A system of ups and downs: Roman rural landscapes in Northern Noricum

(Supplementary Materials)

Settlement development of Roman Antiquity in the Area of Interest (AOI)

Appendix 1: Materials – Addendum

1 Material culture

In the current study, archaeological "material culture" encompasses movable and immovable objects of past societies – these simultaneously are derived from and contribute to the archaeological record. "Movable" objects, often referred to as "small finds" or, more broadly, "artifacts," encompass manufactured items such as pottery fragments, coins, and tools. These tangible remnants testify to human craftsmanship and the routine facets of daily life. Regardless of their size or perceived value, artifacts offer essential insights into various societal aspects, such as socio-economic structures, technological proficiency, and artistic inclinations. Conversely, "features" or "contexts" denote immovable or fixed elements of the material culture and, by extension, the archaeological record. This category includes artificial structures as well as landscape modifications such as walls, kilns, and roadways. As enduring elements within the archaeological milieu, these "immovable" features impart significant information concerning architectural practices, urban planning strategies, environmental adaptations, and the spatial dimensions underpinning human activity. In sum, artifacts and features constitute material culture, yielding a holistic and multi-dimensional perspective on the past. They represent fundamental components of the archaeological record and contribute invaluable data to reconstruct and interpret human history. The combined study of these elements facilitates a comprehensive analysis of societal evolution, cultural practices, and historical progression, thus enriching our understanding of cultural heritage.[1]

Accordingly, for the analysis presented in this study, the archaeological features, based on the reworked "BDA-sites," were classified into 11 types: "agricultural features" include all aspects of farming, such as soil cultivation and livestock management. "Ceremonial features" cover finds related to various cultural and social practices, including commemorating individuals, political events, or religious celebrations. "Fortificatory features" consist of a range of defensive structures, from extensive fortifications to specific sections with multiple functions. "Funerary features" are linked to burials and related practices, including grave pits and monuments. "Industrial features" relate to technologies used in manufacturing products like pottery. "Infrastructural features" support essential societal functions through elements such as roads and waterways. "Monuments" are representative objects, aesthetically designed, and capable of bearing reliefs and/or inscriptions; "monuments" catalog items that do not fit elsewhere, in contrast to, e.g., burial structures with inscriptions which belong to "funerary features." The "other features" category includes entirely unclassifiable findings, indicating potential for further archaeological investigation. "Settlements" are defined areas showing signs of prolonged human activity, structured for residential and

[1] Balme 2008; Emery 2008; Hagmann 2019b, 100; Renfrew and Bahn 2000, 567; Watkinson and Corfield 2008.

possibly economic functions. “Single finds,” often accidental, can indicate further archaeological interest in an area and include isolated surface finds from ancient losses. “Treasures” refer to valuable items stored to protect them from theft, sometimes found as hoards together due to their cultural deposition process.[2]

2 Extended history of research

To understand the broader Roman rural landscape in the study area, overview works are invaluable, providing a “bird’s eye view” of the ancient rural settlement. Seminal works supplying such overviews for (Northern) Noricum include those by G. Alföldy (1974), T. Fischer (2002), V. Gassner et al. (2002–2003), M. Konrad (2012), R. Risy (2009), W. Rosner (2008), Scherrer (2002b) and J. J. Wilkes (2005). These resources offer a comprehensive understanding of the characteristics of Noricum, serving as a fundamental reference for archaeological and historical investigations.

Aside from texts, cartographic visualizations stand out as seminal works in the field of the research questions treated in the present study, providing valuable geographical context for scholars and researchers interested in the Roman settlement in Noricum. The history of mapping the general Roman settlements in the AOI is rich and varied, with significant contributions from several scholars: Early cartographic representations have been produced by Beninger (1934), Egger and Vetters (1963), Kenner (1869 and 1870), Mitscha-Märheim (1967), Pascher (1949), Polaschek (1928 and 1936), Riedl (1936), Sacken

[2] Hagmann 2021a; Hagmann 2021b; Hagmann 2024.

(1877), as well as Vetters and Mitscha-Märheim (1958).[3] A more recent one is provided by E. Olshausen (2011). Among these, one of the most renowned, and notably the only one in English solely dedicated to the region of interest, is the general map of Noricum by Alföldy (1974).

[3] Alföldy 1974, 414 General Map of Noricum; Beninger 1934; Egger and Vetters 1963; Kenner 1869; Kenner 1870; Mitscha-Märheim 1967; Olshausen 2011; Pascher 1949; Polaschek 1928; Polaschek 1936; Riedl 1936; Sacken 1877; Vetters and Mitscha-Märheim 1958.

Appendix 2: Methods – Addendum

3 GIS data management and data analysis

A Geographic Information System (GIS) is a computer-based tool designed for the digital capture, storage, management, updating, analysis, and presentation of spatial data, serving as the central software for all archaeological work. The project workflow extensively and systematically utilized Free and Open-Source Software (FOSS). QGIS, developed in C++ with Long Term Release (LTR) versions from 2018 to 2022—including versions 3.4 "Madeira," 3.10 "A Coruña," 3.16 "Hannover," 3.22 "Białowieża," and 3.28 "Firenze"—was the primary software for most GIS-related tasks. QGIS supports various data types and file formats, enabling the processing of archaeological data and facilitating temporal, thematic, and spatial analyses. The source code, available under the GNU Public License (GPL) Version, is freely accessible and modifiable, promoting reproducibility and transparency in research and avoiding "black boxes." Nevertheless, in pursuit of practicality, maximum flexibility, and efficiency, the project also selectively used ESRI ArcGIS versions, including ArcGIS Pro 2.5.0, 2.9.5, and 3.2.1, specifically for diverse analytical purposes. These software applications are considered integral tools in the scientific process, used for both data processing and socio-archaeological interpretation.[4]

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[4] Conolly and Lake 2006; Gillings et al. 2019; Gillings et al. 2020; de Lange 2020; Marwick 2017; Menéndez-Marsh et al. 2023.

All information on rural Roman settlement was stored in a GeoPackage database, which is technically an open source SQLite container. Data sets obtained from third parties mostly in the form of widely used ESRI shapefiles, which serve as the de facto file type standard, were exported to the GeoPackage database. The use of GeoPackage as a relational database system (RDBS) allows the spatial and non-spatial information to be managed in a simple and platform-independent database that does not rely on a server and is thus completely maintenance-free in the form of only a single file that could be opened on mobile devices. QGIS was used as the relational database management system (RDBMS) for indexing and managing the data, although other GIS such as ArcGIS Pro are also suitable for working with GeoPackages. This approach also allows, if desired, the maximum dissemination of archaeological information to all interested recipients by making the database itself, and thus the entire data base, available in an online repository.[5]

4 GIS-based cartographic data visualization

Cartographic visualizations, as graphic presentations of geodata, serve as the ideal medium for communicating archaeological data, which inherently possess spatial references. Within the context of this project's digital cartography, such visualizations are accorded significant importance. A tailored design has been established for the maps, manifesting as a unique "visual signature" for the study – such a signature aims to

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[5] Morgan and Eve 2012, 525.

increase the recognizability of all project-related outcomes by employing a consistent and distinctive visual language. This approach is primarily based on systematically using standardized, project-specific templates for cartographic presentations; additional elements, such as a custom-designed north arrow, uniform color schemes optimized for individuals with color vision deficiencies, and a modern, legible font aligned with the University of Vienna's corporate design further contribute to this signature. The commitment to creating barrier-free visual elements, mainly through color optimization, fosters an inclusive research and academic environment. This approach can be considered a stride towards a more comprehensive open science and is especially crucial for the geostatistical classifications visualized as variably colored thematic maps – commonly area cartograms or choropleth maps. These maps visualize singular, relative, and area-related quantities (e.g., feature density per administrative unit) by adapting the graphical representations of the corresponding areas. These representations hold significant importance across various disciplines; consequently, theoretical research on choropleth maps began gaining attention as early as the 1970s. Given that color schemes used in such maps could adversely affect individuals with color vision deficiencies, it is imperative to take specific precautions to ensure that the visualizations are accessible to all. Fortunately, ample resources, such as color schemes designed to accommodate various color vision deficiencies (e.g., protanopia and deuteranopia), are readily available and implemented in widely used GIS software solutions like QGIS.[6]

The visualization of results through static digital maps enables the representation of socio-temporal aspects of ancient Roman settlements in the AOI from diverse archaeological, cultural, and humanistic perspectives. This component is distinct within the work and transcends the mere depiction of individual aspects typically presented in a simple drawn map or sketch.[7]

Rather than merely illustrating data, this study aims to create a "spatial narrative" that complements the written text, visually conveying the complexities of rural settlement. This approach is not without its challenges. Visually attractive maps and graphical depictions of archaeology may inadvertently obscure intricate details and perpetuate preconceived notions. The risk lies in a dualism where both the conveyed and received information could potentially be distorted. In the model of cartographic communication discussed by N. de Lange, the inherently fragmented and subjectively interpreted past reality is first abstracted by the researchers into a "primary model." This primary model is then further abstracted for cartographic representation into a "secondary model." In the present case, both the primary and secondary models are authored by the writer of

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[6] Brewer 2003; Brewer and Pickle 2002, 662–63; Culp 2012, 302–4; Ehlers and Schiewe 2012, 101; Fisher 1958; Hagmann 2020a, 125–26; Jenks and Caspall 1971; Lange 2020, 289, 317; Wu et al. 2018. Adobe's open-source font "Source Sans Pro" was used: https://github.com/adobe-fonts/source-sans/tree/main. As for the north arrows used, see https://phaidra.univie.ac.at/o:922234 and https://phaidra.univie.ac.at/o:922236. Although the use of a north arrow is not strictly necessary, as maps are generally oriented to the north, it was included for consistency.

[7] Grzybalska 2010; Kempf 2019; Smejda 2014; Šmejda and Turek 2004.

this study. Depending on the effectiveness of the cartographic visualization, these models can serve as the basis for an adequate "tertiary model." Finally, this multi-layered tertiary abstraction – or, in the worst case, distortion – is interpreted by the audience. The quality of this interpretation, respectively the tertiary model, depends on both the viewer's prior knowledge and the representational quality of the cartographic visualization originating from the primary and secondary models. Thus, it's a complex interplay between the production and reception of cartographic visualizations that determines whether a map can be read correctly, meaning in a manner that closely and precisely represents reality.[8]

To address these challenges, each cartographic output was generated exclusively within a digital workflow in a GIS based solely on data. As a result, the cartographic visualizations are transparent and repeatable products of a data-driven scientific methodology, whereby the data basis is supplied as supplementary material of this study. This approach eliminates the subjective, purely – "artistic," i.e., subjective – drafting of a map that could otherwise significantly influence the visualizations. Instead, it provides a digital representation of various types of data, either collected during the research or generated independently and subsequently analyzed. This approach ensures that all visualizations can be reproduced and verified by third parties in the exact manner presented in this work – a verification level not easily achieved with subjective drawings.

[8] Dunn 2019; Lange 2020, 298–301; McCoy and Ladefoged 2009.

Further, these visualizations extend beyond mere map sketches, particularly in the archaeological context, by integrating various aspects of interpretive representation with additional information. For example, they can combine 2.5D representations of the topography and examine space and time from diverse perspectives within a single visualization. Distribution maps based on geostatically analyzed and classified site distribution patterns are combined with geodata related to bodies of water, their flow direction, and elevation values providing 3D information, telling a complex story about the past using contemporary data – this methodology can be termed "deep mapping." However, there is a lack of consensus within relevant research on the precise definition of deep mapping. In this paper, the interpretation of deep mapping, as outlined by Early-Spadoni, is employed. According to this view, a deep map is a multi-layered, digital cartographic representation that empowers cartographers to illustrate both geographical and, for instance, social spaces in various ways. Such a map can be achieved by including multimedia content or intricate information compositions distributed across multiple layers and presented in a single digital map.[9]

A map visually narrates its sub-story related to the subject matter, thus contributing its unique aspect to the overall content of the work. The downsides of this form of visualization include the substantial labor required for map creation, susceptibility to errors in detail due to the high complexity of the information, the increased time needed for capturing the map's data, and the potential for viewers to find the map overloaded

[9] Earley-Spadoni 2017, 96.

with an excess of information. Nonetheless, digital cartography and deep mapping, although not always explicitly labeled as such, have long been commonplace in archaeological publications and are fundamentally not new approaches. Consider, for instance, archaeologically interpreted geophysical survey images, which often combine data on various archaeological findings from different periods, along with recent ground interventions such as those related to infrastructure projects. These images may also incorporate current aerial photographs and up-to-date administrative geospatial data, like property boundaries, all unified in a single visualization. Consequently, cartographic visualization can serve not just as an indirect tool but also as an active instrument in archaeological research – moreover, beyond this methodological level, it can be an integral component of the theoretical discourse related to the research question.[10]

Finally, the visualization of terrain models and surface reliefs was conducted using a color-hypsometric representation, complemented by threefold-exaggerated, multidirectional hillshading and a slope gradient. This layered and interrelated approach to depicting the Earth's surface is strongly aligned with an innovative methodology discussed by J. Tzvetkov in 2018. This straightforward yet efficacious combination of multiple overlaid derivations from a single dataset offers a more detailed portrayal, thereby improving the quality of surface relief visualization compared to simple hill-shading alone.[11]

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[10] Earley-Spadoni 2017; Hagmann 2020b; Lewis 2015; Roberts 2016.
[11] Tzvetkov 2018.

The resulting maps were subsequently employed for cartographic visualization, primarily plotted in the TIF file format, and integrated into the text.[12]

5 Digital elevation data and hydrological data

In the present context, a Digital Terrain Model (DTM) represents the Earth's surface after removing any recent anthropogenic and natural features, such as vegetation or buildings. Conversely, a Digital Surface Model (DSM) represents the Earth's surface inclusive of these current anthropogenic and natural features. Within the scope of this work, the term Digital Elevation Model (DEM) serves as an umbrella term encompassing both DTM and DSM, notwithstanding the existence of alternative definitions.[13] For analyses in the AOI necessitating a DEM, the foundational dataset utilized was the DTM of Lower Austria, which is available as Open Government Data (OGD) and has a resolution of 10 x 10 meters.[14] In addition to the primary DTM, supplementary DTMs were employed mainly for visualization purposes and were primarily acquired through an OGD-WMS (OGD-Web Map Service) server.[15]

In addition to OGD concerning the overall water network within the AOI, OGD on groundwater bodies, groundwater areas, and catchment zones in Lower Austria's Mostviertel-region were provided free of charge upon request. These data are accessible

[12] Smith et al. 2020.
[13] Hesse 2018.
[14] https://www.data.gv.at/katalog/dataset/46a7a06a-f69b-405e-aac2-77f775449ad3.
[15] https://basemap.at.

through the Web Mapping Application (WMA) eHYD. The data were employed to precisely delineate the study area based on spatial factors as well as for further analysis.[16]

6 Geostatistical analysis

For geostatistical analyses involving univariate classifications, the "natural breaks" method developed by F. Jenks was consistently applied to minimize data variance. This method was used to define the most appropriate class divisions based on the data values, specifically for clustering the proportional components of the subject under investigation.[17]

To determine hotspots in the dataset, the Getis-Ord Gi* algorithm was applied using the Hot Spot Analysis (Getis-Ord Gi*) tool from the Spatial Statistics toolbox in ArcGIS Pro.[18] The method was introduced in 1992 by A. Getis and J. K. Ord.[19] The Getis-Ord Gi* statistic is a local measure of spatial association, crucial for identifying areas where high or low values cluster spatially. The Getis-Ord Gi* algorithm calculates a z-score and p-value for each findspot to identify statistically significant spatial clustering. The z-score compares local values to global averages, with high positive values indicating hotspots — areas of unusually dense findspot clustering, suggesting heightened human activity. In contrast, low negative z-scores signify, if relevant, cold spots with sparse findspot concentrations.

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[16] https://ehyd.gv.at/.
[17] Fisher 1958; Jenks and Caspall 1971.
[18] https://pro.arcgis.com/en/pro-app/latest/tool-reference/spatial-statistics/hot-spot-analysis.htm.
[19] Getis and Ord 1992; Ord and Getis 1995.

The p-value determines the likelihood that the observed clustering is due to chance. Together, the z-score and p-value provide a dual measure of the intensity of clustering and its statistical significance, thereby offering a robust basis for identifying and interpreting spatial patterns in archaeological data. As a data basis, a hex-bin map[20] of the AOI was used (*infra*), counting the respective number of features per hexagon from a total of the 1184 Roman features used in the study.

To allocate the existing archaeological sites in the study area into four clusters based on the settlement centers identified in the AOI (namely, Arelape, Favianis, Augustianis, and Aelium Cetium), the k-means clustering algorithm was implemented using QGIS. In this algorithm, the set of features is divided into "k" clusters, with each feature being assigned to the cluster whose mean is closest to it. Hence, in the current study, "k" was defined as "4" according to given social-archaeological information, i.e., the four regional centers as defined by the hotspot analysis. K-means clustering was applied to Voronoi diagrams of the AOI based on the 551 findspots as well as the 129 sites respectively. To achieve this output, the algorithm in QGIS calculates the centroid of the clustered features and their respective 2D distances to this centroid.[21] The conceptual foundation of k-means clustering is attributed to different researchers who have developed it at different times,

[20] Each hexagon has a 2000-meter edge length.
[21] In the current study the software QGIS was used for this task: https://github.com/qgis/QGIS-Documentation/blob/master/docs/user_manual/processing_algs/qgis/vectoranalysis.rst#k-means-clustering.

including H. Steinhaus in 1956, J. MacQueen in 1967, S. Lloyd in 1957/1982, and E. W. Forgy in 1965.[22]

7 Tessellation

In more advanced applications, particularly in archaeology, tessellation is used to analyze and interpret various spatial information types: Like most applications in archaeological computing, the approach of defining associated territories based on known centers and thereby segmenting the landscape originates from the realm of Processual Archaeology. The procedure related to tessellation or tiling involves breaking down a given area into smaller, adjacent tiles without leaving any empty spaces between them – consequently, it is also assumed that there are no "empty" spaces between the polygons and every part of the whole study area is covered by a polygon. The most used method in this field involves dividing a study area based on a known spatial point distribution. In this case, these points symbolize archaeological rural sites. Each individual point is surrounded by a polygon designed to encompass the maximum possible area about that point. Due to its historical development and multiple parallel definitions, this approach is known by various names, including "Dirichlet Tessellation" (after P. G. Lejeune Dirichlet), "Thiessen Polygons" (after A. H. Thiessen), and most

[22] Forgy 1965; Lloyd 1982; MacQueen 1967; Steinhaus 1957.

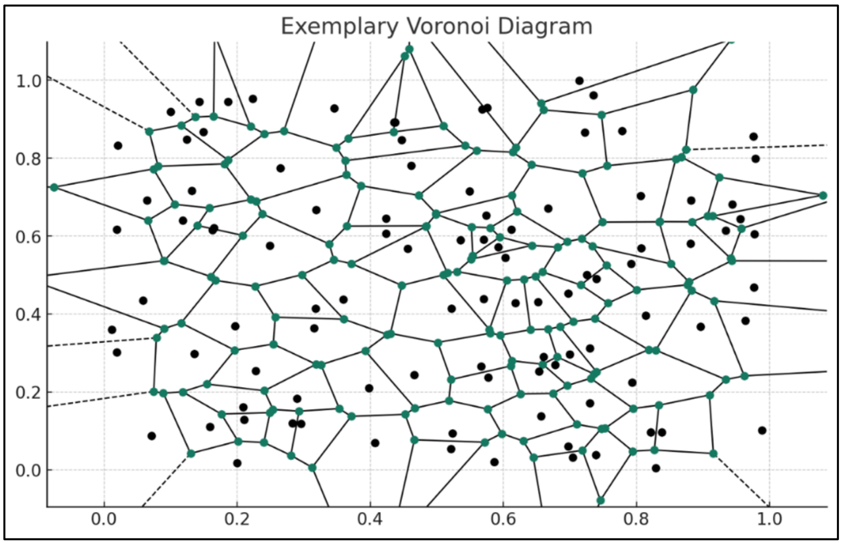
commonly, “Voronoi Diagrams” (after G. Feodosyevich Voronoi).[23] Appendix – Figure 1 shows an exemplary Voronoi diagram based on 100 randomly generated points. For the figure, the software ChatGPT (GPT-4, August 3, 2023 Version) was used, applying Python:

```
import matplotlib.pyplot as plt
import numpy as np
from scipy.spatial import Voronoi, voronoi_plot_2d

# Generate 100 random points
np.random.seed(0)
points = np.random.rand(100, 2)

# Compute Voronoi diagram
vor = Voronoi(points)

# Plot Voronoi diagram
fig, ax = plt.subplots()
voronoi_plot_2d(vor, ax=ax)
ax.plot(points[:, 0], points[:, 1], 'ko')
ax.set_title('Exemplary Voronoi Diagram')
plt.show()
```



Appendix – Figure 1 An exemplary Voronoi diagram based on 100 randomly generated points: Each point (black dot) represents a generator element, and the lines divide the space into regions that are each closer to a specific point than to any other.

[23] Conolly and Lake 2006, 211; Herzog and Schröer 2019, 2; Hodder and Orton 1979, 187–95; in the current study the software QGIS was used: https://github.com/qgis/QGIS-Documentation/blob/master/docs/user_manual/processing_algs/qgis/vectorgeometry.rst#voronoi-polygons.

8 Binning and Cartograms

Cartograms are map-like representations that come in various forms and are intentionally distorted. One such variant is the continuous area cartogram, or anamorphic map, where the map is distorted based on selected data values. The aim is to preserve the original map's topology at least to a certain extent, so features like national borders remain recognizable despite the distortion. To generate such maps, specialized algorithms and GIS tools are employed, including the QGIS cartogram3 plugin developed by C. Fink. This plugin uses a widely adopted algorithm for map anamorphosis from 1985 by J. A. Dougenik, N. R. Chrisman, and D. R. Niemeyer.[24] Cartograms are combined in this study with another visualization method, called "binning." In the course of binning, dense and complex point patterns are mapped onto an underlying artificial grid to distinguish more clearly between denser point clusters and sparser distributions. Among the variants, "hexagonal binning" is visually and communicatively appealing: It uses hexagons as the foundational grid for generating "hex-bin maps." Hexagons offer a symmetrical and regular internal division of the base grid, enhancing the readability of cartographically displayed object distributions. Hence, for supplementary visualization of Roman-era sites in the AOI, a combined approach was chosen, blending a hex-bin map with a map anamorphosis based on B. Hennig's 2014 "gridded cartograms" concept. Since no ancient internal divisions exist for the AOI, an

[24] It is important to note that, in German, "Kartogramme" refers to choropleth maps, which are thematic maps, and should not be confused with cartograms.

alternative method was sought to display site distributions beyond simple point patterns or heat maps. Employing modern administrative boundaries for ancient-related questions would yield anachronistic visualizations, connecting ancient sites with current administrative borders and creating distribution patterns that were irrelevant in antiquity. For this reason, a hex-bin map was used to develop an alternative framework for displaying site distributions, including also map anamorphosis. The hex-bin map for the AOI, featuring hexagons with a side length of 66 meters, was generated using the QGIS plugin MMQGIS.[25] (**Error! Reference source not found.**)

9 Calculation of settlement decrease – code (Python)

For the most recent analysis of the settlement decline, the software ChatGPT (GPT-4, August 3, 2023 Version) was used, applying Python for calculation:

The decline from 112 to 53 sites represents a decrease of approximately 52.68%:

```
# Given values
initial_sites = 112
final_sites = 53

# Calculating the decline in percentage
decline_percentage = ((initial_sites - final_sites) / initial_sites) * 100
decline_percentage
```

```
RESULT
52.67857142857143
```

[25] Battersby et al. 2017; Briney 2014; Dempsey 2017; Dougenik et al. 1985; Hennig 2014; Horne 2018; Kam et al. 2012, 1354–55; Lange 2020, 315; Mapbox 2012; Minn 2012; Nusrat and Kobourov 2016; Tobler 2004; https://github.com/austromorph/cartogram3.

The decline from 110 to 53 sites represents a decrease of approximately 51.82%:

```
# Updating the initial sites value
initial_sites_updated = 110

# Calculating the decline in percentage for the updated value
decline_percentage_updated = ((initial_sites_updated - final_sites) / initial_sites_updated) * 100
decline_percentage_updated
```

```
RESULT
51.81818181818182
```

10 Plus Codes

To establish a consistent scheme for site localization and orientation within the catalog of archaeological sites, a decision was made against using a locally restricted grid tailored exclusively to the AOI. Instead, "Plus Codes" have been adopted to segment the AOI into standardized sections. These Plus Codes are primarily utilized to facilitate orientation within the catalog. They are based on the Open Location Code, a geocoding system that functions as an open-source standard. This system enables any global location to be represented consistently machine-readable, even in areas where traditional addresses do not exist. The principal advantage of this approach lies in the utilization of a globally standardized grid. Moreover, specific Plus Codes can be designated as "addresses" for each individual archaeological site or feature. Data for Lower Austria's spatial extent and the spatial scope of the AOI were procured via the Plus Code Grid Service.[26]

[26] Rinckes and Bunge 2019; data corresponding to level 0, 1, 2, and 6 was used.

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Appendix 4: Results

11 Settlement development

The AOI is a favorable place for human settlement, as evidenced in the study's dataset by the presence of 5,030 features within the AOI and the 1,184 features that are specifically pertinent to Roman Antiquity. These features, which span various time periods, are reflected in the dataset, comprising 7,694 features. Of these, 6,924 have precise geographical coordinates. The 1,184 features of Roman Antiquity can be clustered in 129 sites. (Appendix – Table 1; Appendix – Figure 2)

The dataset presents a structured tabulation of archaeological features across three distinct chronological periods: the Early Period, the Middle Imperial Period, and Late Antiquity. Each period is characterized by counts of distinct types of archaeological features, such as treasures, single finds, fortificatory, funerary, industrial, infrastructural, agricultural, and ceremonial features, among others. The categories are derived from a tailored controlled vocabulary, as the periods.[27] The dataset is an effective tool for temporal social-archaeological analysis: It provides a comprehensive overview, offering valuable insights into the complexities of life, economy, and social structures during these periods in the AOI.[28] (Table 1)

[27] Hagmann 2021a; Hagmann 2021b.
[28] Hagmann 2024.

The following general categories are the core of the analysis:

A notable trend across all periods is the decline in features from the Early Period (980) to Late Antiquity (449). This overall reduction is particularly evident in categories like single finds, settlements, and industrial and infrastructural features, which may signify socio-economic and cultural shifts over time. However, some categories, like fortificatory and funerary features, remain relatively stable, indicating a sustained focus on defense and mortuary practices. (Appendix – Figure 3; Appendix – Figure 4; Appendix – Figure 5)

The information provided by the dataset offers a multidimensional view of societal changes over time:

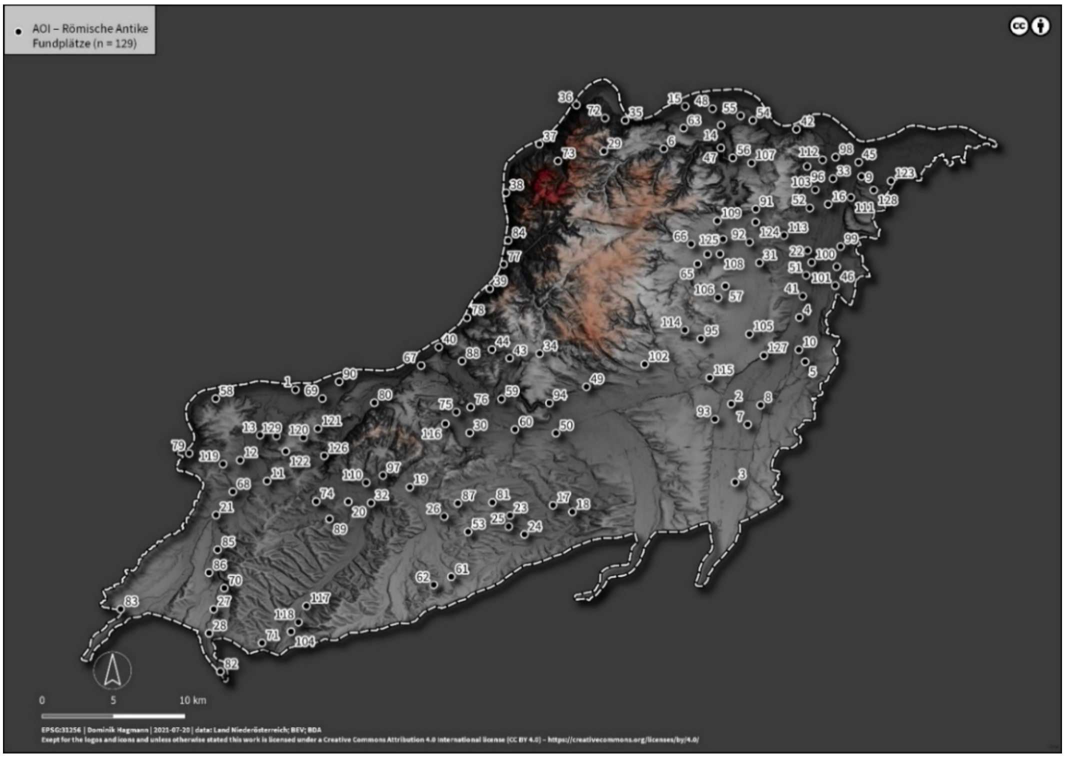
- Treasures: The dataset shows a slight increase in the number of treasure finds from the Early Period (16) to the Middle Imperial Period (17), followed by a significant decline in Late Antiquity (5). This pattern could suggest varying levels of prosperity or diverse cultural values attached to wealth hoarding and display across the periods. (Appendix – Figure 6; Appendix – Figure 7; Appendix – Figure 8)
- Single finds: The counts for single finds remain relatively stable from the Early Period (238) to the Middle Imperial Period (241) but experience a significant drop during Late Antiquity (70). This decrease could reflect a decline in population, trade, or both. (Appendix – Figure 9; Appendix – Figure 10; Appendix – Figure 11)
- Fortificatory features: Interestingly, the number of fortificatory features is relatively stable across all three periods. This situation may indicate a consistent

need for defense, irrespective of the period, and could signify a protracted period of military or political instability in the region. (Appendix – Figure 12; Appendix – Figure 13; Appendix – Figure 14)

- Funerary features: These also remain consistent, declining only slightly in Late Antiquity (113) from the Early Period (150). This observation may suggest persistent cultural practices related to death and burial despite early cremation and later inhumation practices. (Appendix – Figure 15; Appendix – Figure 16; Appendix – Figure 17)
- Industrial features: The counts are stable in the first two periods (39) but decline sharply in Late Antiquity (19), perhaps suggesting a breakdown in organized industrial activity or economic downturn. (Appendix – Figure 18; Appendix – Figure 19; Appendix – Figure 20)
- Infrastructural features: A steady decrease is noted from the Early Period (85) to Late Antiquity (31), perhaps indicative of declining maintenance and settlement density. (Appendix – Figure 21; Appendix – Figure 22; Appendix – Figure 23)
- Agricultural features: This category is shallow in counts across all periods, with an absolute absence in Late Antiquity. This category most likely reflects biased data, showing that stand-alone agricultural features (e.g., corn dryers) are less common or features like ancient field boundaries are less likely to be preserved in the archaeological record. (Appendix – Figure 24; Appendix – Figure 25)
- Monuments: A consistent number is seen in the Early and Middle Imperial Periods (4), with a decline to 1 in Late Antiquity, indicating a decrease in monumental

constructions possibly due to economic or sociopolitical reasons. (Appendix – Figure 26; Appendix – Figure 27; Appendix – Figure 28)

- Settlements: These are consistent in the Early (252) and Middle Imperial Periods (255) but experience a sharp decline in Late Antiquity (74), perhaps reflective of population movements, fall, or urbanization patterns. (Appendix – Figure 29; Appendix – Figure 30; Appendix – Figure 31)
- Ceremonial features: A decrease from 5 in the Early and Middle periods to 1 in Late Antiquity could indicate a shift in religious or communal activities, possibly related to broader societal changes. (Appendix – Figure 32; Appendix – Figure 33; Appendix – Figure 34)
- Other features: A significant decline is noted from the Early (62) to Late Antiquity (1), which could signify several aspects, from a decrease in miscellaneous activities to differences in categorization across periods. (Appendix – Figure 35; Appendix – Figure 36; Appendix – Figure 37)



Appendix – Figure 2: Sites from Roman antiquity in the AOI (n = 129) (D. Hagmann 2021; data: Land NÖ, BDA).

Appendix – Table 1 Listing of all sites from Roman antiquity in the study area (n = 129).

ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
1	2, Gernotstraße, Am Rechen, Municipality of Pöchlarn, District of Melk, Lower Austria, 3380, Austria	place
2	4, Kremser Gasse, St. Pölten, Lower Austria, 3100, Austria	building
3	Altmannsdorf, St. Pölten, Lower Austria, 3100, Austria	highway
4	75, Mitterweg, Unterradlberg, St. Pölten, Lower Austria, 3105, Austria	building
5	Bründlweg, Pottenbrunn, St. Pölten, Lower Austria, 3140, Austria	highway
6	L7105, Baumgarten, municipality of Mautern an der Donau, district of Krems, Lower Austria, 3512, Austria	highway
7	Lilienhof, 62, Stattersdorfer Hauptstraße, Stattersdorf, St. Pölten, Lower Austria, 3100, Austria	building
8	11, Mittererstraße, Oberwagram, St. Pölten, Lower Austria, 3100, Austria	building
9	Traismauer Bahnhofstraße, Bahnhofstraße, Mitterndorf, Waldlesberg, Traismauer, District St. Pölten, Lower Austria, 3133, Austria	highway
10	Alte Hofmühlgasse, Pottenbrunn, St. Pölten, Lower Austria, 3140, Austria	highway
11	Bergland, Landfriedstetten, municipality Bergland, district Melk, Lower Austria, 3252, Austria	highway
12	Westautobahn, Polln, Kendl, municipality Bergland, district Melk, Lower Austria, 3254, Austria	highway
13	8, Sportplatzgasse, Erlauf, Municipality of Erlauf, District of Melk, Lower Austria, 3253, Austria	place
14	Wehrbachweg, Palt, municipality Furth bei Göttweig, district Krems, Lower Austria, 3511, Austria	highway
15	11, Hans-Kudlich-Gasse, Mautern an der Donau, Municipality of Mautern an der Donau, District of Krems, Lower Austria, 3512, Austria	building
16	4, Industriestrasse, Reichersdorf, municipality of Nußdorf ob der Traisen, district of St. Pölten, Lower Austria, 3134, Austria	building
17	7, L5297, Strohdorf, Rametzhofen, municipality Bischofstetten, district Melk, Lower Austria, 3232, Austria	building
18	7, Rametzhofen, Zauching, Rametzhofen, municipality Bischofstetten, district Melk, Lower Austria, 3232, Austria	building

ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
19	L5278, Rinn, St. Leonhard am Forst, municipality of St. Leonhard am Forst, district of Melk, Lower Austria, 3243, Austria	highway
20	L5256, Grub, Ruprechtshofen, municipality of Ruprechtshofen, district of Melk, Lower Austria, 3244, Austria	highway
21	Getränkevertrieb Wieland, 16, Bahnhofstraße, Wieselburg, municipality of Wieselburg, district of Scheibbs, Lower Austria, 3250, Austria	store
22	Traismauerstraße, Municipality Inzersdorf-Getzersdorf, District St. Pölten, Lower Austria, 3130, Austria	highway
23	Unterhaag, Schlatzendorf, Hürm municipality, Melk district, Lower Austria, 3383, Austria	highway
24	L5309, Ranzenbach, Niederhofen, Kilb municipality, Melk district, Lower Austria, 3233, Austria	highway
25	L5309, Ranzenbach, Niederhofen, Kilb municipality, Melk district, Lower Austria, 3233, Austria	highway
26	L5289, Kälberhart, Loitsdorf, Mank municipality, Melk district, Lower Austria, 3240, Austria	highway
27	14, Föhrengasse, Pratersiedlung, Purgstall, municipality of Purgstall an der Erlauf, district of Scheibbs, Lower Austria, 3251, Austria	building
28	6, Franz-Zehetgruber-Platz, Purgstall an der Erlauf, Kleinstein, Purgstall, municipality of Purgstall an der Erlauf, district of Scheibbs, Lower Austria, 3251, Austria	building
29	Rossatzbach, municipality Rossatz-Arnsdorf, district Krems, Lower Austria, 3601, Austria	place
30	L5340, Klein-Schollach, Groß-Schollach, municipality of Schollach, district of Melk, Lower Austria, 3382, Austria	highway
31	8, Ederdinger Straße, Weidling, Rottersdorf, Municipality of Statzendorf, District of St. Pölten, Lower Austria, 3125, Austria	building
32	6/3-4, Malerstraße, Urbachsiedlung, St. Leonhard am Forst, Municipality of St. Leonhard am Forst, District of Melk, Lower Austria, 3243, Austria	building
33	Kiesstraße, Franzhausen, municipality of Nußdorf ob der Traisen, district of St. Pölten, Lower Austria, 3134, Austria	highway

ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
34	Roman bridge, L5359, Pfaffing bei Mauer, Mauer bei Melk, Dunkelsteinerwald municipality, Melk district, Lower Austria, 3382, Austria	tourism
35	Roman tower, B33, Hundsheim, Rossatz-Arnsdorf municipality, Krems district, Lower Austria, 3601, Austria	historic
36	St. Lawrence, B33, St. Lawrence, Rührsdorf, Rossatz-Arnsdorf parish, Krems district, Lower Austria, 3610, Austria	amenity
37	B33, Bacharnsdorf, municipality Rossatz-Arnsdorf, district Krems, Lower Austria, 3621, Austria	highway
38	Filial Church of St. John the Baptist, B33, St. Johann im Mauerthale, Rossatz-Arnsdorf parish, Krems district, Lower Austria, 3620, Austria	amenity
39	Hubertuskapelle, B33, Aggsbach-Dorf, municipality Schönbühel-Aggsbach, district Melk, Lower Austria, 3641, Austria	amenity
40	B3a, Spielberg, Municipality of Melk, District of Melk, Lower Austria, 3390, Austria	highway
41	Nursery Rath, St. Pöltner Straße, Oberndorf in der Ebene, Herzogenburg, municipality of Herzogenburg, district of St. Pölten, Lower Austria, 3130, Austria	store
42	Obere Hollenburger Hauptstraße, Hollenburg, Krems-Süd, Krems on the Danube, Lower Austria, 3506, Austria	highway
43	1, L5354, Thal, Mauer bei Melk, Dunkelsteinerwald municipality, Melk district, Lower Austria, 3382, Austria	building
44	L5353, Lerchfeld, Gerolding, Dunkelsteinerwald municipality, Melk district, Lower Austria, 3392, Austria	highway
45	Treppelweg, Rittersfeld, Sankt Georgen an der Traisen, Traismauer, District St. Pölten, Lower Austria, 3133, Austria	highway
46	Small baroque road, Unterwinden, Herzogenburg municipality, St. Pölten district, Lower Austria, 3130, Austria	highway
47	Göttweig Abbey, L7108, Aigen, Klein-Wien, Municipality of Furth bei Göttweig, Krems District, Lower Austria, 3511, Austria	amenity
48	Ziestelweg, Palt, municipality Furth bei Göttweig, district Krems, Lower Austria, 3511, Austria	highway

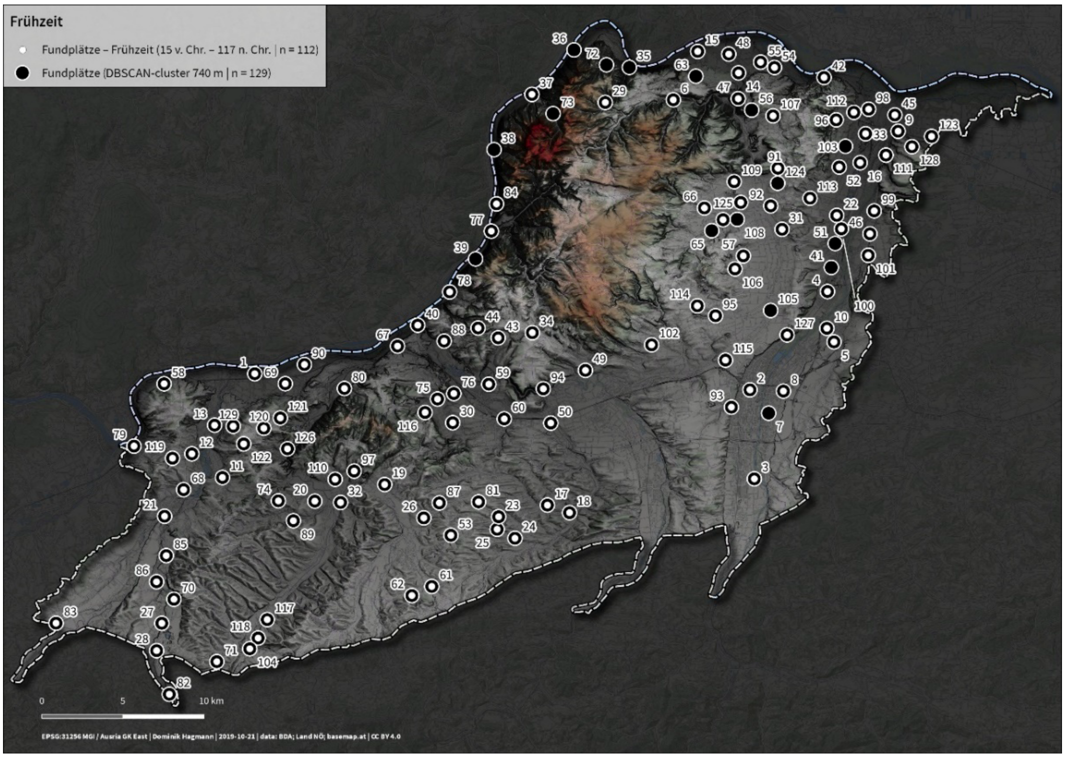
ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
49	Wimpassing an der Pielach, municipality of Hafnerbach, district of St. Pölten, Lower Austria, 3386, Austria	highway
50	Bründlstraße, Pottschollach, Haunoldstein municipality, St. Pölten district, Lower Austria, 3384, Austria	highway
51	14, Herrengasse, Herzogenburg, Municipality of Herzogenburg, District of St. Pölten, Lower Austria, 3130, Austria	building
52	7, Gartengasse, Getzersdorf, Municipality Inzersdorf-Getzersdorf, District St. Pölten, Lower Austria, 3131, Austria	building
53	Oberschmidbach, Mank parish, Melk district, Lower Austria, 3240, Austria	highway
54	Thallerner Hauptstraße, Thallern, Krems on the Danube, Lower Austria, 3506, Austria	highway
55	10, Jägerweg, Brunnkirchen, Krems on the Danube, Lower Austria, 3506, Austria	building
56	L100, Paudorf, Municipality of Paudorf, District of Krems, Lower Austria, 3508, Austria	highway
57	Am Schmittenberg, Mittermerking, Großrust, Obritzberg-Rust municipality, St. Pölten district, Lower Austria, 3123, Austria	highway
58	27, Wallenbach, municipality Krummnußbaum, district Melk, Lower Austria, 3375, Austria	place
59	Hubertusweg, Loosdorf, Municipality of Loosdorf, District of Melk, Lower Austria, 3, Austria	highway
60	Westautobahn, Inning, municipality of Hürm, district of Melk, Lower Austria, 3383, Austria	highway
61	16, Großaigen, Mank, Mank municipality, Melk district, Lower Austria, 3240, Austria	building
62	1, Güterweg Aichen, access road house no. 1,2, Aichen, Mank, municipality of Mank, district of Melk, Lower Austria, 3233, Austria	building
63	53, Baumgarten, municipality of Mautern an der Donau, district of Krems, Lower Austria, 3512, Austria	place
64	Talstraße, Eitzendorf, Obritzberg, Municipality Obritzberg-Rust, District St. Pölten, Lower Austria, 3123, Austria	highway
65	13, Grünzerstraße, Eitzendorf, Obritzberg, Municipality Obritzberg-Rust, District St. Pölten, Lower Austria, 3123, Austria	place

ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
66	79, Ambach, municipality of Wölbling, district of St. Pölten, Lower Austria, 3124, Austria	place
67	14, Rathausplatz, Municipality of Melk, District of Melk, Lower Austria, 3390, Austria	building
68	Church Petzenkirchen, Kirchenplatz, Petzenkirchen, municipality Petzenkirchen, district Melk, Lower Austria, 3252, Austria	amenity
69	Ornding, municipality of Pöchlarn, district of Melk, Lower Austria, 3380, Austria	highway
70	Bergmühle, municipality of Purgstall an der Erlauf, district of Scheibbs, Lower Austria, 3251, Austria	highway
71	Weigstatt, municipality of Purgstall an der Erlauf, district of Scheibbs, Lower Austria, 3251, Austria	highway
72	Holzweg, Rossatzbach, municipality Rossatz-Arnsdorf, district Krems, Lower Austria, 3602, Austria	highway
73	Türkentor, Römerweg, Bacharnsdorf, Rossatz-Arnsdorf municipality, Krems district, Lower Austria, 3621, Austria	historic
74	5, Fittenberg, Zwerbach, municipality of Ruprechtshofen, district of Melk, Lower Austria, 3244, Austria	place
75	L5340, Merkendorf, municipality of Schollach, district of Melk, Lower Austria, 3390, Austria	highway
76	4, Feldgasse, Roggendorf, municipality of Schollach, district of Melk, Lower Austria, 3382, Austria	building
77	Aggsbach village, municipality Schönbühel-Aggsbach, district Melk, Lower Austria, 3641, Austria	highway
78	143, L5355, municipality of Schönbühel-Aggsbach, district of Melk, Lower Austria, 3392, Austria	building
79	Sarling, municipality of Ybbs an der Donau, district of Melk, Lower Austria, 3374, Austria	highway
80	Großprielstraße, Großpriel, Matzleinsdorf, municipality Zelking-Matzleinsdorf, district Melk, Lower Austria, 3393, Austria	highway
81	5, Hösing, Hainberg, Hürm municipality, Melk district, Lower Austria, 3383, Austria	place
82	Ötscherlandsteg, Stock, municipality of Purgstall an der Erlauf, district of Scheibbs, Lower Austria, 3251, Austria	highway
83	10, Am Graben, Götzwang, Steinakirchen am Forst, municipality of Steinakirchen am Forst, district of Scheibbs, Lower Austria, 3261, Austria	building

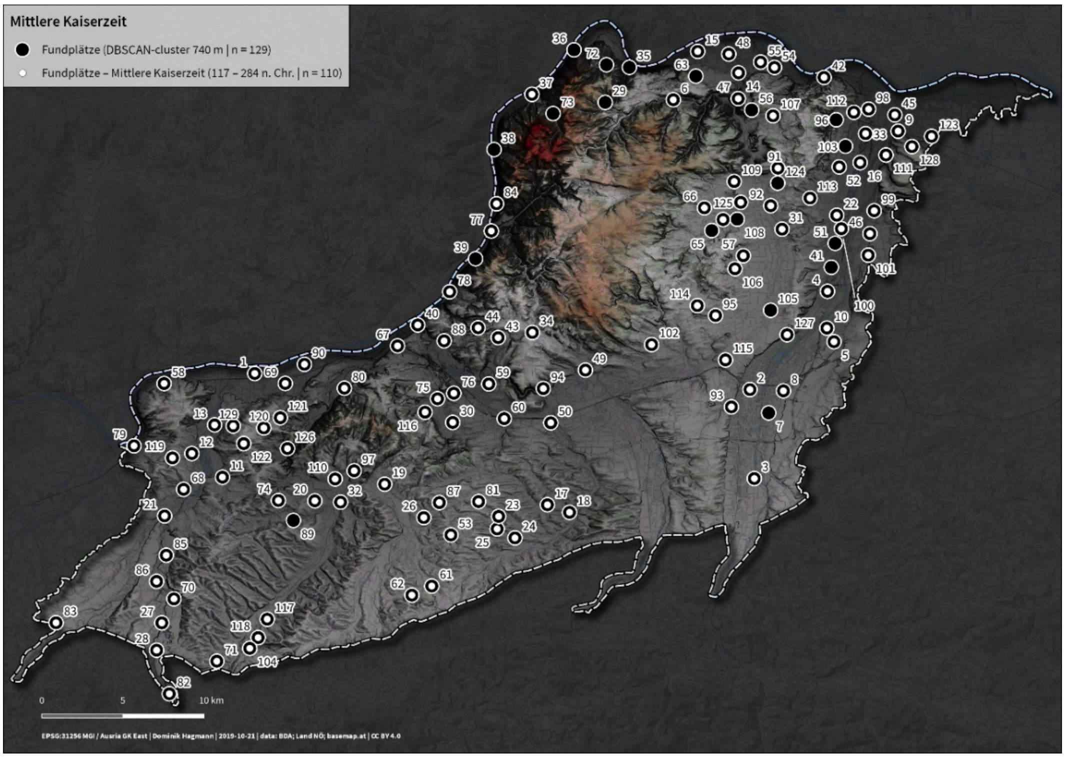
ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
84	7, B33, Aggstein, Aggsbach-Dorf, municipality Schönbühel-Aggsbach, district Melk, Lower Austria, 3642, Austria	building
85	L6142, Neumühl, Mühling, municipality of Wieselburg-Land, district of Scheibbs, Lower Austria, 3250, Austria	highway
86	B25, Würth, Mühling, municipality Wieselburg-Land, district Scheibbs, Lower Austria, 3250, Austria	highway
87	L5289, Murschratten, Unter-Siegendorf, municipality of Hürm, district of Melk, Lower Austria, 3383, Austria	highway
88	68, Pielach, Municipality of Melk, District of Melk, Lower Austria, 3390, Austria	building
89	'Secret passage to Ruprechtshofen', Güterweg Koth, Schlattenbauer, Zwerbach, municipality of Ruprechtshofen, district of Melk, Lower Austria, 3244, Austria.	natural
90	Pöchlarn-Wörth, Anton Lasselsberger Straße, Wörth, Ornding, municipality of Pöchlarn, district of Melk, Lower Austria, 3380, Austria	aeroway
91	Steinriedweg, Kuffern, Municipality of Statzendorf, District of St. Pölten, Lower Austria, 3125, Austria	highway
92	39, Hauptstraße, Weidling, Statzendorf, Municipality of Statzendorf, District of St. Pölten, Lower Austria, 3125, Austria	building
93	Nadelbacher Straße, Teufelhof, St. Pölten, Lower Austria, 3100, Austria	highway
94	10, Pielachstraße, Pielachhäuser, Haunoldstein, Haunoldstein municipality, St. Pölten district, Lower Austria, 3384, Austria	building
95	18, Obermamau, Karlstetten municipality, St. Pölten district, Lower Austria, 3121, Austria	building
96	Parish Church, 3, Kirchenplatz, Nußdorf ob der Traisen, Parish of Nußdorf ob der Traisen, District of St. Pölten, Lower Austria, 3134, Austria	amenity
97	Thal, Gassen, Municipality of St. Leonhard am Forst, District of Melk, Lower Austria, 3243, Austria	highway
98	Rittersfeld, Wagram ob der Traisen, Traismauer, district St. Pölten, Lower Austria, 3133, Austria	highway
99	96, St. Andräer Ortsstraße, Angern, municipality of Herzogenburg, district of St. Pölten, Lower Austria, 3130, Austria	place

ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
100	Herzogenburg, Herzogenburg municipality, St. Pölten district, Lower Austria, 3130, Austria	highway
101	L110, Oberwinden, municipality of Herzogenburg, district of St. Pölten, Lower Austria, 3130, Austria	highway
102	L5139, Watzelsdorf, Neidling, District St. Pölten, Lower Austria, 3110, Austria	highway
103	Reichersdorf, municipality Nußdorf ob der Traisen, district St. Pölten, Lower Austria, 3134, Austria	highway
104	3, Melk, municipality Oberndorf an der Melk, district Scheibbs, Lower Austria, 3281, Austria	place
105	Kremser Landstraße, Großhain, Obritzberg-Rust municipality, St. Pölten district, Lower Austria, 3107, Austria	highway
106	11, Schulgasse, Mittermerking, Großrust, Obritzberg-Rust municipality, St. Pölten district, Lower Austria, 3123, Austria	building
107	77, Am Spickenberg, Höbenbach, Municipality of Paudorf, Krems District, Lower Austria, 3508, Austria	building
108	Noppendorf Ort, L111, Noppendorf, municipality of Wölbling, district of St. Pölten, Lower Austria, 3123, Austria	highway
109	Flötzersteig, Hermannschacht, Unterwölbling, municipality of Wölbling, district of St. Pölten, Lower Austria, 3124, Austria	highway
110	1, Hub an der Mank, Gassen, municipality of St. Leonhard am Forst, district of Melk, Lower Austria, 3243, Austria	building
111	23, Oberndorfer Straße, Venusberg, Oberndorf am Gebirge, Traismauer, St. Pölten district, Lower Austria, 3133, Austria	building
112	Wagram ob der Traisen, Traismauer, District St. Pölten, Lower Austria, 3133, Austria	highway
113	4, Am Schlossteich, Walpersdorf, Municipality Inzersdorf-Getzersdorf, District St. Pölten, Lower Austria, 3131, Austria	building
114	Lady Chapel Traunleiten, L162, Karlstetten, Karlstetten municipality, St. Pölten district, Lower Austria, 3121, Austria	amenity
115	Gamsbichelweg, Iceberg, Waitzendorf, St. Pölten, Lower Austria, 3100, Austria	highway

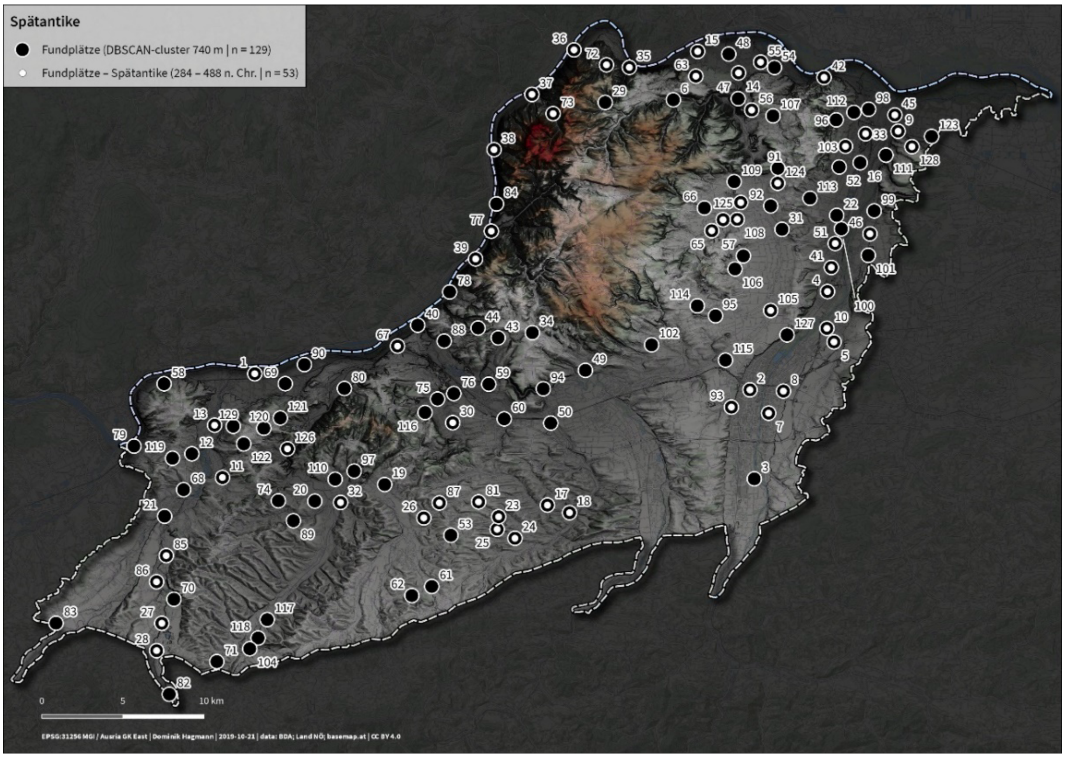
ID	Name/Address (OpenStreetMap)	Category (OpenStreetMap)
116	21, Schallaburg, municipality of Schollach, district of Melk, Lower Austria, 3382, Austria	building
117	B29, Gstetten, Oberndorf an der Melk, Municipality of Oberndorf an der Melk, District of Scheibbs, Lower Austria, 3281, Austria	highway
118	Oberndorf Parish Church, 2, Oberer Markt, Altenmarkt, Oberndorf an der Melk, Municipality of Oberndorf an der Melk, District of Scheibbs, Lower Austria, 3281, Austria	amenity
119	L6009, Krottenthal, municipality Bergland, district Melk, Lower Austria, 3254, Austria	highway
120	Röhrapoint, municipality of Pöchlarn, district of Melk, Lower Austria, 3380, Austria	highway
121	L5331, Zelking, Einsiedl, Zelking, municipality of Zelking-Matzleinsdorf, district of Melk, Lower Austria, 3393, Austria	highway
122	Briafatonz, L5316, Wocking, Wohlfahrtsbrunn, municipality Bergland, district Melk, Lower Austria, 3253, Austria	tourism
123	Wiener Straße, Mitterndorf, Stollhofen, Traismauer, District St. Pölten, Lower Austria, 3133, Austria	highway
124	L5015, Kuffern, municipality of Statzendorf, district of St. Pölten, Lower Austria, 3125, Austria	highway
125	L5041, Absdorf, municipality of Statzendorf, district of St. Pölten, Lower Austria, 3125, Austria	highway
126	26, L5325, Hofstetten, Mannersdorf, municipality of Zelking-Matzleinsdorf, district of Melk, Lower Austria, 3393, Austria	building
127	115, Austinstraße, Viehofen, St. Pölten, Lower Austria, 3107, Austria	building
128	Am Nasenberg, Mitterndorf, Stollhofen, Traismauer, District St. Pölten, Lower Austria, 3133, Austria	highway
129	Harlanderstraße, Knocking, Harlanden, Municipality of Erlauf, District of Melk, Lower Austria, 3253, Austria	highway



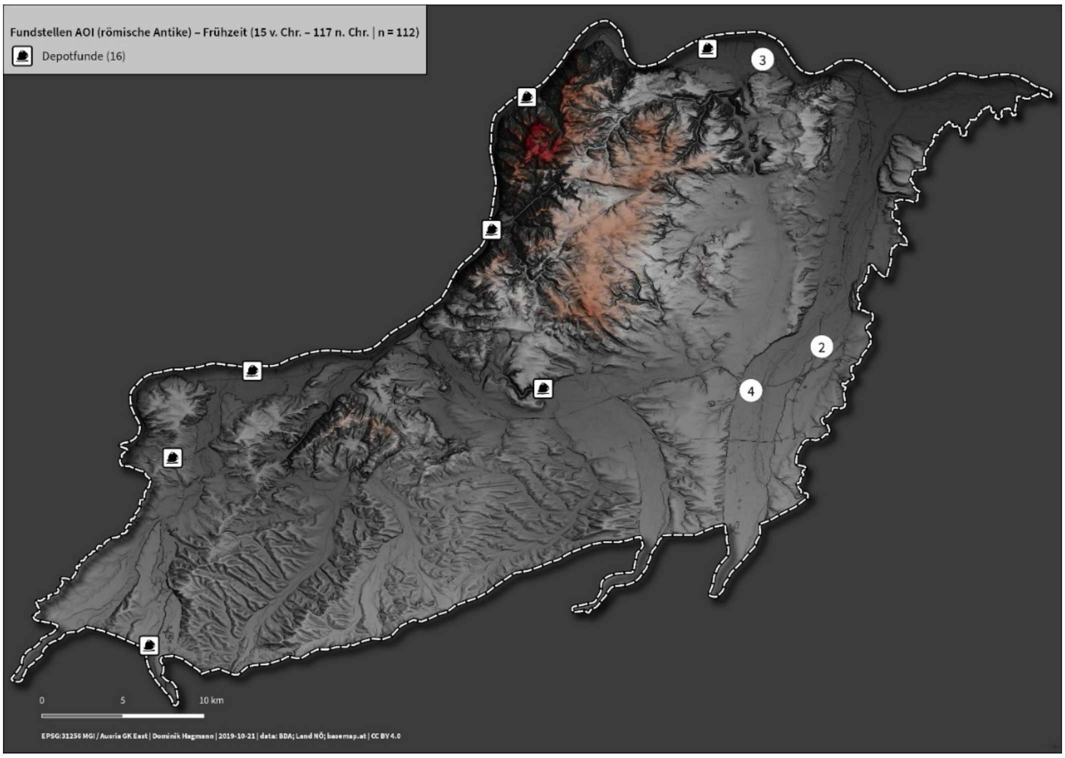
Appendix – Figure 3: Early period sites (n = 112) in the AOI compared to the total inventory of Roman sites (n = 129) (D. Hagmann 2021; data: Land NÖ; BDA; basemap.at).



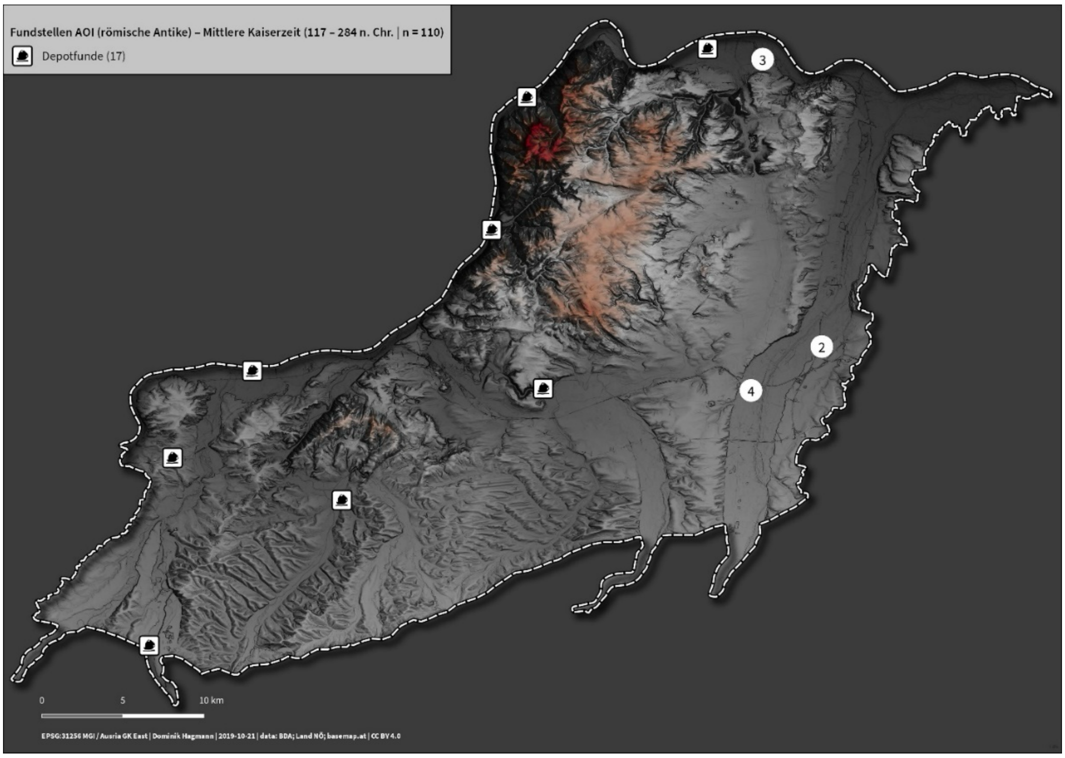
Appendix – Figure 4: Middle Imperial Period sites (n = 110) in the AOI in comparison with the total inventory of Roman sites (n = 129) (D. Hagmann 2021; data basis: Province of Lower Austria; BDA; basemap.at).



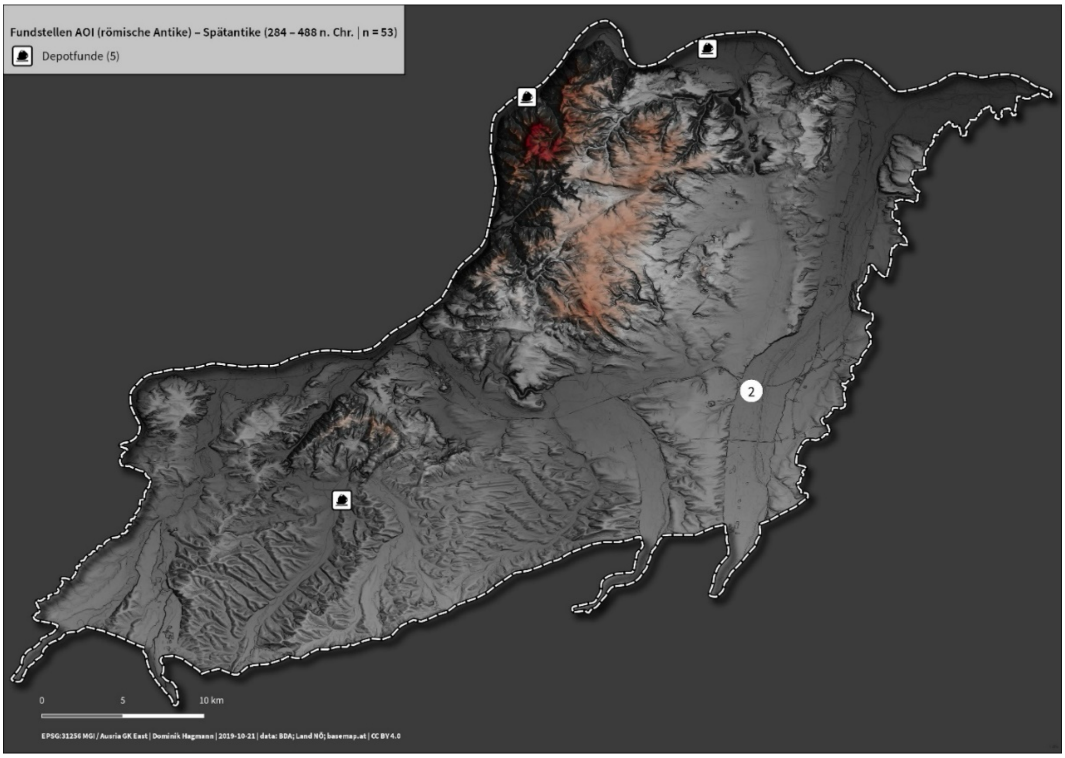
Appendix – Figure 5: Sites (n = 53) of Late Antiquity in the AOI in comparison with the total inventory of Roman sites (n = 129) (D. Hagmann 2021; data basis: Land NÖ; BDA; basemap.at)



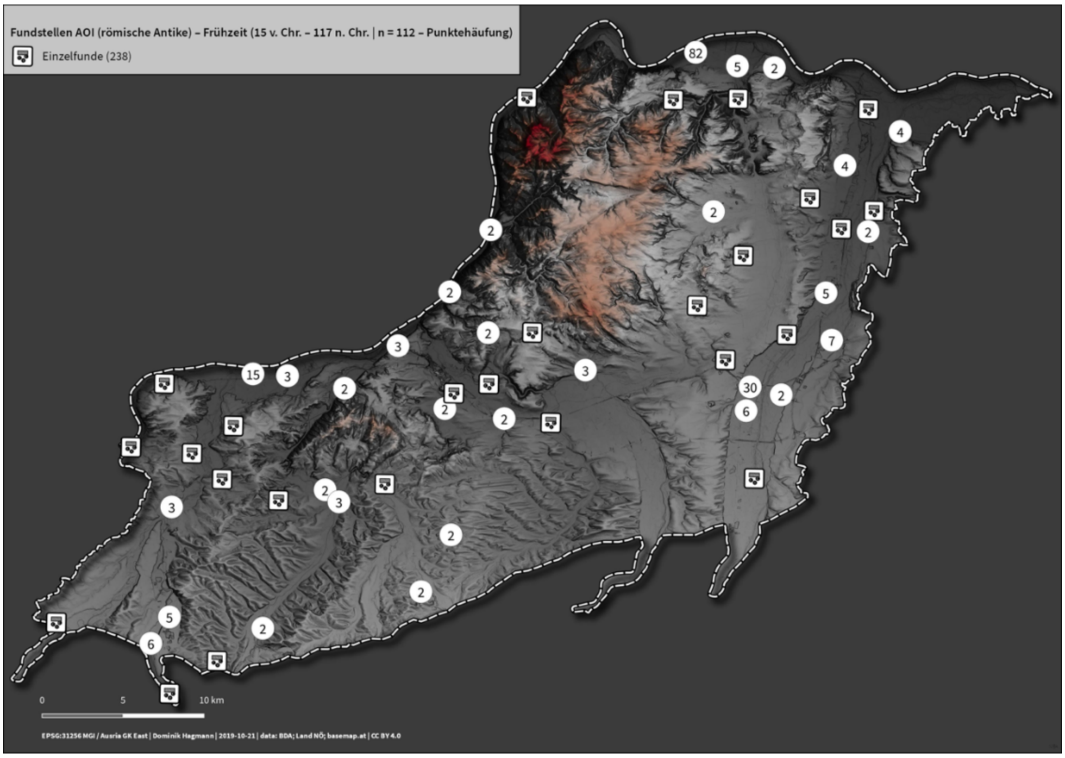
Appendix – Figure 6: Treasure-features (n = 16) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA



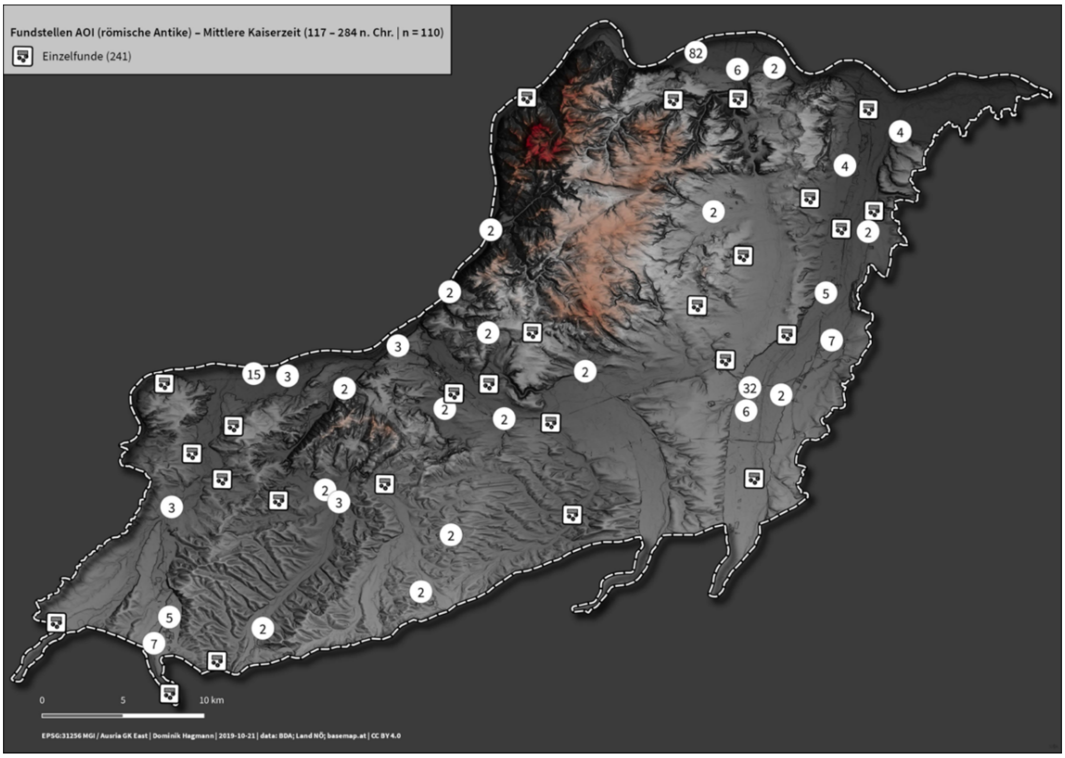
Appendix – Figure 7: Treasure-features (n = 17) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA



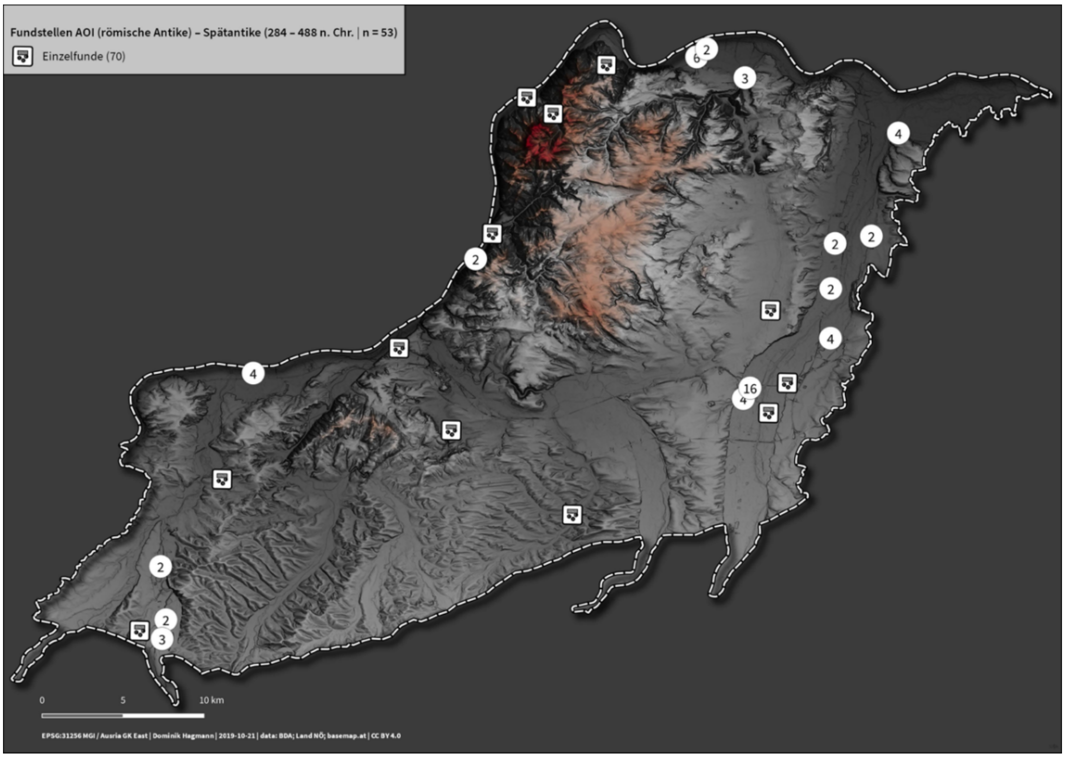
Appendix – Figure 8: Treasure-features (n = 5) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA



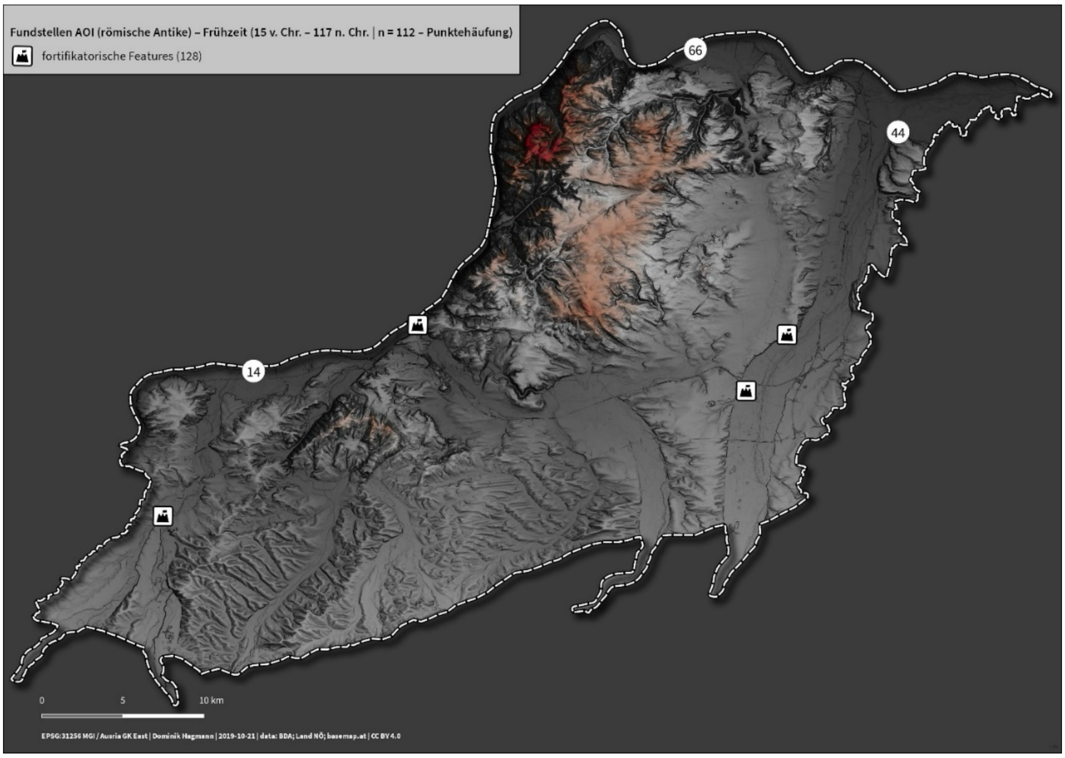
Appendix – Figure 9: Single-find-features (n = 238) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



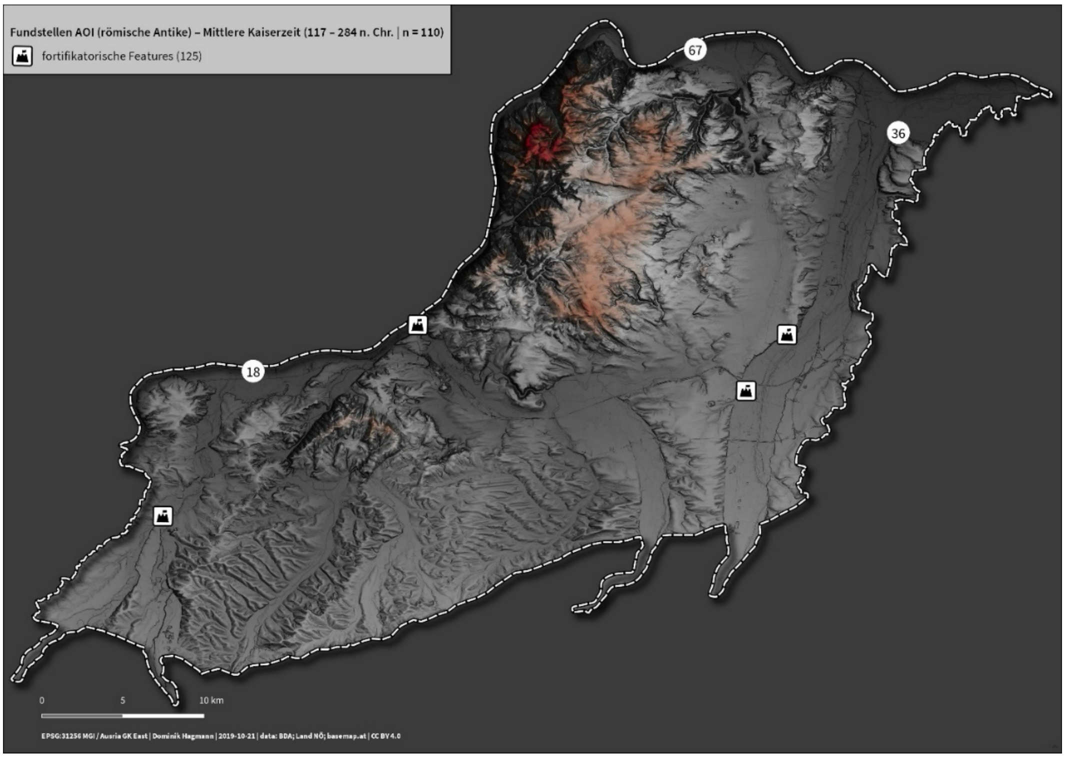
Appendix – Figure 10: Single-find-features (n = 241) of the Middle Imperial period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



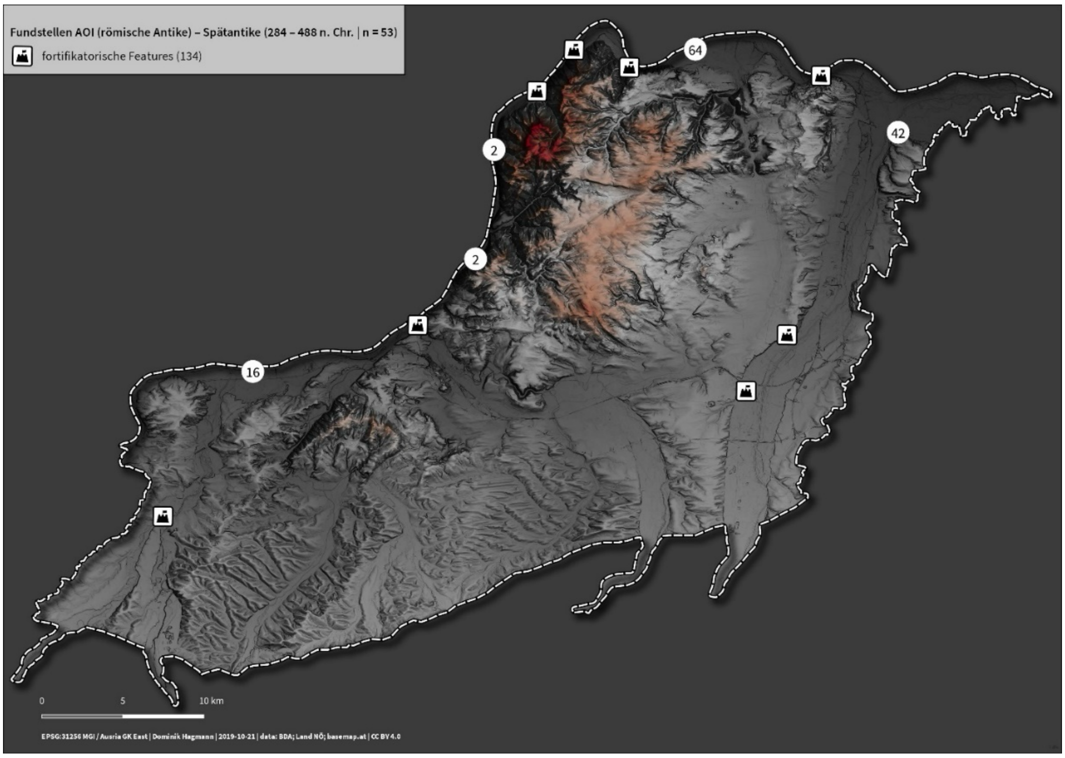
Appendix – Figure 11: Single-find-features (n = 70) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



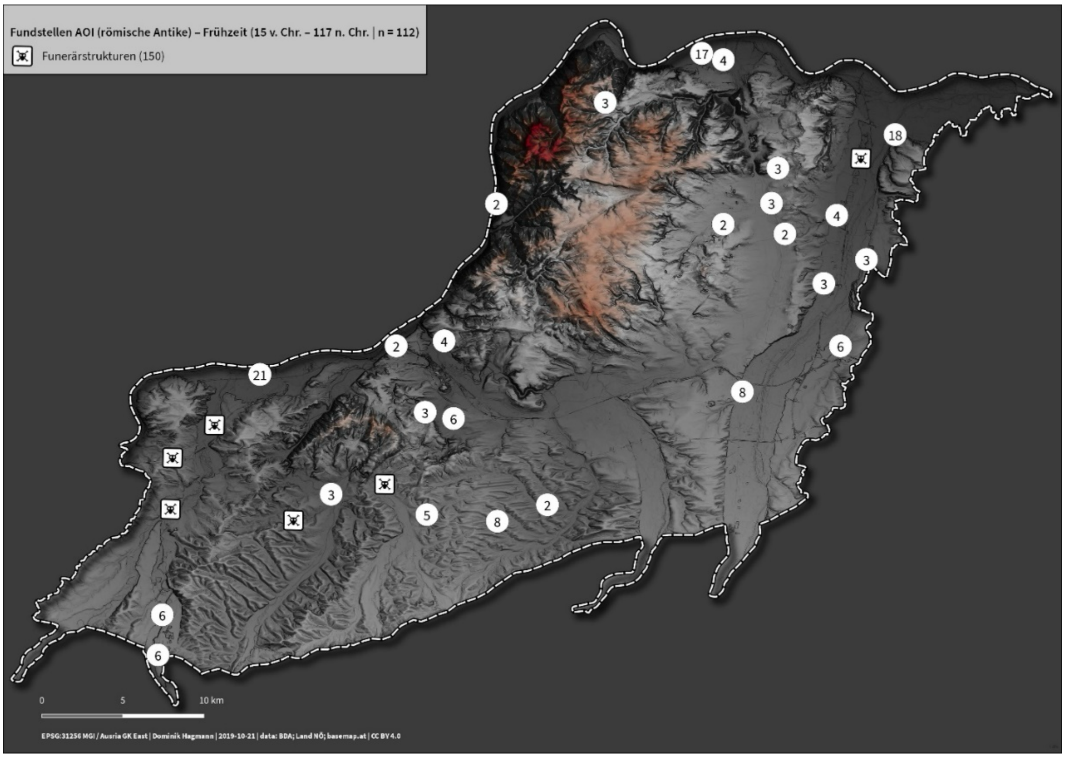
Appendix – Figure 12: Fortificatory features (n = 128) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA



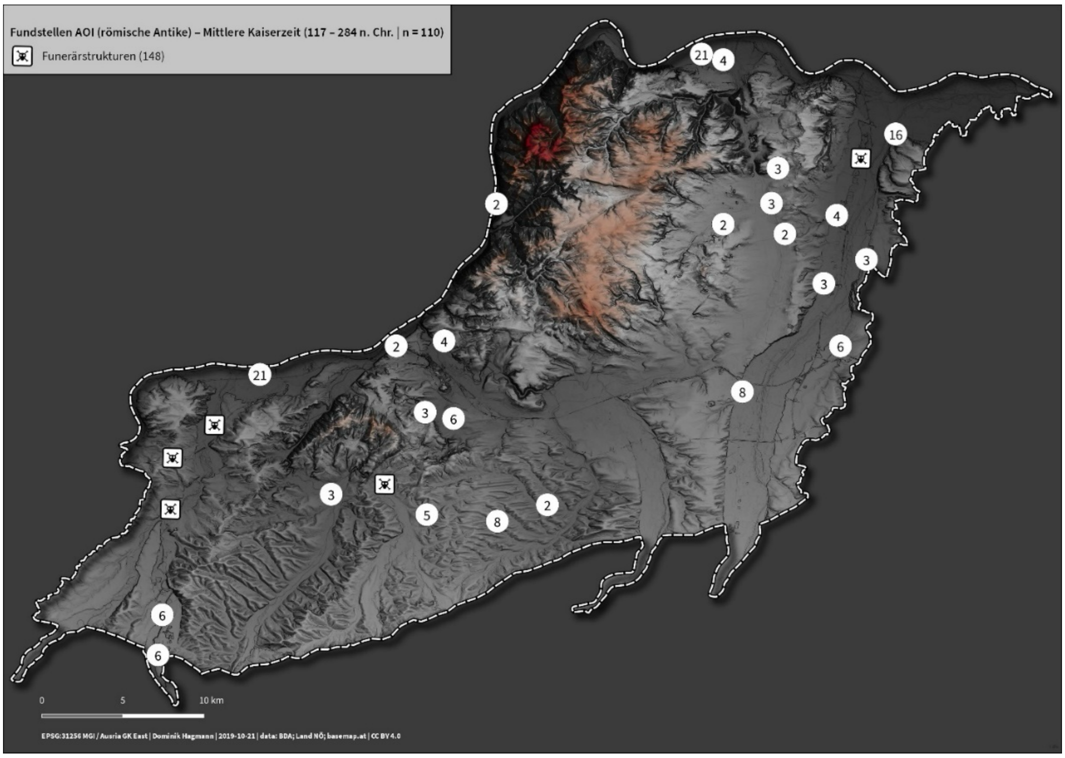
Appendix – Figure 13: Fortificatory features (n = 125) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



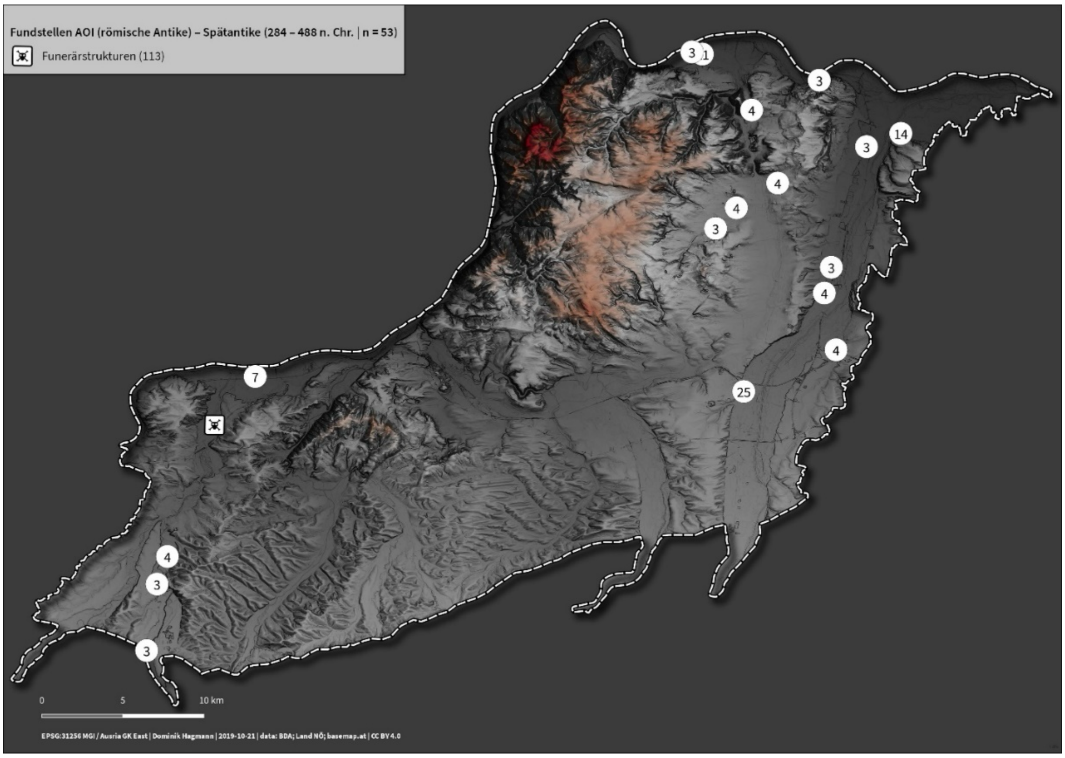
Appendix – Figure 14: Fortificatory features (n = 134) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



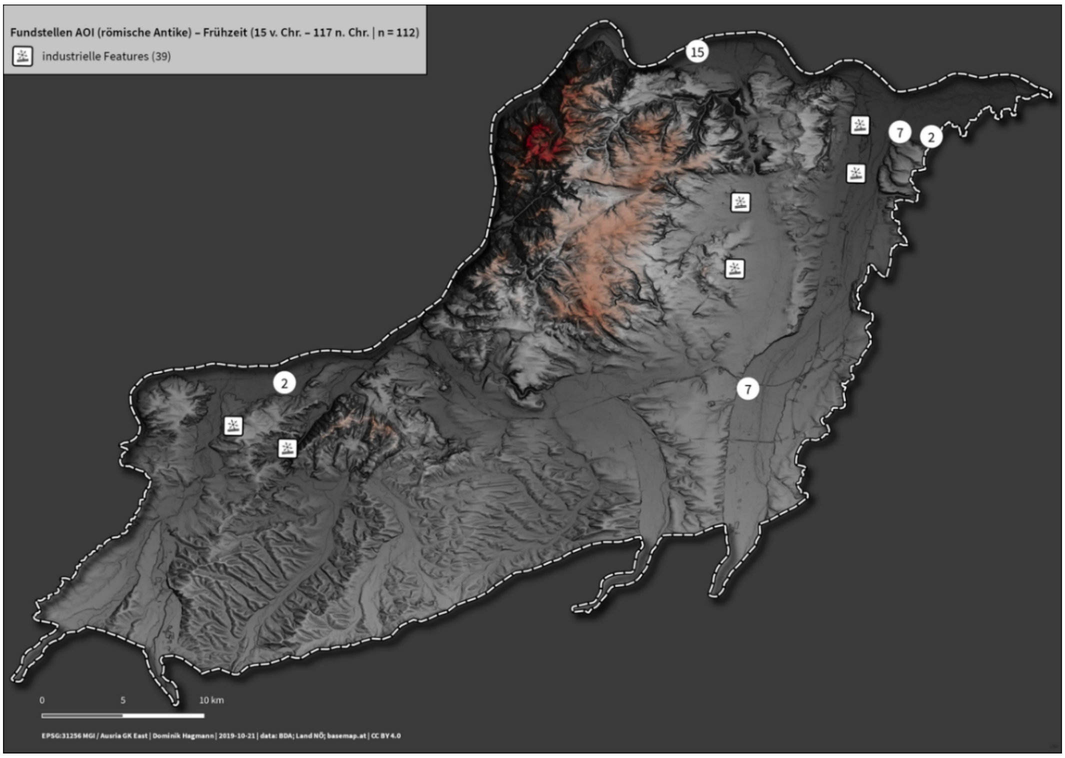
Appendix – Figure 15: Funerary features (n = 150) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



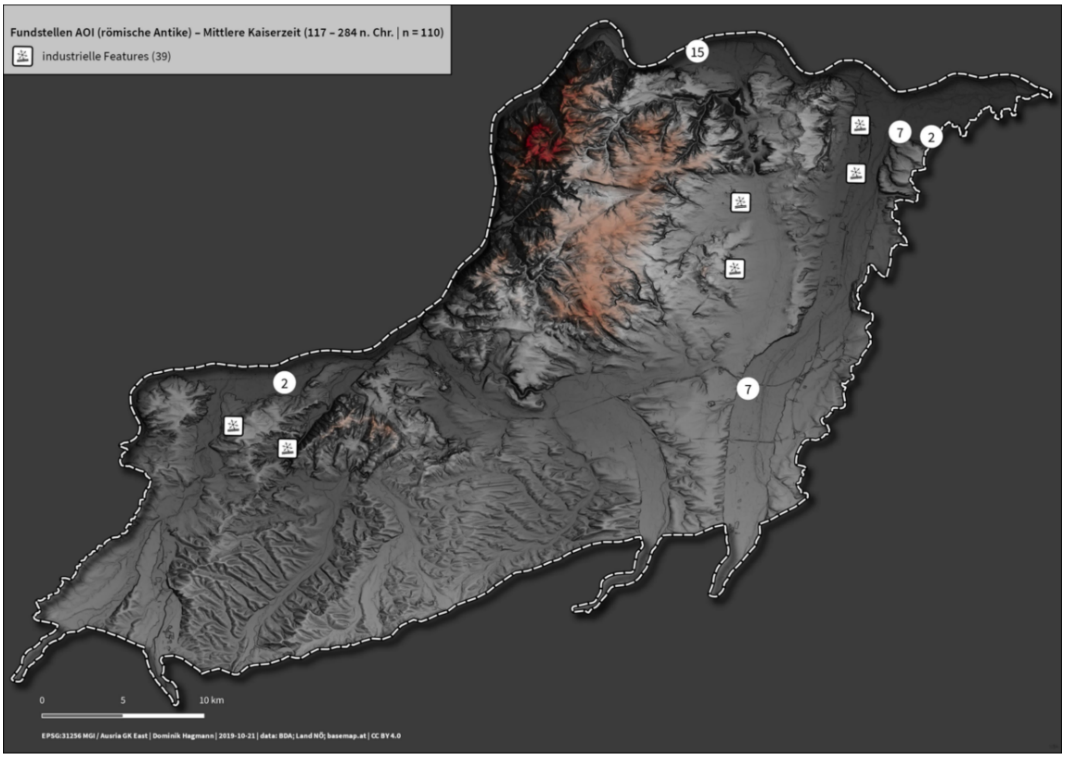
Appendix – Figure 16: Funerary features (n = 148) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



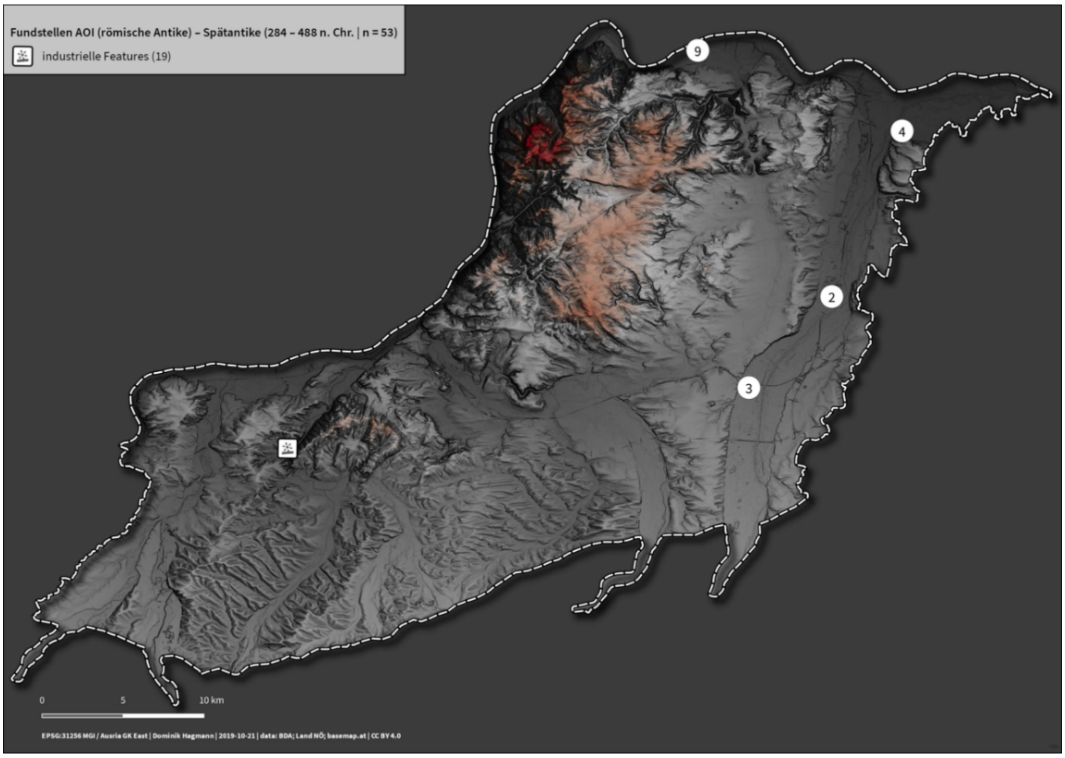
Appendix – Figure 17: Funerary features (n = 113) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



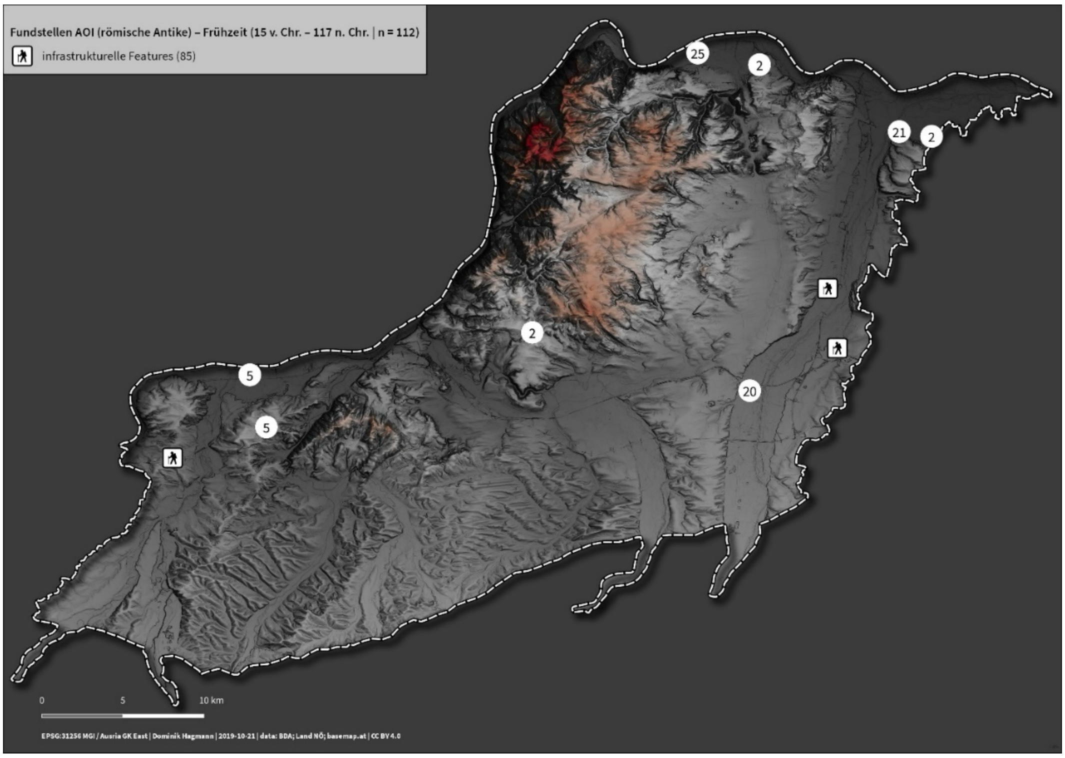
Appendix – Figure 18: Industrial features (n = 39) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



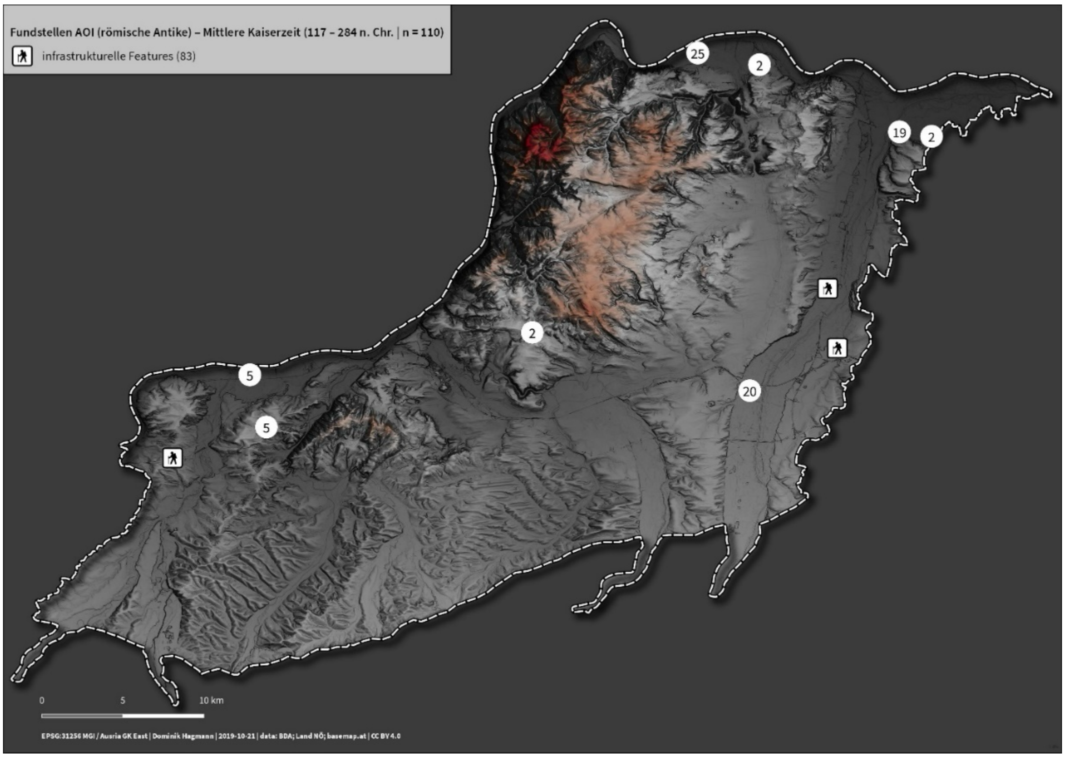
Appendix – Figure 19: Industrial features (n = 39) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



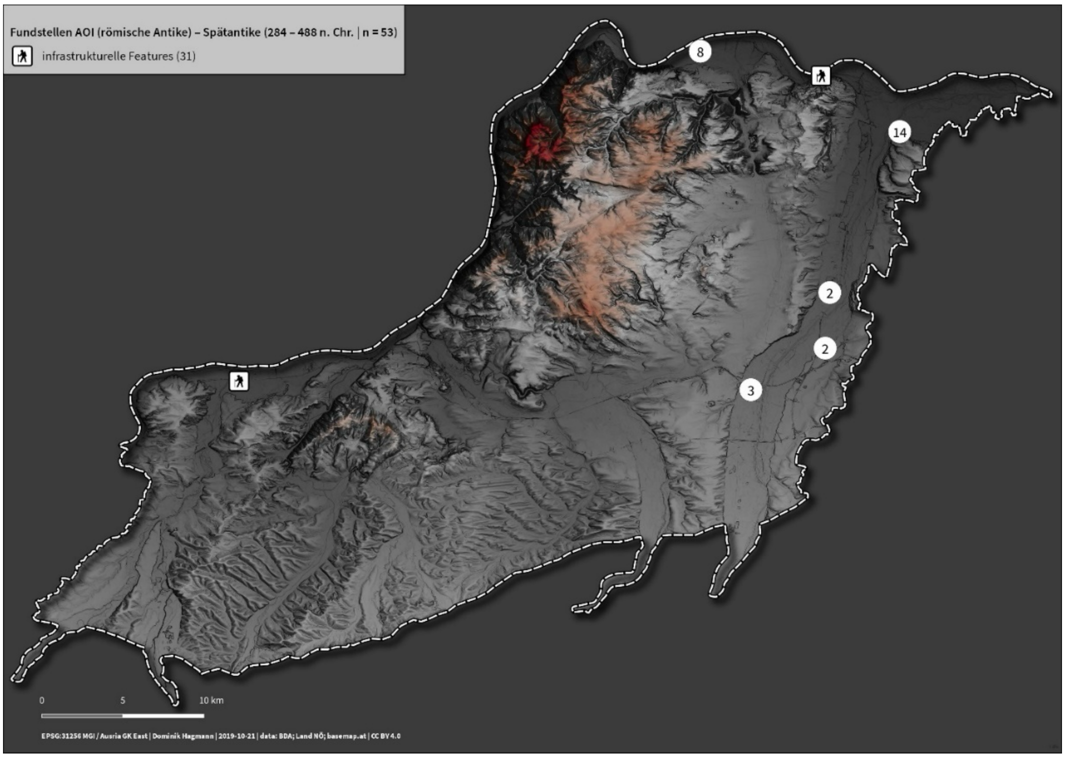
Appendix – Figure 20: Industrial features (n = 19) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data basis: Land NÖ; BDA)



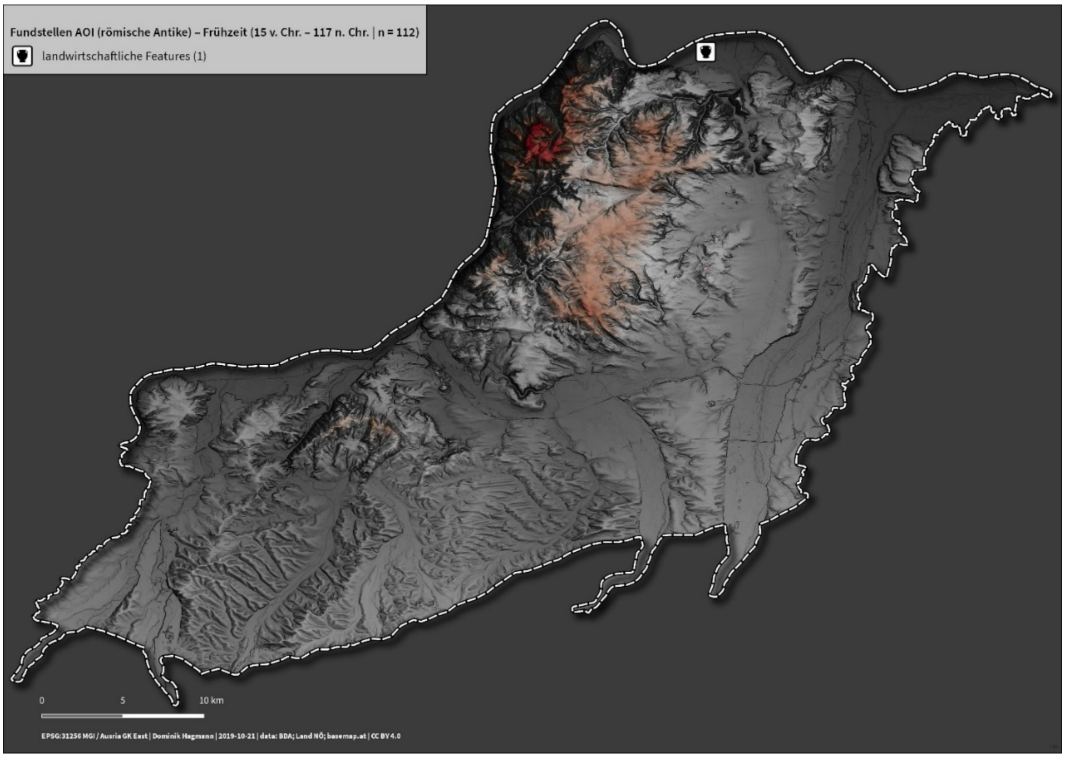
Appendix – Figure 21: Infrastructural features (n = 85) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



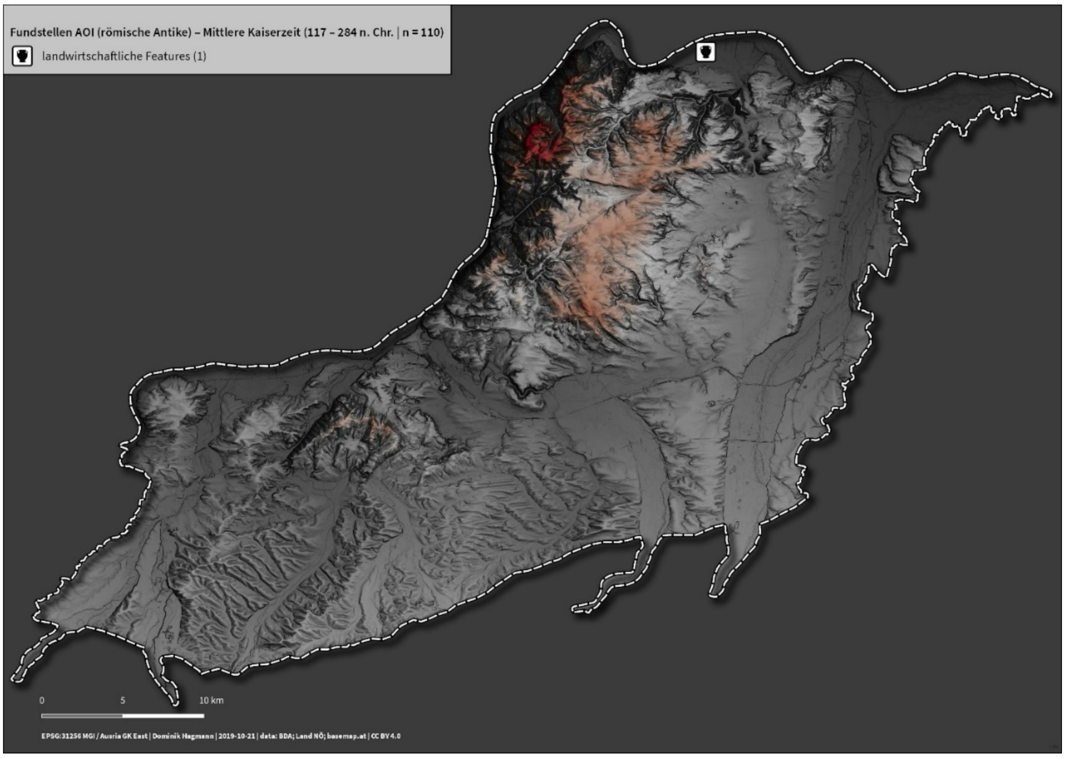
Appendix – Figure 22: Infrastructural features (n = 83) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



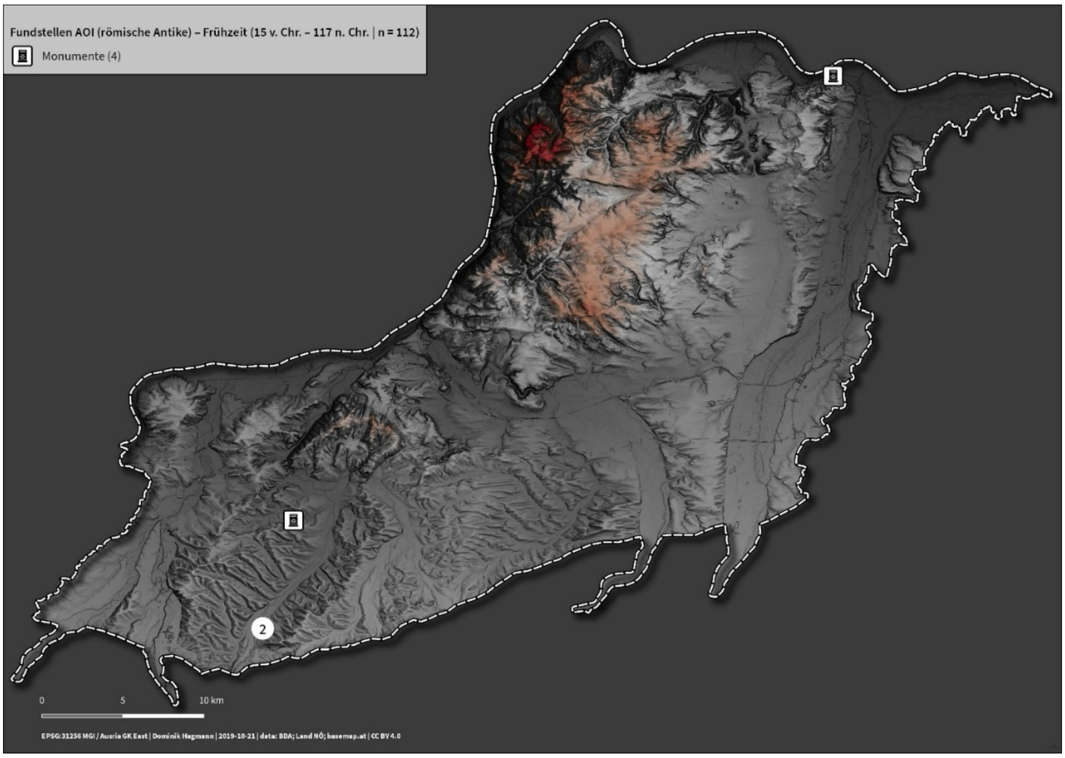
Appendix – Figure 23: Infrastructural features (n = 31) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



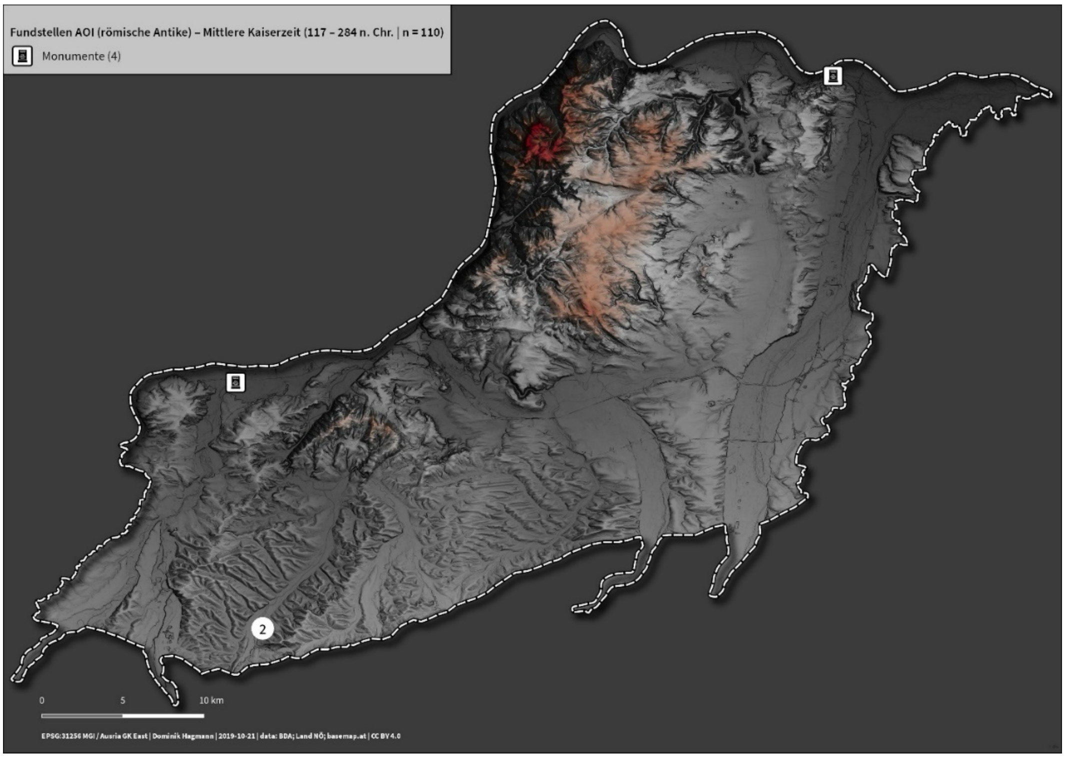
Appendix – Figure 24: Agricultural features (n = 1) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



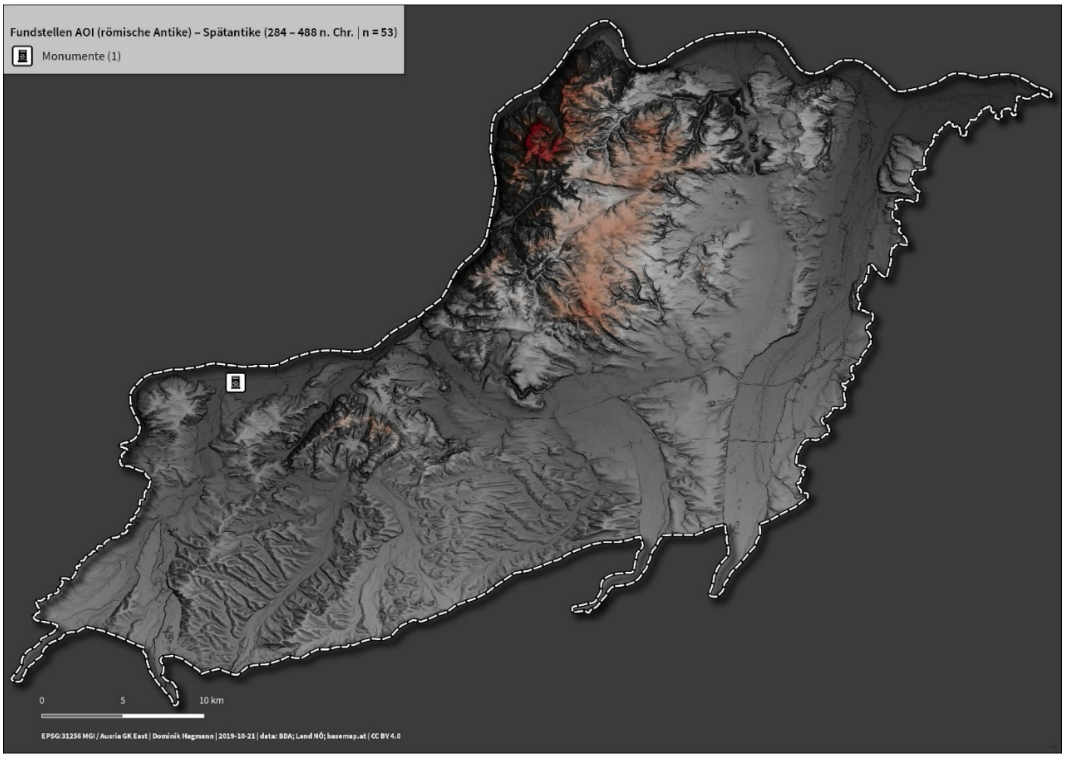
Appendix – Figure 25: Agricultural features (n = 1) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



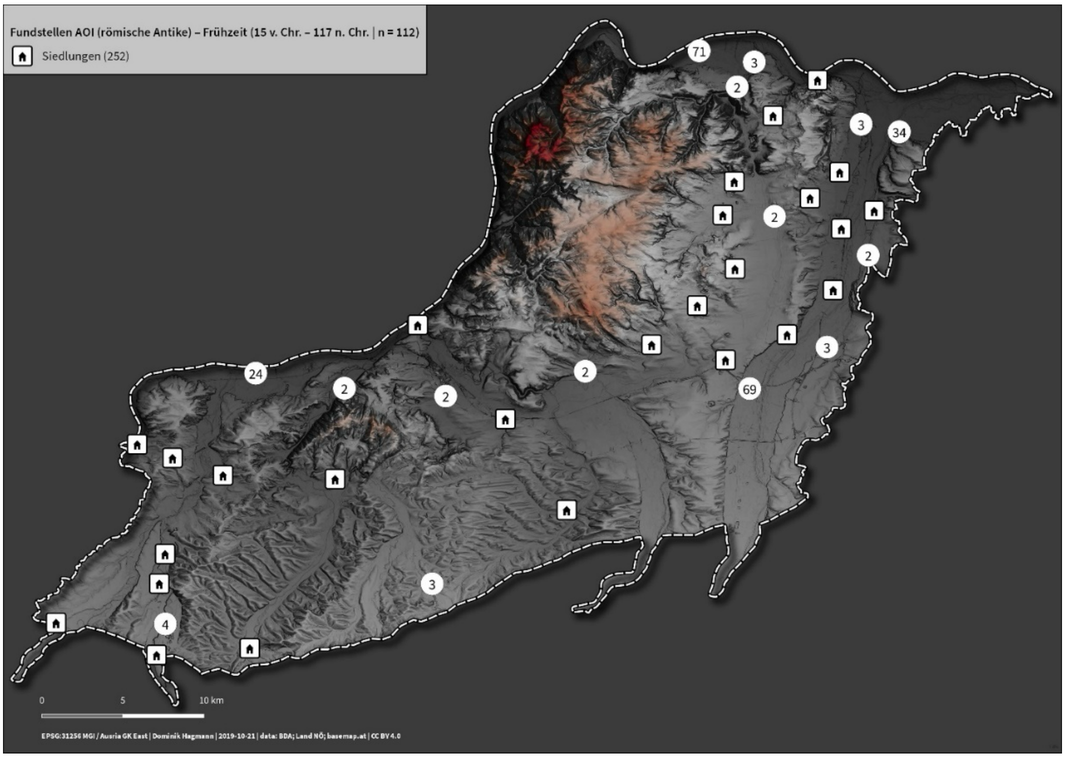
Appendix – Figure 26: Monument-features (n = 4) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



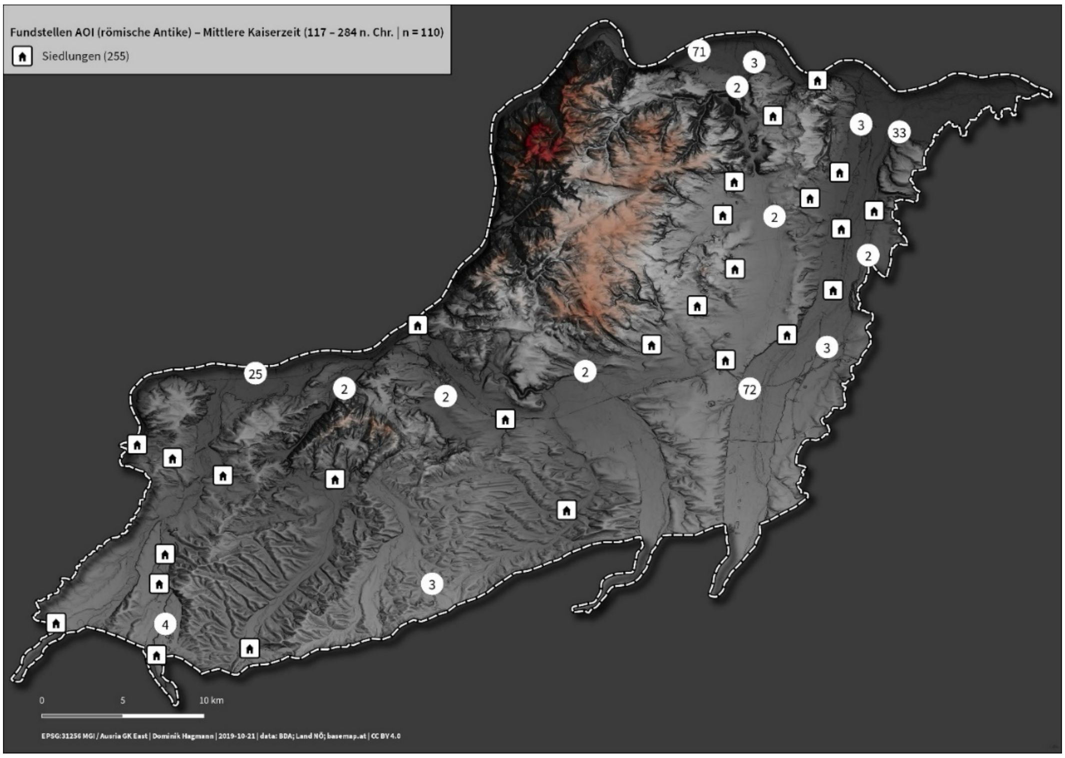
Appendix – Figure 27: Monument-features (n = 4) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



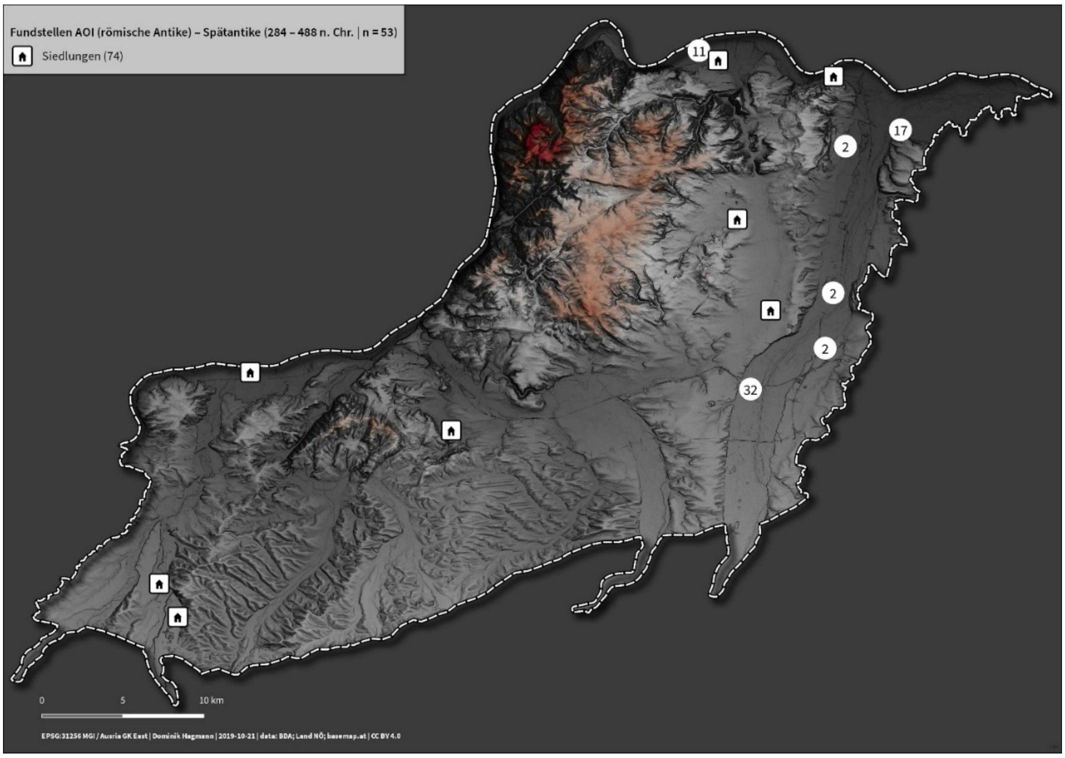
Appendix – Figure 28: Monument-features (n = 1) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



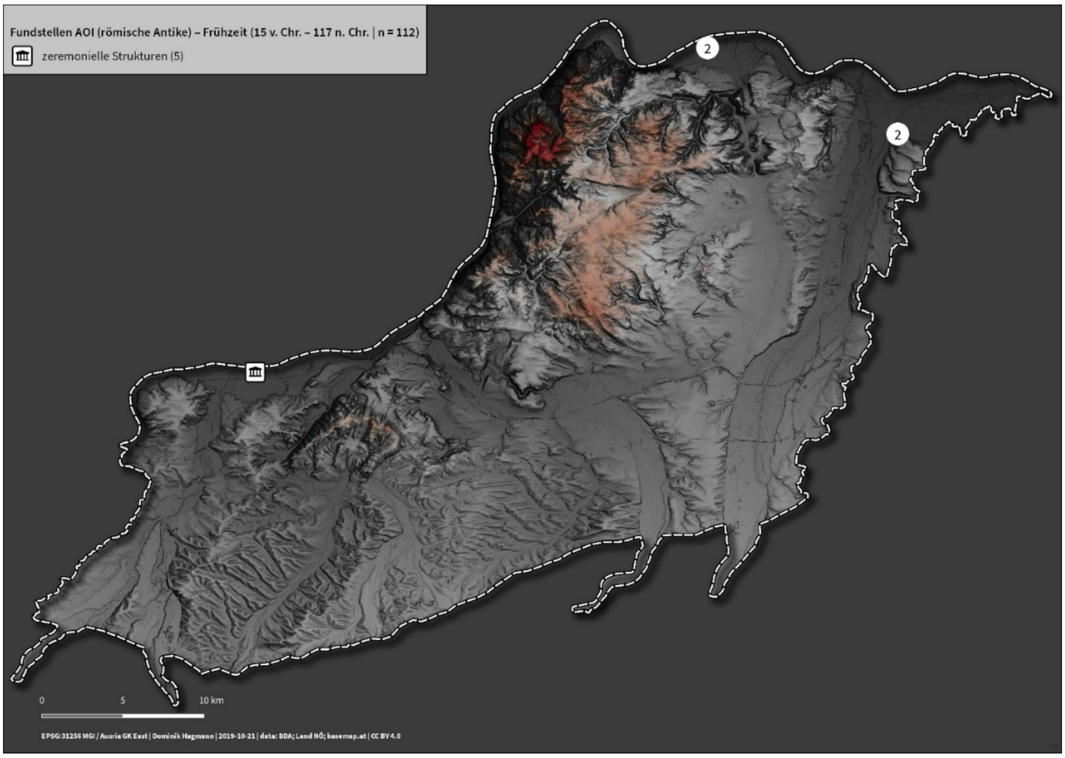
Appendix – Figure 29: Settlement-features (n = 252) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



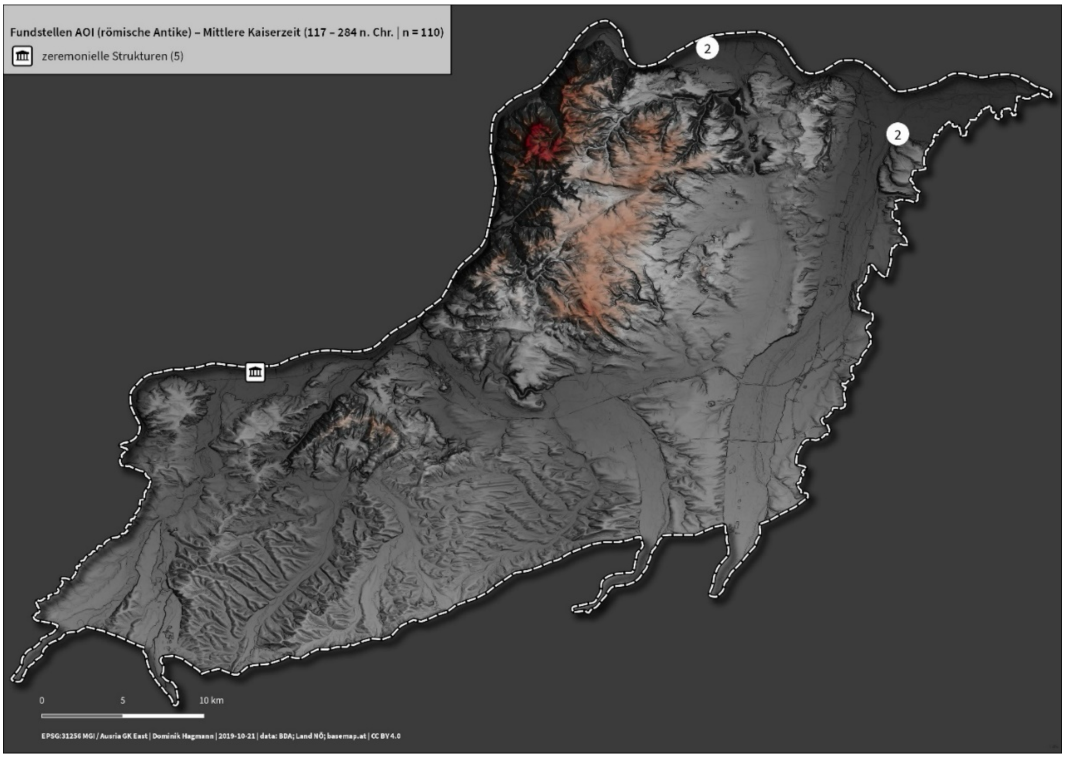
Appendix – Figure 30: Settlement-features (n = 255) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



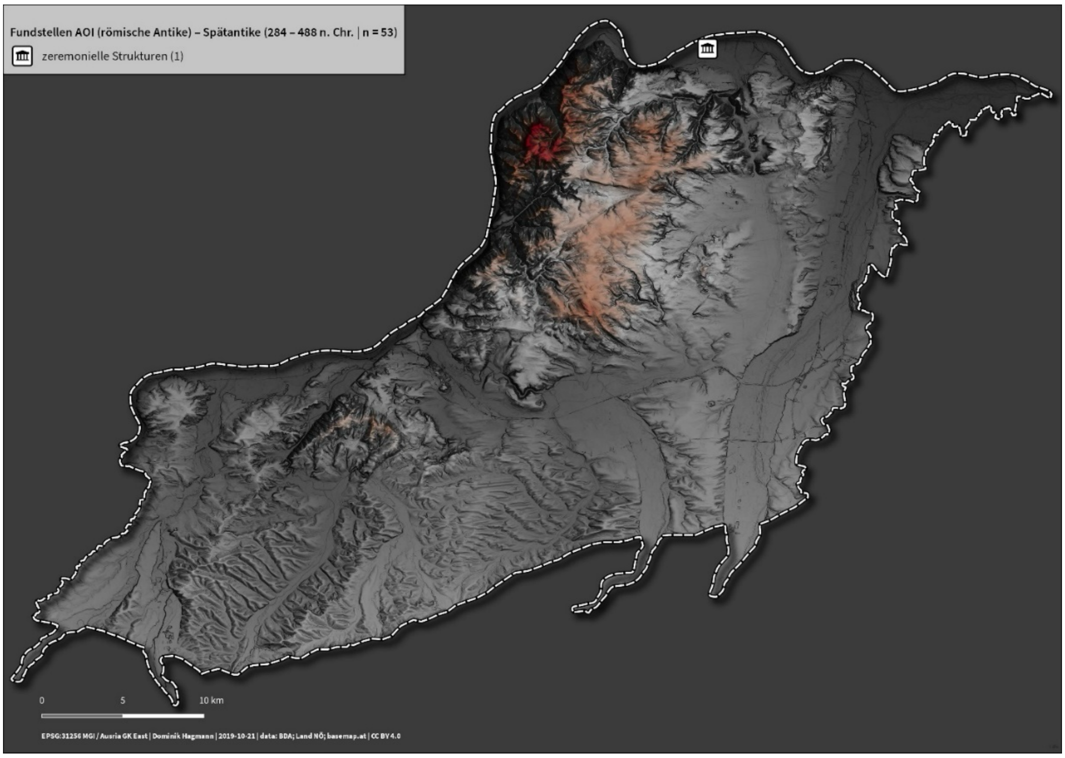
Appendix – Figure 31: Settlement-features (n = 74) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



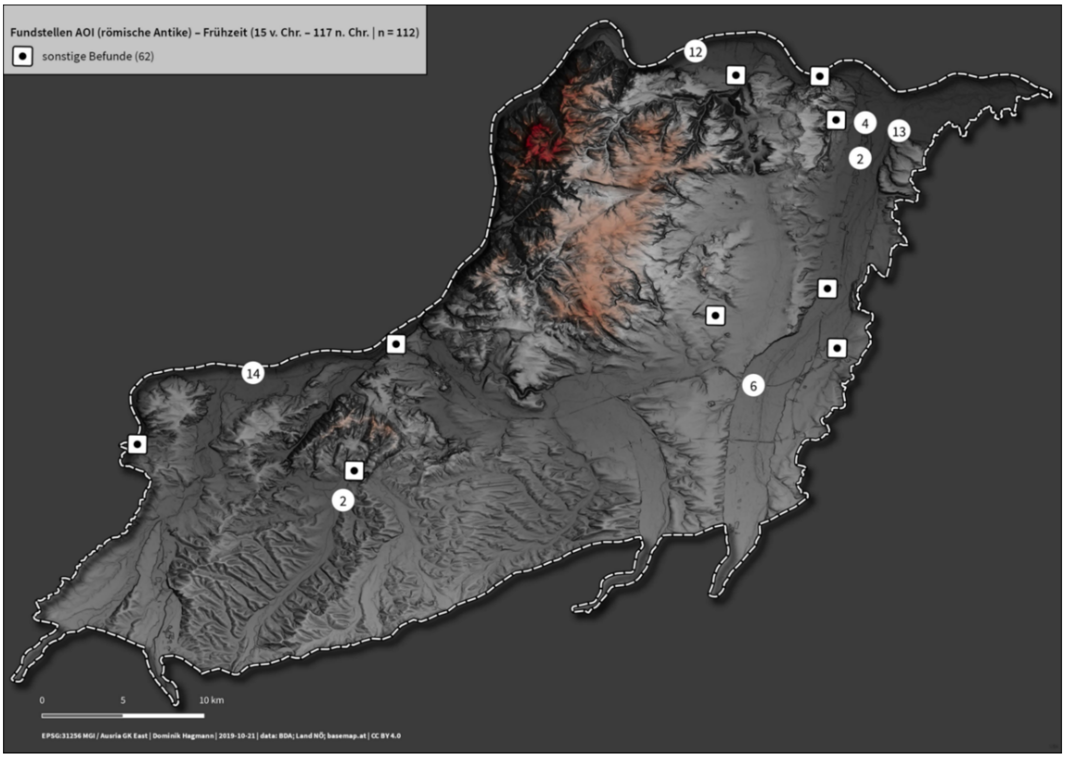
Appendix – Figure 32: Ceremonial features (n = 5) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA)



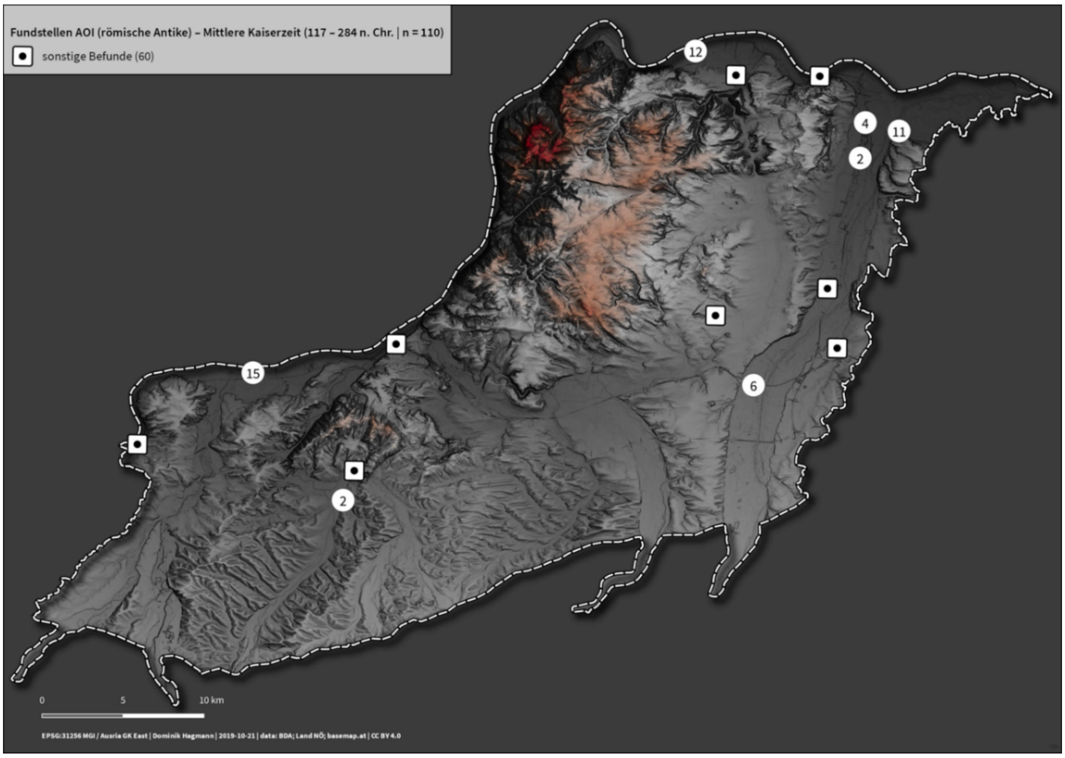
Appendix – Figure 33: Ceremonial features (n = 5) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA)



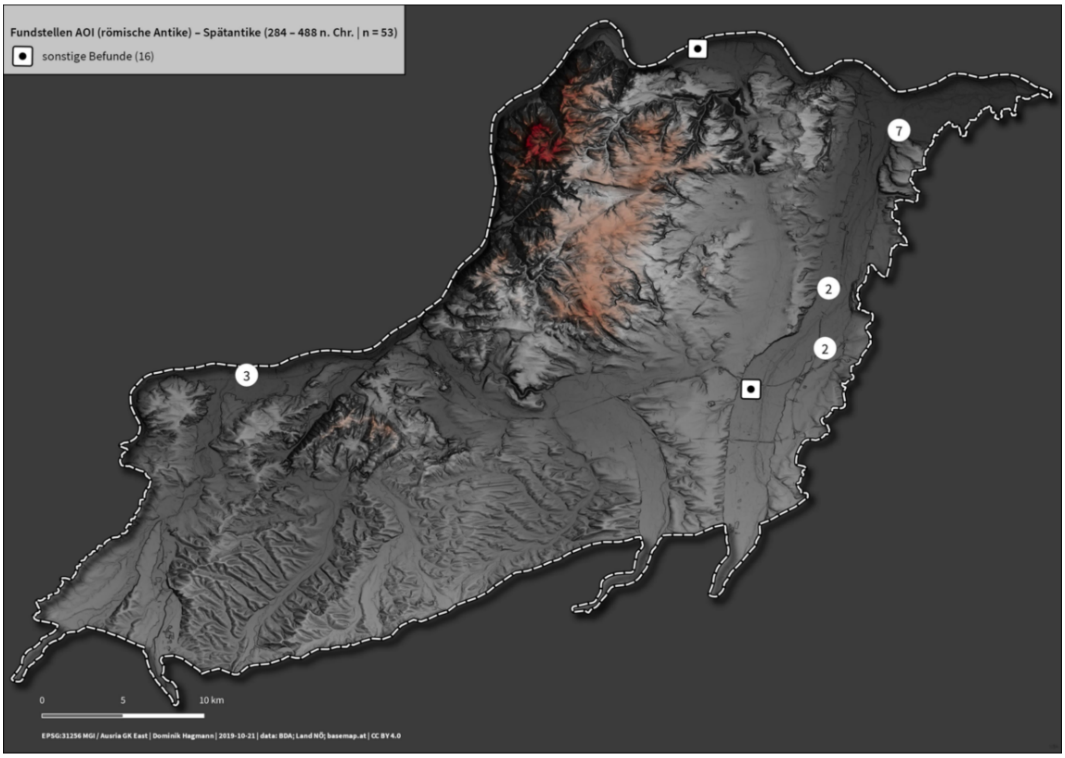
Appendix – Figure 34: Ceremonial features (n = 1) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA)



Appendix – Figure 35: Other features (n = 62) of the Early Period in the AOI (sites: n = 112) (D. Hagmann 2021; data: Land NÖ; BDA).



Appendix – Figure 36: Other features (n = 60) of the Middle Imperial Period in the AOI (sites: n = 110) (D. Hagmann 2021; data: Land NÖ; BDA).



Appendix – Figure 37: Other features (n = 16) of Late Antiquity in the AOI (sites: n = 53) (D. Hagmann 2021; data: Land NÖ; BDA).

12 Data and catalog

The primary dataset comprises processed and restructured data from the BDA-FSDB (Fundstellendatenbank/site database [FSDB] of the Austrian Bundesdenkmalamt/Federal Monuments Office [BDA]), supplemented with additional information. This dataset is detailed in Hagmann (2024) and archived in tabular format on the long-term archiving platform Phaidra, accessible at https://doi.org/10.25365/phaidra.100.

The online accessible catalog, archived and available at https://doi.org/10.25365/phaidra.428, is a comprehensive document serving as a textual foundation for verifying the archaeological analyses conducted in the paper and as a gazetteer of archaeological sites in the Area of Interest (AOI). The catalog begins with a concordance list providing a systematic overview of the archaeological sites and findspots. It then transitions into thematic appendices organized chronologically by epochs, from the Stone Age to the Modern Era. Special attention is given to Roman-era archaeological sites, detailed in separate appendices.

Additionally, the catalog includes appendices addressing site features with unknown or undefined dating. A concluding section compiles the site features, offering in-depth insights into the foundational data.

For efficient navigation, the map sheets in the catalog are organized according to Plus Codes, with an overview map provided for easy location identification. The catalog's interactive component features QR codes for quick geographical position determination, enhancing user-friendliness.

Thus, the catalog is not merely a data collection but a tool for scientific analysis and interpretation, enabling readers to trace the conclusions in the work.