Stone Resource Economy during the 1st Century BC and 1st Century AD in Aeduan and Lingon Territories

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Stone is a major element in Roman construction and its systematic use contributed to the complex process of economical and cultural changes known as romanization.

These problems allow us to discuss the appearance and the subsequent diffusion of Roman building materials in central-eastern Gaul as much as their role as cultural and identity markers.[1] Indeed, they can be considered witnesses of intercultural relationships between the Mediterranean world and Gallic tribes, before and after the Roman conquest.

It is clearly shown that the appearance of monumentalized and petrified towns, mostly during the first decades of the 1st century AD and before, is irremediably linked to changes in building design. Thus, Gallic construction methods, which are characterized by perishable resources such as wood, thatch or unbaked clay, are gradually replaced by new architectural forms with materials of Roman origins (involving stones and architectural terracotta). These materials can be recorded in multiple contexts, belonging to private houses, institutional structures and also temples.

The analysis of building stone supply appeared as relevant for several archaeological sites, dated from the 1st century BC to the 1st century AD, belonging to two territories located in central-eastern Gaul: Aeduan and Lingon *ciuitates* (fig. 1a). We aim to describe the use of stone resources in the buildings of these territories to shed light upon the plurality of supply sources, the economy and the management of construction. These aspects can be approached by the description of the natural resources, their origins, the implementation and the shaping of the materials.

Analyses applied to the corpus are based on macroscopic identifications of stone materials compared to local and regional geological data. The correlation with the outcrops, which were the most likely to have been exploited, allows us to characterize supply perimeters following a classification system into five categories.[2] They define origin scales (immediate, adjacent, local, regional and extra-regional perimeters) according to the distance between outcrops and construction sites.

Stone Materials Analysis on the Aeduan Territory

Our interest for the Aeduan territory lies in two sites, which are chief towns. They are integrated in a vast area focused on the Morvan region. This Hercynian massif, made of granitic, volcanic, metamorphic and sandstone rocks, is surrounded by calcareous and chalky plateaus. The position of the towns of Autun-*Augustodunum* and Bibracte

Published in: Dimitri van Limbergen – Devi Taelman (Eds.), The Exploitation of Raw Materials in the Roman World: A Closer Look at Producer-Resource Dynamics, Panel 4.4, Archaeology and Economy in the Ancient World 27 (Heidelberg, Propylaeum 2021) 63–77. DOI: *https://doi.org/10.11588/propylaeum.706.c10593*

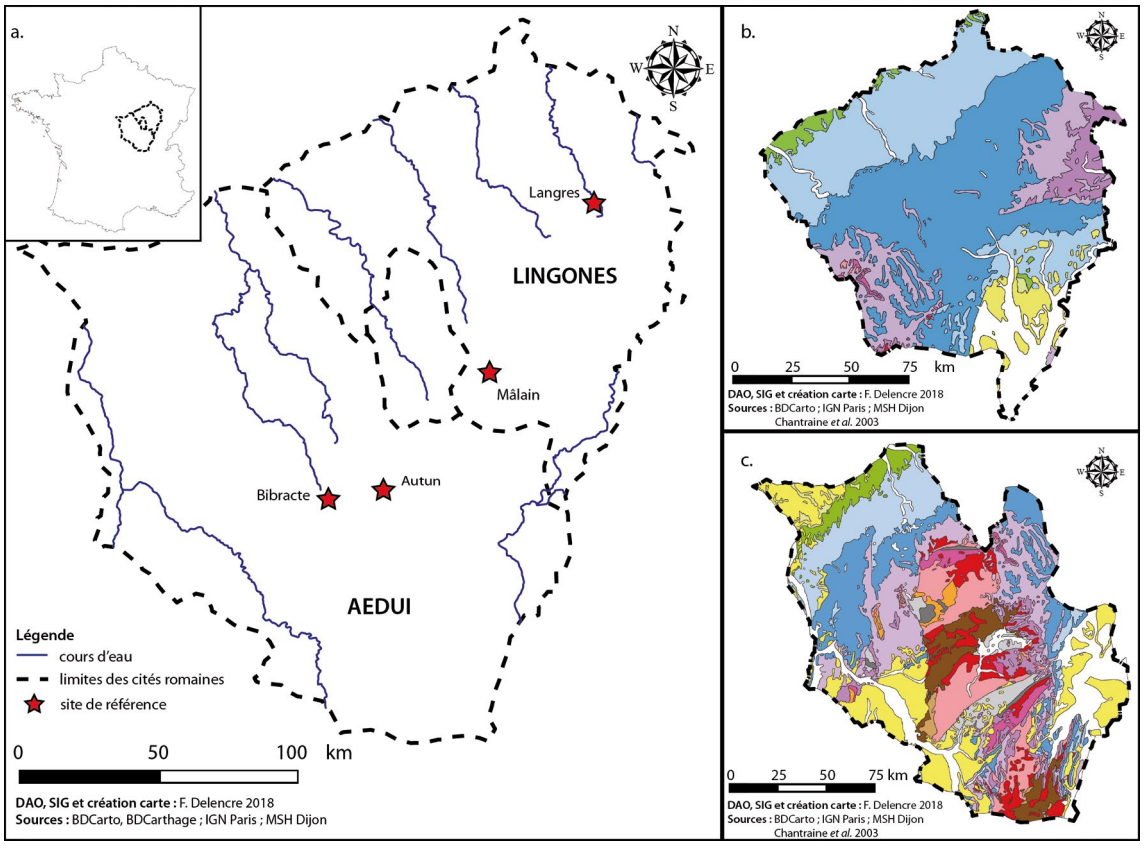

Fig. 1: Spatial and geological frameworks for the Aeduan and Lingon territories.

is central in this area (fig. 1c): they are well served by communication routes and give access to three catchment areas of importance. They correspond to argillaceous plains and valleys: "la Loire" in the south, "la Seine" in the north and "la Saône" in the east.

The *oppidum* of Bibracte

Regarding stone building materials of the *oppidum* of Bibracte, the earliness in the appearance of new construction methods is remarkable. It seems to be the result of long-term contacts established with the Mediterranean world. Indeed, this *oppidum* occupied since the end of the 2nd century BC is the chief town of the Aedui, a Gallic tribe considered by the Roman Senate as "brother of the same blood".[3] The petrographic analysis of stone materials is therefore relevant to characterize the modalities of integration for the construction techniques and the know-how.

A substantial corpus has been collected in different excavations of the *oppidum*[4] and the forensic record for the petrographic nature turns out to be preliminary to determine the stone's resources origins.[5]

The most abundant facies correspond to volcanic rocks (mostly rhyolite) and stones from sills of microgranite and microdiorite.[6] These precise facies are involved in the

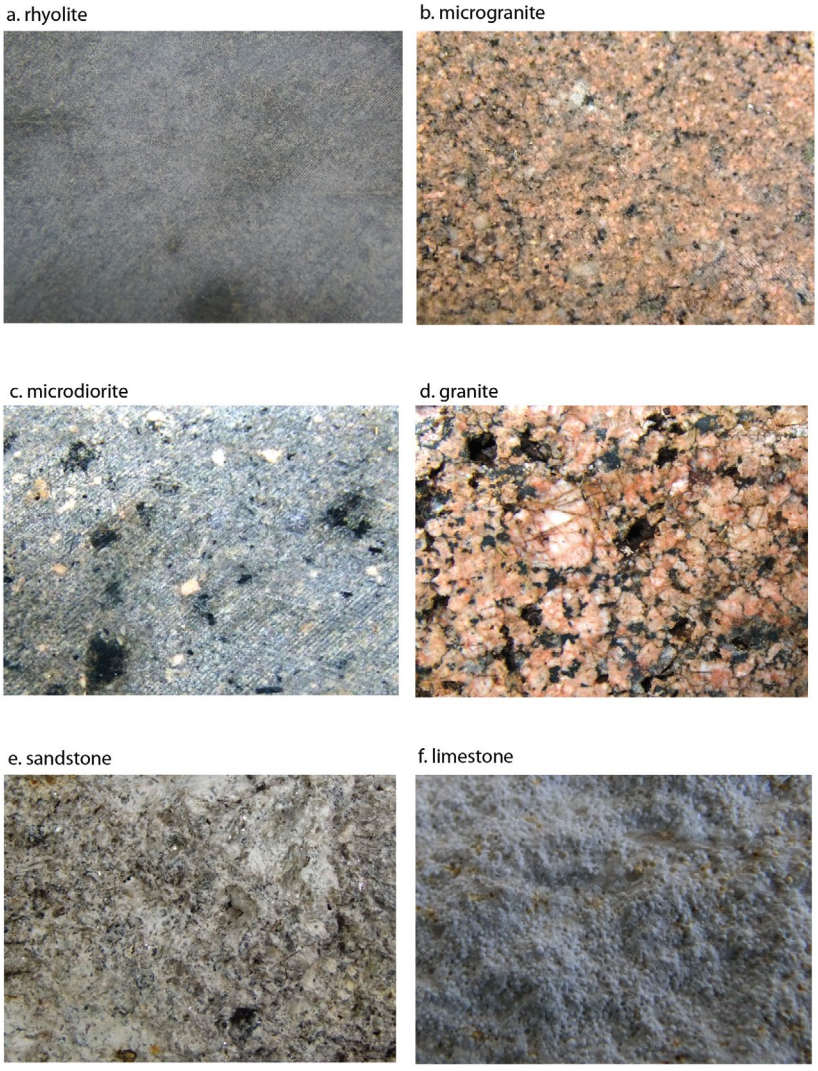

Fig. 2: Petrographical corpus for building materials used in Bibracte.

appearance of Roman building methods and by the introduction of lime mortar in the masonries of Bibracte (fig. 2 and 3). This is achieved as soon as the middle of the 1st century BC when a building so-called "with basilica floor plan" was erected. This building turns out to be the earliest example of the implementation of Roman techniques in the construction for central-eastern Gaul.[7]

A few stone resources, imported from far away areas (fig. 2 and 3), experienced a more specific use. For this reason, several facies of granite recognized in Bibracte are shaped into architectural elements of great dimensions such as stones for stairways and quoins. We can also see them mobilized in a monumental basin construction. These different facies of granites are successively exposed on about a five-kilometer distance in the east of Bibracte.

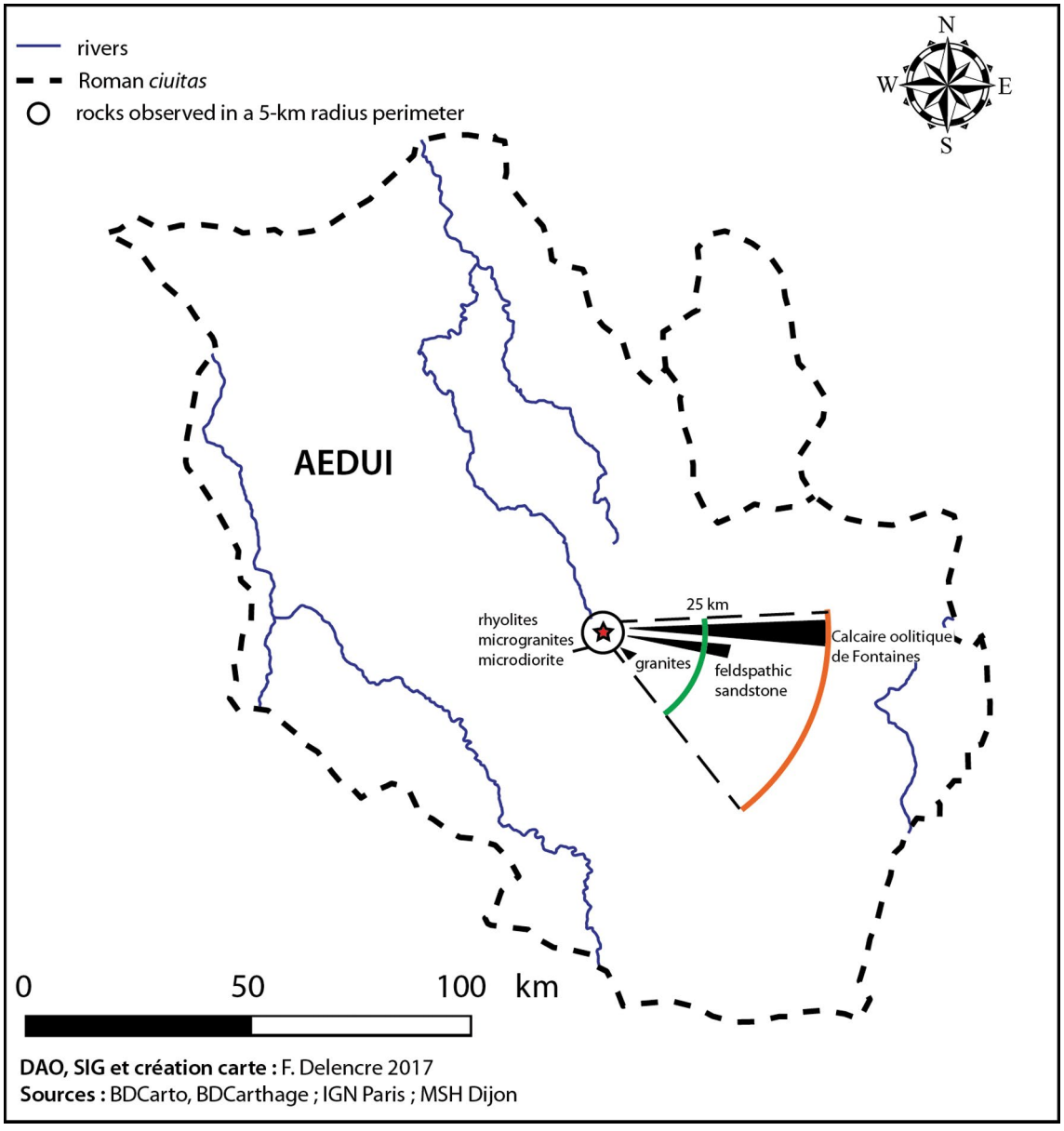

Fig. 3: Stone resources supply in Bibracte.

Resources from further beyond are used to shape the columns of the building with a basilica floor plan (fig. 2 and 3). A triassic feldspar sandstone outcropping about 30–40 kilometers from Bibracte is mainly implemented with the facies of granite for disc sections composing column shafts.

The choice of a limestone named "Calcaire oolitique de Fontaine" does not seem to be a coincidence either as it is exploited in the regions of Beaune and Chalon-sur-Saône, at

a distance greater than 50 kilometers. If our first deduction is the easiness to shape those stones, other solutions can be evoked due to the distant origin and the Roman norms, which seem to rule the elaboration of columns capitals and bases. Moreover, this rock is naturally white and catches the eye by comparison with the darker colors of the local stones.

The study of these materials confirms the variability of stone supplies. Local stones mobilized within a 25-kilometers perimeter are widely used and can be observed in the masonries. Some petrographic natures, belonging to regional perimeters, are however specifically employed in construction to fulfill architectural needs.

The chief town of Autun-*Augustodunum*

As all the "*caput ciuitas*", Autun-*Augustodunum* reveals a great diversity regarding functional buildings, in which construction areas are characterized by Roman techniques and a very important stone resources supply.[8]

The Gallo-Roman town is surrounded by a 6 kilometers-long fortification[9] and one of its four main gates leaving access to the city still exists today, known as the "Porte de Saint André" (fig. 4a). It has been studied for its historical, architectural or archaeological aspects and the question of building material has obviously been considered for this typically Roman monument.[10]

The fortification wall on each side of the gate is quite well preserved and made of local granite and gneiss stones. The outcrops of these rocks are recognized at the limits of the Permian basin of Autun, in the south and west of the town (fig. 4b and 5).

The substructures supporting the gate jambs and the superior arcatures are made of feldspar sandstone. It can be seen on the plateau of Antully-Planoise,[11] about 10 and 20 km east of the town (fig. 4b and 5).

The exterior facings exhibit oolitic calcareous slabs of great dimensions, which is exactly the same stone used for the columns of Bibracte.[12] As we saw earlier, this limestone can be found near the region of Beaune and Chalon-sur-Saône, more than 30 km away from Autun (fig. 4b and 5).

The rubble stone walls forming the towers inserted on each side of the gate are made of sandstone named "Grès blond du Rhétien". It can be found in a 10 km –perimeter from Autun (fig. 4b and 5).

Stone resources engaged in the construction reveal different origins that can be retraced thanks to the characterization and the recognition of rocks. Various distance scales can be defined, even if the precise quarries have never been located. As in the example of Bibracte, local stones seem to be mobilized for the construction requiring important volumes. In the same time, distant resources are sought to fulfill specific architectural needs.

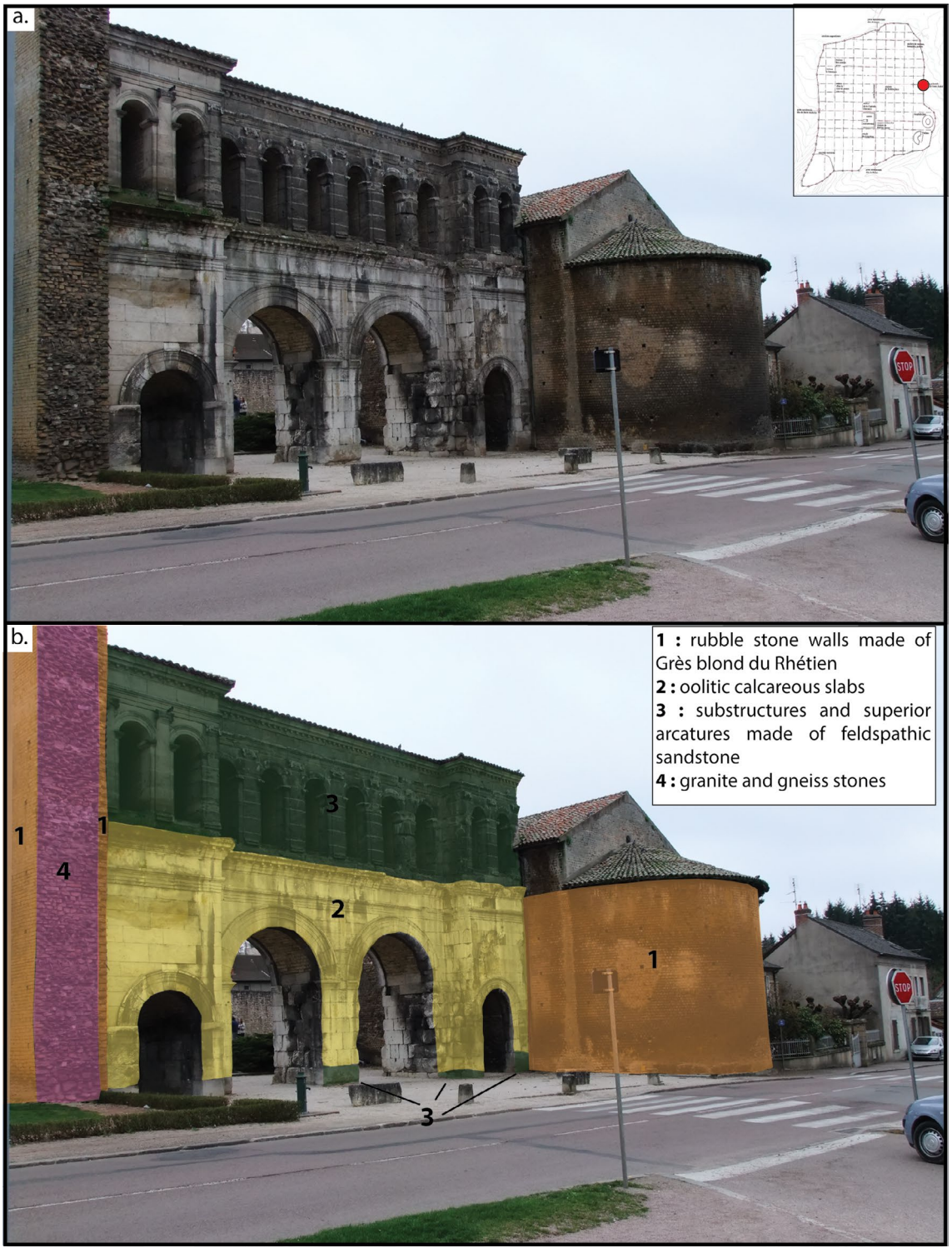

Fig. 4: Petrographical identification of building materials implemented in the "Porte de Saint-André" of Autun-*Augustodunum*.

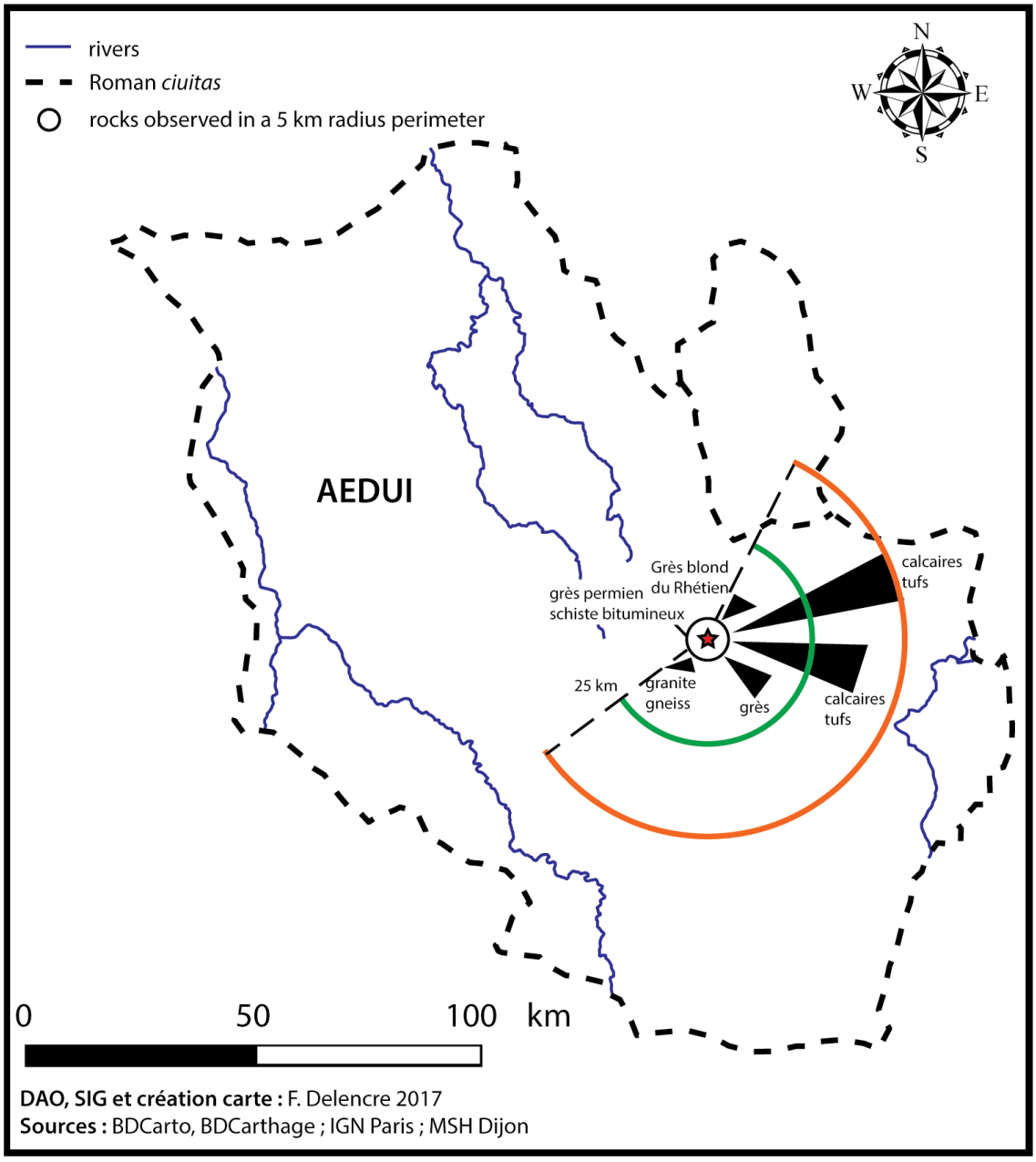

Fig. 5: Stone resources supply in Autun-*Augustodunum*.

Stone Materials Analysis on the Lingon Territory

The Lingon territory, located north from the Aedui, is spread on an area where geological resources are mostly formed by calcareous plateaus. Two argillaceous and marly regions can also be found in the west and south of the *ciuitas*. Concerning stone building materials, here we can focus on two peculiar sites: a secondary agglomeration and the *caput ciuitas* (fig. 1b).

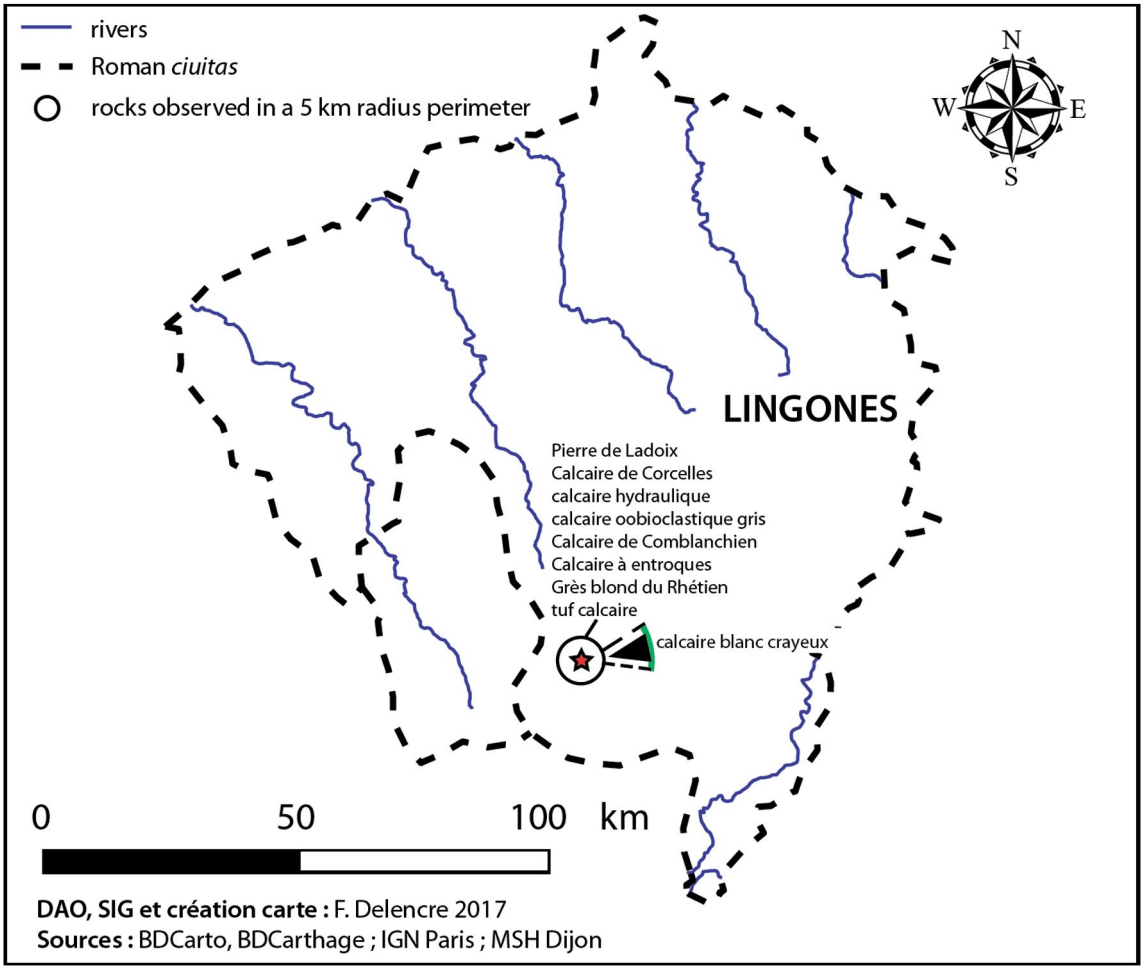

Fig. 6: Stone resources supply in Mâlain-*Mediolanum*.

Mâlain-Mediolanum

The excavations in Mâlain-Mediolanum, which took place in the locality of "La Boussière", revealed structures composing the urban center, including a portico along a rectangular square that could be interpreted as the forum.[13] The studied corpus has been gathered by the remaining masonries, stairway elements, columns and various blocks of great dimensions that add to the selected materials during the archaeological excavations.

Several petrographic facies were defined, helping in finding the precise geological formations they were extracted from. All the stones that can be found used in a construction context are described as various calcareous rocks. Furthermore, the recognition of building stones sheds a light on the fact that the exploited resources all belong to the local perimeter, meaning in a 25 km radius around the site (fig. 6). Regarding the masonries, stones can be found immediately very near to the site, less than 1 km away. Such variability on the use of stone resources seems to be linked with the availability of local geological environment. Local stones are thus employed for

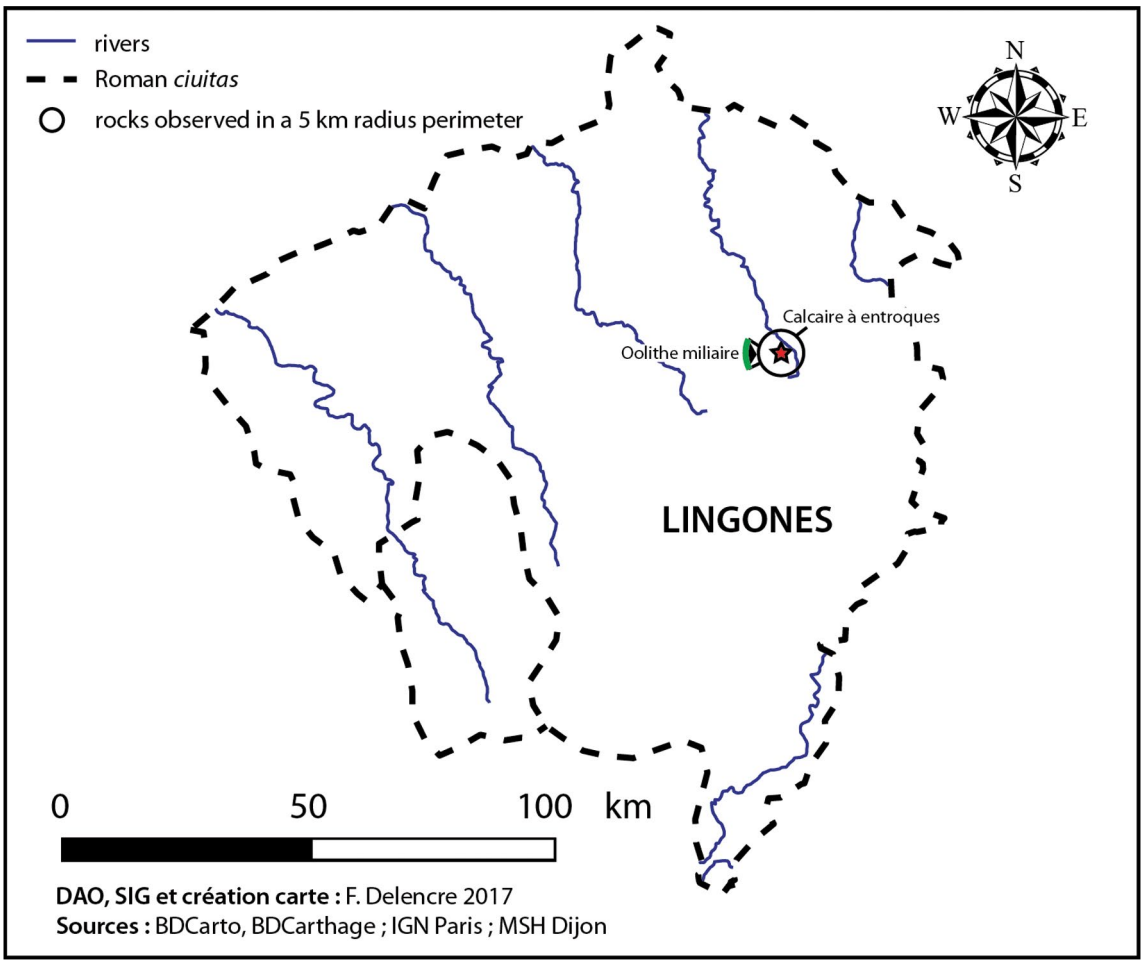

Fig. 7: Stone resources supply in Langres-*Andemantunum*.

specific architectural needs, contrary to what we could observe in Aeduan examples. This characterization for the selection of materials therefore defines a maximal mobilization of the close environment to fulfill specific requirements of construction.

Langres-*Andemantunum*

Regarding the *caput ciuitas* of the Lingones' territory, Langres-*Andemantunum*, it is not very well documented because of the scarcity of large-scale excavations.[14] Despite this, some recent archaeological activities give us information concerning the origin and the occupation of the agglomeration.

That is the case, for instance, for two *insulae* established on each side of a *decumanus*, excavated between 1968 and 1981, revealing structures and artifacts, which date the site back to the beginning of the 1st century AD.[15] The collected corpus for stone building materials is very partial. Indeed, only a few observations could be undertaken on the masonries and a sampling has been realized for stoned-roof elements.

Therefore, it is difficult to appreciate supply variability for the construction sites in the Lingones *caput ciuitas*. The most employed facies concern the masonries, involving consistent volumes, correspond to a calcareous rock with crinoid fossils. It is interesting to notice that this very stone constitutes the geological substrate on which the agglomeration is established.

In contrast, stoned-roof elements are made of a distinctive petrographic nature clearly different from this substrate. The first outcrops of this oolitic calcareous rock are located at a distance of 10 kilometers west of Langres. We can also notice that this geological formation can be found further to several tens of kilometers. We can deduce, from these information and the lack of knowledge about ancient quarries, that the supply sources can be located in several points belonging to the local perimeter (fig. 7). The analysis of stoned-roof elements shows that when a peculiar stone resource is wanted for a construction, only the local environment is mobilized.

Identification of Two Distinctive Behaviors in the Use of Roman Building Materials

It is not a surprise that stone resources observed in constructions have very little in common for each site, apart from a few exceptions. This can be easily explained by the diversity of geologic formations in the considered territories.

However, stones of various petrographic natures can be found sometimes very far from the construction site where they are shaped and implemented. By these observations, we can put in evidence a common feature with the use of substantial local rocks in the masonries. All these stones belong to the local perimeter and can be found in a 25-kilometer radius around the considered site to produce rubble stone, quoins, etc.

Specific needs related to the construction have led the builders to seek stones bearing particular qualities. Compact and isotropic rocks are selected to create the elevations with stones arranged following regular bedrocks bound with lime mortar. Oolitic limestones are particularly wanted to shape architectural elements such as columns as they are easily carved, etc.

The highlighting of different origins of stones according to construction needs marks precise selections depending on economical, technical, and aesthetic criteria.[16]

These last aspects are materialized by searching geological origins, by bringing out supply organizations or by identifying the inherent properties of the rocks for their shaping and implementing.

The analysis of materials for several Aedui sites emphasizes a typical supply pattern, first seen with Bibracte and Autun (fig. 8). Thus, most of the stones used for each construction site are extracted from less than a 25-kilometer distance. However,

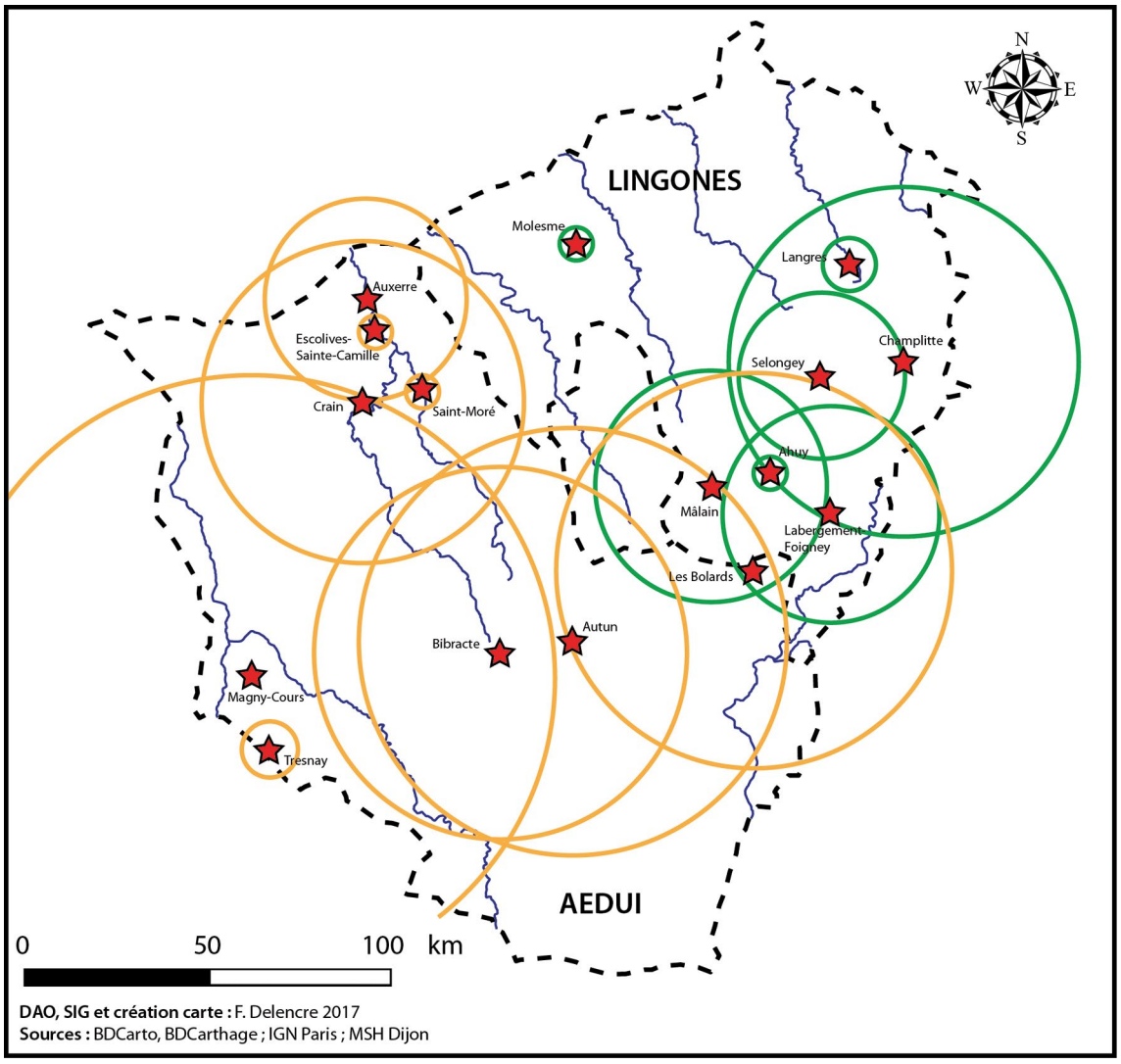

Fig. 8: Stone resources supply in Aeduan and Lingon territories

concerning construction, some petrographical facies are particularly sought to meet specific architectural needs. This implies selecting and carrying stones, which are found inside a 50-kilometer perimeter. The Aedui therefore are prone to have a peculiar form of independence to the natural resources.

Buildings on Lingones' territory, described with Langres and Mâlain, are characterized by an exclusive use of local stones, never exceeding a 25 kilometers distance (fig. 8). The choices made for these materials draw a maximum mobilization of the surrounding environment to meet required architectural needs. A building in the Lingones' territory reflects *de facto* its geological environment.

The overview of the results that we have presented finally highlights two different behaviors concerning the relationship to building natural resources. This can be

observed by the supply of construction sites inside these territories with an important variety of geological resources.

A very remarkable pattern emerges by the recognition of each *ciuitas* in its construction methods linked to the local geology and to be able or not to carry materials over great distances. These observations confirm our research results concerning the integration (appearance and subsequent diffusion) of Roman building materials in these territories.[17]

Concerning the Lingones, the variety of construction methods testifies for strictly localized supplies. Lingones' roofs are made of *tegulae* and *imbrices* only where argillaceous formations are prone to be exploited for terracotta. The use of lime mortar is limited to calcareous regions.

On the contrary, the Aedui buildings are defined by the use of Roman building materials, even if local resources are not able to properly produce them. Lime mortar and tiles are widely used, no matter the geological context.

There is no valid argument allowing us to think that the Aedui are more able than the Lingones to transport goods. Indeed, the road and fluvial networks are almost identical for both Gallic tribes. Moreover, these two territories are characterized by important catchment areas and the Roman roads have been established regardless of the *ciuitates*. The issues of resources availability can be considered, if we take territorial legislation into account insuring with the administration the coherence of Roman *ciuitates*.[18] We have to keep in mind that a large portion of these territories belongs to the *ager publicus* and the exploited resources can be located in areas that cannot be assigned to a private owner.[19] However, if this point could be mentioned to explain the choice of specific stones, it does not quite explain this neat differentiation between Lingones and Aedui, all the more when both *ciuitates* are considered as *foederati* in the same way by Rome.

It would be compulsory to shed light on other specifications that could differentiate those two areas to explain these underlying mechanisms. Those two distinct managements of natural resources in each *ciuitas* we have analyzed seem to be consistent. They appear to be based on specific cultural aspects, religious beliefs and/or institutional frameworks that can explain this neat differentiation.

Conclusion

These discrepancies raise a question concerning the insertion of various building sites in economical and architectural problems. Our results show that the use of stones in construction is not only an issue of material conditions but they also show that building materials can be considered cultural markers, just like more classical ones, linked to a global transformation of construction and perception of material resources in the environment.

To conclude, the search and the implementation of basic materials essential to produce these building materials are motivated by several parameters. Nonetheless, we have to be careful about the fact that the characterization of stone resources is different from ours. Indeed, ancient texts teach us that stone workers have their own classification guided by a pragmatic recognition of the technical properties specific to the crafted stones.[20] The plurality in the arrangement of building materials, the way to conceive natural resources, the persistence of new integrated construction methods, etc. express changes that can be linked to the cultural acquaintance between these two Gallic tribes and Rome. These changes are supported by an important knowledge of the more or less local natural environment to correspond to practical, technical and even aesthetic aspects, which are developed throughout construction programs.

Notes

[1] Delencre 2017.
[2] Fronteau et al. 2014.
[3] Goudineau – Peyre 1993, 171.
[4] Delencre 2017, 130–140.
[5] Delencre – Garcia 2012.
[6] Gradeler 2018.
[7] Szabó et al. 2007.
[8] Labaune – Kasprzyk 2015.
[9] Labaune 2011, 42.
[10] Blanc et al. 1985 ; Delencre 2017.
[11] Rat 1996, 475 f.
[12] Delencre et al. 2014.
[13] Roussel 2003.
[14] Joly et al. 2015, 218.
[15] Menec 2008, 103 f.
[16] Delencre 2017, 143–147.
[17] Delencre – Garcia 2014 ; Delencre – Garcia 2016 ; Delencre 2017.
[18] Chouquer 2010, 93.
[19] Chouquer 2010, 144.
[20] Dessales 2011, 47.

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