NETWORK ANALYSIS IN ARCHAEOLOGY

THEORY, PRACTICE, AND APPLICATIONS

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Structure

- Network Thinking in History and Archaeology
- Example based on the Eastern Mediterranean Economic Networks from the late 11th to the mid-14th century using as case study the material from the Peloponnese

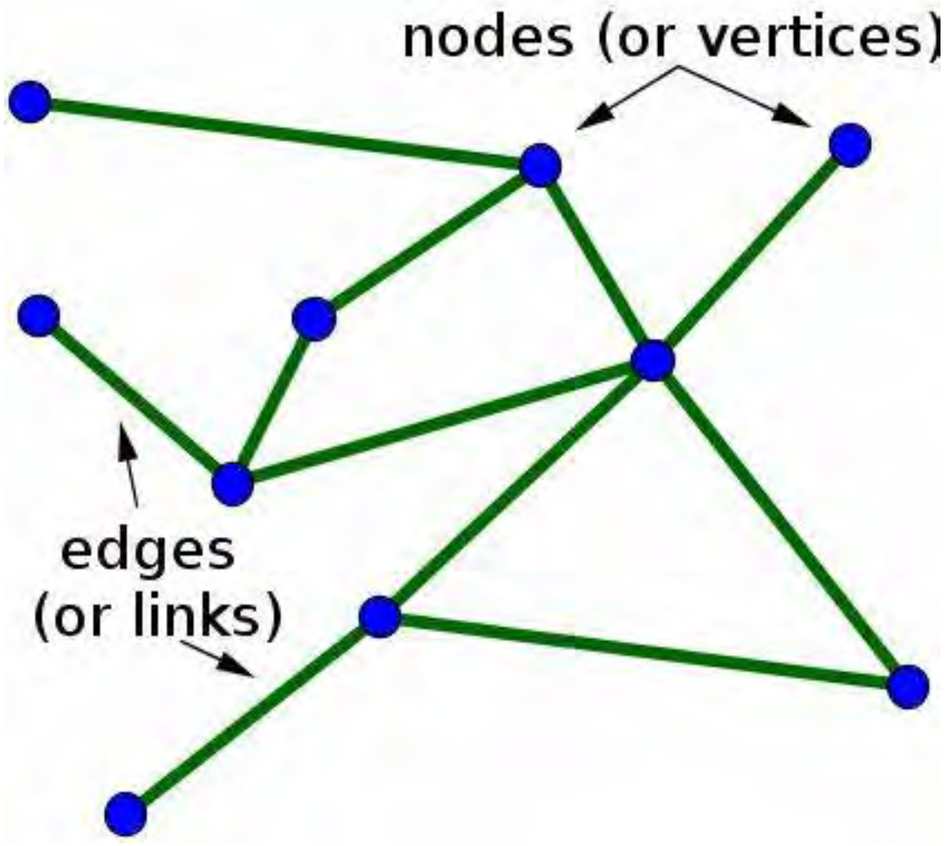
I. Network Thinking in History and Archaeology

- How can we define Networks??

I. Network Thinking in History and Archaeology

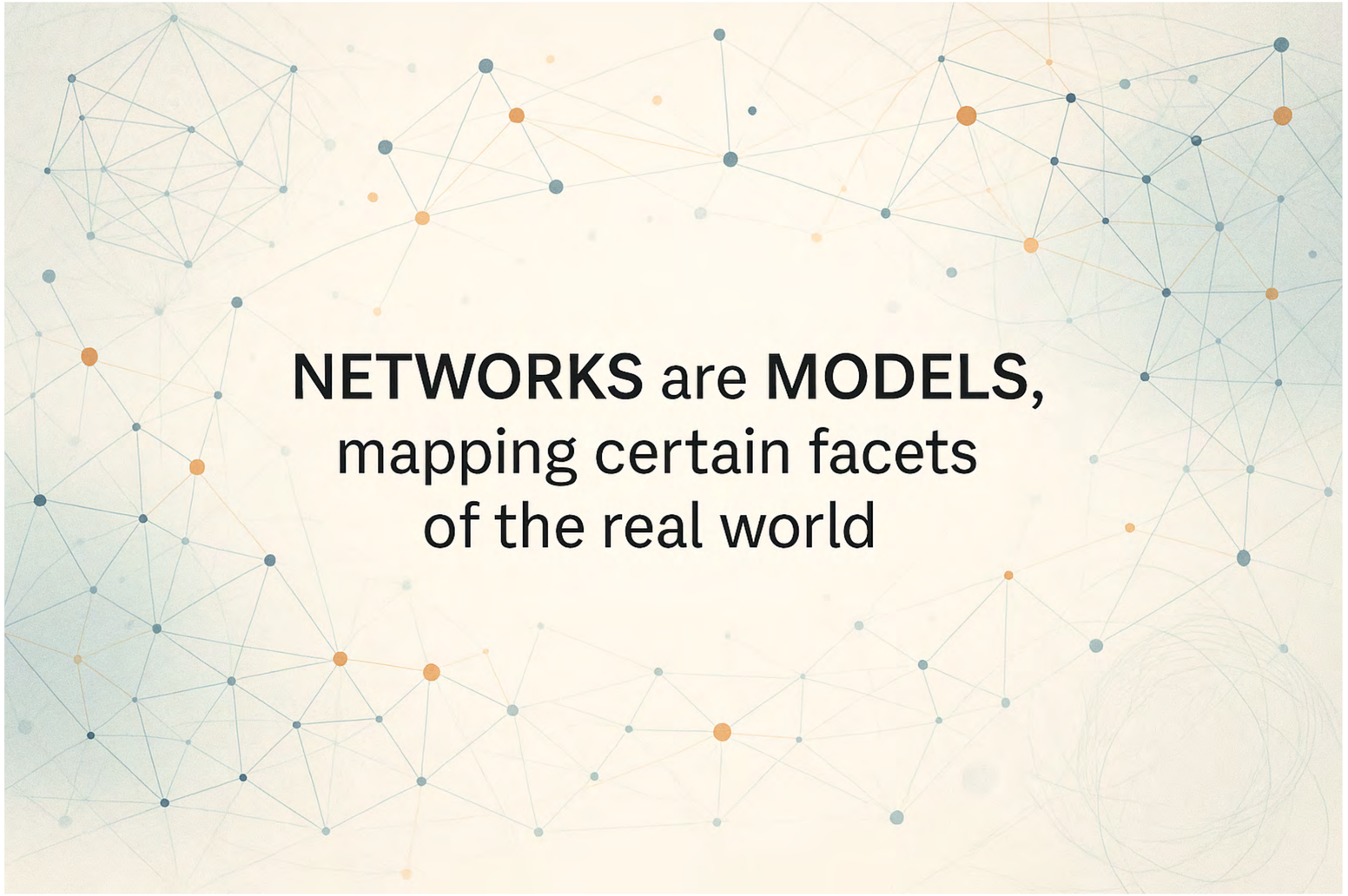
How can we define Networks??

- Networks provide the tools to map and measure **INTERACTION**, relationships and flows between people, groups, settlements and, in general, entities and data that can be connected in some way. These relationships are portrayed through a collection of nodes/vertices and the links/edges between them.



I. Network Thinking in History and Archaeology

How can we define Networks??



The concept of interaction

The concept of interaction can be used to analyse nearly all kinds of human behaviour.

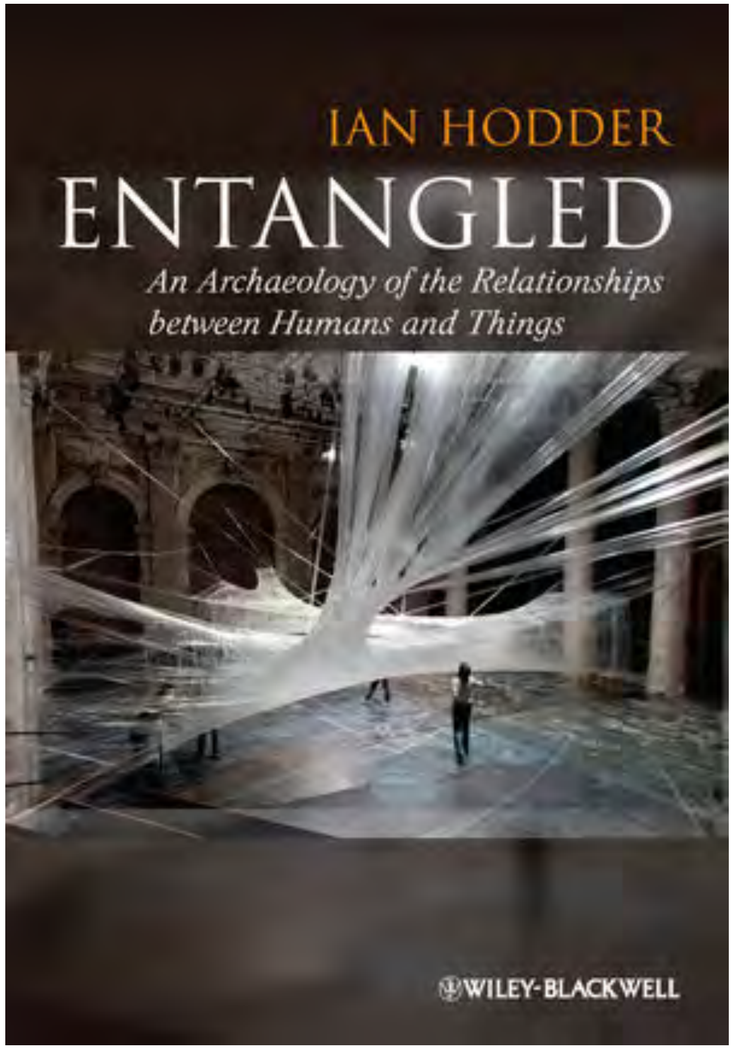
Interacting Partners:

- Individual interaction
- Interaction in groups
- Interaction between groups

1. Humans -things relationships

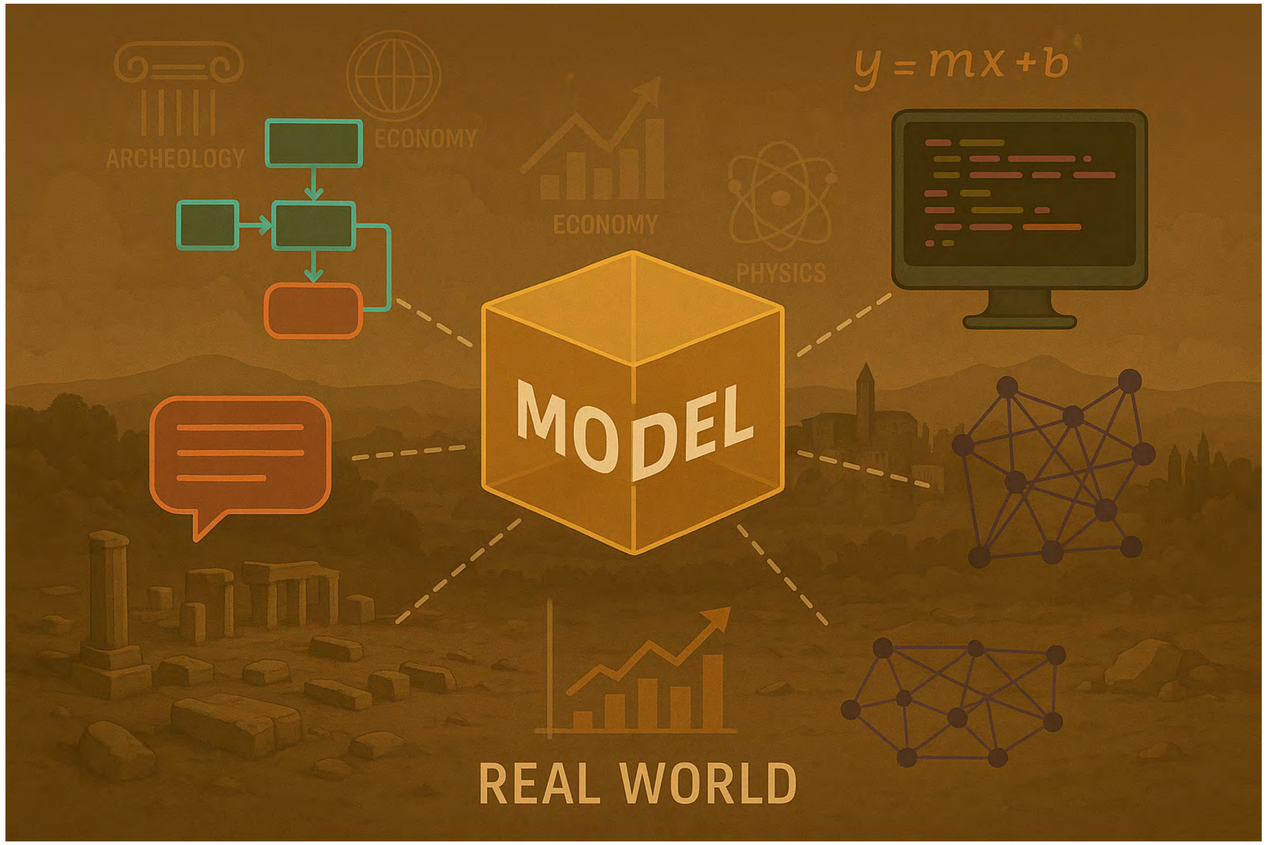
Entanglement Theory

- “Humans depend on things”
- “Things depend on humans”
- “Things depend on other things”
- “Humans depend on humans”



The concept of model

- The term model is a recurrent tool in archaeology, history, geography, economy, physics and every aspect of science over a broad spectrum. Moreover, a model can be presented in many forms, dimensions and modes and it can be described using a graph, or as a verbally simplified version of a theory and its assumptions. Although models are used to gain a better understanding of real world systems by stimulating hypothetical scenarios in order to interpret or foresee specific events and data, they are mere perspectives of the reality and not the actual world.



The concept of model

- There are two types of model: the theoretical and empirical. The theoretical model is shaped upon a concept and a theory and can be associated with deductive reasoning. The usage of this model presents what would have been ideal and not what is actually happening. The empirical model, on the other hand, can be associated with inductive reasoning and pictures observations which help to visualise what is (partially) real, even when it is not easily understandable.

Deductive Reasoning	Inductive Reasoning
1.Theory	1. Observation
2. Hypothesis	2. Pattern
3. Observation	3. Tentative Hypothesis
4. Confirmation	4. Theory

Network Thinking in History and Archaeology

There are currently two leading and correlated movements in network theory:

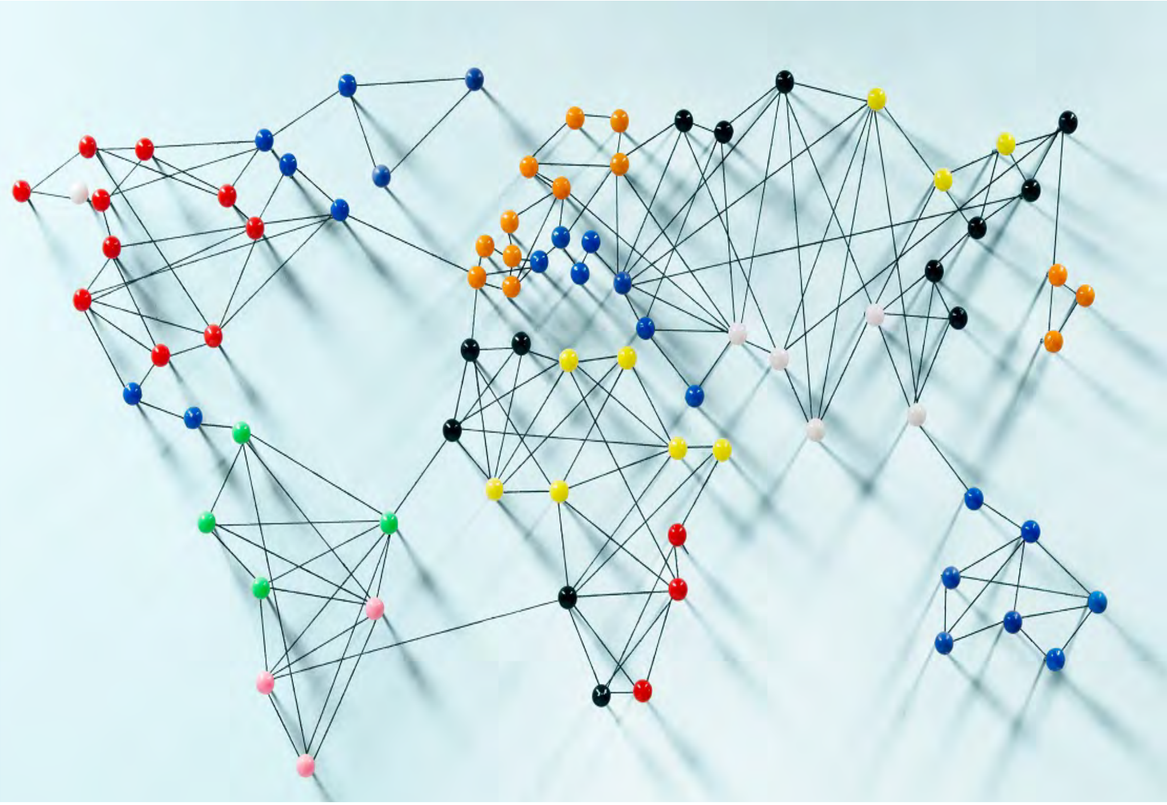
i. Social Network Analysis (SNA) derived from sociology, and

ii. Formal Network Science derived from mathematics.

- **SNA** has been used to define and elucidate various types of links. Just as the form of the node in a network can vary, so too can links, which may be roughly classified as economic interactions, communication, connections, commonalities and flows, and separated subsequently into smaller subdivisions. Networks created through SNA are ontological, since they explore the mode of being actors, while networks from network science are epistemological tools signifying a means to approach the world and to induce knowledge about that world.

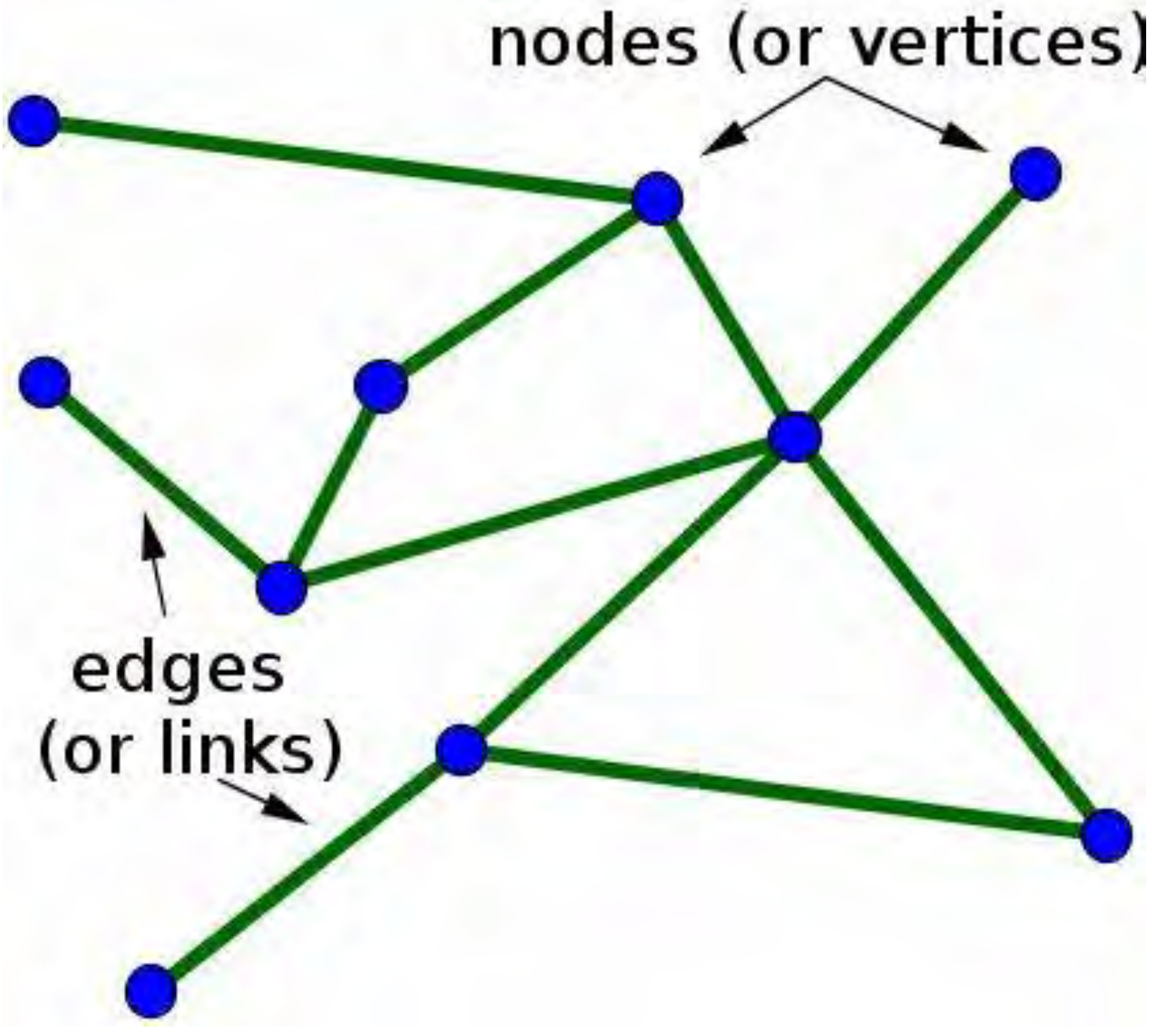
Social Network Analysis

- Social network analysis (SNA) in archaeology has become important for a range of theoretical and methodological approaches that can more generally be characterized as relational. They are relational in that it is the ties between actors (or nodes) that define social connections.



Social Network Analysis

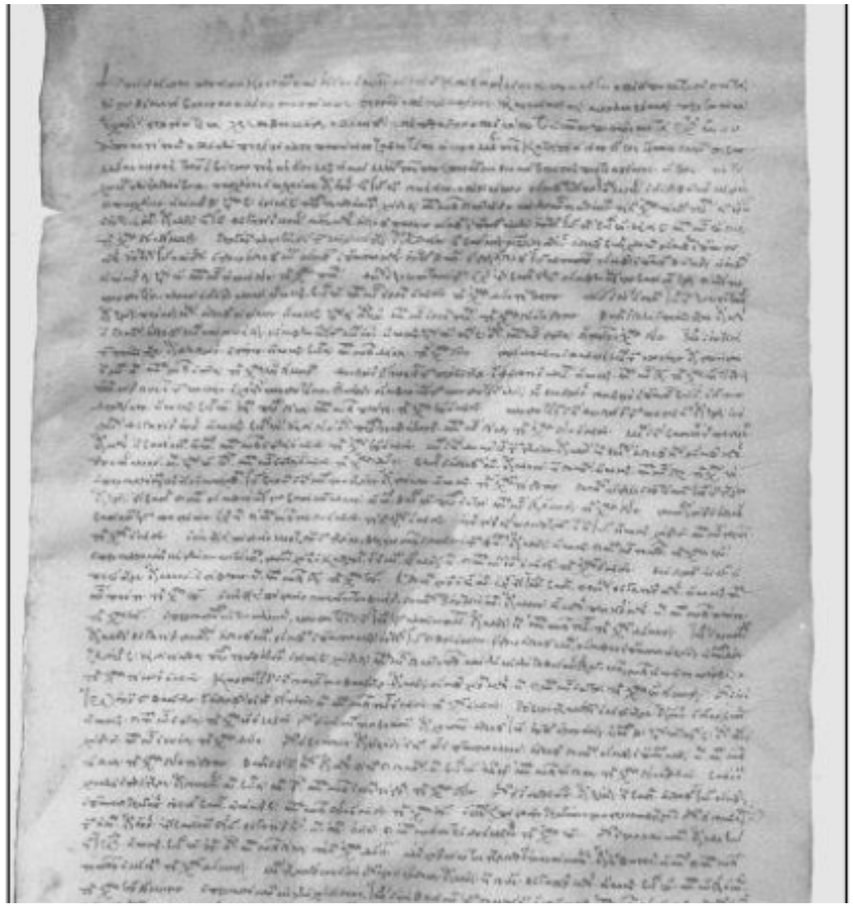
- In network science, actors are referred to as nodes (the dots on the graph) and relationships as edges (the lines on the graph). Nodes can represent a variety of 'actors'. Nodes can represent people, workshops, cult sites, settlements etc. While nodes can represent a variety of things, they are all the thing that has a relationship with another thing. Edges can represent a variety of 'relationships'. In social networks, edges most likely represent interaction/connections through the transfer of goods, social relationship etc. Like nodes, edges can represent a variety of things.



From the Source to the Networks

The register of dues to the Monastery of Iviron (Mt. Athos), 1316 (AIv III, nr. 74)

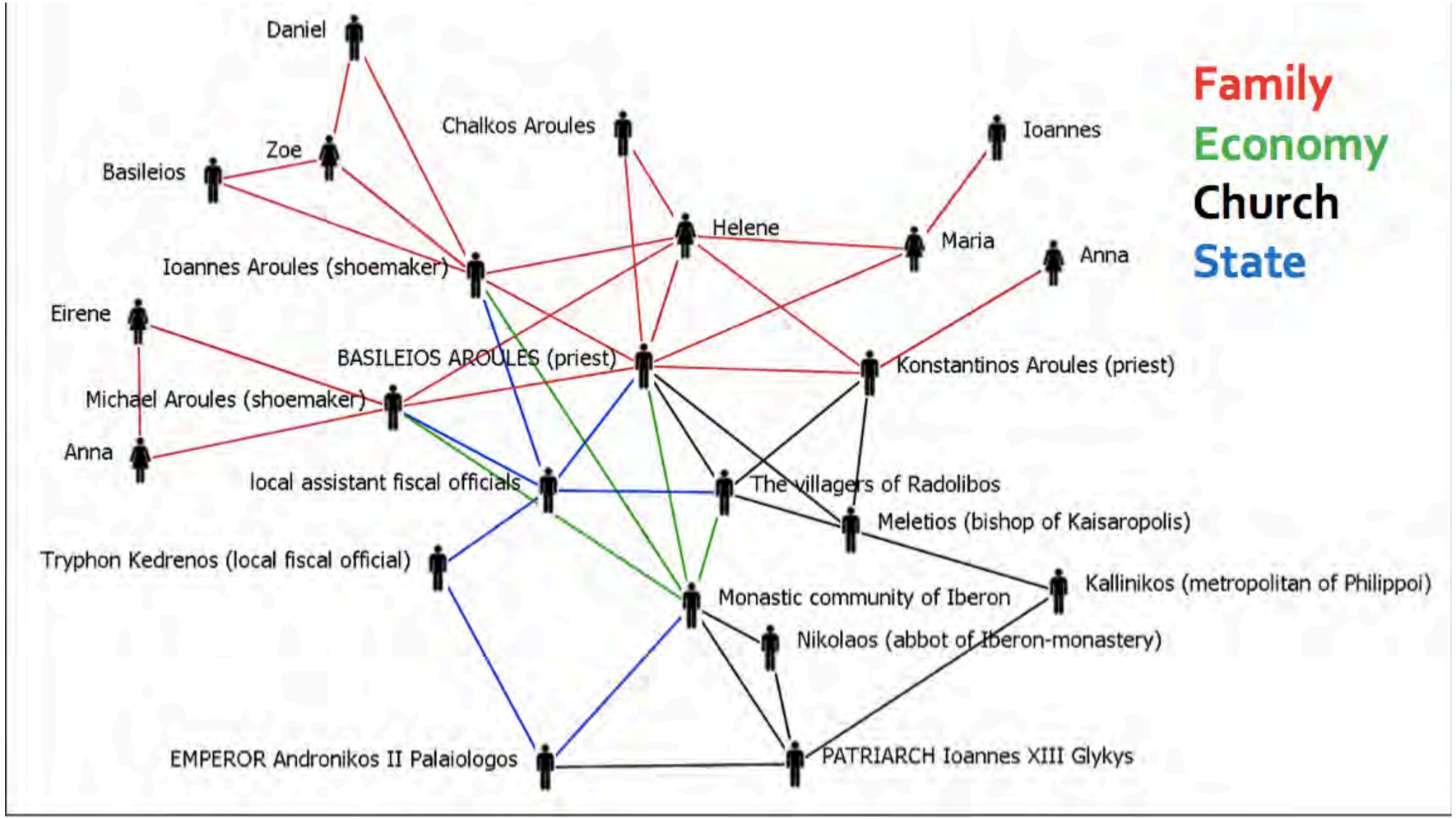
- “The priest Basileios Aroules, has (a woman) Helene, a son, the priest Konstantinos, from him a daughter-in-law Anna, another son Chalkos, a daughter Maria, from her a son-in-law Ioannes, one house, one ox, a vineyard of nine modioi; the total tax amount is two hyperpyra.
- Ioannes, the shoemaker, his son, has (a woman) Zoe, the sons Daniel und Basileios, a house, a vineyard of three modioi; the total tax amount is one hyperpyron.
- Michael, the shoemaker, his other son, has (a woman) Eirene, a daughter Anna, a house, a vineyard of three modioi; the total tax amount is one hyperpyron.”



Courtesy of Johannes Preiser-Kapeller

From the Source to the Networks

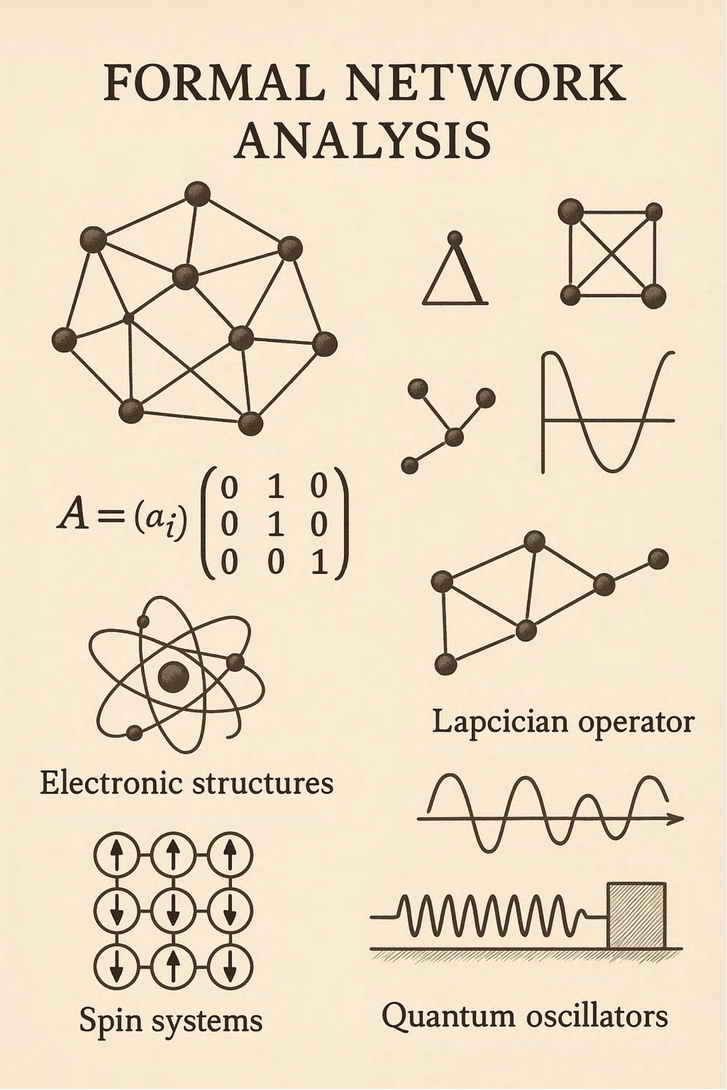
The Graph of the network of Basileios Aroules,1316



Courtesy of Johannes Preiser-Kapeller

Formal Network Analysis

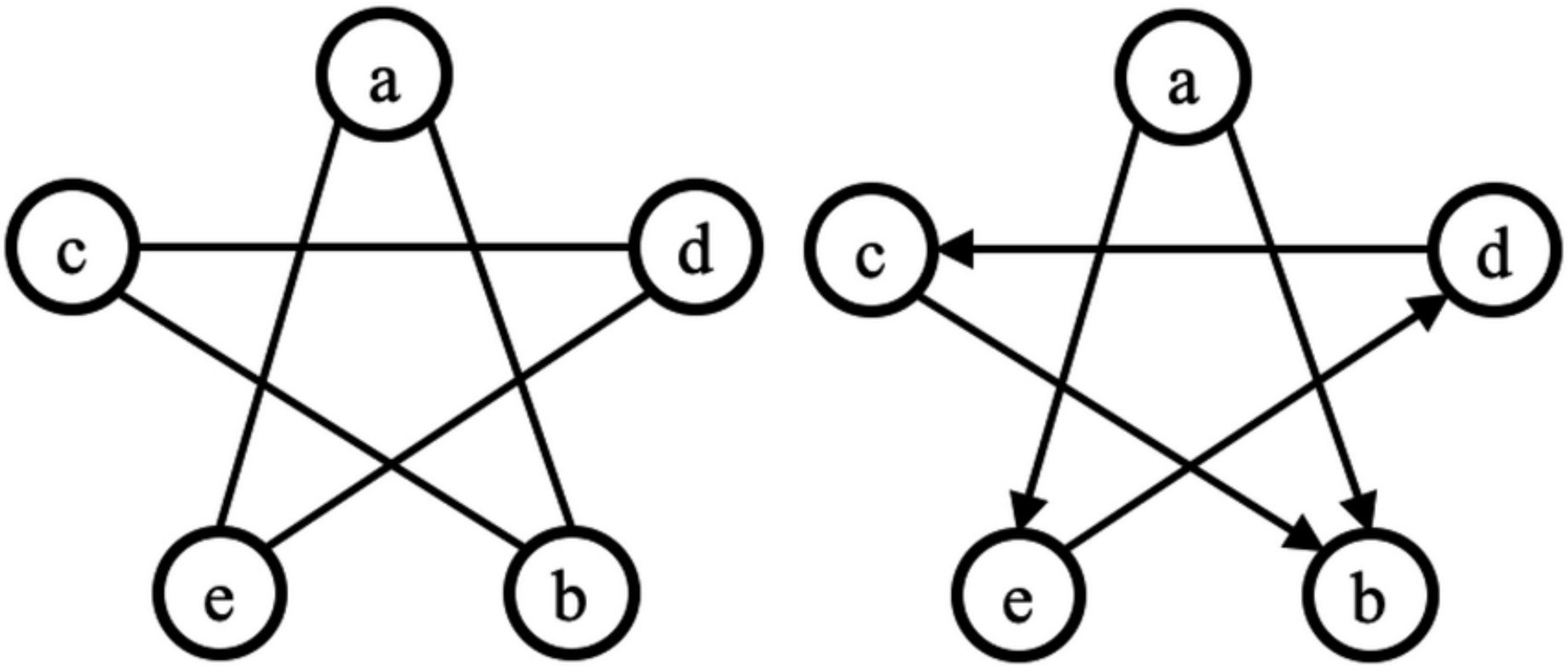
- Network analysis was developed for maths and physics and aimed largely at understanding relationships among a known set of data. The nodes function as correlation points and the links as the connection between them. Network theory can illuminate general patterns in the performance of these conceptualised nodes and links.



Formal Network Analysis

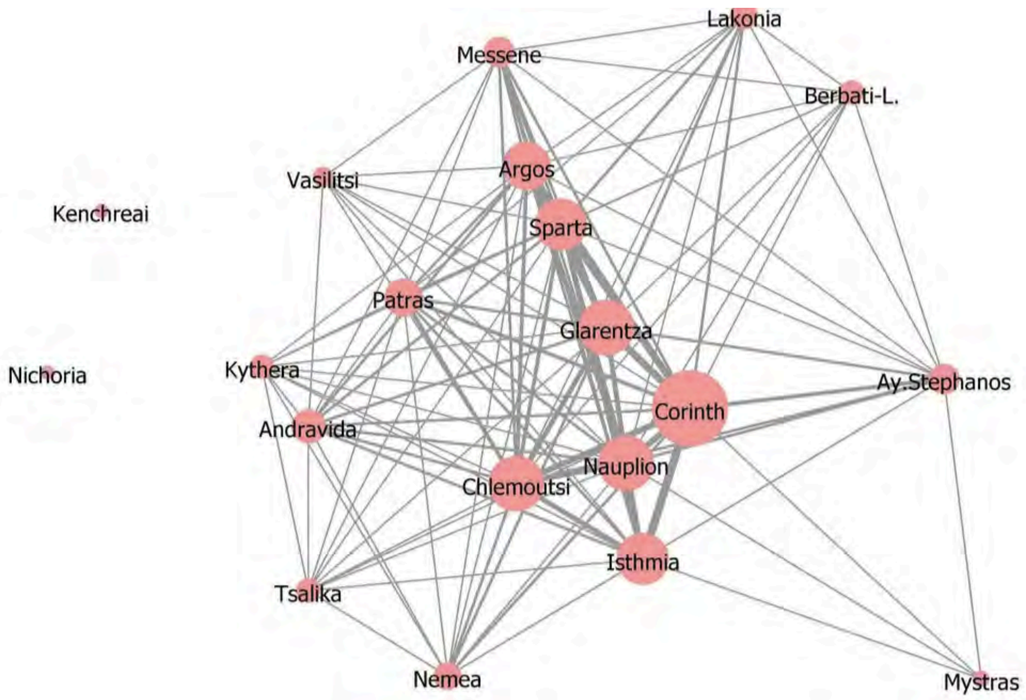
- Archaeological evidence is fragmented and incomplete. Hence network analysis in archaeology is applied to i) create models, which form networks that are then compared to empirical archaeological data and ii) generate networks directly from archaeological assemblages. In archaeological network analysis considering a state as a node might seem unnecessarily reductive and the links between the nodes incomplete, due to limited data.
- However, network analysis forces the researcher to be explicit about the reasons s/he picked this type of data, the way s/he classified them and the way s/he analysed them. Hence, network analysis reveals interpretations that would otherwise have remained hidden, even if that means underscoring the limited data that archaeologists have at hand, in comparison to sociologists or physicists.

Undirected and Directed Graph



Generate networks directly from archaeological assemblages: Example from J. Preiser-Kapeller, Entangling the Morea: a network model of ceramic distributions on the late medieval Peloponnese

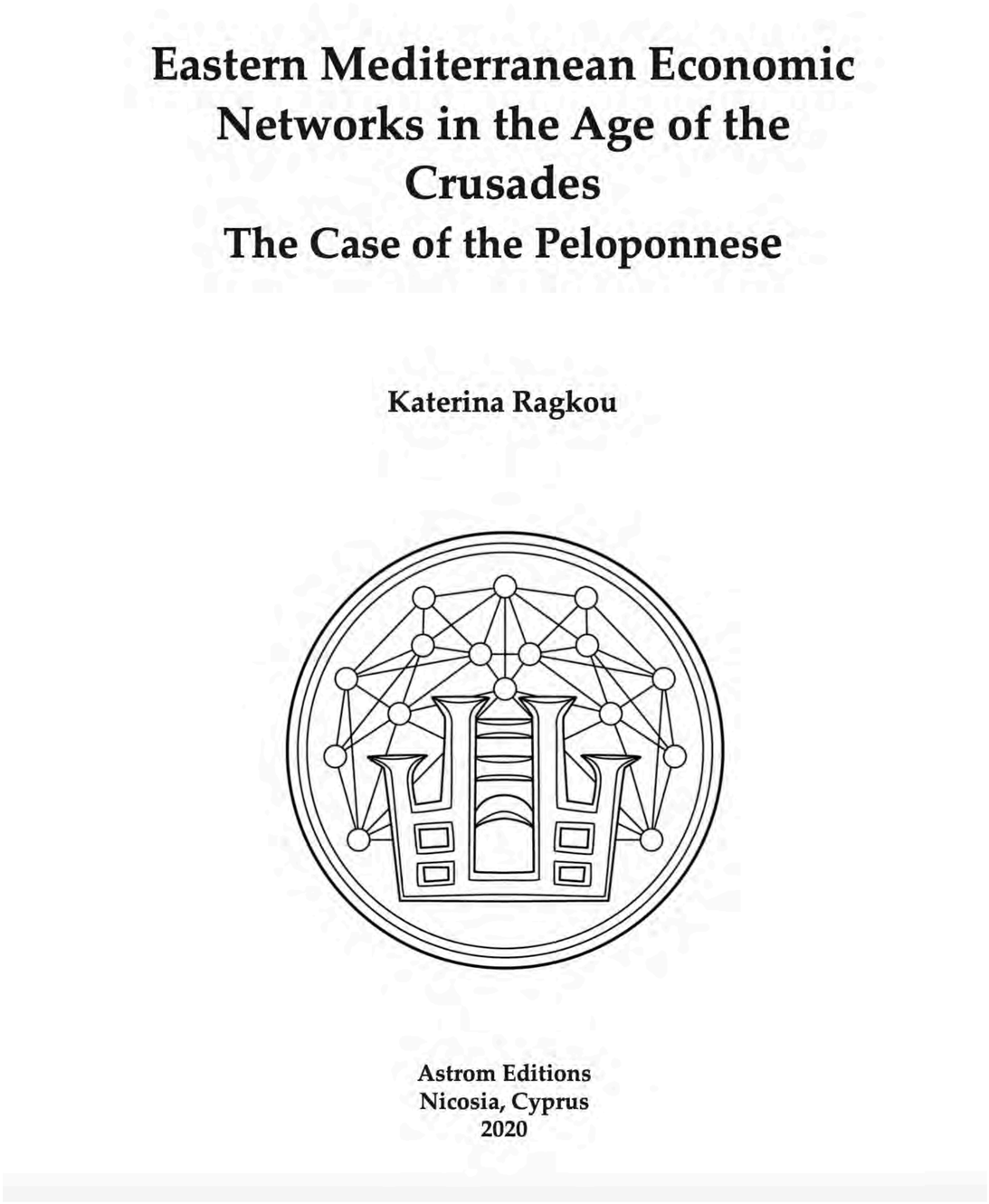
- In most network analyses in an archaeological context, connections between nodes are based on a single criterion—such as the co-occurrence of a particular artifact at two sites or the presence of a road linking them. Both examples are grounded in the concept of similarity.
- The primary reason for using similarity is that nodes sharing more characteristics are more likely to be causally or socially connected than those with fewer commonalities.
- For instance, J. Preiser-Kapeller constructed a general similarity network by examining shared pottery types across settlements in the Peloponnese, using similar material culture as a proxy for potential interaction



Courtesy of Johannes Preiser-Kapeller

2. Eastern Mediterranean Economic Networks in the Age of the Crusades (late 11th to mid-14th Centuries)

The case of the Peloponnese



Eastern Mediterranean Economic Networks in the Age of the Crusades

The Case of the Peloponnese

Katerina Ragkou

Astrom Editions
Nicosia, Cyprus
2020

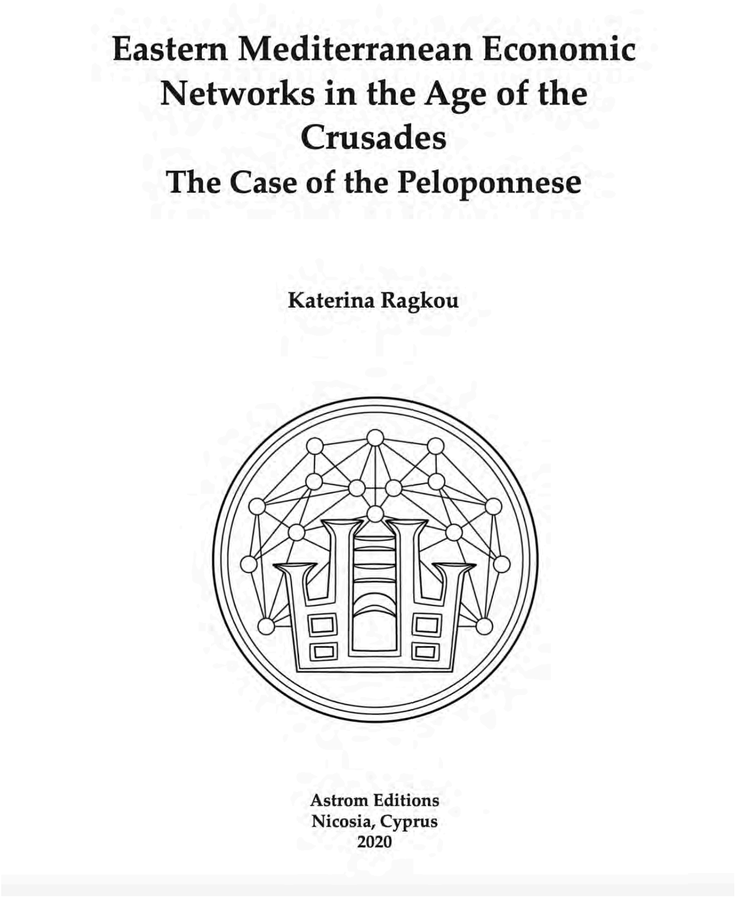
Eastern Mediterranean Economic Networks in the Age of the Crusades: The case of the Peloponnese

(Late 11th to the mid-14th centuries)

i. Historical Background

ii. Research Agenda

iii. Outcomes



I. Historical Background

The Byzantine Empire in the 12th century

(Gregory 2005: 259)

I. Historical Background

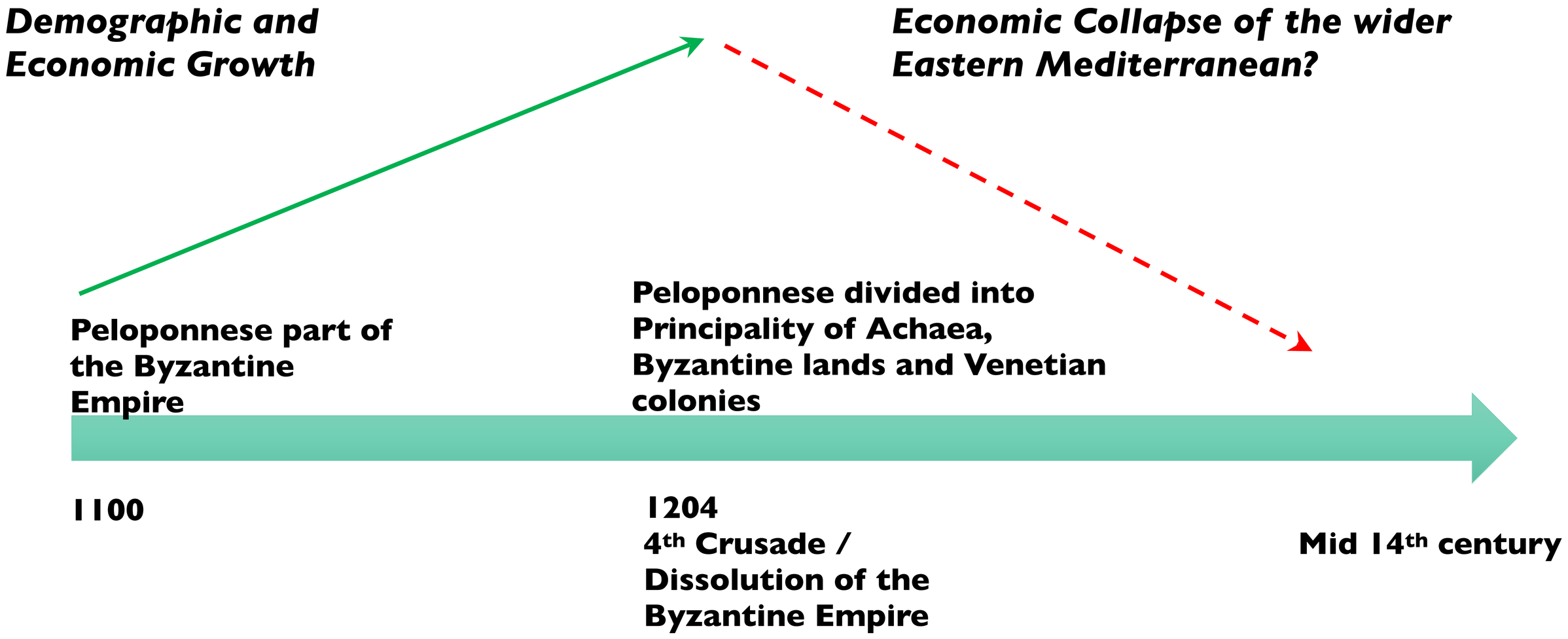
The Crusader States of the Eastern Mediterranean in the early 13th century

(Gregory 2005: 267)

I. Historical Background

The byzantine Empire in 1261

2. Research Agenta



2. Research Agenda

1100-1204: province of the Byzantine empire

After 1204: three political entities

1) *Latin Territories:* Frankish Principality of Achaea
2) *Latin Territories:* Venetian colonies
3) *Byzantine Lands*

K.Ragkou

Transformation of Economic Networks

1. Eastern Mediterranean Trade Network: Distribution of tableware pottery and numismatic trends within the Eastern Mediterranean region.

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2. Regional Perspective: Industrialized Sector, Coin Circulation Agricultural Production in the Peloponnese

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3. Settlement Organization of the Peloponnese and its model of interaction and exchange based on aspects of network analysis

Outcomes

1. Eastern Mediterranean Trade Network: Distribution of Tableware Pottery within the Eastern Mediterranean region
2. Regional Perspective: Industrialized Sector, Coin Circulation and Agricultural Production in the Peloponnese
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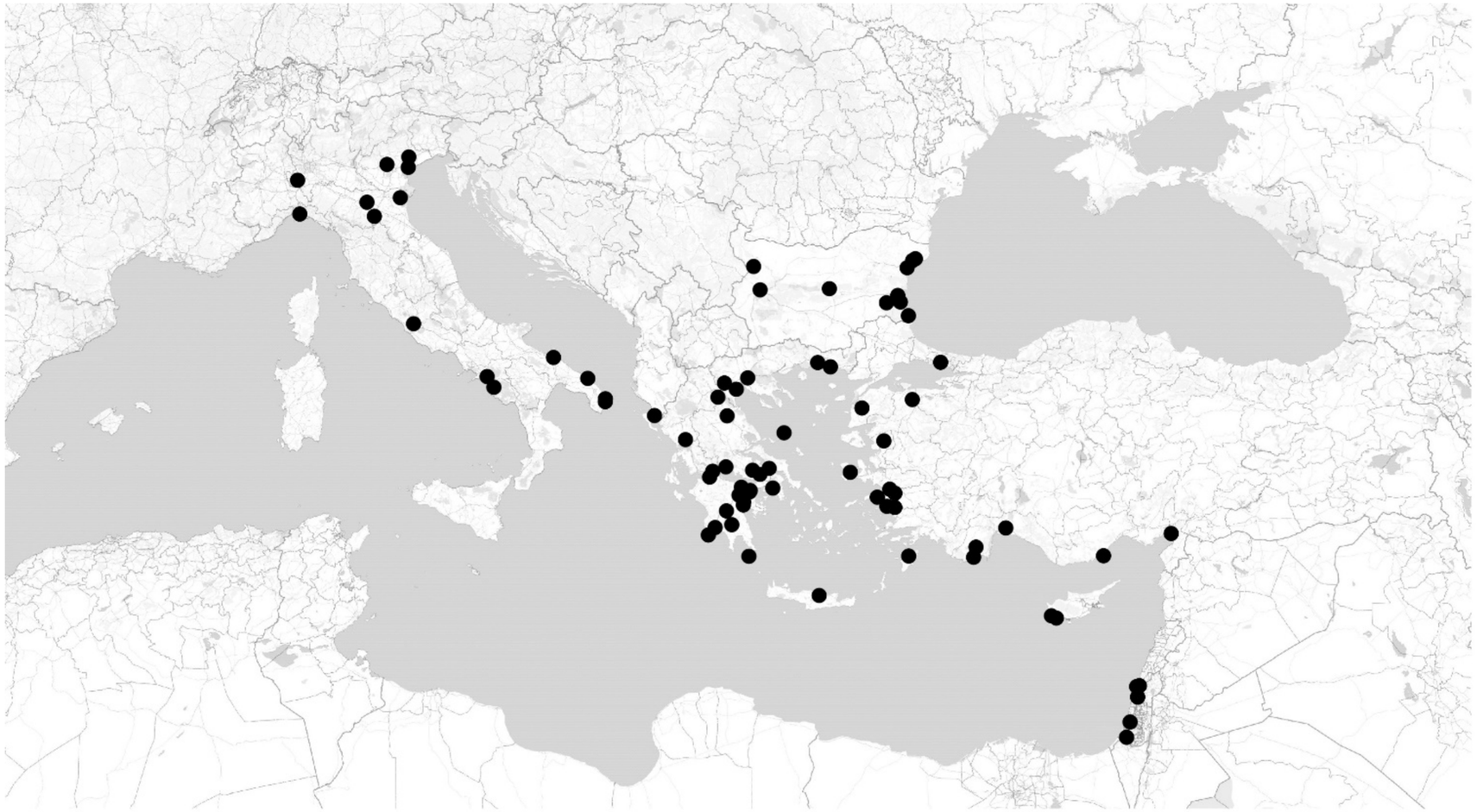
Trade Patterns: Green and Brown Painted Ware, Byzantine Workshop

Late 11th - early 13th centuries

(K.Ragkou)

Trade Patterns: Fine Sgraffito Ware, Byzantine Workshop



Mid 12th to mid 13th century

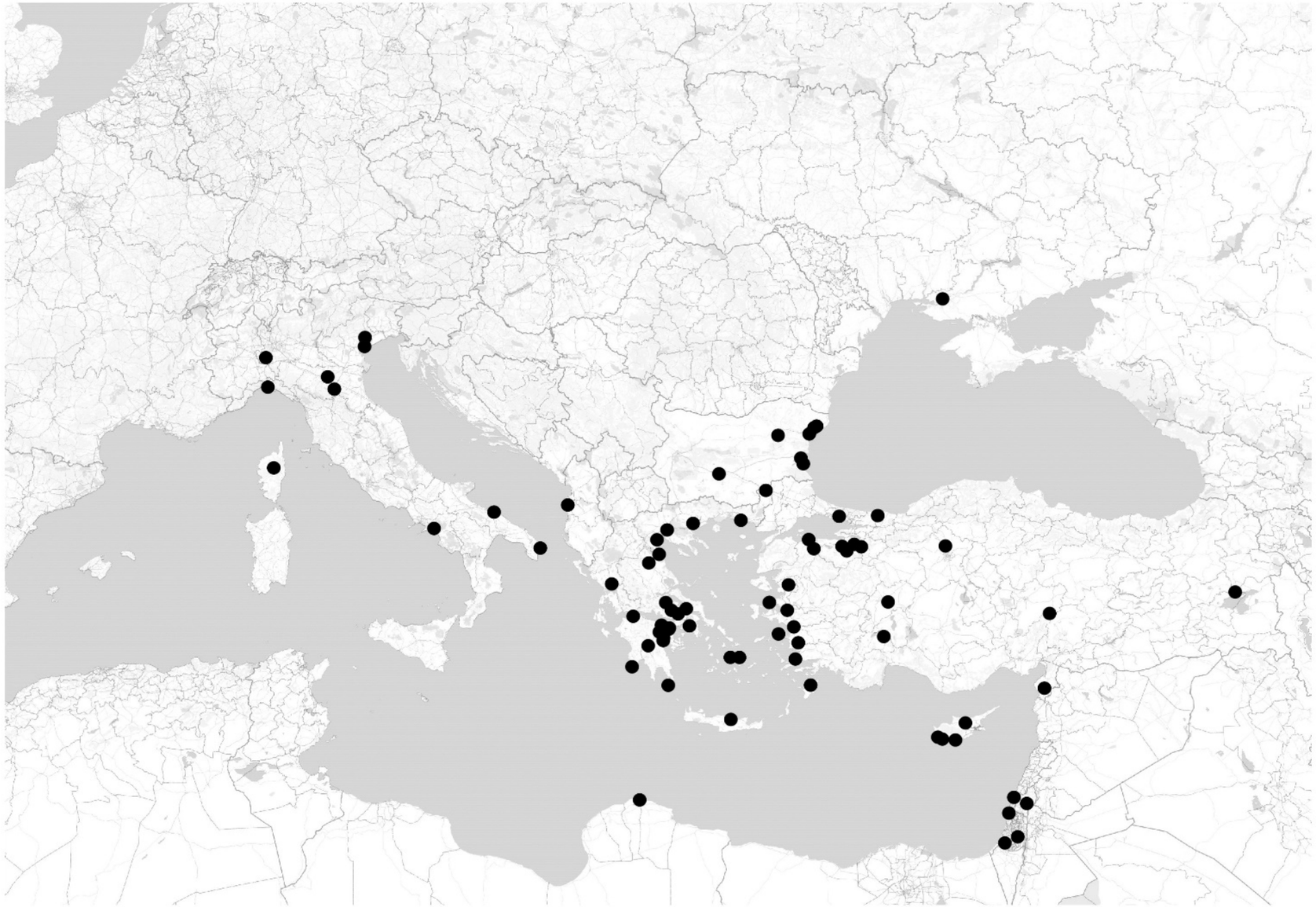
(K.Ragkou)

Trade Patterns: Measles Ware, Peloponnesian Workshop

Ca. 1125-1175

(K.Ragkou)

Trade Patterns, Aegean Ware, Byzantine Workshop



Late 12th-mid
13th century

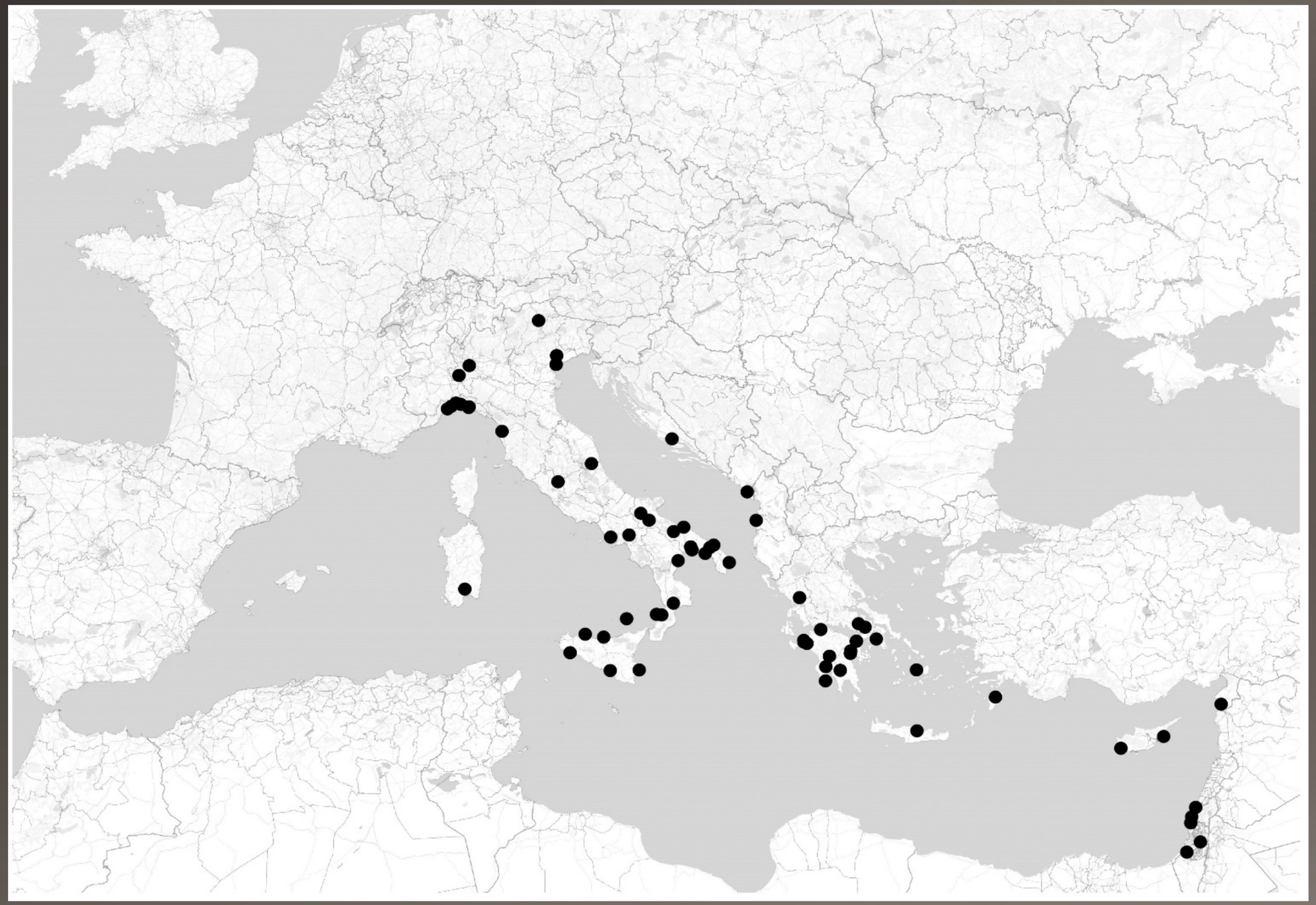
(K.Ragkou)

Trade Patterns: Thessaloniki Ware

Mid 13th -14th centuries

(K.Ragkou)

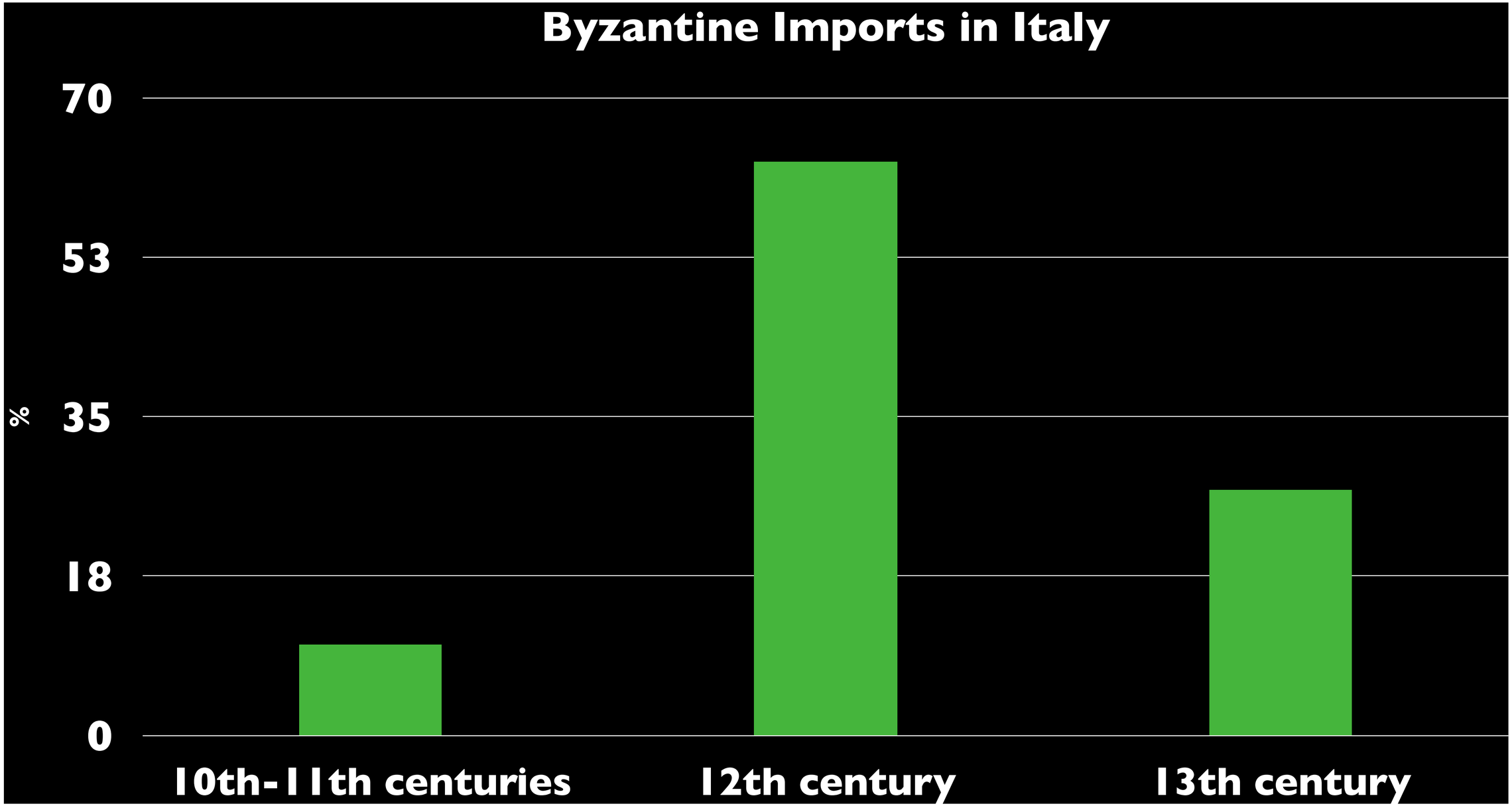
Trade Patterns: Protomaiolica Ware, Italian Workshops



Ca. 1225-1340

(K.Ragkou)

Trade Patterns: Byzantine Ceramics in Italy



Outcomes

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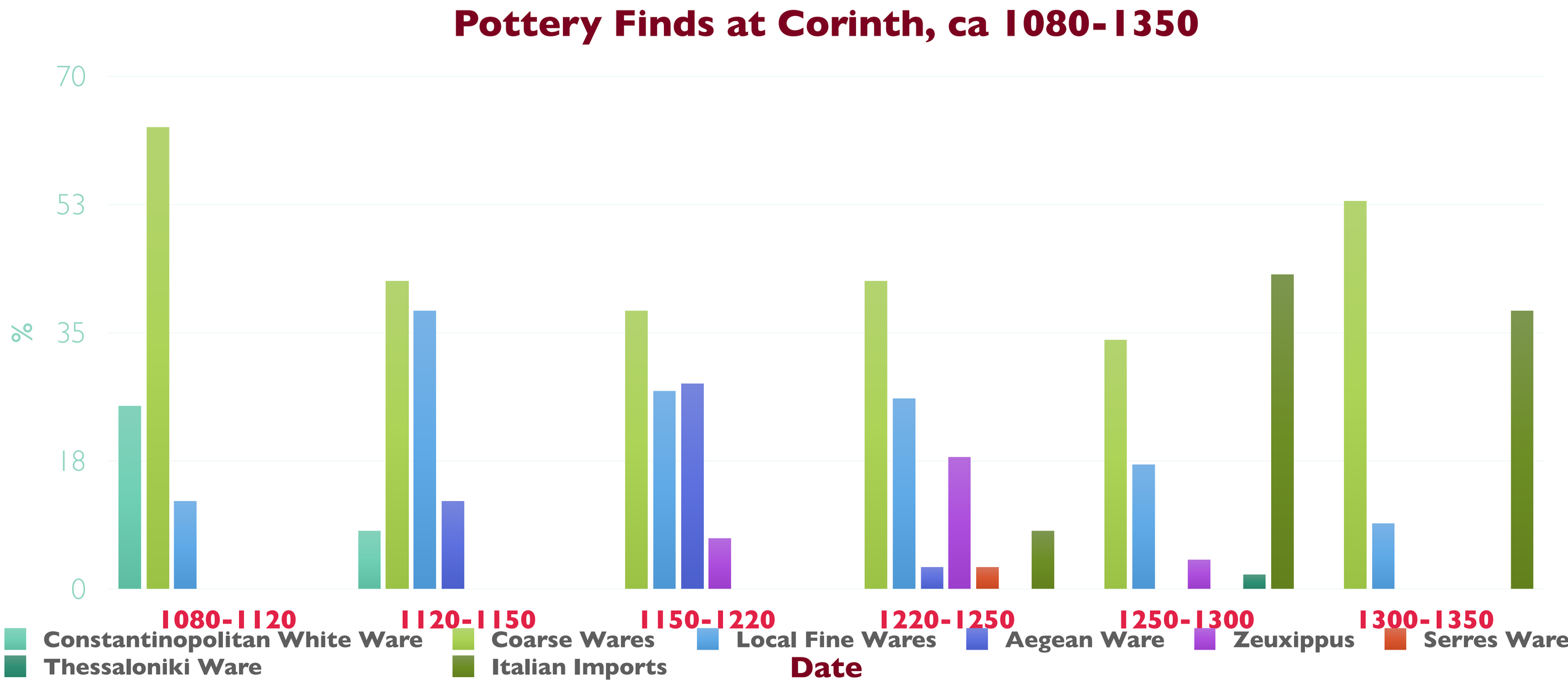
Ceramic Trens in the Peloponnese: A Glimpse from Corinth



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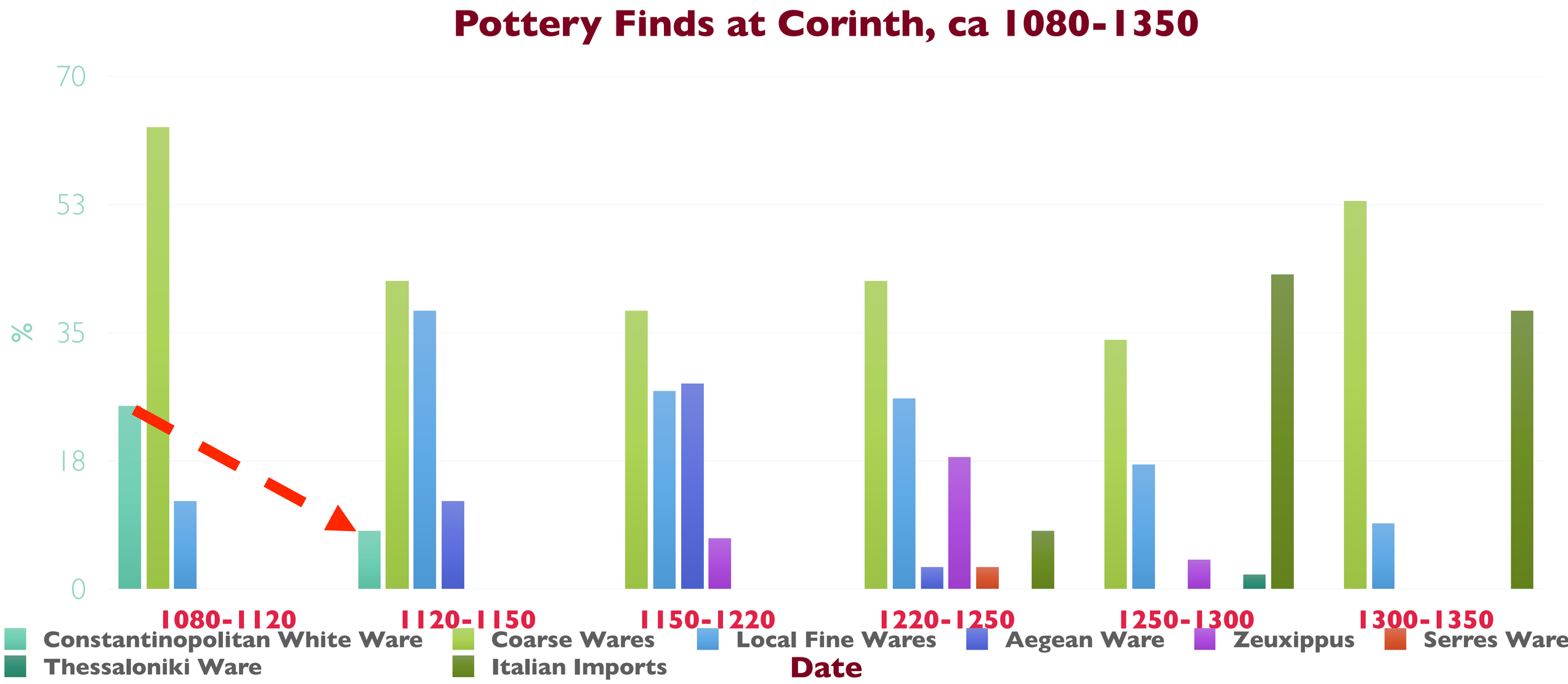

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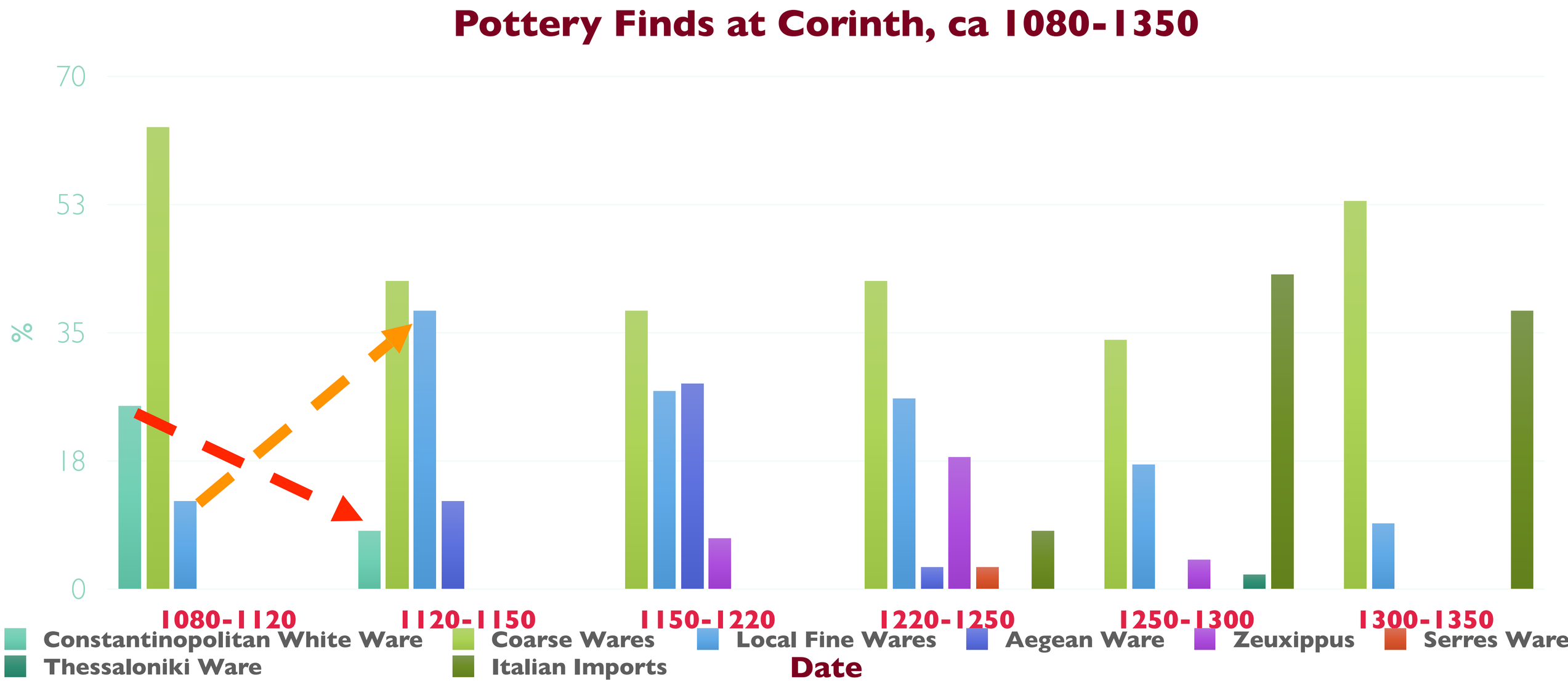

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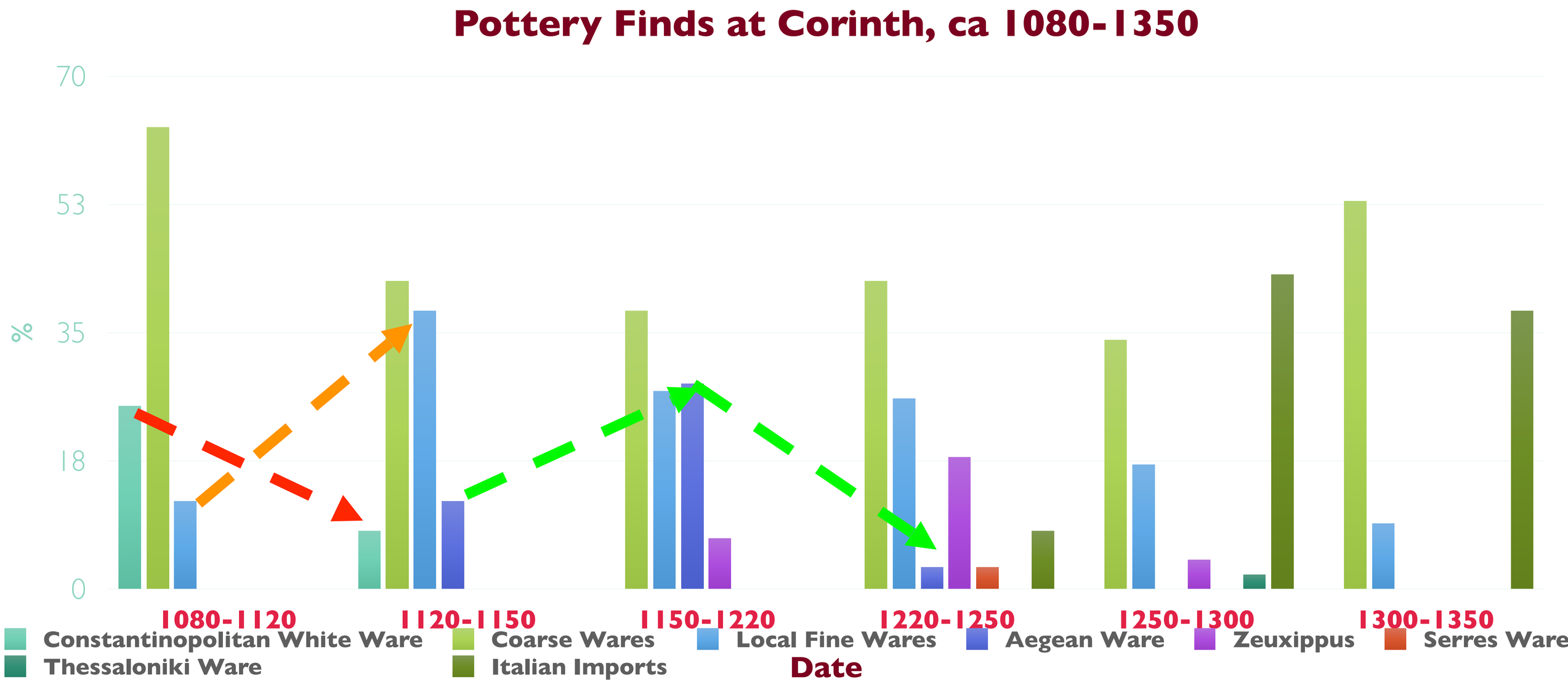

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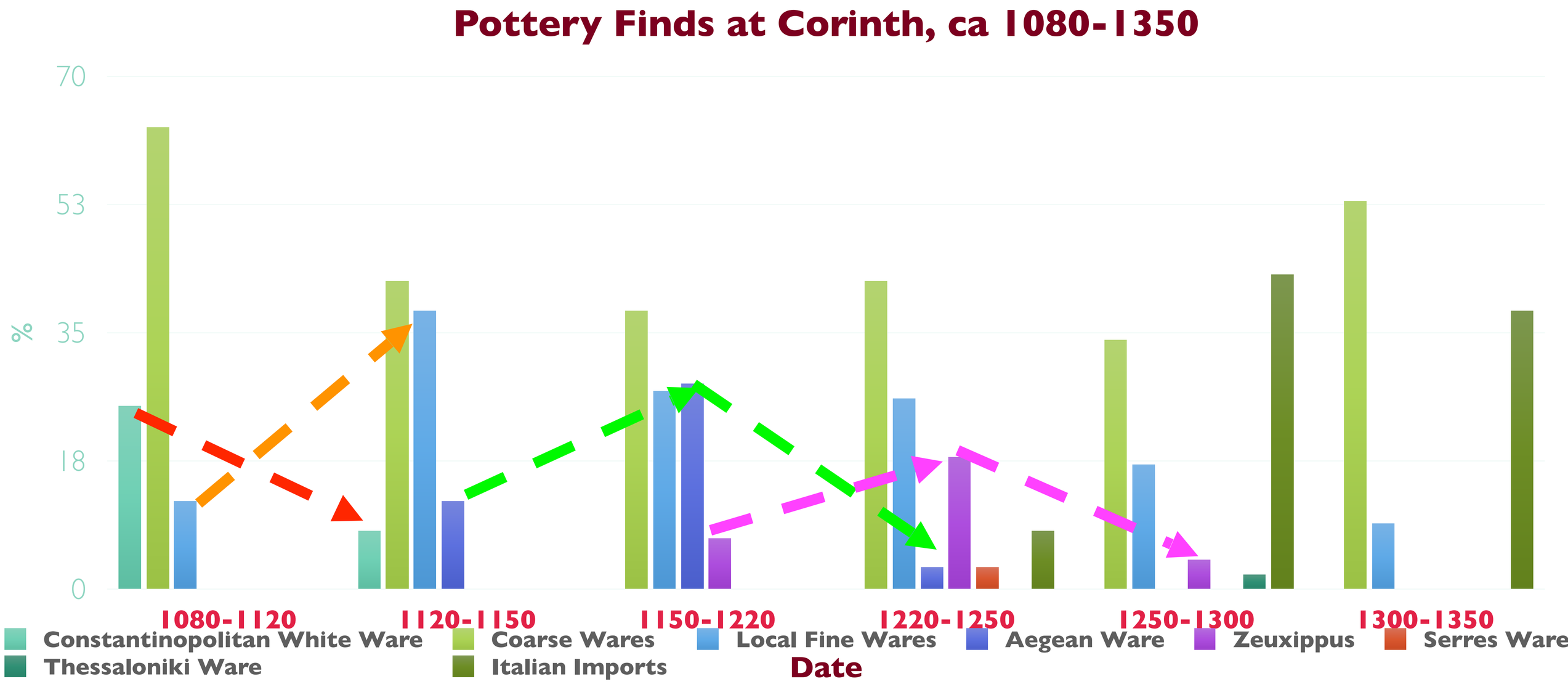

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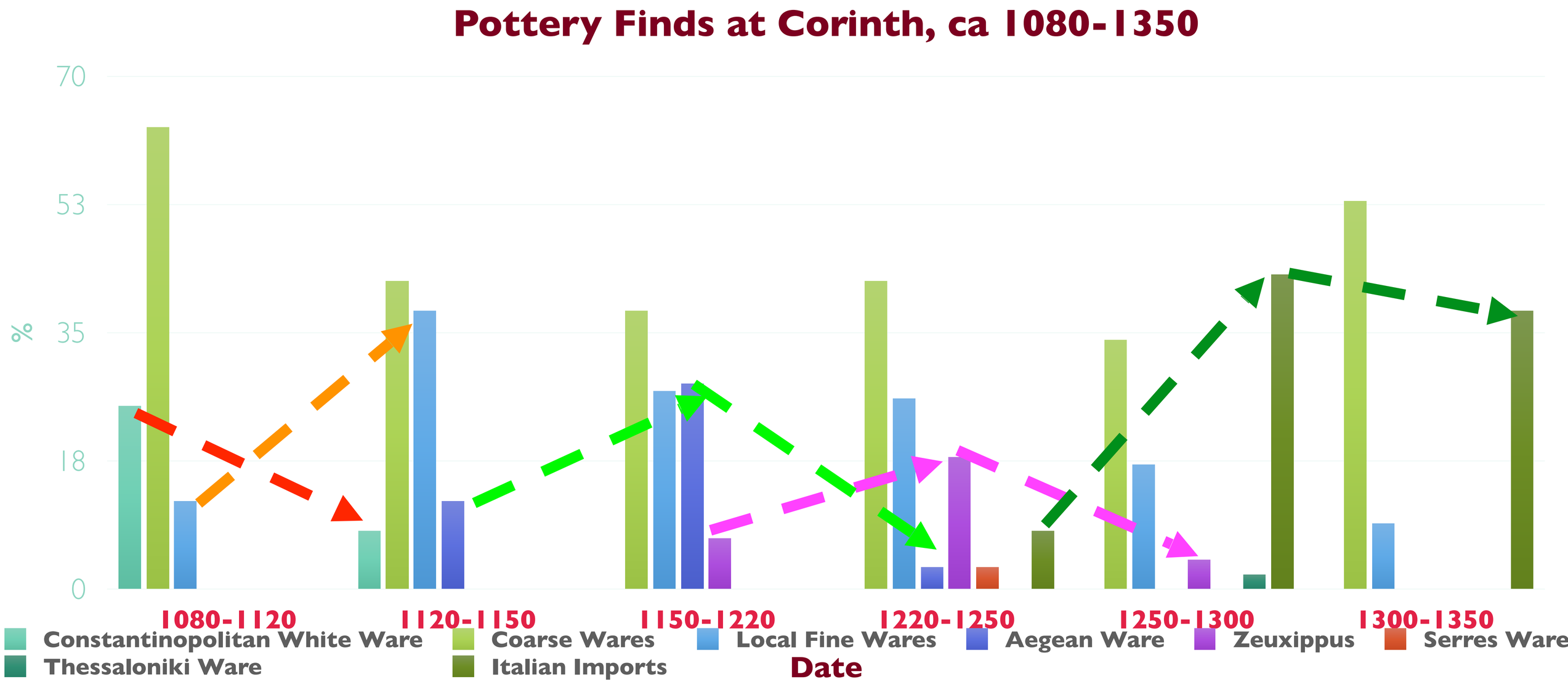

Numismatic Trends in the Peloponnese

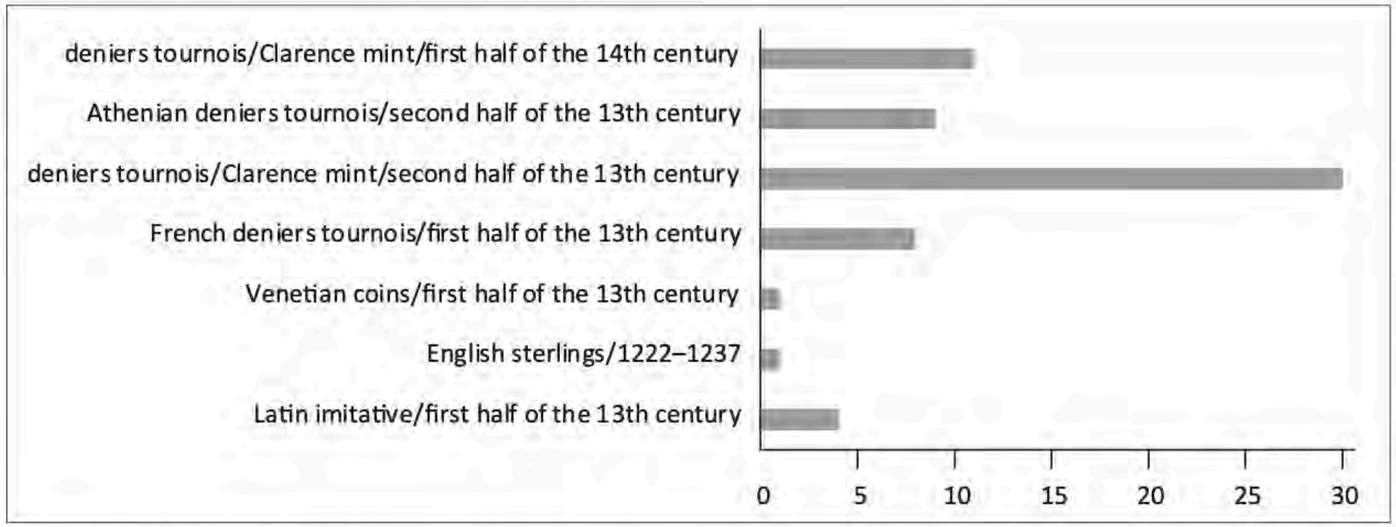

Figure 7.20. Number of single coin finds of 1204 to mid-14th century date from various authorities found at Nemea (based on Miller 2005)

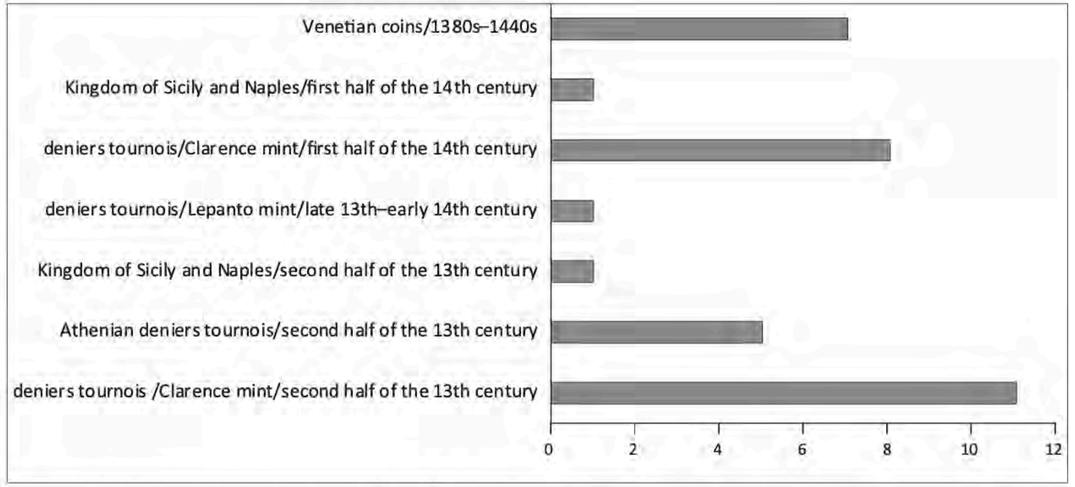

Figure 7.21. Number of single coin finds dating from the 1250s to the 1350s from various authorities found at Clarence (based on Athanasoulis & Baker 2008)

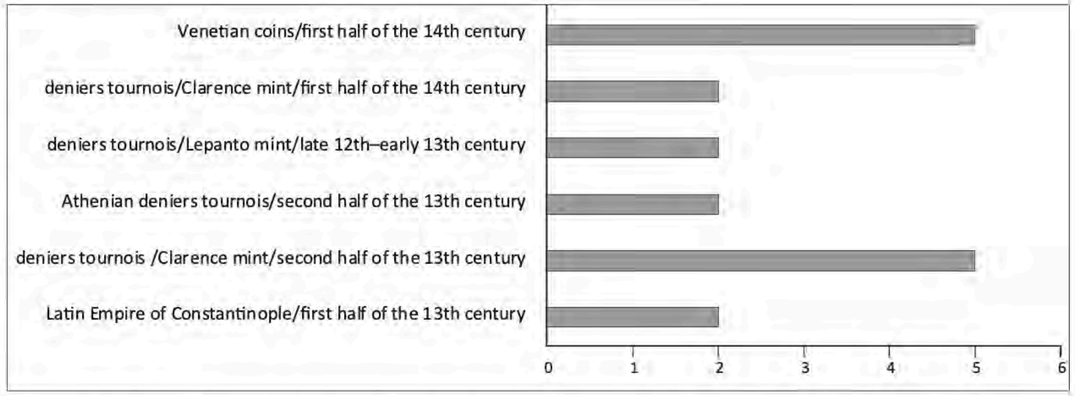

Figure 7.22. Number of single coin finds dating from the 1250s to the 1350s from various authorities found at Elis (based on Athanasoulis & Baker 2008)

(Ragkou:2020)

Trade Patterns: Rural Products

Peloponnesian Agricultural Products	11th Century	12th Century	13th Century	14th Century
Wheat/ Grain	Local Markets and Markets within the Byzantine Empire		Local Markets and various Markets in the Wider Eastern Mediterranean	
Olive Oil	Local Markets and Markets within the Byzantine Empire	Local Markets and various Markets in the Wider Eastern Mediterranean		
Wine		Local Markets	Local Markets and various Markets in the Wider Mediterranean	
Currant			Local Markets and various Markets in the Wider Mediterranean	
Cheese			Local Markets	
Raw Silk	Local Markets and various Markets in the Wider Eastern Mediterranean			

Outcomes

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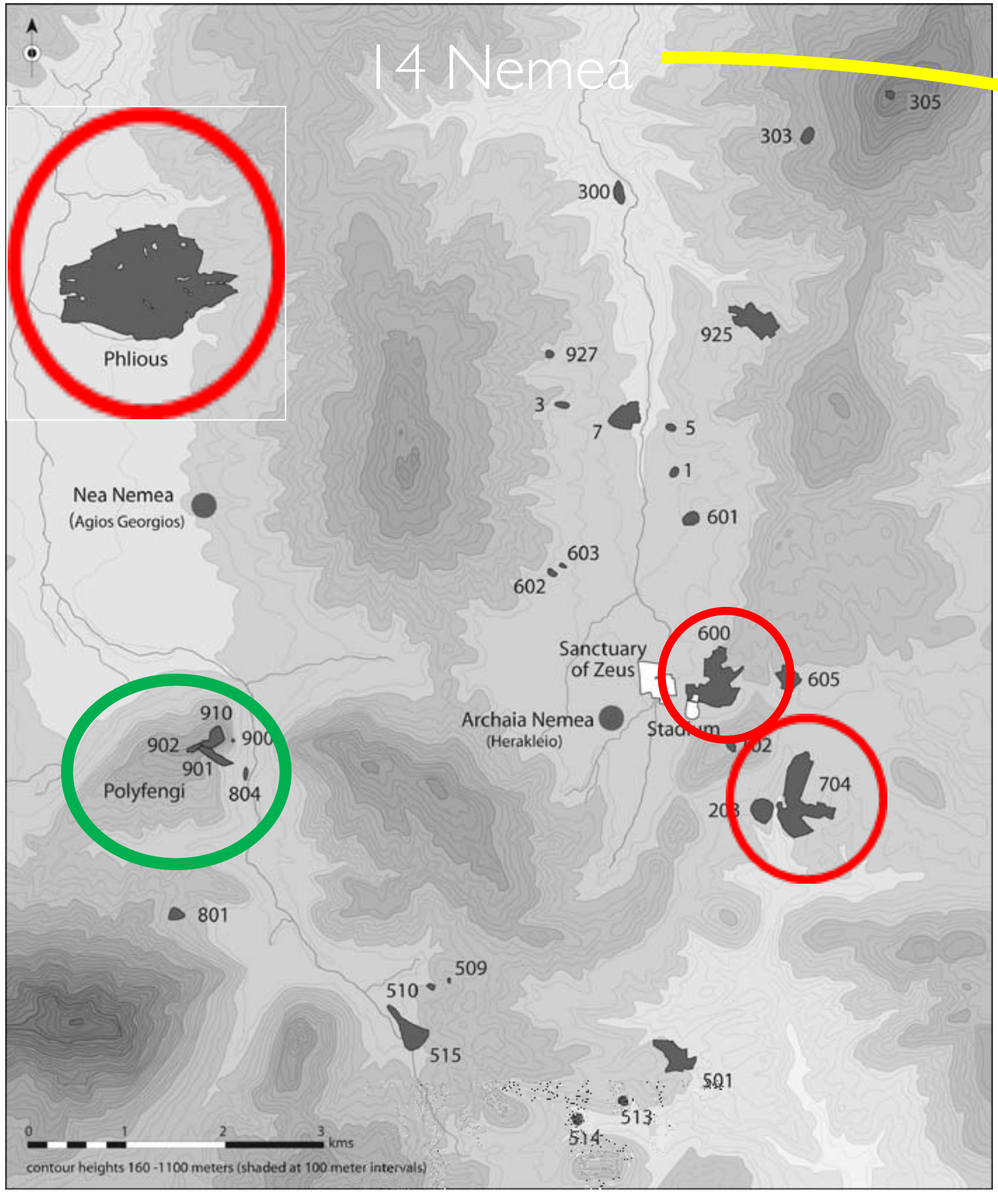
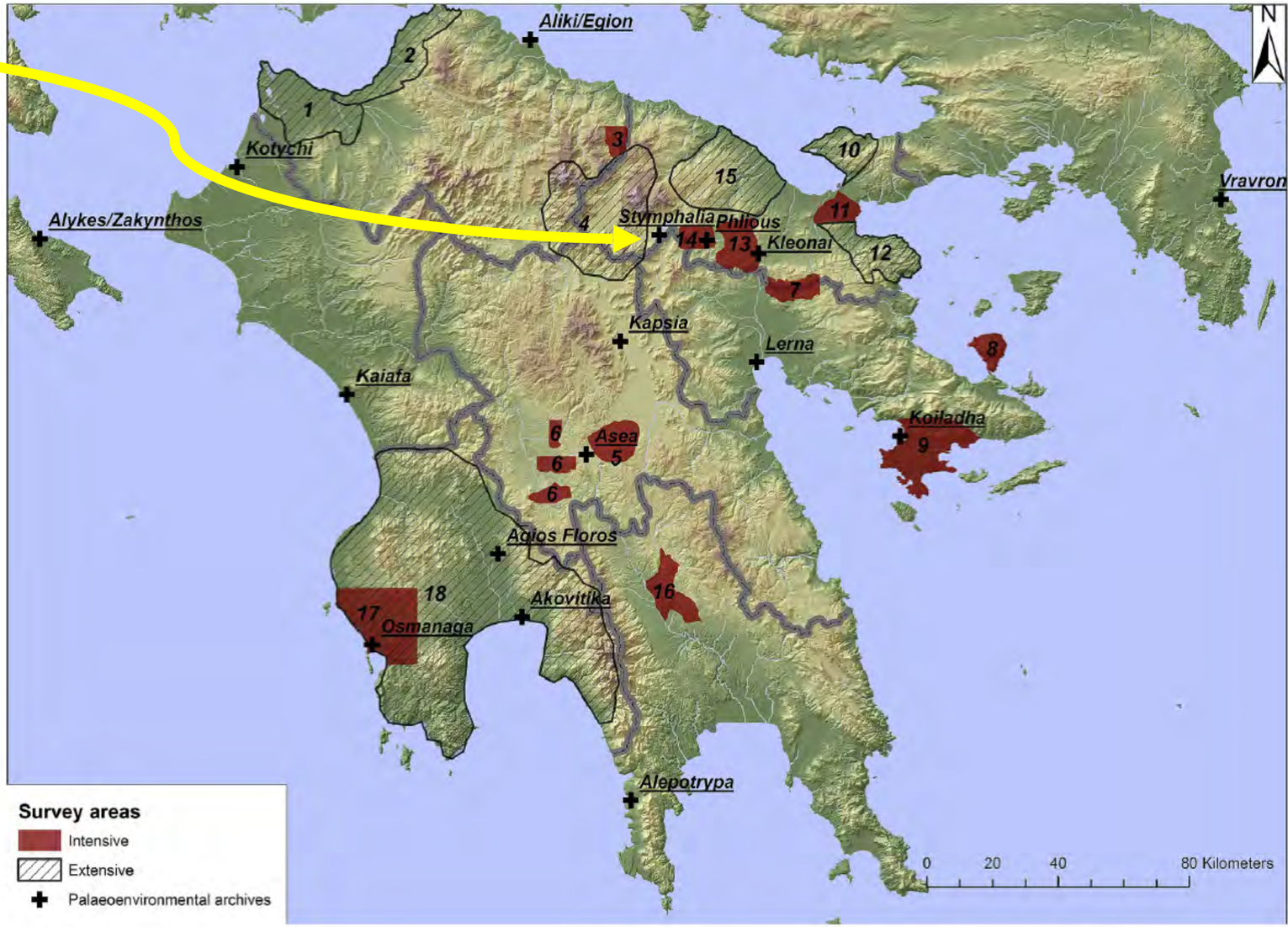
Evidence from Surveys

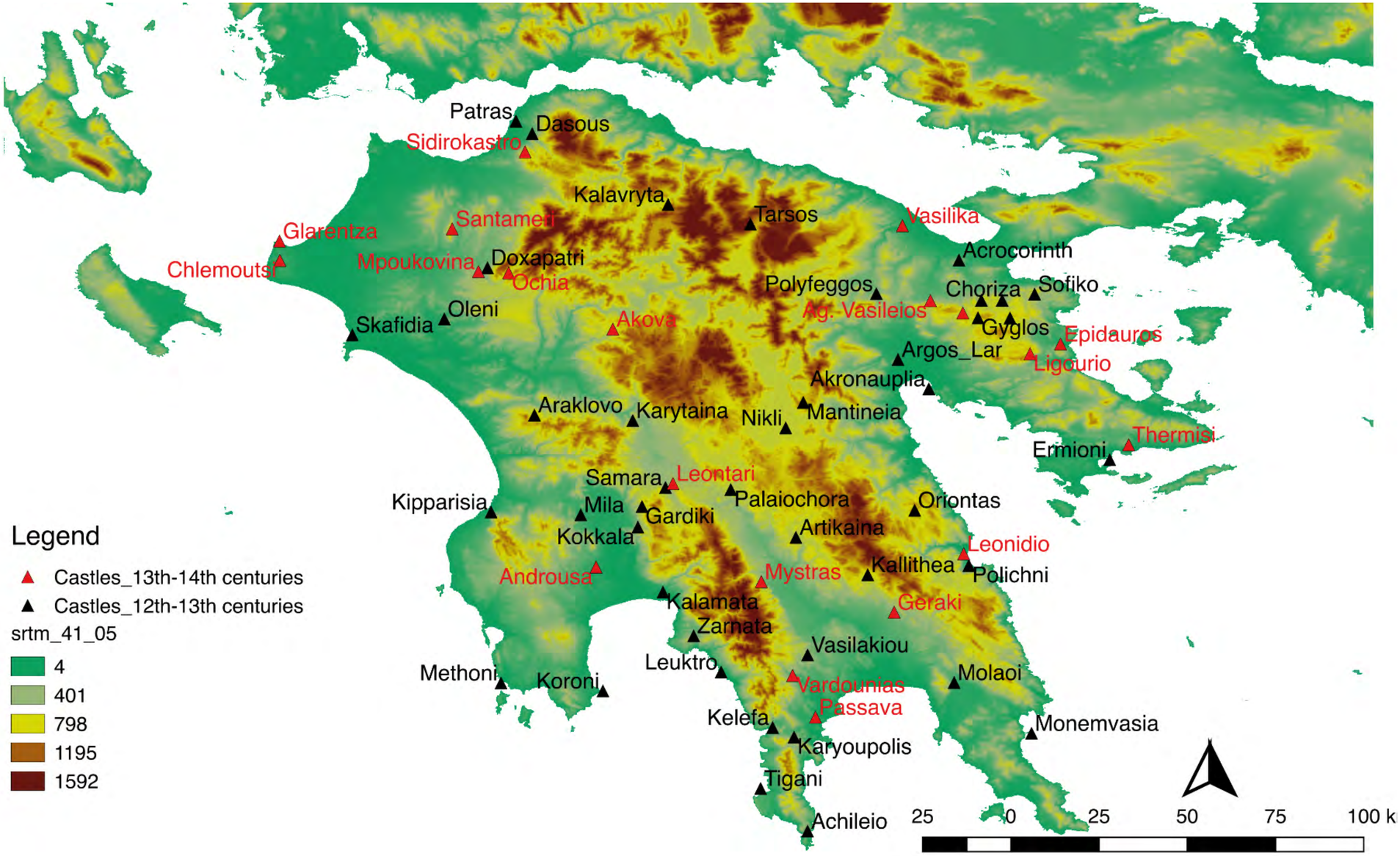


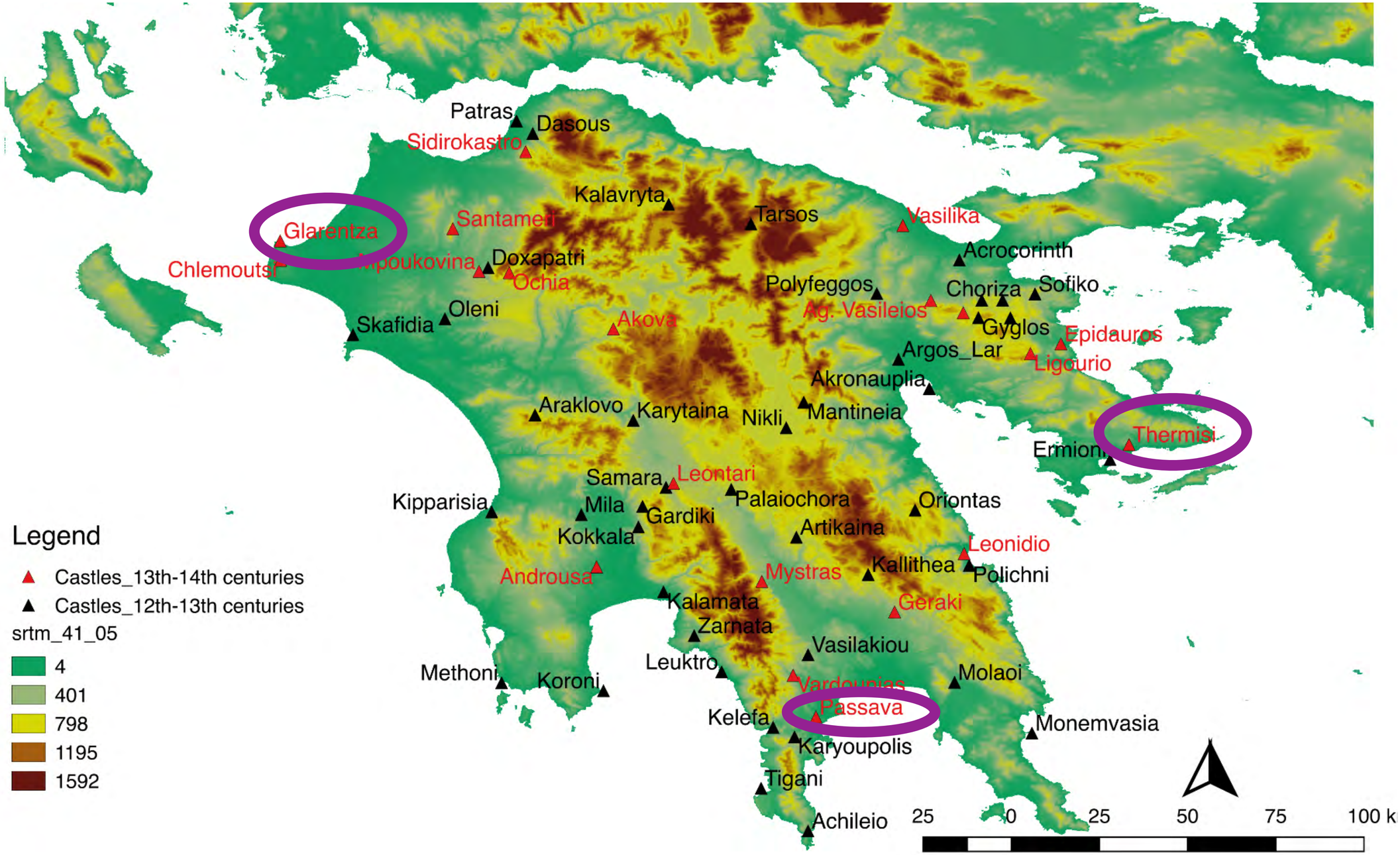
Athanassopoulos 2017: 73



Weiberg et al. 2016:45

Settlement Organisation of the Peloponnese




Patras
Dasous
Sidirokastro
Kalavryta
Tarsos
Vasilika
Glarentza
Santameri
Chlemoutsi
Ampoukovina
Doxapatri
Ochia
Acrocorinth
Polyfeggos
Choriza
Sofiko
Ag. Vasileios
Gyglos
Epidauros
Ligourio
Argos_Lar
Oleni
Skafidia
Akova
Akronauplia
Araklovo
Karytaina
Nikli
Mantineia
Thermisi
Ermioni
Samara
Leontari
Palaiochora
Kipparisia
Mila
Gardiki
Oriontas
Kokkala
Artikaina
Leonidio
Androusa
Mystras
Kallithea
Polichni
Kalamata
Geraki
Zarnata
Vasilakiou
Leuktro
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Molaoi
Vardounias
Passava
Kelefa
Monemvasia
Karyoupolis
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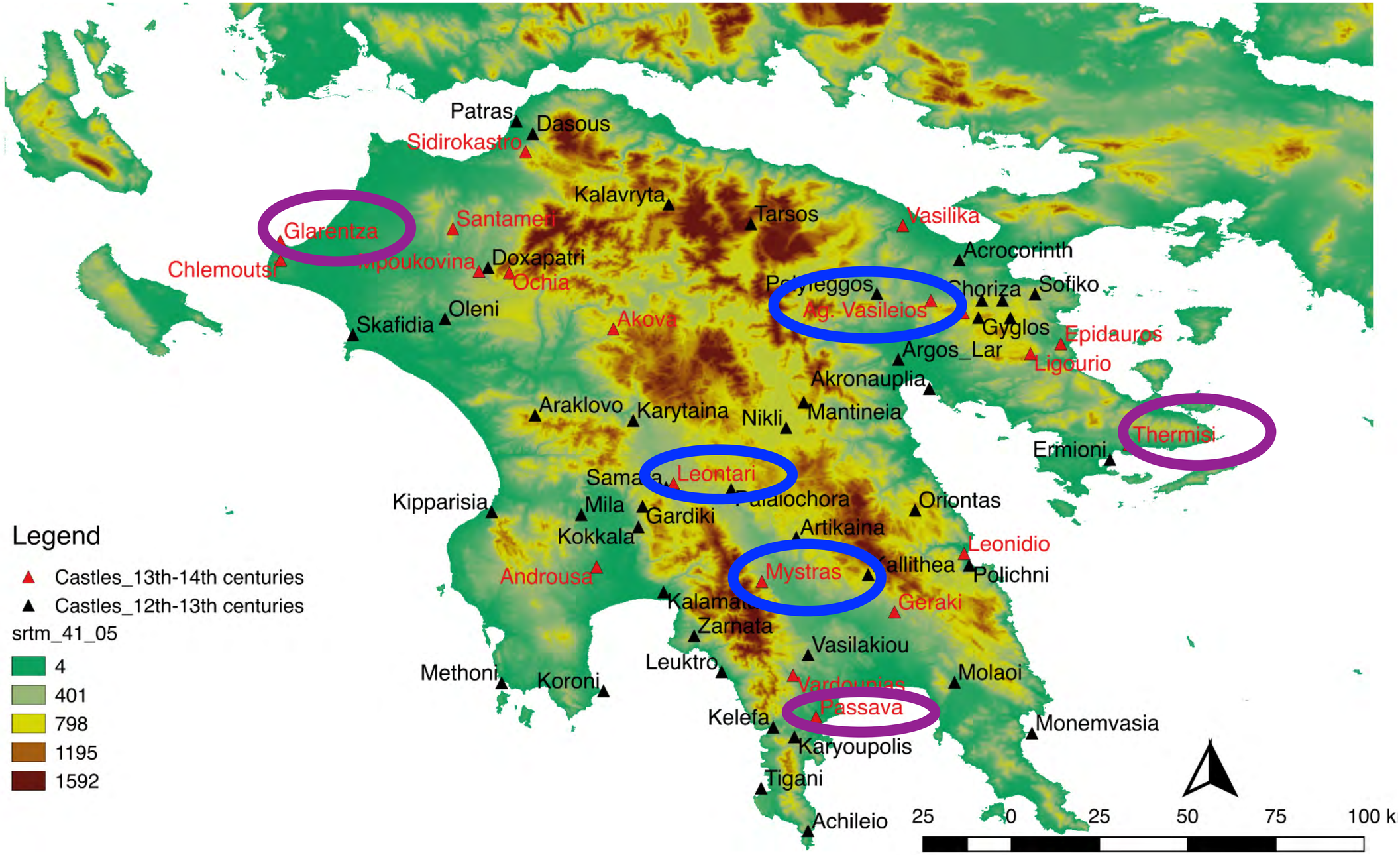
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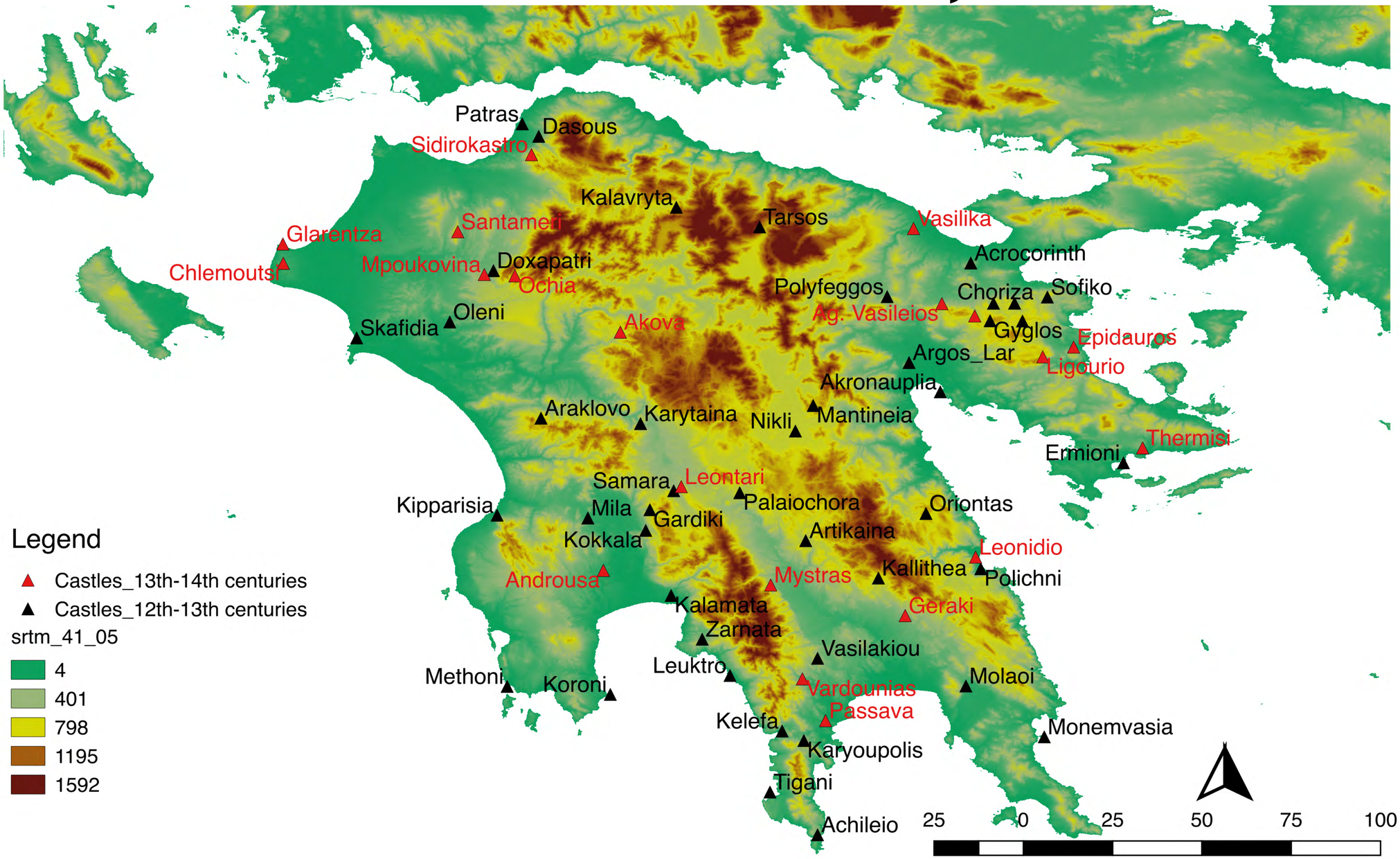
Geraki
Zarnata
Vasilakiou
Leuktro
Methoni
Koroni
Molaoi
Passava
Kelefa
Monemvasia
Karyoupolis
Tigani
Achileio
Legend
Castles_13th-14th centuries
Castles_12th-13th centuries
srtm_41_05
4
401
798
1195
1592
25
0
25
50
75
100 k

What kind of network analysis should I have used?

Could I have used Social Network Analysis??

Could I have used Social Network Analysis??
Formal Network Analysis??
Similarity Networks? ?

Castles!!! Why??



(K.Ragkou)

Little reminder: Centrality measures

- Betweenness

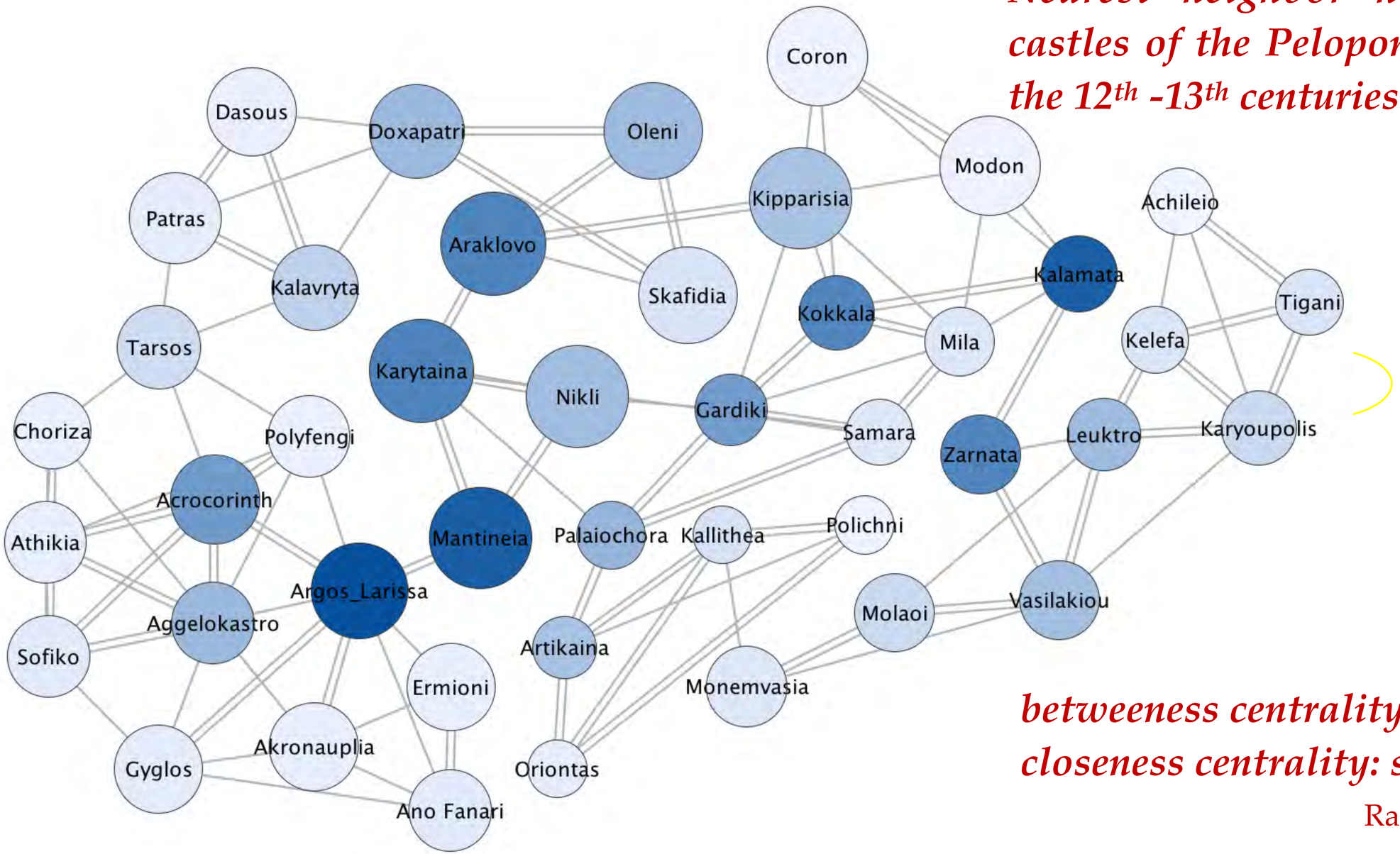
The Betweenness of a node is defined as the number of times a node acts as a bridge on the shortest path between two other nodes. Thus, nodes with high betweenness can be regarded as important waypoints on the connections between other nodes, but also as bottlenecks in the network.

- Closeness

The Closeness of a node is the distance of the node to all other nodes in the network. Nodes with a high closeness can reach all other nodes of the network in fewer steps than nodes with a low closeness.

Spatial Networks: model of Interaction and exchange based on the location of the castles

Nearest neighbor networks of castles of the Peloponnese during the 12th -13th centuries



betweeness centrality: colour

closeness centrality: size

Ragkou 2020)

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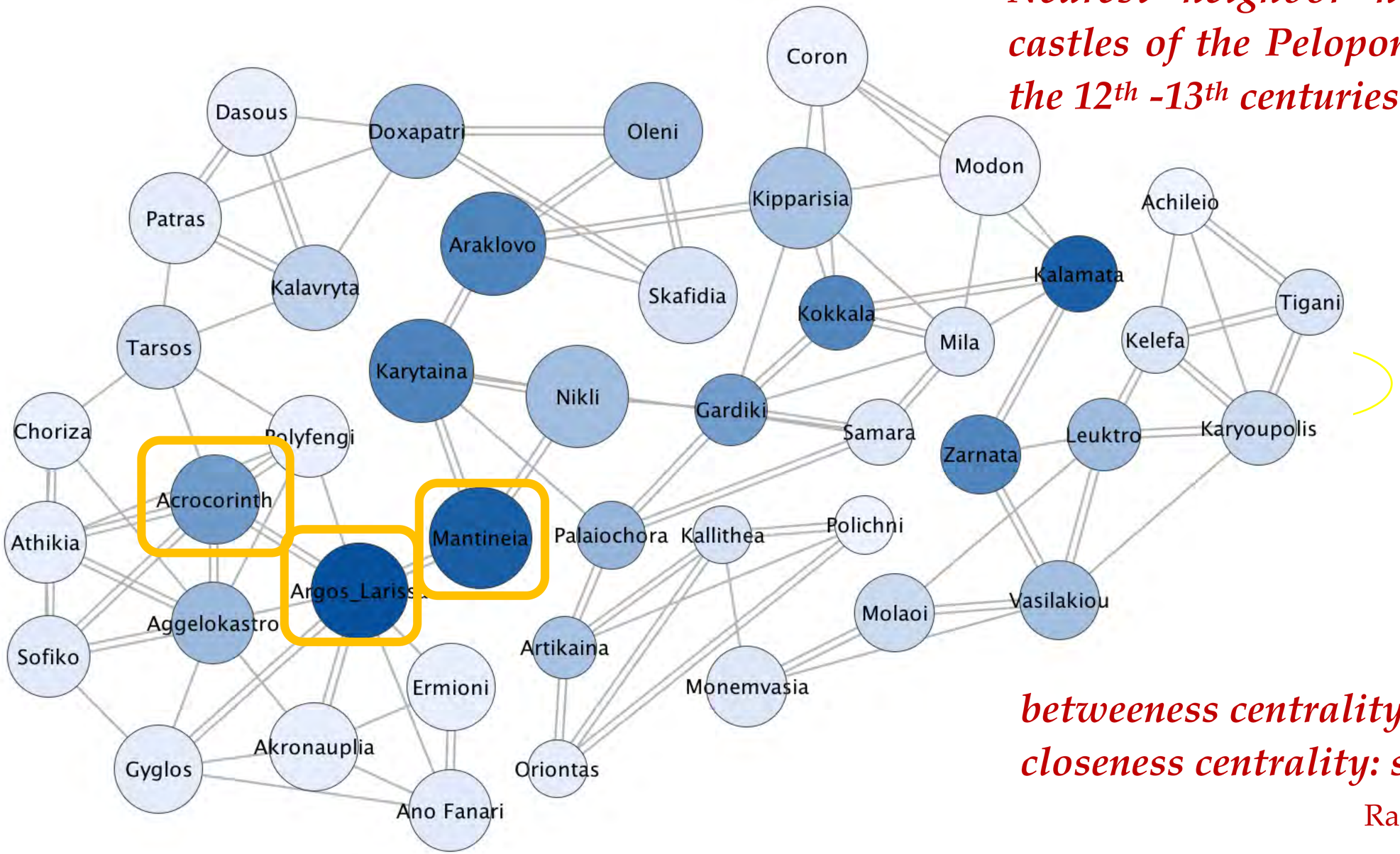

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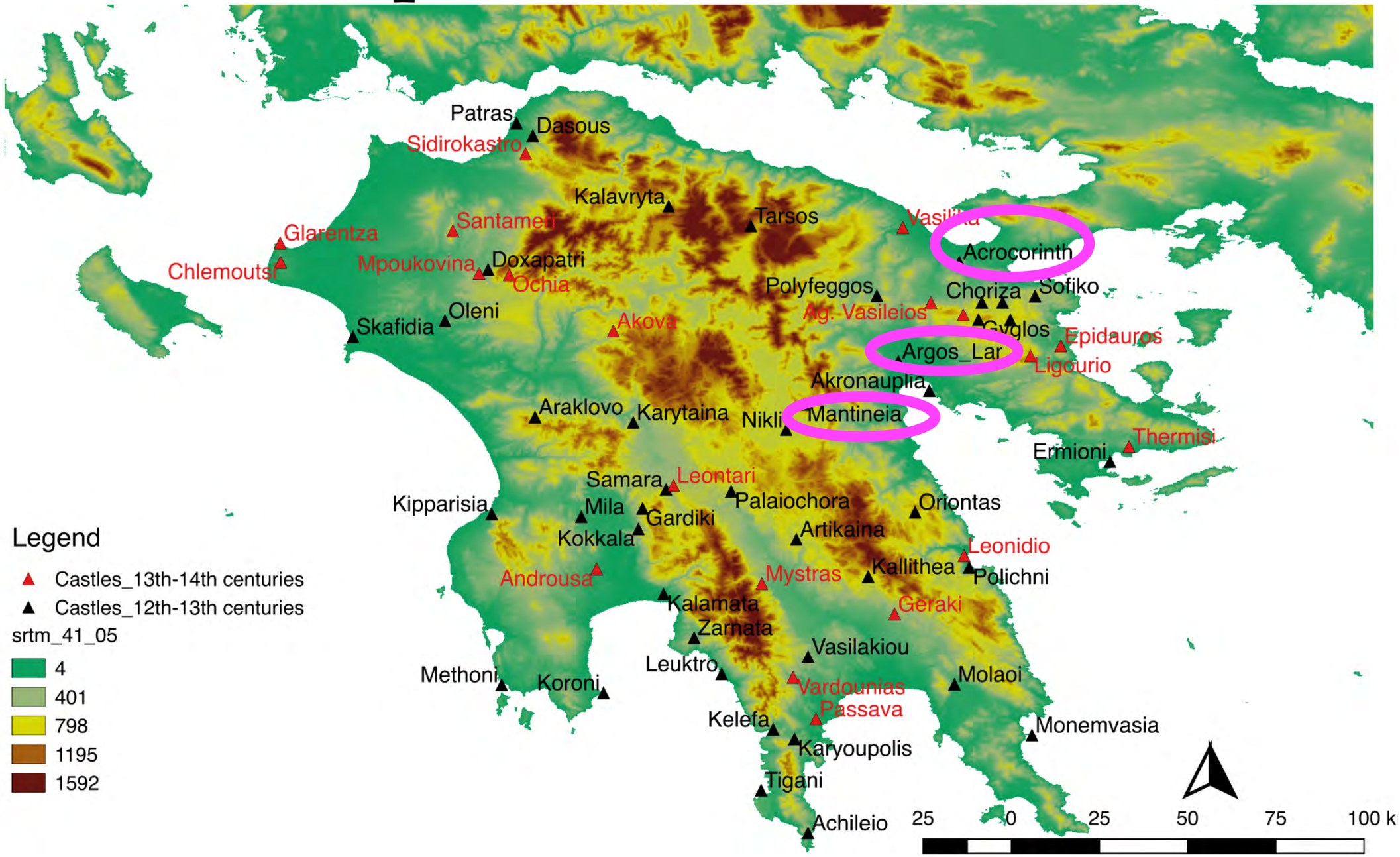
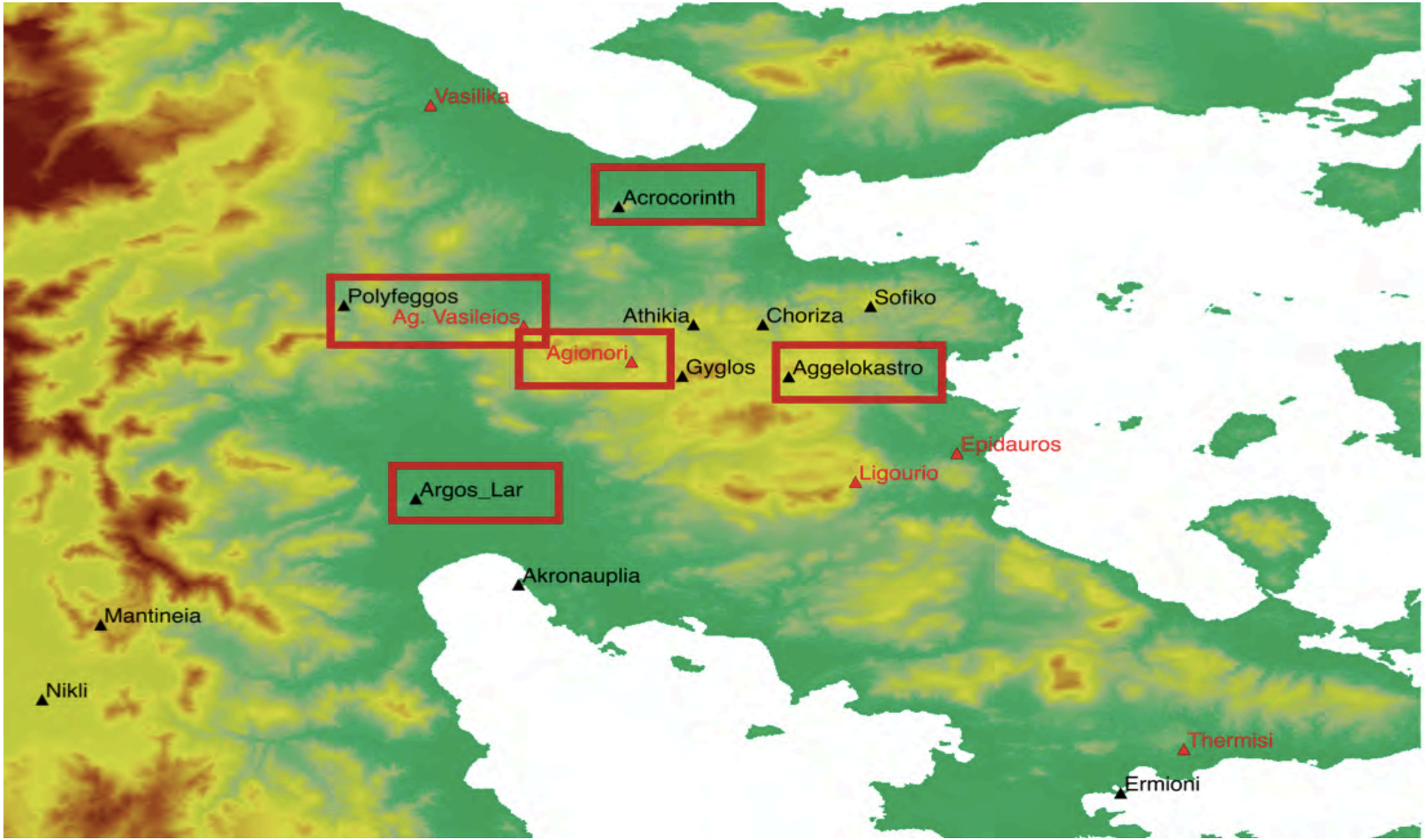
closeness centrality: size

Ragkou 2020)

Spatial Networks



Spatial Networks



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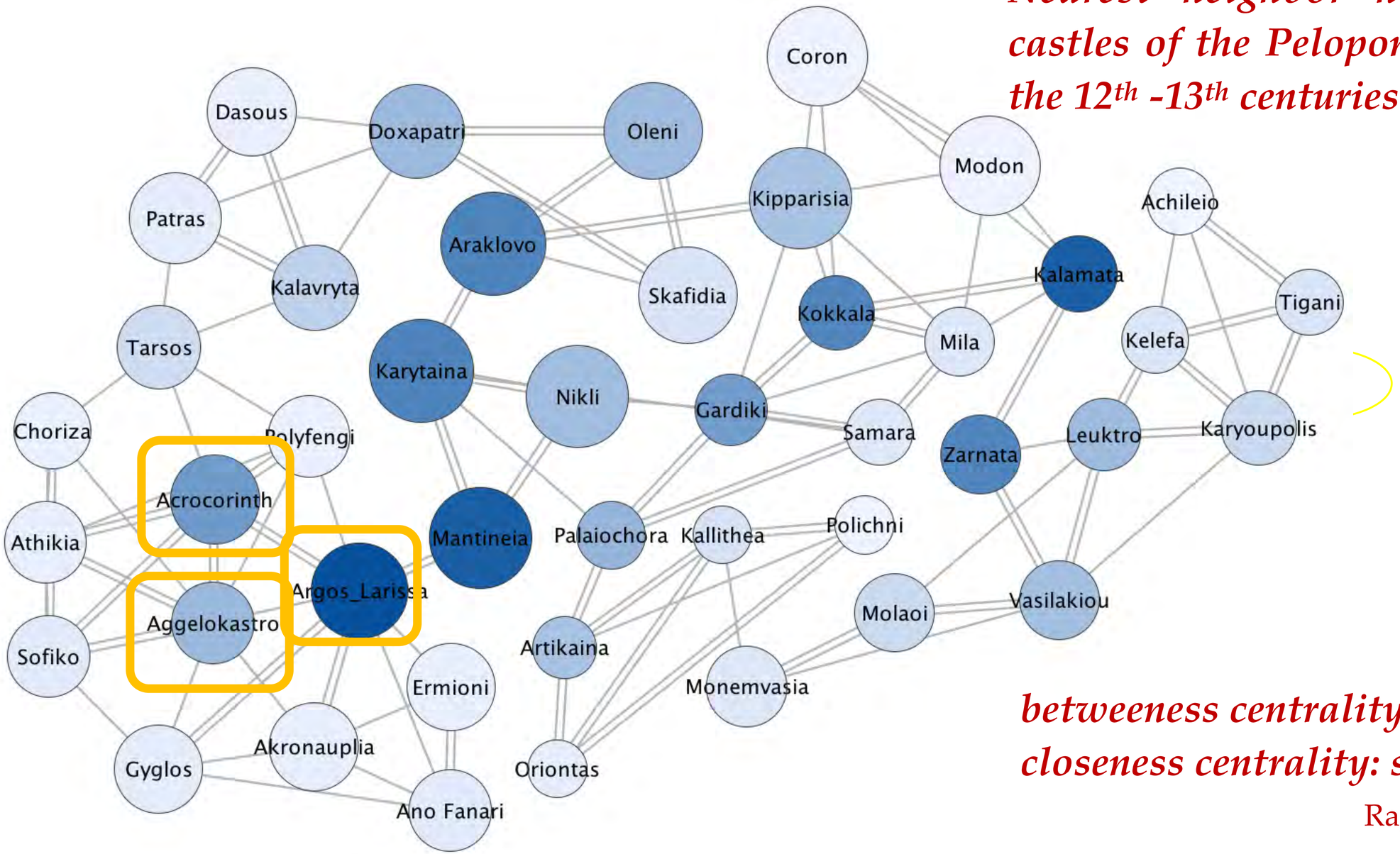

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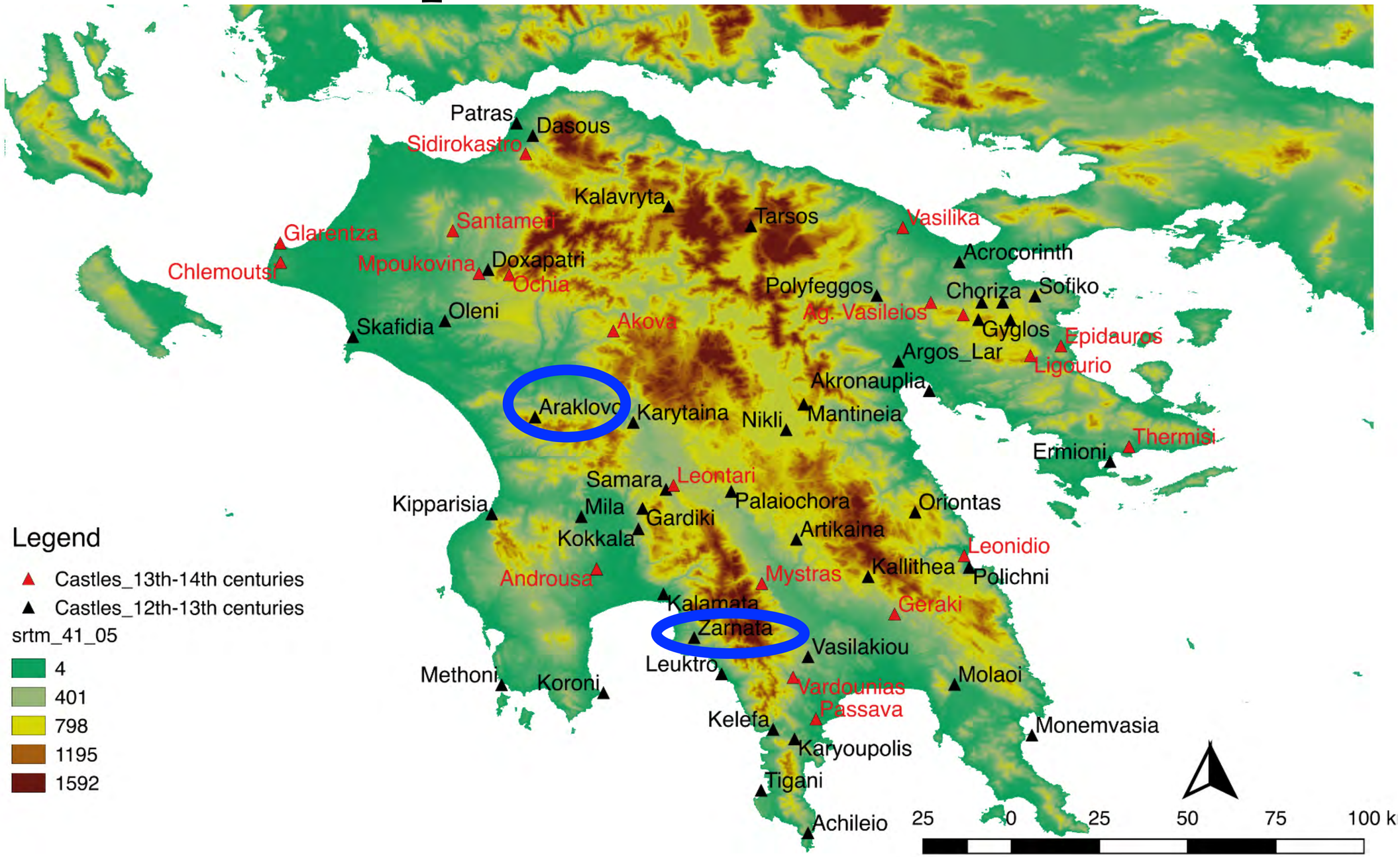
closeness centrality: size

Ragkou 2020)

Spatial Networks



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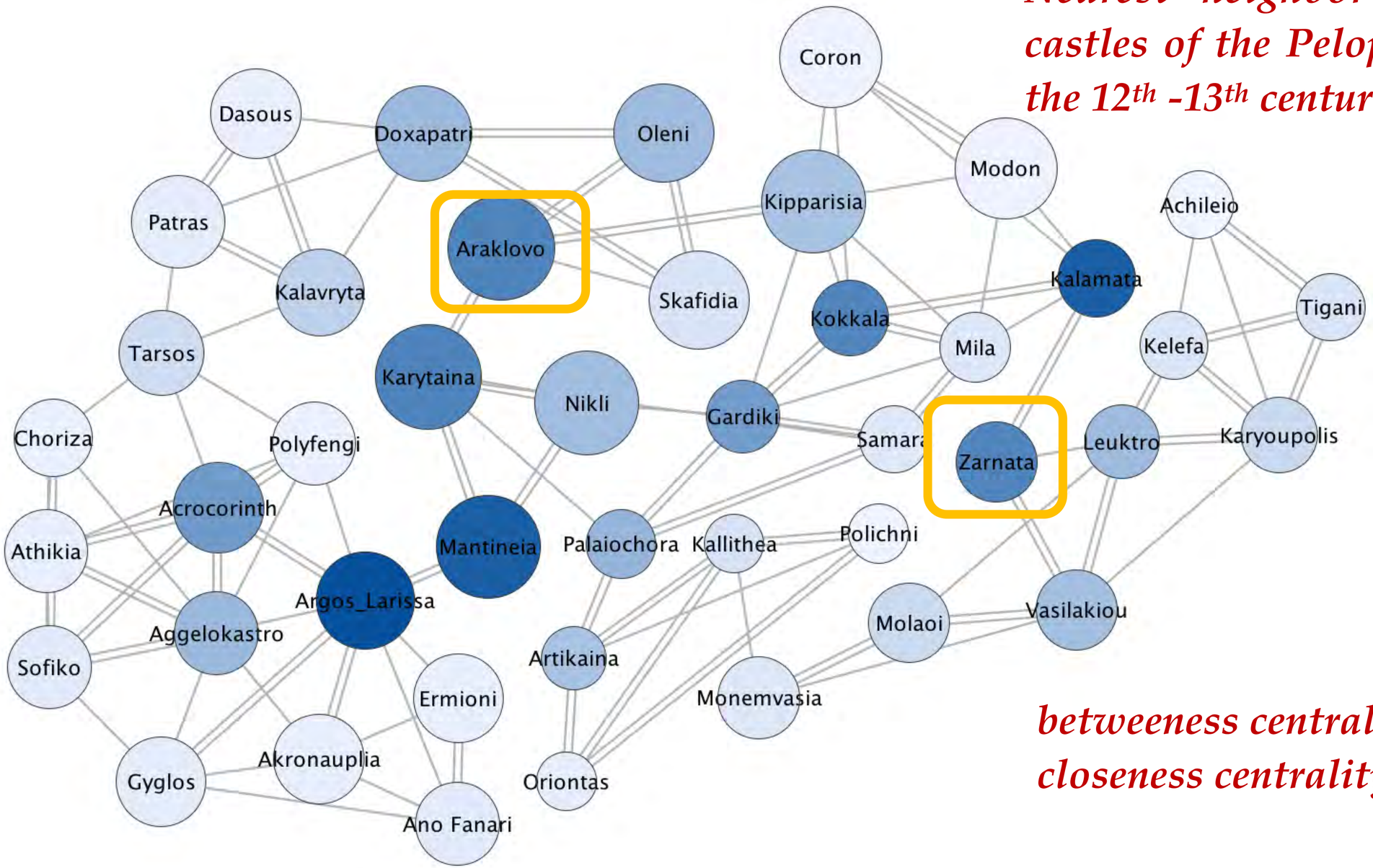

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Ragkou 2020)

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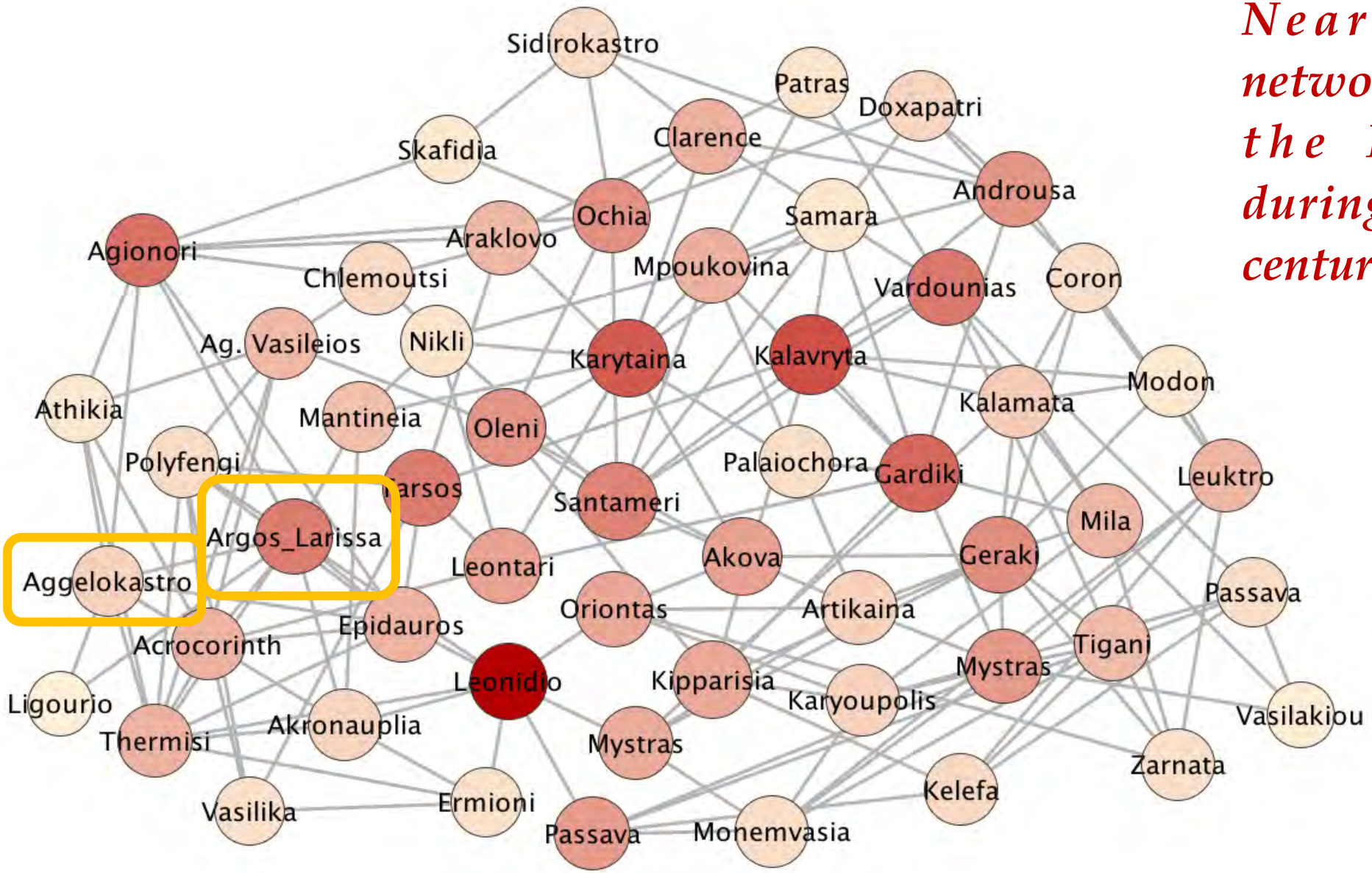

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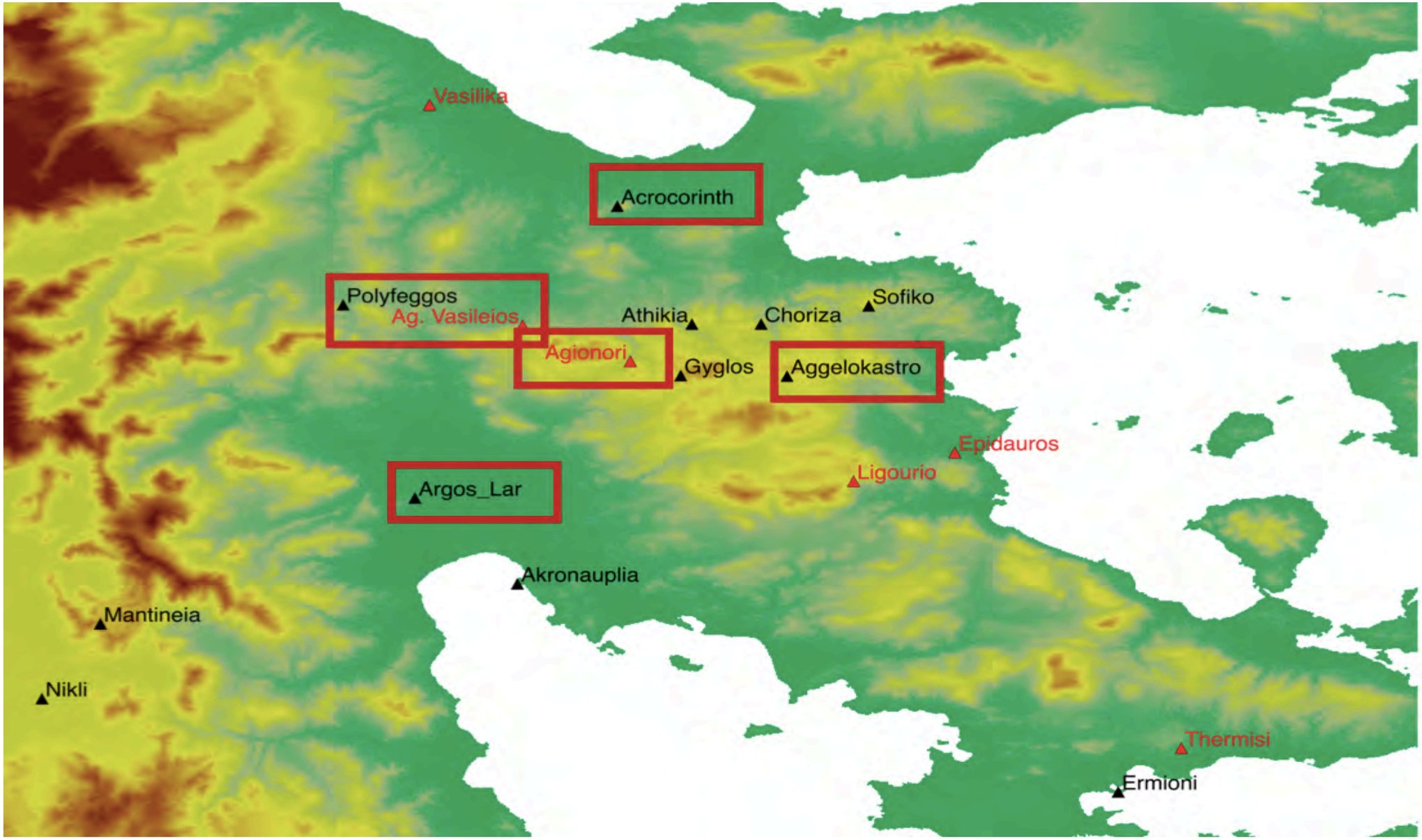
closeness centrality: size

(Ragkou 2020)

Spatial Networks



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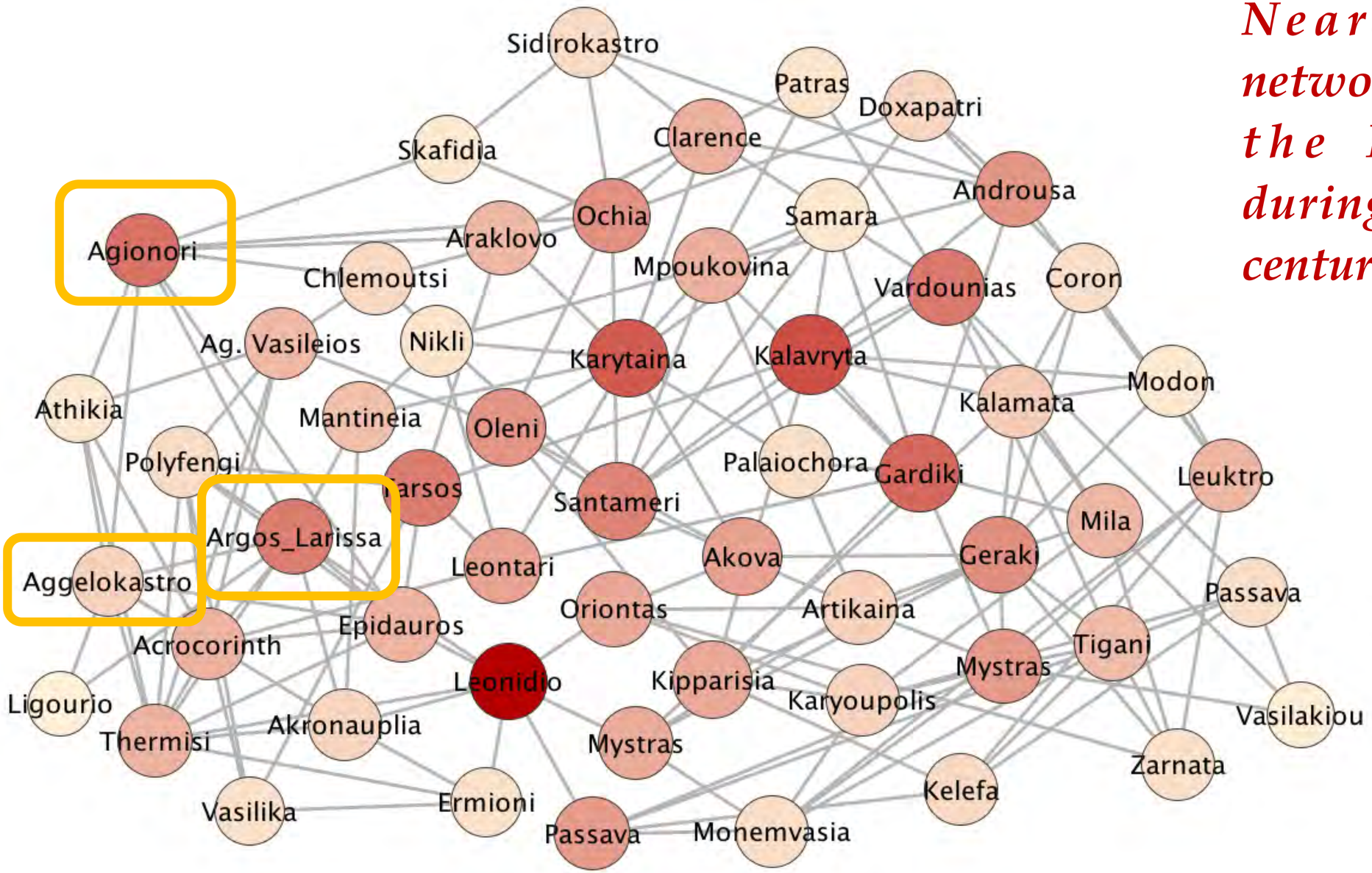

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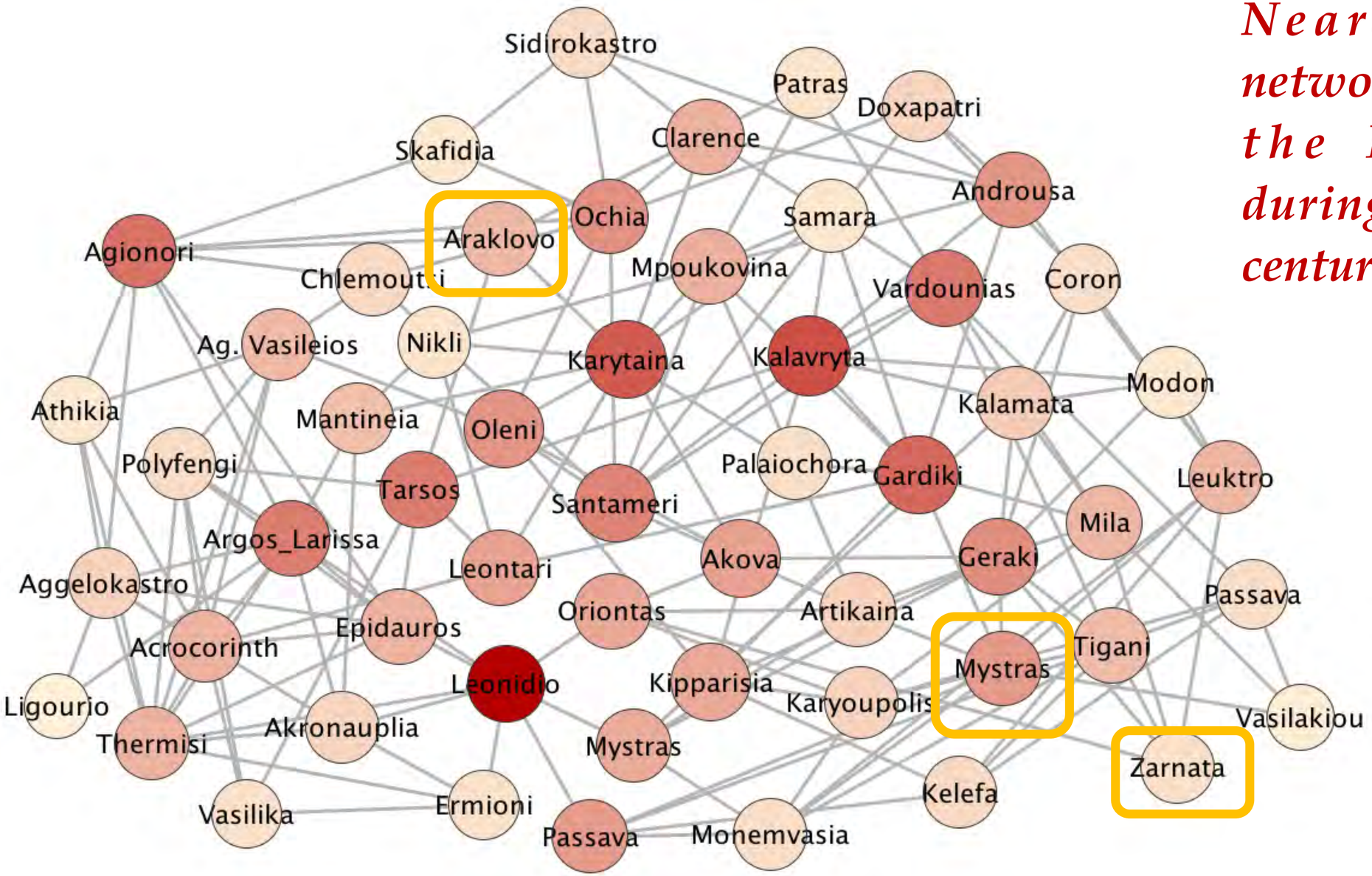

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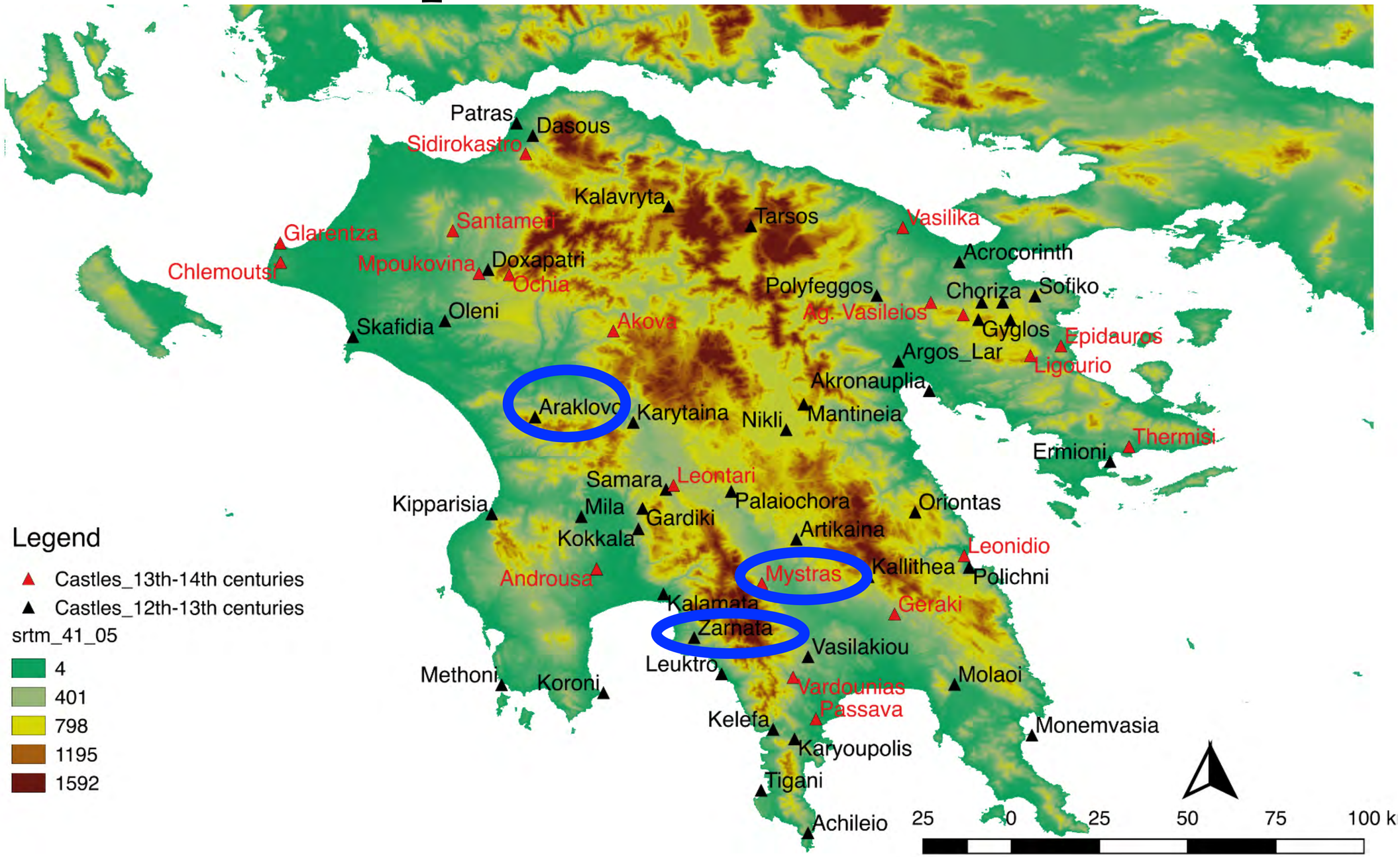

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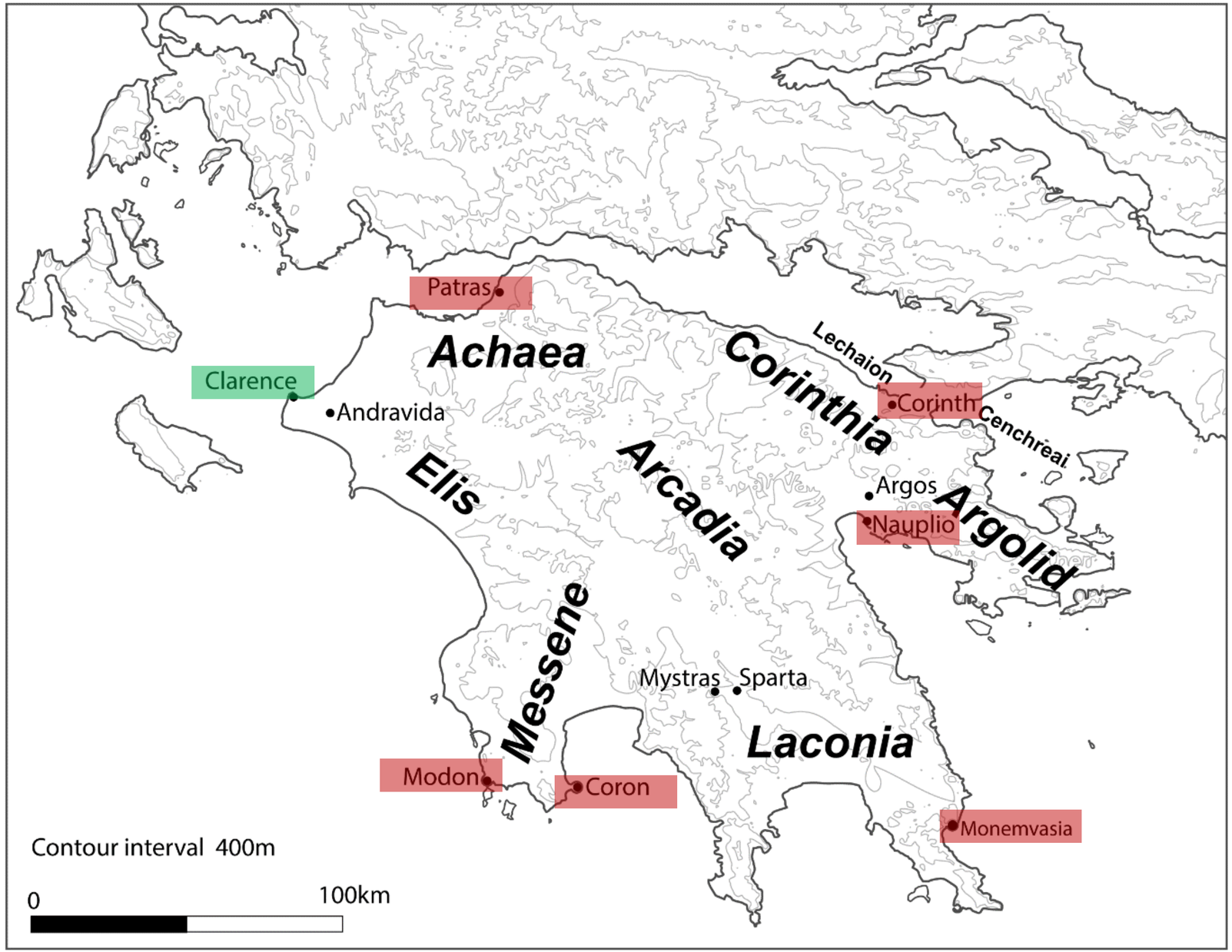

Spatial Networks

Port Town	Administration Service	Safety Service	Manufacturing Service	Commerce Service	Religious Service	Higher-Order Center	Lower-Order Center
1. Corinth	X	X	X	X	X	v	
2. Patras		X	X	X	X	v	
3. Monemvasia		X	X	X	X	v	
4. Nauplion		X		X	X		v
5. Modon		X		X	X		v
6. Coron		X		X	X		v

The port towns in the 11th and 12th centuries with their central services (Ragkou 2019).

Port Town	Administration Service	Safety Service	Manufacturing Service	Commerce Service	Religious Service	Higher-Order Center	Lower-Order Center
1. Glarentza	X	X	X	X	X	v	
2. Patras		X	X	X	X	v	
3. Monemvasia		X	X	X	X	v	
4. Corinth		X	X	X	X	v	
5. Modon		X		X	X		v
6. Coron		X		X	X		v
7. Nauplion		X		X	X		v

The port towns in the 13th and 14th centuries with their central services (Ragkou 2019).

Concluding Remarks

11th-12th centuries

- **Economic advancement of the Byzantine Empire**
- **Growth of primary and secondary production.**
- **The manufactured products of the Empire and its coins are distributed beyond it, but agricultural products are not exported outside the Byzantine Empire**
- **Dispersed settlements patterns**

13th-14th centuries

- **Re-organization of the economy**
- **Focus on the exploitation of the countryside, surplus is distributed across the Mediterranean**
- **The industrialized sector diminishes, manufactured products of the West appear in the Peloponnese and former Byzantine lands. The number of Byzantine coins outside the Empire drops significantly, while the coins of the Principality of Achaea can be found in Southern Italy.**
- **Nucleated settlements patterns.**

Concluding Remarks: Wider Perspective

This type of analysis ascertained:

- The long term impact of the political-territorial changes on the economy of the Eastern Mediterranean, as well as how these changes affected the region of the Peloponnese

- The diachronic dynamics of socio-economic complexity through the interdependence of multi-scalar networks

NETWORK ANALYSIS IN ARCHAEOLOGY
THEORY, PRACTICE, AND APPLICATIONS

Thank you!!!!

Katerina Ragkou, katerina.ragkou@uni-marburg.de, 13.05.2025

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