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## Geoarchaeological Research in the Roman Town of *Ammaia* (Alentejo, Portugal)

### Introduction

The key objective of this research is to define the interactions of the Roman provincial urban site of *Ammaia* (Alentejo, Portugal) with its surrounding landscape. Since these interactions are very complex and influenced by a multitude of interfering factors, the adoption of a geoarchaeological approach is self-evident.

This essay not only aims to present the results of the previous work, special attention is also given to the applied geoarchaeological methods and approaches. As geoarchaeology uses techniques of the geosciences (e.g. geology, geomorphology, geochemistry, geophysics, petrology, climatology, etc.) for the study of human history, multidisciplinary is indispensable<sup>1</sup>. The geoarchaeological team from *Universiteit Gent* (Belgium), *Universidade de Évora* (Portugal) and *Università degli Studi di Cassino* (Italy) studying the Roman site of *Ammaia* is therefore composed of archaeologists<sup>2</sup>, geologists<sup>3</sup> and geomorphologists<sup>4</sup>.

The first phase of the research project focused on the geomorphological setting of the urban site and the surrounding landscape, the town's water provisioning, and the Roman gold-mining in the north of its territory. Other aspects that are currently being investigated are the *intra muros* urban layout and the stone economy of the town.

### *Ammaia*

#### *Geographic location*

The ancient town of *Ammaia* is located in the northeastern Alentejo region of Portugal (São Salvador da Aramenha, community of Marvão, district of Portalegre). The landscape is dominated by the *Serra de São Mamede*, a mountain range of circa 40 km in length and with a maximum altitude of 1027 m<sup>5</sup>. Contrary to the

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<sup>5</sup> VERMEULEN 2005, 2; see also CORSI and VERMEULEN 2008, 178.

rest of the Alentejo, which is characterized by an unfertile soil and a low humidity, the region of *Ammaia* is abundant in water and features good agricultural properties (fig. 1)<sup>6</sup>.

In ancient times, the town belonged to the *provincia Lusitania* and was incorporated in the *conventus Emeritensis* (fig. 2)<sup>7</sup>.

The exact location of *Ammaia* has long-time been the subject of discussion. Archaeologists and historians were persuaded that the ancient structures in São Salvador da Aramenha belonged to the Roman city of *Medobriga*. *Ammaia* was initially believed to be located in modern Portalegre (circa 15 km in southwestern direction), a presumption based on an epigraphic find from Portalegre<sup>8</sup>. In 1935, however, a study of a recently discovered inscription<sup>9</sup> proved that the ruins in São Salvador da Aramenha correspond to Roman *Ammaia* and not Roman *Medobriga*<sup>10</sup>.

#### Historical context

As a consequence of the scarceness of archaeological and historical data of the first occupation phase, it is extremely difficult to determine the exact foundation date of *Ammaia*<sup>11</sup>. Until present day, no indications of pre-Roman occupation have been encountered and suggestions for the establishment of the

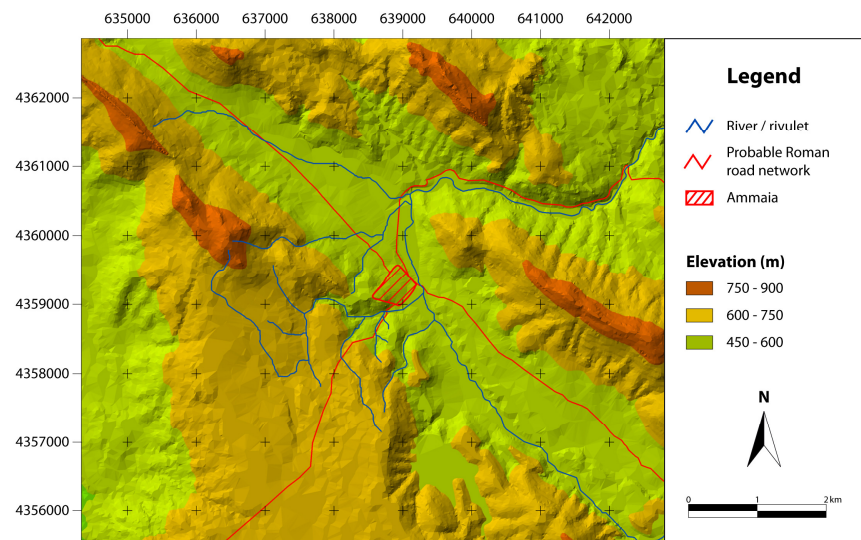


Fig. 1 - Topography of the Roman site of Ammaia and its surroundings (Modified from VERMEULEN ET ALII 2005, fig. 2).

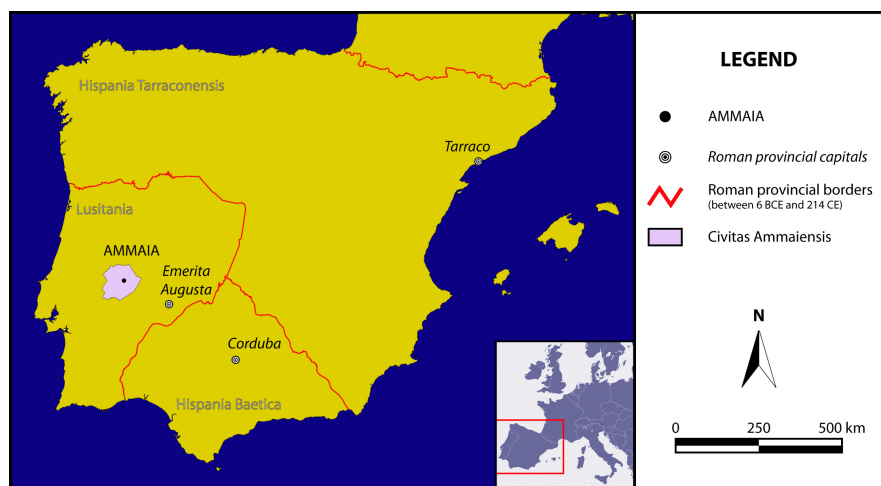


Fig. 2 - Location of Ammaia and the *civitas Ammaiensis* in the Iberian peninsula (Map by Taelman Devi).

<sup>6</sup> COELHO 1988, 252.

<sup>7</sup> CARVALHO 2002, 71.

<sup>8</sup> *Inscrições romanas do conventus Pacensis* 616. MANTAS 2000, 392.

<sup>9</sup> *Inscrições romanas do conventus Pacensis* 615.

<sup>10</sup> This idea was first propounded by Vasconcellos (1935, 6–8). Evidences are the absence of Roman *archaeologica* in Portalegre and the finding of other inscriptions from the area of São Salvador de Aramenha.

<sup>11</sup> MANTAS 2000, 396–7; see also PEREIRA 2005a, 36.

town range between the final years of the first century BC and the end of the first half of the first century AD<sup>12</sup>.

Between the second half of the first century AD and the end of the second century AD, *Ammaia* experienced its most prosperous age. In this period, probably under emperor Vespasian, the town received the status of *municipium*<sup>13</sup>, an event that initiated or stimulated the development of the monumental city centre. Public buildings and central zones in the city (e.g. *forum*, *forum* baths, city gates, etc.) were remodelled and rebuilt in a monumental way<sup>14</sup>.

The study of fine wares (e.g. *terra sigillata*, thin-walled pottery, oil lamps, etc.) suggests an abrupt end of *Ammaia*'s golden age in the Late Roman period. Excavations inside the town's walled area indicate several adaptations to the urban layout in the fourth and fifth century AD. Simultaneously, a remarkable bloom in the development of *villae* structures in the territory of *Ammaia* is visible<sup>15</sup>. A partial abandonment of the town in favour of the countryside, as a consequence of economic instability, demographic decline and reduced urban investment, are some of the interlinked explanations for this evolution.

This limited occupation of the town site remained in the early years of the Visigothic period<sup>16</sup>. From the sixth/seventh century AD onwards, *Ammaia* was completely depopulated in favour of smaller villages in the vicinity of the Roman town<sup>17</sup>. When Moors arrived in the Iberian Peninsula in the eighth century AD, the urban site had already degraded into ruins<sup>18</sup> and when in the last quarter of the ninth century the Muladi chieftain Ibn Marwân settled on the nearby and strategically well-situated stronghold named Marvão after him<sup>19</sup>, the ancient town was intensively used as a source of building material for constructions in nearby villages<sup>20</sup>.

## **Geoarchaeological observations**

### *Urban layout*

The data concerning the urban layout of *Ammaia* are derived from a combined study of the visible archaeological structures, traditional archaeological excavations<sup>21</sup>, and more recently, geoarchaeological survey work such as traditional field surveying, aerial photography analysis, topographic study and intensive geophysical survey.

Field survey campaigns in 2001 and 2002 aimed at defining the exact trace of the circuit wall of the Roman town. This consisted of mapping the visible parts of the city wall while additional field observations allowed to propose a location for the unknown parts of the wall circuit. By Confronting the previous data with the aerial photographs and with a topographical study of the proposed urban area<sup>22</sup>, a complete reconstruction of the town defences were suggested (fig. 3)<sup>23</sup>. It was concluded that the walled enclosure had a length of around 1800 m, was interrupted possibly by five gates and enclosed an area of circa 21 ha<sup>24</sup>.

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<sup>12</sup> FERNANDES 1997, 173; see also MANTAS 2000, 397–8; PEREIRA 2005a, 39.

<sup>13</sup> MANTAS 2000, 412.

<sup>14</sup> ALARCÃO 1988, 42; see also PEREIRA 2002, 113; PEREIRA 2005a, 40.

<sup>15</sup> PEREIRA 2005b, 64.

<sup>16</sup> PEREIRA 2005b, 67.

<sup>17</sup> Pereira 2005b, 68.

<sup>18</sup> Ibn Maruán, the founder of Marvão, calls himself "Lord of Ammaia and its ruins": SIDARUS 1991, 18; see also MANTAS 2000, 417.

<sup>19</sup> CAMPOS 1963, 111–112.

<sup>20</sup> MANTAS 2002, 417; see also OLIVEIRA 2002, 16–7.

<sup>21</sup> Archaeological excavations in Ammaia have been taking place since 1994, and have mainly focused on the *forum* area, the *forum* baths, the southern gate and the area around the archaeological museum.

<sup>22</sup> *Carta Militar de Portugal 1/25000 - Folha 347*, Instituto Geográfico do Exército, Lisboa; see also *Carta Militar de Portugal 1/25000 - Folha 348*, Instituto Geográfico do Exército, Lisboa.

<sup>23</sup> VERMEULEN *ET ALII* 2005, 7.

<sup>24</sup> VERMEULEN *ET ALII* 2005, 8, 13.

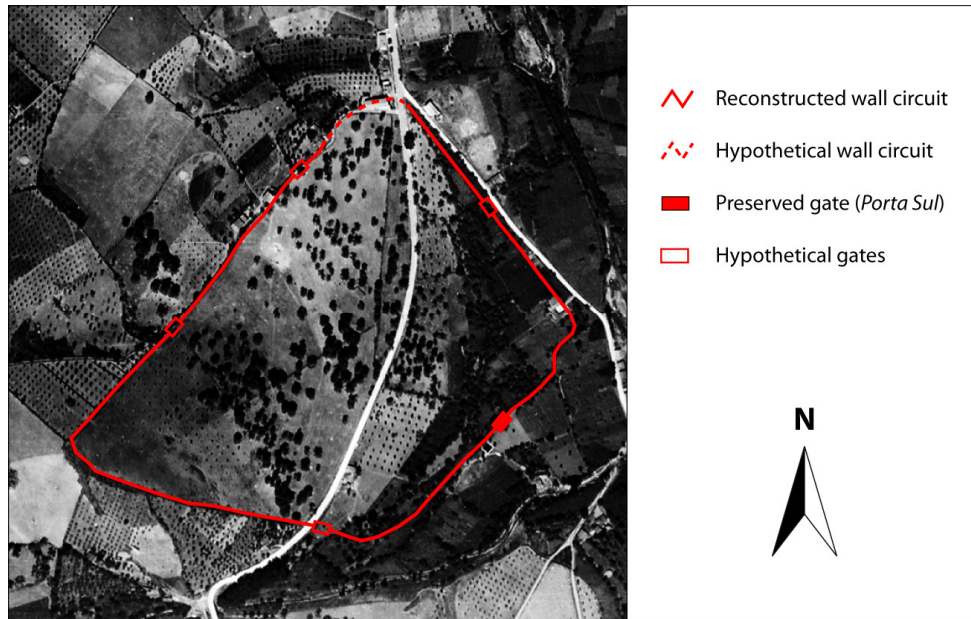


Fig. 3 - Vertical aerial photograph of Ammaia with indication of the Roman town wall and the gates (After VERMEULEN ET ALII 2005, fig. 13).



Fig. 4 - Horizontal slice (representing an depth of ca. 70 cm below the surface) of the GPR-survey of the forum area (Map by Verdonck Lieven).

In the spring of 2008, a geophysical campaign with the objective to map the city's central area was carried out, using mainly a ground penetrating radar (GPR). A georadar sends radar waves into the ground, which are reflected by archaeological structures. The time needed for the waves to arrive back at the surface gives an indication of how deeply the archaeological remains are buried<sup>25</sup>. After data processing, horizontal depth slices can be extracted (fig. 4).

The northwest-southeast orientation of the forum was known from the above-ground preserved temple base and from recent (No. 2) the excavations of part of the portico (No. 1). Whereas previously the forum square was assumed to be simply rectangular, the GPR survey revealed a more complex shape. In the northwestern part around the temple, it is much wider (53,5 m) than in the southeastern part (32 m), due to the presence of two rows of tabernae (No. 3).

The basilica of 45 by 17 m at the southeastern side of the forum (No. 4) is characterised by a double row of columns, and probably has a few entrances in the northwestern and southwestern walls. Several structures within the central area of the forum, possibly relate to water supply or drainage (channels, cisterns: No. 5) or belong to the tem-

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<sup>25</sup> A good introduction into the use of ground penetrating radar for archaeological purposes can be found in: CONYERS 2004.

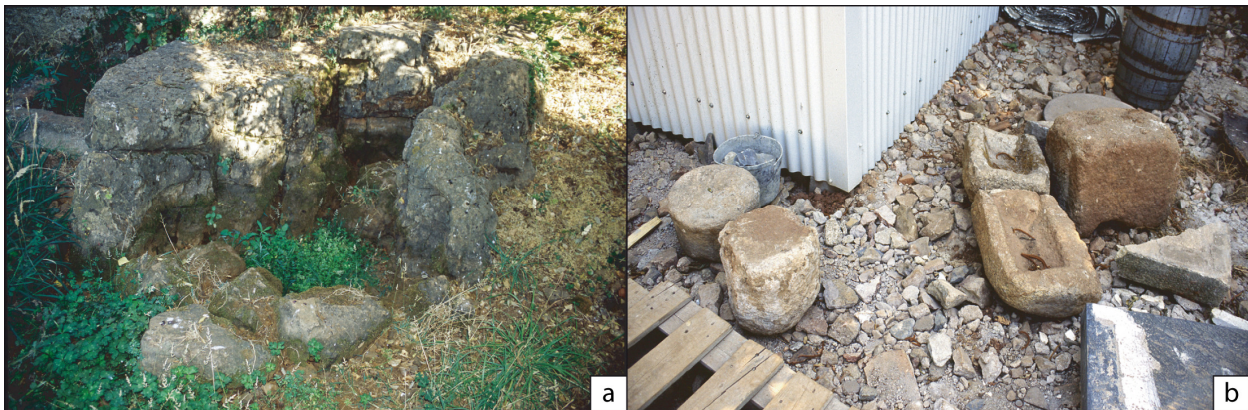


Fig. 5 - Water-related structures at Olhos de Agua (a. Possible Roman water capture, b. Roman *spolia* (columns, small granite water basin) found near the water capture) (Photo's by Vermeulen Frank).

ple (No. 6). Outside the forum, streets were detected (Nos. 7 and 8). Although not apparent in the geophysical results, the area of No. 9 is probably the location of the *cardo maximus* as it forms an axis parallel to the *forum* when connected with the southern gate. In the northeastern and southwestern corners of the survey area, structures were detected that can be interpreted as houses.

Southeast of the *forum* baths (No. 10) a second small GPR survey was conducted. Walls running parallel and perpendicular to the excavated structures may form the remains of the baths' entrance. The remainder of the investigated area revealed less clear structures, mainly because of a high amount of stone rubble in the soil.

### *Water provisioning*<sup>26</sup>

Like in all Roman towns, water played an indispensable role in *Ammaia*. Vast volumes were consumed daily for both public (e.g. public baths, fountains, latrines, etc.) and private purposes (e.g. private baths). Excavations revealed a large public thermal complex, as well as private housing complexes with smaller bathing zones, reserved for the inhabitants<sup>27</sup>.

As the Romans used the “no nonsense – least effort” principle wherever possible with regard to the construction of water provisioning systems, the use of GIS and geoarchaeological methods is very helpful for the study of the water collection, transport and distribution<sup>28</sup>.

Aerial photography analysis and field campaigns conducted between 2001 and 2006 evinced several possible water sources for the urban centre of *Ammaia*. An exhaustive study of the nature of the sources and their capacity allowed narrowing the selection down to two principal water captures<sup>29</sup>.

The first source, located 300 m east of the town and 8 m higher than the lowest point in town, presumably supplied the lowest part of *Ammaia*<sup>30</sup>. On the contact zone of schist (which acts as an aquifer) and dolomitic limestone (which acts as an aquitard), remnants of Roman water capture structures were encountered (fig. 5)<sup>31</sup>. Through a topographical study of the terrain, and by analysing these data in a GIS-environment, the most likely aqueduct route between the capture and the city was reconstructed (fig. 6)<sup>32</sup>.

<sup>26</sup> For further details concerning the water provisioning of *Ammaia* consult: DEPREZ ET ALII 2006, 109–33 and DEPREZ 2009.

<sup>27</sup> BORGES 2002, 85; see also PEREIRA 2005a, 45–6.

<sup>28</sup> VERMEULEN ET ALII 2005, 16; see also DEPREZ ET ALII 2006, 115.

<sup>29</sup> DEPREZ ET ALII 2006, 121–131.

<sup>30</sup> DEPREZ ET ALII 2006, 121.

<sup>31</sup> VERMEULEN ET ALII 2005, 16–17.

<sup>32</sup> DEPREZ ET ALII 2006, 121; see also *Carta Militar de Portugal 1/25000 - Folha 348*, Instituto Geográfico do Exército, Lisboa.

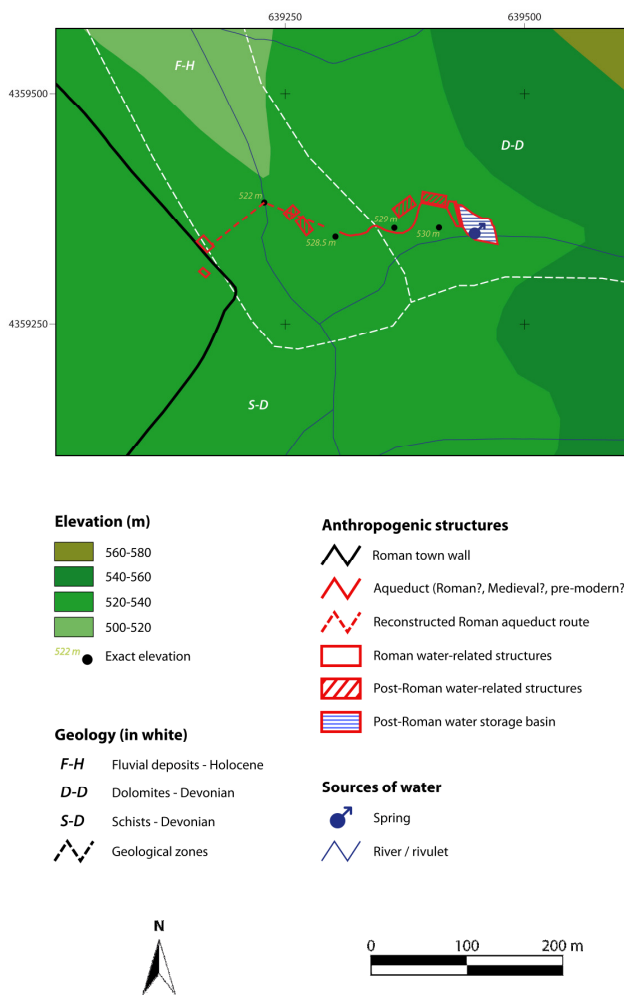


Fig. 6 - Reconstructed aqueduct route of the "Olhos de Agua" water source (After DEPRez 2009).

### Extractive industries

- *Gold*<sup>36</sup>. North of *Ammaia*, on the left bank of the Tagus River, remains of a historic gold mining site are preserved (fig. 9). Toponymic study divulged that the name of this place, *Conhal*, refers to a gold extraction site of either the Roman or the Moorish period. An on-site survey unveiled a clear human interference and similarities with other well-know Roman gold mines in the northwestern Iberian Peninsula are evident<sup>37</sup>.

A profound geologic and geomorphologic study was essential for the understanding of this extremely

A large capacity source for the upper town part, needed for the *thermae* complex and several fountains, was located along a tributary of the Sever River, approximately 820 m west of the town. Vestiges of the actual capture, with the construction of a small dam, and elements of a Roman aqueduct are still *in situ* (fig. 7). The proper water channel, in some places cut into large granite blocks, is 38 cm wide and 32 cm deep<sup>33</sup>. *Extra muros*, except for the last 100 m, it was possible to follow and map the aqueduct (fig. 8). *Intra muros*, a similar conduit structure has been found<sup>34</sup>. Together with aerial photography analysis the exact aqueduct course could be further located<sup>35</sup>.



Fig. 7 - Remains of the western aqueduct of *Ammaia* (Photo by Deprez Sarah).

<sup>33</sup> VERMEULEN ET ALII 2005, 19; see also DEPRez ET ALII 2006, 123-9; CORSI and VERMEULEN 2008, 188.

<sup>34</sup> BORGES 2002, 93.

<sup>35</sup> VERMEULEN ET ALII 2005, 19-20; see also DEPRez ET ALII 2006, 129-30; CORSI and VERMEULEN 2008, 188-189; see also DEPRez ET ALII 2006, 129-30.

<sup>36</sup> For further details concerning gold mining in the study area consult: DEPRez ET ALII 2007, 33-41 and DEPRez 2009.

<sup>37</sup> DEPRez ET ALII 2007, 33.

disturbed landscape. This was complemented with an analysis of the river sediments (both in the field and in laboratory). Combined with an interpretation of the aerial photographs of the area, this provided an excellent basis for the study of the genesis, composition and age of the gold-bearing sediments and the gold extraction itself<sup>38</sup>.

Remains of the original auriferous river terrace are still preserved, allowing a measure of the gold concentration. Values up to 100 mg/m<sup>3</sup> have been recorded<sup>39</sup>, making the mining of this site economically profitable.

The used extraction method in the Conhal was the *arrugia* technique<sup>40</sup>. Remains that indicate the application of this technique are the numerous smaller and large stone heaps (or *muria*) of quartzite cobbles and boulders, the large water evacuation channels, and the remains of storage basins and aqueducts for the water provisioning of the mining activities<sup>41</sup>.

- *Granite*<sup>42</sup> - The different building stones employed in *Ammaia* reflect both a chronologic and a social diversification. Locally available stone types (mainly river cobbles from the Sever river, schist and sandstone) were used in the early construction phases of the town and for non-monumental building. These rock types form the geologic substratum of the town or are readily available in its immediate vicinity<sup>43</sup>. From the second half of the first century CE onwards, the excavated archaeological structures show a tendency to the use of the more solid granite. In this period, the city centre and the public buildings were subjected to a complete reorganization<sup>44</sup>. This implied the start of a well-organized stone economy in *Ammaia*.

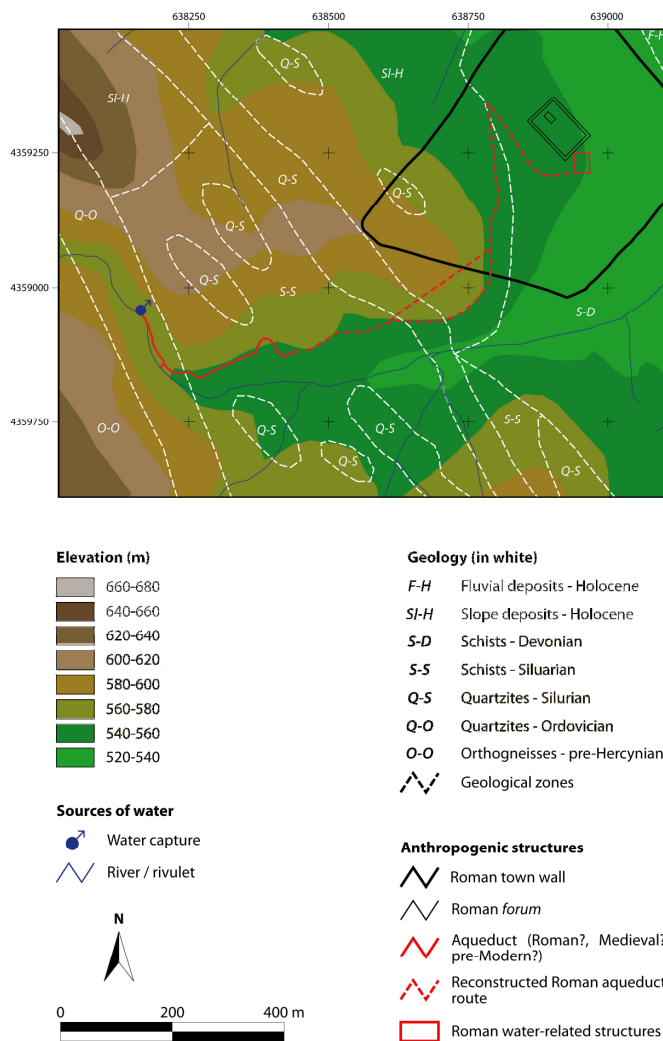


Fig. 8 - The area west of *Ammaia*: aqueduct remains and reconstructed aqueduct route to the town (after DEPREZ 2009).

<sup>38</sup> DEPREZ ET ALII 2007, 33.

<sup>39</sup> DEPREZ 2009.

<sup>40</sup> This technique involves dismantling the gold-bearing sediments by means of large quantities of water. Subsequently the gold particles are separated from the sediment in water channels or *agogae*. The large pebbles are removed by hand. The smaller sediment particles, due to a smaller relative density than gold, are rinsed out, leaving only the small gold particles: BIRD 1984; see also DOMERGUE 1986; DOMERGUE 1990; SÁNCHEZ-PALENCIA 2000.

<sup>41</sup> DEPREZ ET ALII 2007, 38-40.

<sup>42</sup> For further details concerning granite quarrying in the *civitas Ammaiensis* consult: TAE LMAN ET ALII 2008, 28-36; TAE LMAN ET ALII 2009, 177-88 and DEPREZ 2009.

<sup>43</sup> COELHO 1988, 248-9; see also *Carta Geológica de Portugal 1/50000 - Folha 28C*, Serviços Geológicos de Portugal, Direcção Géral de Geologia e Minas, Lisboa; *Carta Geológica de Portugal 1/50000 - Folha 29D*, Serviços Geológicos de Portugal, Direcção Géral de Geologia e Minas, Lisboa. Geologic field campaigns have been organized to verify the data of the geologic maps.

<sup>44</sup> ALARCÃO 1988, 42; see also PEREIRA 2002, 113; PEREIRA 2005a, 40.



Fig. 9 - Overview of the historic gold-mining site of the Conchal (Photo by Deprez Sarah).

Geoarchaeological field campaigns between 2006 and 2008 focused on the stone industry of imperial *Ammaia*. Four possible source areas for the Ammaian granite were pinpointed after an intensive field survey in a 10 km radius around the Roman town. The granite of these sites was geomorphologically and petrographically analysed, and compared to the granites used in the city<sup>45</sup>. Subsequently, the appropriateness of the quarry sites for providing *Ammaia* with building stone was examined. This research method allowed to conclude that the Pitaranha quarry was the main source of the Ammaian granite<sup>46</sup>.

A study of the topography<sup>47</sup> and geology<sup>48</sup> of the area revealed that the Pitaranha quarry is the closest site (ca. 8,5 km) in the vast granite landscape north of the Roman town with a good accessibility, an important aspect given the large difficulties for transporting heavy stones<sup>49</sup>. Since several large quartz veins cut the quarry zone, it was possible to simultaneously extract rock crystal. Traces of the dismantlement of quartz have been detected<sup>50</sup>.



Fig. 10 - Traces of Roman quarrying activity in Pitaranha (a. semi-finished column element, b. traces of the wedging technique, c. water basin) (Photo's by Taelman Devi).

<sup>45</sup> DEPRez 2009.

<sup>46</sup> The quarry is named after the small village that is located nearby.

<sup>47</sup> *Carta Militar de Portugal 1/25000 – Folha 348*, Instituto Geográfico do Exército, Lisboa.

<sup>48</sup> *Carta Geológica de Portugal 1/50000 - Folha 29C*, Serviços Geológicos de Portugal, Direcção Geral de Geologia e Minas, Lisboa.

<sup>49</sup> Taelman *ET ALII* 2008, 34; see also Taelman *ET ALII* 2009, 184.

<sup>50</sup> Taelman *ET ALII* 2008, 32; see also Taelman *ET ALII* 2009, 183.



Intensive surveying already revealed ample aspects concerning the quarry method and the organization of the activities. Large amounts of semi-finished and semi-extracted granite blocks indicate the use of the typical ancient wedging technique for rock extraction (fig. 10a-b)<sup>51</sup>. Internal organization is visible under the form of pathways and small roads on the quarry hill and on the plain at the foot of the hill. Other remains of extraction are several large heaps of stone debris and the presence of a small water basin connected to a possible kiln structure (fig. 10c)<sup>52</sup>. In the vicinity of the quarry, traces of a small Roman settlement for the housing of the quarry men, were encountered<sup>53</sup>.

A next research phase will comprise a complete and detailed mapping (via LIDAR and photogrammetric analysis) of the entire extraction site and the surrounding areas. This will provide more information about the organization and the extent of the quarry.

- *Rock Crystal*<sup>54</sup> - A third aspect of *Ammaia's* extractive industry that is being investigated is rock crystal mining. Pliny the Elder mentions the presence of large quantities of *crystallum* in the *Ammaeensis* hill of *Ammaia* (*Nat. Hist.*, XXXVII, IX, 24)<sup>55</sup>. As this is the only Roman literary record for *Ammaia*, it is supposed that the mineral was an important economic commodity for the town<sup>56</sup>.

Field campaigns with a team of archaeologists, geomorphologists and geologists between 2006 and 2008 revealed the frequent occurrence of pure quartz or rock crystal in the territory of *Ammaia*<sup>57</sup>. Starting from the geologic map, the quartz veins around the town were mapped. Subsequently, those located near Roman habitation remains were selected for closer examination. At present, four ancient rock crystal mines are identified this way. Two of these mines were in close relationship with the extraction of granite stone; the two others were associated with a Roman villa. As the mines were located at or near sites with other important economic activities (quarrying or agriculture), their exploitation was economically profitable.

The first rock crystal extraction site is located in the granite quarry of Pitaranha<sup>58</sup>. The joint appearance of the two resources was a significant advantage, given that only one extraction site had to be opened to obtain both products<sup>59</sup>. The main purpose of the quarry was the extraction of granite, but the outcrop of a large quartz vein made it opportune to mine for rock crystal as well. Indications of the actual extraction of the rock crystal are the large waste heaps with a combination of larger and smaller quartz fragments<sup>60</sup>.

Along the modern road between São Salvador da Aramenha and Marvão (ca. 4 km north of *Ammaia*), traces of the dismantlement of a quartz vein have been detected<sup>61</sup>. Due to the presence of large granite outcrops in the vicinity of the mine, it is unthinkable that the site was aimed at obtaining granite. It is more plausible that the quarry workers were in pursuit of the rock crystal present in the quartz veins. A dating of the activities is not possible, due to the lack of datable archaeological artefacts.

A third rock crystal mine was identified at Naves (c. 4 km southeast of *Ammaia*), near the Roman road connecting *Annaia* with *Butua* (modern Bótoa, Spain)<sup>62</sup>. The mining activities are limited to the extraction of rock crystal. Again large heaps of quartz debris are indicative of ancient rock crystal mining activity (fig. 11)<sup>63</sup>.

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<sup>51</sup> ORLANDOS 1968, 19; see also BEDON 1984, 125; ADAM 2005, 25; TAE LMAN ET ALII 2008, 32; TAE LMAN ET ALII 2009, 184.

<sup>52</sup> OLIVEIRA ET ALII 2007, 242; see also TAE LMAN ET ALII 2008, 33–4; TAE LMAN ET ALII 2009, 184.

<sup>53</sup> OLIVEIRA ET ALII 2007, 240; see also TAE LMAN ET ALII 2008, 34; TAE LMAN ET ALII 2009, 184.

<sup>54</sup> For further details concerning rock crystal mining in the *civitas Ammaiensis* consult: TAE LMAN ET ALII 2009, 177–88.

<sup>55</sup> These hills correspond to the present-day *serra de São Mamede* and the *serra de Marvão*.

<sup>56</sup> PEREIRA 2005a, 37.

<sup>57</sup> TAE LMAN ET ALII 2009, 182–3.

<sup>58</sup> TAE LMAN ET ALII 2008, 32.

<sup>59</sup> TAE LMAN ET ALII 2009, 183.

<sup>60</sup> OLIVEIRA ET ALII 2007, 242; see also TAE LMAN ET ALII 2009, 184.

<sup>61</sup> TAE LMAN ET ALII 2009, 186.

<sup>62</sup> CARVALHO 2002, 72.

<sup>63</sup> TAE LMAN ET ALII 2009, 186.

The presence of Roman building material (*tegulae* and *imbrices*) and Roman *dolia* and the proximity to the Roman road suggest a Roman date for the extractive activities<sup>64</sup>.

Finally, a fourth rock crystal extraction site was detected north of *Ammaia* (ca. 11 km), nearby. The Roman *villa* of Vale do Cano (north)<sup>65</sup>. Two large heaps of quartz debris and several quartz veins point to the presence of an ancient Roman mine.



Fig. 11 - Large waste heap composed of quartz and rock crystal at the Naves site, as a result of rock crystal mining (Photo by Taelman Devi).

### **Conclusions**

The importance of geoarchaeological methods for the study of the human past has been proved by numerous studies. In the case of *Ammaia*, a wide range of such interdisciplinary techniques has been applied in order to gain a clearer and more detailed insight in the history of the Roman town.

The main advantage of the application of a geoarchaeological strategy for the study of the urban layout of *Ammaia* is its non-destructive nature. The survey of the city wall, the *forum* zone and the *thermae* complex allowed a first reconstruction of large parts of the town. The next phase will confront the geoarchaeological data with the results of previous excavations and determine an appropriate excavation strategy for the different structures.

Secondly, techniques and strategies of the geosciences are indispensable for the study of the relationships between the town and its surrounding landscape. The main investigated topics so far are the water provisioning and the extractive industry. Concerning the water provisioning of *Ammaia*, the main water sources supplying the town were identified. Regarding the extractive industries, the use of geomorphology was extremely important, because most of the landscapes at these sites have been subjected to large mutations as a consequence of the extractive activities. The study of the quarries and the mines provides information on the sites themselves and, on a higher level, on the economic organization of the town in general.

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<sup>64</sup> OLIVEIRA *ET ALII* 2007, 266; see also Taelman *ET ALII* 2009, 186.

<sup>65</sup> OLIVEIRA *ET ALII* 2007, 64.

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