Winter-Jacobsen).

consist mainly of ashlar blocks, but capitals and bases of both the Doric and Ionic order were also recorded.

### *The individual zones*

Ayios Konstantinos is located on the southeastern slope of the Hellenistic plateau just below the rocky outcrop, with the earliest settlement remains of the area. From the current terrain it is obvious that the area consisted of multiple smaller terraces. As indicated above, Ayios Konstantinos is an area of high archaeological significance. Pottery densities were generally high and Classical period material made up a significant proportion of the recorded finds, and architecture has been found in as well as ex situ (Fig. 6). Three wells/cisterns were identified at the edge of Ayios Konstantinos close together (Fig. 7). In the same area several looters' pits revealed pottery, as well as fragments of polychrome pebble mosaics, though no architectural remains were observed. In this area, previous excavations revealed a pebble mosaic of the late 5<sup>th</sup>–early 4<sup>th</sup> century BC at a vineyard next to the chapel of Ayios Konstantinos, and Vassilios Papathanasiou of the Ephorate recorded the remains of a mosaic during works for establishing a pipeline close by.<sup>10</sup> Finds densities

<sup>8</sup> Lolos et al. 2007, 282, fig. 5. The highest was 7–12 sherds per square metre.

<sup>9</sup> The necessary discussion of the methodology of correcting for visibility and its potential is too complex for this report.

<sup>10</sup> Orlandos 1939, 122–3; Papathanasiou personal comment. For other mosaics' fragments deriving from the plain without further specification of the exact find spot, see Orlandos 1936, 83; Orlandos 1937, 94; Orlandos 1947, 59–60.



Fig. 8. Southeast view of Kamaratiza towards the Asopos from the Plateau (Photo: Kristina Winther-Jacobsen).

are high at Ayios Konstantinos, and there appears to be a general correlation between high finds densities and increased numbers of architectural fragments in several zones. Corrected densities seem to homogenize or flatten the distribution pattern.

Ayios Nikolaos is a more homogeneous landscape, apart from the northwestern corner, where it slopes upwards towards the Hellenistic plateau. At the church of Ayios Nikolaos several spolia have been collected over the last few years by the Archaeological Service, but their precise original contexts are unknown. In general, densities at Ayios Nikolaos are more homogeneous and the proportion of post-Classical material is higher compared to Ayios Konstantinos. The corrected visibilities extend the area of relatively high densities. There are no recorded excavations at Ayios Nikolaos.

Kamaratiza is located on the eastern slope of the Hellenistic plateau and like Ayios Konstantinos consists of multiple smaller terraces (Fig. 8). The area is charac-

terized by high densities in general and there is a strong correlation between the high densities and architectural fragments, many of which derive from the Hellenistic city wall. The corrected visibilities extend the area of relatively high densities. The pre-Hellenistic element appears not to be as significant among the finds in this area. In 2007 and 2009 the Ephorate conducted an excavation of a Roman road leading to the Hellenistic plateau under the direction of Athanasios Tsiogas. Burials of the same period and a cistern were found at the sides of the road.<sup>11</sup>

Moulki consists of two geological zones, a homogeneous plateau below the Hellenistic plateau and a lower flood plain along the southern bank of Helisson River. The visibility on the flood plain was generally too low to survey, while access to the higher plateau was restricted by the modern settlement of Moulki. Due to these restrictions the interpretation of the observed data is less secure, but if observed tendencies are to be believed, finds appeared to be dating mainly to post-Classical or even post-Antique



Fig. 9. Southeast view of the lowest marine terrace from Palaiochori (Photo: Giorgos Giannakopoulos).

times. During emergency excavations, the Archaeological Service recorded a water pipe, a small quarry and fragmentary structures, as well as a Late Archaic to Hellenistic roadside necropolis at the location of the tollbooth.<sup>12</sup> Several burials of the 4<sup>th</sup> and 3<sup>rd</sup> centuries BC, pits opened in the smooth bedrock, have been excavated on the slope of plateau west of Moulki, in the area called Gkraves.<sup>13</sup> Additionally, on the southwestern border of Moulki in the Karampetsos vineyard an old emergency excavation brought to light another pebble mosaic, dated to c. 400 BC.<sup>14</sup>

Syriona cuts across the second and third marine terraces but generally the landscape is homogeneous, apart from the strip of fields adjacent to the north bank of Asopos. The old and the recent National Highway emergency excavations have brought to light a complex of domestic remains, often with mosaics, workshops and technical works as well as graves, which span from the Early Geometric to the Classical period.<sup>15</sup> The surface finds, however, appear less promising. This is probably due to the 1.50 m-thick layer of sedimentation covering

the structures recorded by the emergency excavations.

Merkouri is located on the second marine terrace. The highest densities are mainly associated with areas previously excavated by the Archaeological Service, e.g. in the Kollias, Protopappas and Kostouros plots, which brought to light a pebble mosaic of the 5<sup>th</sup> century BC and other fragmentary structures potentially interpreted as private houses and workshops.<sup>16</sup> One survey unit in the southern part proved particularly interesting. The topsoil has been recently removed mechanically, and the highest density in the zone was recorded in this field, clearly indicating that the thickness of sedimentation is a significant factor which needs to be explored. The preliminary study of the assemblages suggests that tablewares and cooking wares make up a significant proportion.

Chtiri cuts across the second to third marine terrace and is dominated by middle-range densities. In general, assemblages from Chtiri are more heterogeneous. Zogeri is located on the third marine terrace, but generally finds are very similar to those at Chtiri. In Chtiri and Zogeri

12 Papathanasiou, personal communication.

13 Orlandos 1933, 75-6; Orlandos 1937, 91; Kasimi 2004, 138; Papathanasiou & Maragoudaki 2013, 128.

14 Orlandos 1947, 59; Lolos 2011, 273-4.

15 Charitonidis 1968, 124; Papathanasiou & Maragoudaki 2013, 116, 127.

16 Krystalli 1968, 165-6; Krystalli Votsi 1976; Papathanasiou 2012, 152-4.



Fig. 10. Geomagnetic survey in summer 2015 (Photo: Rune Frederiksen).

an extended necropolis dating from the Late Archaic to the Roman period has been excavated by the Archaeological Service.<sup>17</sup> Nonetheless, in both zones emergency excavations have revealed structures or even complexes of multiple structures of the Classical or Early Hellenistic period, preliminarily interpreted as private houses and workshops.<sup>18</sup>

Dragatsoula and Palaiochori are located on the second and third marine terraces. Both zones, as well as the settlement patterns, are dependent on the change in level. Generally assemblages are heterogeneous and densities in the middle to low range. The general drop-off in densities as we move from west to east is first clearly observable in this area. At Dragatsoula, Vassilios Papathanasiou excavated a quarry of oolitic limestone, while Late Helladic and Classical necropoleis have been excavated at Palaiochori.<sup>19</sup>

Tragana-Dourvationa is located on the second marine terrace and access is restricted by the modern homonymous settlement. Generally, assemblages are heterogeneous and densities are in the low range.



Fig. 11. Parallel resistivity and seismic measurements in summer 2015 (Photo: Wolfgang Rabbel).

<sup>17</sup> Krystalli 1968, 164-5; Krystalli Votsi 1984, 65; Krystalli Votsi 2013; Balla 2013; Papathanasiou – Maragoudaki 2013, 128.

<sup>18</sup> Archive of the Ephorate of Corinth. Emergency excavations at Zarkotos, Papakyriakos and Kampardi plots.

<sup>19</sup> For the quarry, see Papathanasiou 2012, 155; Papathanasiou – Maragoudaki 2013, 125. For the necropoleis, see Orlandos 1937, 92-4; Papathanasiou 2012, 154-6; Papathanasiou 2013; Papathanasiou & Maragoudaki 2013, 127; Anagnostopoulou & Kasimi 2014, 474-6.



Fig. 12. Radar measurements in summer 2015 (Photo: Rune Frederiksen).

Lakkos, Valtos and Ayios Ioannis are located on the lowest marine terrace, which is dominated by the modern settlement of Kiato (Fig. 9). In this area the drop-off in densities is remarkable, with many survey units without any recorded finds. The exception is one survey unit at Valtos that has a very high density of finds. Trial trenches that produced no finds were dug in a field less than 50 m to the west, suggesting that the high density of the survey unit is an isolated phenomenon, possibly a farmstead. The proportion of cooking wares appears to be significant and in terms of chronology the Roman element is noteworthy. The area east of Lakkos, in the town of Kiato, is hypothetically a strong candidate for the ancient harbour area. The hypothesis is mostly based on the large Basilica of the 5<sup>th</sup> century AD and the adjacent Magoula hill, where three graves of uncertain date have been excavated by the Archaeological Service.<sup>20</sup>

## Geophysical Prospection

### *Aim and methods*

The main objective of the geophysical survey was to discover remains (e.g. building structures, streets, open

spaces, etc.) of the pre-Hellenistic city of Sikyon. The primary method of the survey was extensive geomagnetic mapping (Fig. 10). In areas where the magnetic survey showed significant anomalies, electrical resistivity, georadar and seismic measurements were applied to gain more insight into the nature of these anomalies (Figs 11-12).

Geomagnetic surveying is one of the classical geophysical methods used in archaeological prospection because it enables mapping of large areas very quickly, depending on local conditions. For magnetic surveys the contrast in magnetization between the cultural elements (e.g. remains of walls, streets or tombs) and the surrounding material is important. In case of a low contrast, objects might not be detectable at greater depth. Another factor regarding the penetration depth is the size of the object: the larger the object, the greater the penetration.

Geoelectric surveying is one of a number of geophysical investigation methods which are able to deliver more detailed information than the magnetic data. The geoelectric method measures the specific electric resistivity of the subsurface, which is affected mainly by porosity, water saturation and clay content of the soil.

Georadar (GPR) is – conditions providing – like the magnetic method very suitable for answering archaeolo-

<sup>20</sup> For the Basilica, see Orlandos 1934; Orlandos 1957.



Fig. 13. General map of geophysical prospections in Old Sikyon, 2015.

gical questions due to its excellent vertical resolution. A short high-frequency electromagnetic pulse is sent into the subsurface and all its reflections are recorded over a certain time (comparable to reflection seismics).

In the seismic survey, mechanical (seismic) waves are used to explore the underground. For near-surface applications, waves are produced with a sledgehammer or a vibration device ('shot'). Geophones positioned

along a profile record the amplitude and return time of the seismic waves. In general, differentiation is made between reflection and refraction seismics, which differ in the configurations of shot points and geophones.

For topographical positioning, a local coordinate system was set up, which was later used by both teams for the stationing of their respective differential GPS base stations.

*Results (Fig. 13)*

In Syriona, a flat area next to the rescue excavations was used to test the different geophysical methods (Fig. 14). The advantage of using this location for the tests was that the depth of the cultural layer and the size of the expected buildings were known. In the magnetic map, the tests showed nothing but dark patches that coincided with the geoelectric anomalies. The geoelectric results showed a zone of higher resistivity values in a depth corresponding with the cultural layer (1.5-2 m). Due to the depth of 2 m, the resolution was not as clear as if the houses were lying within the first metre under the surface. It is important to mention, however, that the orientations of the anomalies did match the direction of the known house walls.

The whole survey area was subdivided into smaller areas (Areas A–H), and only find spots of potential importance will be reported on. In Area A, which is located at Zogeri and Chtiri, the most prominent anomaly is a cross-like structure (A<sub>1</sub>, Zogeri; see Fig. 15), and the most

obvious interpretation of this would be a crossroad. An alternative interpretation is, however, possible: the anomaly may be caused by a mud-brick wall. A geoelectric profile on the spot should be able to resolve this ambiguity, and rule out one of these two most likely options. South and southwest of this area, more anomalies point to a street grid in approximately the same orientation.

In the eastern part of Area B (Chtiri), a broad double magnetic maximum (B<sub>2</sub>) more than 150 m in length with high amplitudes runs slightly off this orientation from the northwest to the southeast, and merges into one in its further progress, while the area around appears rather quiet in the magnetic map (Fig. 16). Here, an electric profile was measured, which shows a 3 m-wide and 1.5 m-high block of high resistivity in a depth of c. 1.5 m. Perhaps it can be connected to a wall, but further methods need to be applied here to arrive at a correct interpretation. South of this, the magnetic map is characterized by a disrupted pattern of a rather rectangular orientation, which could point to a former building development in this area.

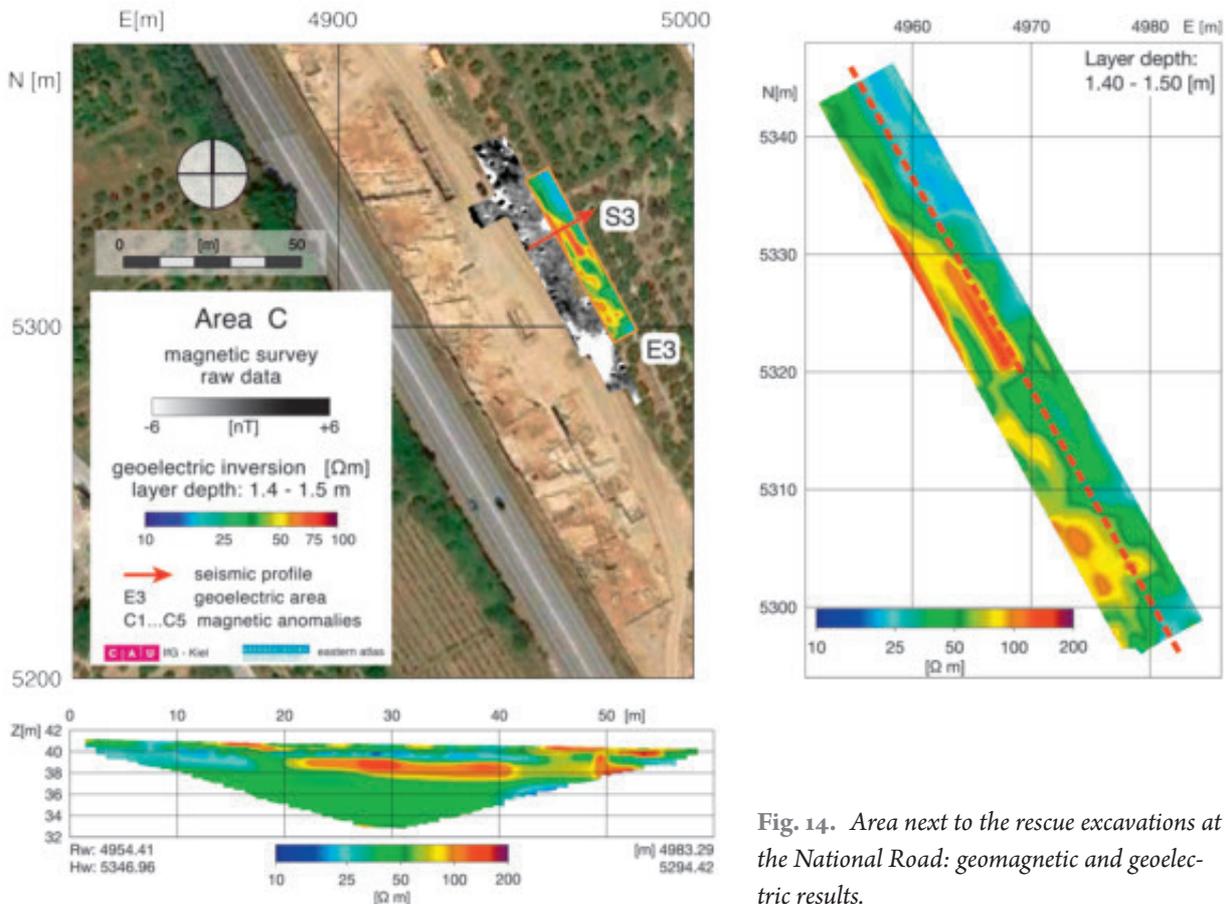


Fig. 14. Area next to the rescue excavations at the National Road: geomagnetic and geoelectric results.



Fig. 15. Possible crossroads (A1) in geomagnetic results in Zogeri.

Indications for the densest occupation are found in Area E, located in the zone of Ayios Konstantinos immediately to the east of the southernmost spur of the plateau. Here, the magnetic map shows many small-scale magnetic anomalies. In comparison to other areas, these small-scale anomalies do not appear to be caused by metal on the surface, but might be indicators of an ancient surface. Several continuous linear structures may be interpreted as streets that form a roughly rectangular pattern. Additional geoelectric investigation applied in the same area (E5) was able to detect two parallel high-resistivity lineaments which can be interpreted as walls (Fig. 17). Moreover, a narrow zone with a thickness of about 1 m and resistivities of 100 to 200  $\Omega\text{m}$  in a depth of 0.5 to 1 m could indicate the depth of the cultural layer in this area. In combination with the adjacent walls, it might also be the floor of a large building.

In the very south of Area F (F3, Dragatsoula), where it overlaps with Area G, there is a trapezoidal anomaly that is interesting due to the arrangement of maximum and minimum with the maximum always on the inside and the minimum always on the outside (see Fig. 13). This structure on the edge of the second marine terrace, close

to the new train track, might be connected to an ancient quarry, traces of which have been found nearby.

In the western part of Area H (Merkouri), a magnetic maximum between two minima runs for around 140 m roughly in an east–west direction (H2, see Fig. 18). At a little bend to the north, the northern minimum separates from the other two anomalies. A geoelectric profile (E4) is marked by a block of very high resistivity (over 250  $\Omega\text{m}$ ) at the place of the magnetic maximum (Fig. 19). A seismic profile (S4) likewise shows an anomaly, which has the shape of a ditch. The interpretation of these structures, however, still requires more detailed investigation. It is not clear if these combined anomalies can be connected with a defensive system.

The general picture points to a city centre close to the southeastern spur of the plateau, with extensions or suburbs and further peripheral structures in the extended area of the second marine terrace. There are some candidates for larger walls, which might mirror parts of the town's defenses in its different phases.

### Remote Sensing Archaeology in Sikyon

For the summer of 2015, attention focused on a zone slightly less than 1 square km immediately below the eastern plateau of the Hellenistic city (Fig. 4). Results were based on a high-resolution multispectral (4-band) WorldView-2 image from 11 April 2014, as well as four historical aerial photographs (1945, 1960, 1972, 1987) and an ASTER GDEM 2 for digital elevations.

The analysis shows that the landscape within and around the target has been altered by anthropogenic and environmental factors since the middle of the 20<sup>th</sup> century. One obvious and remarkable element is the change of crops in the 1960s. In 1945, fields are mostly void of trees and orchards, while by the 1960s, orchards predominate, and by the 1970s the area was densely filled with trees, as we know it today. The courses of small rivers and seasonal streams were more evident in 1945 than they are now. Branches of the Asopos River appear to have impacted the southern and southeastern area of the target zone more than is the case today.

Remote sensing identified a large number of surface anomalies in the target zone that likely relate to palaeochannels. This was to be expected, since the area is still quite hydrologically active. As such, there is an increased

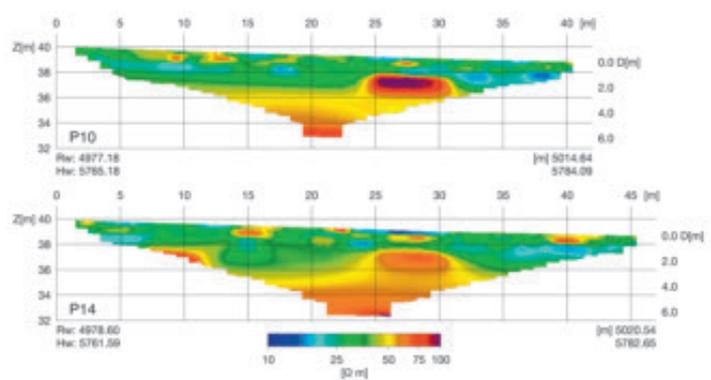
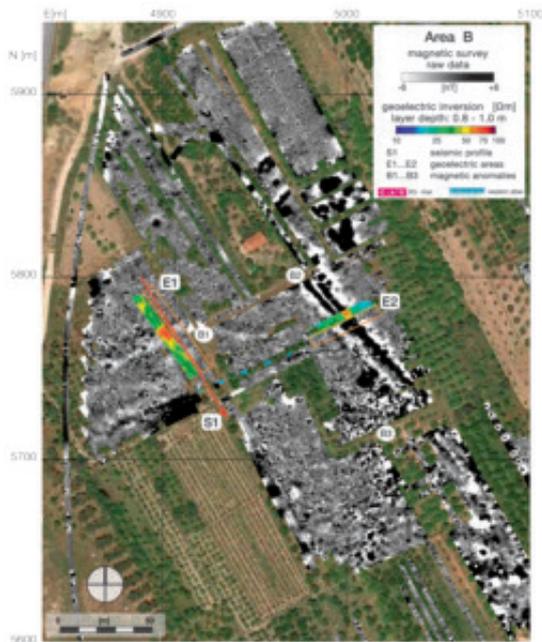


Fig. 16. Long double magnetic maximum (B2) and geoelectric profile (E2) in Chtiri.

likelihood of soil erosion and/or alluvial sedimentation, which can often affect the preservation of subsurface features of archaeological interest and the ability of remote sensing and geophysical methods to identify them.

Very few anomalies in the target appear to be from features other than palaeochannels (Fig. 20), which may be explained by the density of trees and orchards that limit the identification of surface anomalies using satellite

and aerial remote sensing methodologies. To overcome this issue, the project aims to apply LiDAR (Light Detection and Ranging) in the future, since it can identify surface details regardless of vegetation and tree growth. One rectilinear anomaly (c. 70 x 25 m) in Chtiri was identified in the 1945 aerial photograph, but for most of its parts, this unfortunately now lies under the new National Road (Fig. 21). A roughly circular anomaly of c. 20 m in

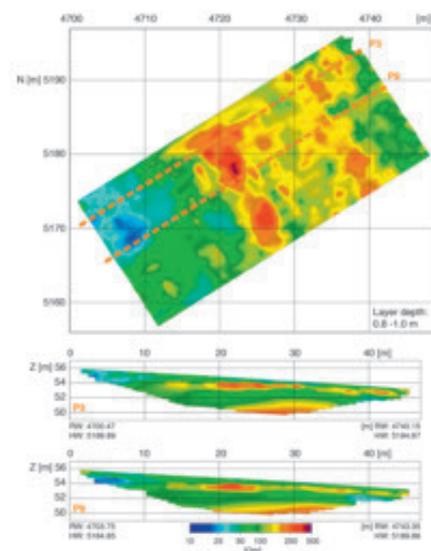
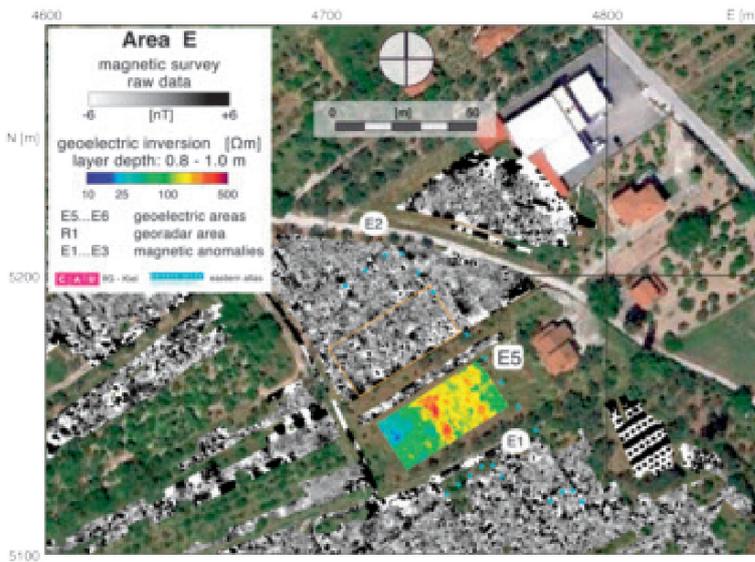


Fig. 17. Geoelectric depth slice and depth profiles (E5) of possible parallel walls in Agios Konstantinos.



Fig. 18. Long magnetic maximum between two minima (H<sub>2</sub>) in Merkouri.

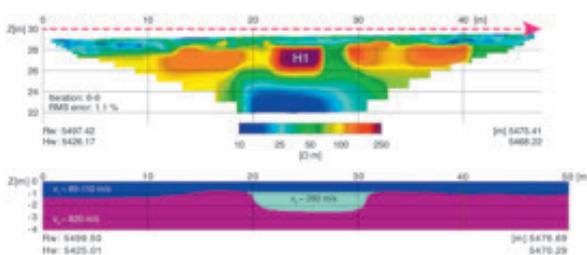


Fig. 19. Geoelectric depth profile E<sub>4</sub> and underground model of seismic velocities (S<sub>4</sub>) at the magnetic maximum (H<sub>2</sub>) in Merkouri.

diameter was noted in Ayios Nikolaos and needs to be further explored by geophysical prospection.

The coastal plain of Vochoa has long been recognized as a region where Roman centuriation still persists in the morphology of modern field boundaries. Two systems have so far been identified: one related to the Roman colony of Corinth founded by Caesar, and another related to a second wave of colonization during the Flavian period.<sup>21</sup> It is notable in this context that field boundaries were vir-

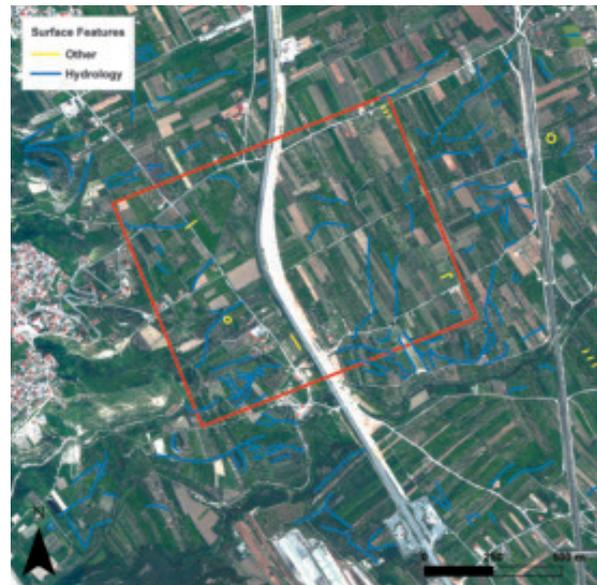
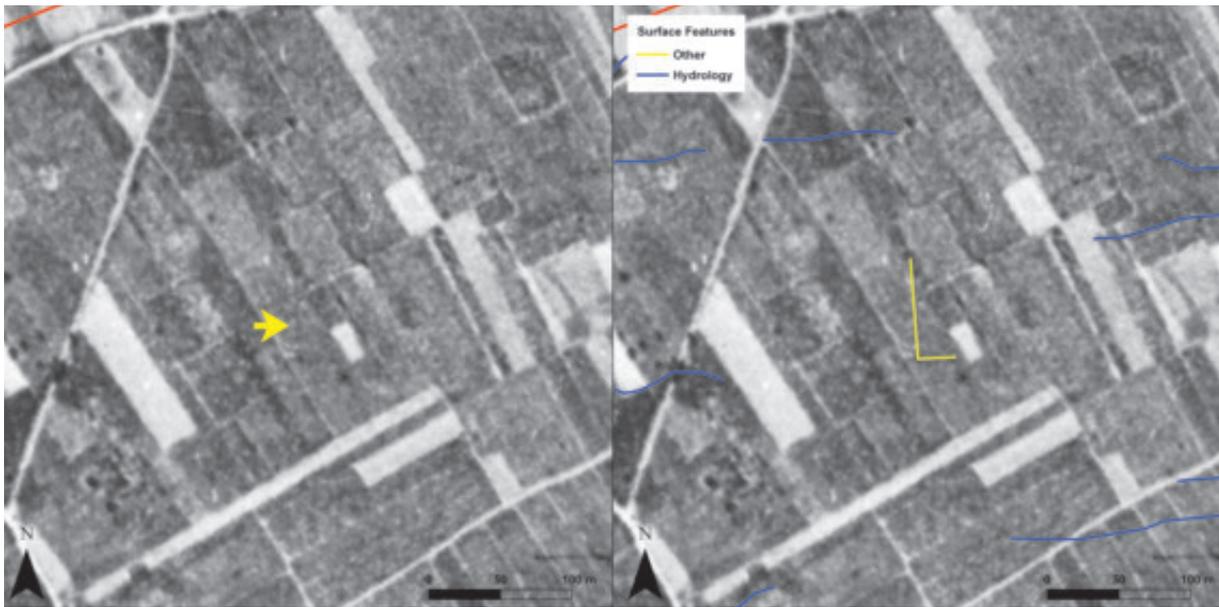


Fig. 20. Surface anomalies (mostly palaeochannels) identified from the WorldView-2 satellite image and its feature enhancement indices.

tually unchanged between the 1945 aerial photograph and the 2014 WorldView-2 satellite image. Internal divisions of some fields have been altered, but by and large the same boundaries have been retained since 1945. An analysis of the alignments of modern field boundaries in a 2 km<sup>2</sup> area around the target shows that a great majority of them cluster in narrow ranges with southwest–northeast orientations. The broader characteristics of field boundary alignments in the Sikyonian coastal plain and the possible relationship to Roman centuriation and/or an earlier Greek system of land division need to be explored more extensively in the future.

## Conclusions

Combining the preliminary surface observations and the knowledge from previous emergency excavations, there can be little doubt that the western part of Old Sikyon occupied the east slopes of the Vasiliko plateau. The Asopos River makes up the southern boundary, and the northern and eastern boundaries we hope to be able to locate more precisely in 2016.



**Fig. 21.** Rectilinear surface anomaly identified from the 1945 aerial photograph, now for most parts lying under the National Road.

This is also supported by the geophysical investigations. After the prospection in 2015, much work still remains to be done in order to complement the obtained data. Especially in the areas where we have gained information about the subsurface with the geomagnetic method, electric and seismic profiles have to be produced. The geoelectric and the magnetic data have to be combined, so that ideally a model can be created that fits all datasets. Moreover, extended geophysical investigation in fields not yet measured in 2015 will supply further information. This will include, for example, the investigation of the presumed harbour area of the town.

Remote sensing in the target area entails different qualities of results. The fact that few subsurface features of possible archaeological value were identified with the above datasets does not necessarily mean that features will not be found with other methods, or even other datasets from different extraction dates. On the other hand, an interesting outcome of remote sensing was the reconstruction of the palaeoenvironment within and around the target. At some point in the past, since Antiquity, the region was heavily impacted by rivers and streams. Soil erosion and soil accumulation, and their likely influence on the preservation of any potential archaeological features, are important considerations for future site exploration and interpretation.

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## Bibliography

- Anagnostopoulou, A. M. & P. Kasimi 2014**  
 'Νομός Κορινθίας', *ArchDelt* 61 B' 1 (2006), 474-6.
- Balla, F. 2013**  
 'Αρχαία Σικυώνα: Η Αποκάλυψη Τμήματος Νεκροταφείου Ελληνιστικής Εποχής', in *Athenaia* 4, *The Corinthia and the Northeast Peloponnese, Topography and History from Prehistoric Times until the End of Antiquity*, K. Kissas & W.-D. Niemeier (eds), Munich, 491-508.
- Bilde, P. Guldager, P. Attema & K. Winther-Jacobsen (eds) 2012**  
*The Dzarylgac Survey Project* (Black Sea Studies 14), Aarhus.
- Brownson, C. & C. H. Young 1893**  
 'Further Excavation at the Theatre of Sicyon in 1891', *The American Journal of Archaeology and the History of the Fine Arts* 8:3, 397-409.
- Charitonidis, S. 1968**  
 'Κορινθία', *ArchDelt* 21 B' 1 (1966), 124.
- Earle, M. L. 1889a**  
 'Excavations by the American School at the Theatre of Sicyon II. Supplementary Report of the Excavations', *The American Journal of Archaeology and of the History of the Fine Arts* 5:3, 286-92.
- Earle, M. L. 1889b**  
 'Excavations by the American School at the Theatre of Sicyon III. A Sikyonian Statue', *The American Journal of Archaeology and of the History of the Fine Arts* 5:3, 292-303.
- Earle, M. L. 1893**  
 'Further Excavation at the Theatre of Sicyon in 1891', *The American Journal of Archaeology and the History of the Fine Arts* 8:3, 388-96.
- Fiechter, W. 1931**  
*Das Theater in Sikyon*, Stuttgart.
- Fossum, A. 1905**  
 'The Theatre at Sikyon', *AJA* 9, 263-76.
- Given, M., A. B. Knapp, J. S. Noller, L. Sollars & V. Kassianidou (eds) 2013a**  
*Landscape and interaction: the Troodos Archaeological and Environmental Survey Project, Cyprus 1, Methodology, analysis and interpretation* (Levant Supplementary Series. London: Council for British Research in the Levant), Oxford.
- Given, M., A. B. Knapp, L. Sollars, J. S. Noller & V. Kassianidou (eds) 2013b**  
*Landscape and interaction: the Troodos Archaeological and Environmental Survey Project, Cyprus 2, The TAESP landscape* (Levant Supplementary Series. London: Council for British Research in the Levant), Oxford.
- Kasimi, P. 2004**  
 'Νομός Κορινθίας', *ArchDelt* 53 B' 1 (1998), 138.
- Krystalli, K. 1968**  
 'Κορινθία', *ArchDelt* 22 B' 1 (1967), 164-6, pls 124α-β.
- Krystalli-Votsi, K. 1976**  
 'Nouvelle Mosaique de Sicyone', *BCH* 100:2, 575-88.
- Krystalli-Votsi, K. 1984**  
 'Νομός Κορινθίας', *ArchDelt* 31 B' 1 (1976), 65, pls 58α-δ.
- Krystalli-Votsi, K. 1988**  
 'Ανασκαφή Σικυώνος', *Prakt* 1984, 241-2.
- Krystalli-Votsi, K. 1991a**  
 'Ανασκαφή Σικυώνος', *Prakt* 1987, 66-8.
- Krystalli-Votsi, K. 1991b**  
 'Ανασκαφή Σικυώνος', *Prakt* 1988, 30-1.
- Krystalli-Votsi, K. 2013**  
 'Πυρά Ταφικού Μνημείου από τη Σικυώνα', in *Athenaia* 4, *The Corinthia and the Northeast Peloponnese, Topography and History from Prehistoric Times until the End of Antiquity*, K. Kissas & W.-D. Niemeier (eds), Munich, 509-18.
- Lolos, Y. 2011**  
*Land of Sikyon: archaeology and history of a Greek city-state* (Hesperia supplement 39), Princeton.
- Lolos, Y. A., B. Gourley & D. R. Stewart 2007**  
 'The Sikyon Survey Project: A Blueprint for Urban Survey?', *JMA* 20, 267-96.
- Lolos, Y. A., B. Gourley, A. Sarris, C. Hayward, C. Trainor, E. Kiriantzi & N. Papadopoulos 2012**  
 'Surveying the Sikyonian plateau: integrated approach to the study of an ancient cityscape', *Proceedings of the 5th Congress of the Greek Archaeometric Society*, Athens, 305-26.
- McMurtry, W. J. 1889**  
 'Excavations by the American School at the Theatre of Sicyon I. General Re-

port of the Excavations', *The American Journal of Archaeology and of the History of the Fine Arts* 5:3, 267-86.

**Orlandos, A. 1933**  
'Ανασκαφή Σικυώνος', *Prakt* 1932, 63-76.

**Orlandos, A. 1934**  
'Ανασκαφή Σικυώνος', *Prakt* 1933, 81-90.

**Orlandos, A. 1935**  
'Ανασκαφή Σικυώνος', *Prakt* 1934, 116-22.

**Orlandos, A. 1936**  
'Ανασκαφή Σικυώνος', *Prakt* 1935, 73-83.

**Orlandos, A. 1937**  
'Ανασκαφή Σικυώνος', *Prakt* 1936, 86-94.

**Orlandos, A. 1938**  
'Ανασκαφή Σικυώνος του 1937', *Prakt* 1937, 94-6.

**Orlandos, A. 1939**  
'Ανασκαφαί Σικυώνος', *Prakt* 1938, 120-3.

**Orlandos, A. 1940**  
'Ανασκαφαί Σικυώνος', *Prakt* 1939, 100-2.

**Orlandos, A. 1947**  
'Ανασκαφαί Σικυώνος 1941', *Prakt* 1941, 56-60.

**Orlandos, A. 1952**  
'Ανασκαφή Σικυώνος', *Prakt* 1951, 187-91.

**Orlandos, A. 1955**  
'Ανασκαφή Σικυώνος', *Prakt* 1952, 387-95.

**Orlandos, A. 1956**  
'Ανασκαφή Σικυώνος', *Prakt* 1953, 184-90.

**Orlandos, A. 1957**  
'Ανασκαφή Σικυώνος', *Prakt* 1954, 219-31.

**Papathanasiou, V. 2012**  
'Νομός Κορινθίας', *ArchDelt* 56-59 B' 4 (2001-4), 152-6.

**Papathanasiou, V. 2013**  
'Μυκηναϊκό και Κλασικό Νεκροταφείο στην Αρχαία Σικυώνα', in *Athenaia* 4, *The Corinthia and the Northeast Peloponnese, Topography and History from Prehistoric Times until the End of Antiquity*, K. Kissas & W.-D. Niemeier (eds), Munich, 479-89.

**Papathanasiou, V. & E. Maragoudaki 2013**  
'Sikyon', in *Ancient Corinthia*, K. Kissas (ed.), Athens, 113-29.

**Philadelphus, A. 1926**  
'Note sur le Bouleuterion (?) de Sicyone', *BCH* 50, 174-82.

**Romano, D. G. 2003**  
'City Planning, Centuriation and Land Division in Roman Corinth: Colonia Laus Iulia Corinthiensis and Colonia Iulia Flavia Augusta Corinthiensis', in *Corinth* 20, *The Centenary, 1896-1996*, C. K. Williams & N. Bookidis (eds), Princeton, 279-301.

**Tsiogas, A. 2013**  
'Ανασκαφική Έρευνα σε Οικόπεδο στη Θέση Καμαράτιζα Αρχαίας Σικυώνας', in *Athenaia* 4, *The Corinthia and the Northeast Peloponnese, Topography and History from Prehistoric Times until the End of Antiquity*, K. Kissas & W.-D. Niemeier (eds), Munich, 519-24.

**Winther-Jacobsen, K. 2010**  
*From Pots to People: A ceramic approach to the archaeological interpretation of ploughsoil assemblages in Late Roman Cyprus* (BABESCH Supplement 17), Leuven.

**Winther-Jacobsen, K. 2015**  
'Contextualising Neoklaudiopolis: a glimpse at settlement dynamics in the city's hinterland', in *Landscape and settlement dynamics in Northern Anatolia in the Roman and Byzantine period* (Geographica Historica 32), K. Winther-Jacobsen & L. Summerer (eds), Stuttgart, 83-100.