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**ORIGINAL ARTICLE**

# The exploitation of silver deposits in early medieval Europe: some documentary, economic and social problems

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**Abstract**

Focusing on Southern Europe, this article sheds light on the mining landscape of the early Middle Ages. Based on the current state of historical and archaeological knowledge, the article raises a number of questions that can be extended to other European regions. The documentary problem shows that the scarcity of sources is due to a less developed mining historiography of the early Middle Ages. The few references show that it was not a question of ignorance, nor of the terrain, nor of the potential, nor of the techniques, taking into account the work in Melle and in the Harz. The study of production from the angle of an economic problem forms the basis of a hypotheses for selective and centralized exploitation during the Carolingian period and of an unbridled mining boom from the early 11th century. Even with the current paucity of documentary evidence, it is reasonable to assume that early medieval societies did not choose to exploit all the resources available to them. Finally, there is the social question. Who was behind the work and trade in ingots? The model of elite dirigisme will be discussed and it will be suggested that the role of the elite be reduced in favour of other actors such as entrepreneurs. Finally, the article argues for the extension of archaeological research to production areas in order to date operations, establish reference systems for ores and read archaeological remains from a social perspective.

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**KEYWORDS**

archaeology, early Middle Ages, economic history, Europe, Mining, silver, writing practices

## INTRODUCTION

‘If every labour produces diverse rewards in equal measure to what gold and silver would procure through customary exchange, why should we not diligently search for that very thing by which we are known to exchange other goods?’ It was with this question that Cassiodorus began a letter that the Ostrogoth king Athalaric sent to Count Bergantino *c.*527, asking him to finance the search for goldmines in Calabria (Cassiodorus, *Variarum*, IX, 3; Bjornlie, 2019, 358–359). In this letter, Cassiodorus praises mining, its work and its techniques, which he presents as the only fair way to get rich—war is an evil, maritime trade a danger, fraud a disgrace (Giardina et al., 2016; Porena, 2018). At the beginning of the sixth century, there was no reason why mining should not be resumed on a large scale: the deposits abandoned by the Romans were not exhausted, the techniques of extraction and smelting were not forgotten, and the work could still be funded and seemed as legitimate as it was desirable.

However, the early medieval period in Europe has long been regarded as the least intensive period of mining in the last two millennia (Edmondson, 1989; Lombard, 1974; Sprandel, 1971). The only two production centres known, or at least considered significant, in Western Europe were around the town of Melle in France (Bompaire & Sarah, 2017; Téreygeol, 2001) and in the Harz massif in Germany (Segers-Glocke & Witthöft, 2000), although Roman miners had worked in most of the Mediterranean mountains (Domergue, 2008; Hirt, 2010). The reorientation of work in the northern part of the Frankish world, associated with the transition to a quasi-monometallism of silver, is one of the arguments in favour of Henri Pirenne’s thesis, according to which the ancient Roman world broke up with the expansion of Islam, causing a definitive break with the southern and eastern shores of the Mediterranean in the seventh and eighth centuries (Pirenne, 2005). The Pirenne thesis has been widely debated (e.g., Hodges & Whitehouse, 1983; Lombard, 1948) and has been extensively revised, notably to better take into account the plague waves of the sixth century (Little, 2006), with the result that the problem of production and the trade in silver metals in the early Middle Ages is still relevant today (Ludwig, 2006).

In recent years, research into production has been stimulated by research on the post-production process. Increases in lead content are recorded for the sixth/ninth centuries in several cores taken from European peat bogs and glaciers (Silva-Sánchez & Armada, 2023, *passim*). Their interpretation raises many questions because of the chronological resolution, and especially because these variations can be correlated with the intensification of both mining and metallurgical activities. However, they have the merit of raising the question of the existence of mining and workshops not yet identified (Bompaire, 2023, 459–461; Tarpin et al., 2000). Improvements in elemental and isotopic analyses also encourage the development of provenance studies of metals used in the material culture of societies (Dillmann & Bellot-Gurlet, 2014)—especially for coins (for the last two overviews for the Frankish empire, see Bompaire, 2023; and Rovelli, 2023a). In a regressive approach, the distribution circuits and origins of metals are explored, leading to the question of mines—which is precisely the subject of this article.

In this article, I propose to shed light on the mining landscape of early medieval Europe, focusing on the regions that I know best: the south of France in particular, where I have carried out most of my research (Minvielle Larousse, 2023), and to a lesser extent the Italian and

Iberian peninsulas. More than simply outlining the current state of knowledge, I would above all like to generate new questions, by bringing together the issues that are scattered throughout a rich and very diverse historiography. These include both solid empirical work on production and its objects (Merkel, 2016; Téreygeol, 2014), as well as extensive synthesis with global ambitions (Blanchard, 2001a; Lombard, 1974), and stimulating theses based on questioning models (Hodges, 2009; Wickham, 2005). These questions will of course not be exhaustive. In particular, I will not address technical, legal or health issues. Nonetheless, I will discuss three recurring problems in historiography, each of which has an impact on the way we understand the production and trade of silver in the early Middle Ages.

## THE DOCUMENTARY PROBLEM

The problem of sources obviously comes first. It is the question of a relative absence, which is difficult to discuss because it seems as real as it is constructed. Real, because the documentary eclipse between the end of antiquity and the Middle Ages is such that it would be risky, to say the least, to opt for continuity. Constructed, however, because it would be just as perilous to ignore the much less developed state of research on the early Middle Ages.

### State of knowledge in the south of France

In southern France, there are practically no written documents or archaeological remains relating to the production of silver before the 11th and 12th centuries (Figure 1). The main abandonment of the deposits exploited by the Roman settlers took place in the first century CE (Mantenant, 2014, 353–354), that is, very early compared with other parts of the empire (Domergue, 2008, 241): there was a gap of more than 10 centuries before the medieval revival. This gap is considerable, particularly in the three massifs rich in metal deposits: the Pyrenees, the Massif-Central and the Alps (Bailly-Maître & Benoit, 1998).

Optimistic hypotheses have been put forward in regional historiography, according to which the Frankish conquest of the Visigoths was motivated by a desire to control mining areas (Rouche, 1979, 193–195 and 244; Elzière, 1993, 68–69, n. 75). However, it must be recognized that they are based only on conjectures. In his *De bello gothico*, Procopius states that Theodebert made a gold coin at the beginning of the sixth century using metal from the mines of Gaul (Procopius, *B.G.*, III, XXXIII; Procopius of Caesarea, 2015, 131), but without specifying their location. An attempt to rework the ancient gold open-cast mines of Limousin (Cauuet, 2004), seems more plausible than the exploitation of the Languedoc mountains. The other relevant narrative extract comes from the *Cosmographia* of Aethicus Ister, who, quoting Virgil of Salzburg, states that Aquitaine was one of the few places where silver and tin mines were found, alongside Spain and Valeria (Prinz, 1993, 114). As it was written between 636 and 727, the reference to Aquitaine can already be linked to Melle, pending the discovery of more southerly occurrences.

However, so far very little evidence has been found to verify the written sources. The state archives of southern Gaul are as rare as they are silent on the mines (Poly, 1980; Renard, 2012), and fieldwork has produced only a handful of radiocarbon dates from the early Middle Ages, which are residual or poorly contextualized: in the Pontet mines (fifth–seventh centuries) and a forge at Lac Blanc (sixth–seventh centuries) in Oisans (Ancel & Dardignac, 2008, 146; Bailly-Maître, 2019, 139), in the mines of Bouque-Payrol (third–seventh centuries) and Labaume (sixth–eighth centuries) in the Montagne Noire (Léchelon, 2011, 254, 266), in a workshop associated with the Colombier mines (sixth–seventh centuries) in the Cévennes (Bailly-Maître et al., 2013, 61), and in the Banca mine (fifth–eighth centuries) in the Basque Pyrenees (Ancel

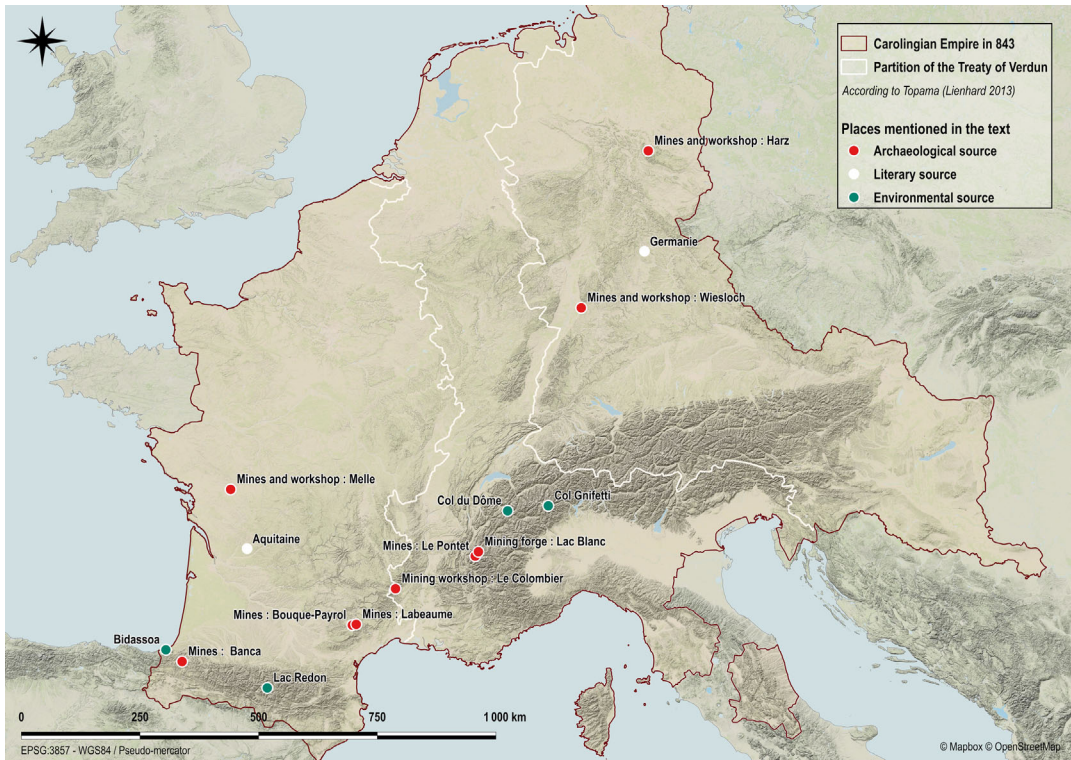


FIGURE 1 The state of silver mining occurrences in the early Middle Ages (sixth–ninth centuries), within the limits of the Carolingian empire (GIS: N. Minvielle) (Lienhard, 2013).

et al., 2001, 189). In each of these cases—with the exception of the Banca mines, which do not appear to have been reworked in the central Middle Ages—both earlier and later workings are known. The extent of these abandoned mines is unknown and their chronology seems to be limited to the centuries preceding the Carolingian period. It has been suggested that Carolingian works may have been carried out in the Corbières in the ninth century, when Charles the Bald granted a tax concession in an area where deposits were located. Likewise, in the Montagne Noire, the toponym *Argentumdublum* appears in several documents from the ninth and 10th centuries (Bailly-Maître & Gardel, 2007, 60, 65). However, both hypotheses are too fragile to be accepted. There is no mention of mines in the imperial concession (Magnou-Nortier et al., 1996, 23–24, n. 15); as for the toponym, it could also be translated as ‘river of gold’, inherited from the Celtic *arganton* (Pailler, 2006, 228). The evidence for the eighth to 11th centuries is therefore entirely negative.

### How representative is it?

The question of the representativeness of these data is all the more debatable given that the Spanish Pyrenees (Camarero et al., 1998; Irabien et al., 2012) and the central Alps (Loveluck et al., 2018; Preunkert et al., 2019) contain the sites which provided peat and ice cores associated with increased lead contamination in the early Middle Ages.

We know that the culture of writing in medieval Europe underwent a revolution at the turn of the 12th and 13th centuries (Clanchy, 2013). This revolution affected not only the

production of writing, but also its conservation. For example, it is estimated that only 0.001% of the Merovingian royal diplomas produced have survived (Bertrand, 2009). The few known attestations must therefore be considered as a minimum and as specimens. Similarly, if the archaeological remains of mining works from the early Middle Ages are relatively rare, this is mainly due to a conservation problem. The earliest mines were often dug, enlarged and filled in by later works, while their workshops may have been fragmented or covered over and their waste recycled. The rarity of these sites can be explained by research gaps. In southern France, no research programmes have focused on silver production during the early Middle Ages. Consequently, works from this period could only be identified projects relating to other periods (prehistory, antiquity, the Middle Ages) or within the framework of diachronic studies of a sector. However, in order to identify and, above all, evaluate all phases of use, it is necessary to carry out a sufficiently advanced excavation. Such excavations are all too rare, especially those that provide a representative overview of a mining complex. Unfortunately, none of the medieval mines in the Massif Central, for example, has been excavated in this way (for a complete historiography, see Minvielle Larousse, 2017, vol. 2 and Minvielle Larousse, forthcoming).

By extension, this means that we do not know which ore minerals might have been extracted. Therefore, we have no elemental or isotopic reference based on ores sampled in an archaeological context, with the exception of those from Melle and the Harz. For the entire Massif Central, for example, only the medieval deposits and slag (11th–15th centuries) of Mont-Lozère have been characterized, that is, a single production area out of several dozen (Baron et al., 2010). To determine the origin of the metals used in various objects and materials, or the contamination found in glaciers, we rely on isotopic references established from a geological perspective (Marcoux, 1986). However, if we look closely at the sites referenced, they correspond almost exclusively minerals exploited in modern times. At best, these data can provide useful background noise in the absence of archaeological references, but they are not sufficient and may even lead to misinterpretation.

Very few documents, insufficiently developed archaeology, absent or contemporary geochemical references, etc. These are admittedly pessimistic observations, all the more so as they can be extended to many other European production areas, but I make them in order to encourage the resumption or development of archival and field research. Faced with this scarcity, any additional information can significantly alter our perception of reality. A particular effort must be made to excavate in the production areas, to establish both representative chronologies and solid geochemical benchmarks, that is, to place them in their geological and archaeological contexts. More generally, a new synthesis of documentary or literary references all from the early Middle Ages would also be welcome, accompanied by diplomatic and philological critiques of the sources and a cartographic analysis to clarify a corpus that is currently too fragmented. In addition to the erudition that will be required, this research could also be developed to address the other issues raised by early medieval silver production.

## THE ECONOMIC PROBLEM

Addressing the economic question means discussing the choices that led societies to exploit or not to exploit a deposit. These choices were never simple; they were constrained by natural and technical conditions, were part, consciously or unconsciously, of the circumstances of the metal trade, and combined the contradictory logics of the actors of production. The debate is wide-ranging, which is why I propose to focus on two apparently antagonistic mining periods: that of the Carolingian Empire and that of the year 1000.

## A Carolingian selection?

It is paradoxical, to say the least, that at a time when the monetary system was based almost exclusively on silver, a large part of the silver deposits of the Frankish Empire remained unexploited. Deposits were not exploited in the south of France, nor were they in Catalonia and Navarre (Canto García & Cressier, 2008, XIII; Casas, 2021; Urteaga, 2014), south-west Sardinia (Tangheroni, 1985), the eastern Alps (Cortese, 2023) or the metalliferous hills of Tuscany (Bianchi & Rovelli, 2017). Hypotheses have been formulated for these hills (Farinelli & Francovich, 1994), but further archaeological research has not yet been able to confirm them. Archaeologists have observed occupations from early Middle Ages, but tangible traces of exploitation have been identified only from the end of the 10th century (Bianchi & Hodges, 2018; Bruttini, 2014). In the empire, the remaining mines were those at Melle, exploited from the sixth century (Bompaire & Sarah, 2017; Téreygeol, 2001), those in the Harz massif, where the remains of smelting sites and lead contamination show that they were exploited for silver and lead from the seventh century (Bartels & Klappauf, 2012, 122, 134–135; Matschullat et al., 1997; Segers-Glocke & Witthöft, 2000) and, apparently to a lesser extent, those around Wiesloch, which were exploited from the ninth century (Bartels & Klappauf, 2012, 136–137).

Does this mean that there were only a few mines? Even if their quantification is debated (Bettenay, 2022; Téreygeol, 2013), the deposits of Melle and Harz are considerable, especially if we compare them with those of other massifs such as the Alps or the Massif Central. Occasionally, their veins could contain higher concentrations of silver, but their dispersion over hundreds of kilometres made their exploitation more difficult and less certain for a power that wanted to guarantee the stability and diffusion of a new silver currency. This is why I proposed the hypothesis that a choice led the Franks to favour the exploitation of these two deposits alone (Minvielle Larousse, 2023, 211–213), following the argumentation of Alain Stoclet, Olivier Bruand and Jean-Pierre Devroey (Bruand, 1997, 48, 55; Devroey, 2015; Stoclet, 1993, 427–428).

The mechanisms behind this choice are not necessarily vertical. We can already see that they settled on deposits that had already been exploited, since the sixth century in the case of Melle and the beginning of the seventh century in the case of the Harz, while those in the other massifs of their empire were in a different situation: abandoned for many centuries with a few scattered and isolated recoveries (Massif Central, etc.) or still unexploited (Metalliferous Hills, etc.). The choice is therefore primarily one of continuity. But the opening of mines throughout the empire could have led to a later phase of prospecting and development of deposits closer to these mines. However, we saw that this was not yet apparent in the field and that the provenance studies carried out on the silver in the coins issued by the mints of Lucca and Pavia correspond more to imports of metal from north of the Alps than to the Metalliferous Hills, even though the latter were geographically closer (Chiarantini et al., 2021). There would then have been a more consistent choice: to remain focused on the two initial areas of production, or at least not to undertake any significant work elsewhere. This could just as easily have been the result of a political desire to standardize and control both the mines and the mints; or it could have been the result of economic rationalities which made the exploitation of other deposits less attractive. The same reasons that, according to Claude Domergue, could explain much of the abandonment of the Massif Central at the end of the first century, when the mines of Brittany, Germania and Iberia were being developed (Domergue, 2008, 196–197). Roman entrepreneurs are said to have abandoned these mines for economic reasons, while being encouraged to do so by the imperial administration, which wanted to rationalize mining operations in order to increase revenue.

Under the Carolingians, silver production once again reflected the logic of empire. The loss of economies of scale that characterized production in late antiquity (McCormick, 2001, 53)

would have been partly offset by the general knowledge of the Carolingians and their desire to adopt a Christian vision, seeking the right measure in government and the right price in the economy (Devroey, 2015). If we draw the consequences of their decisions, their metal mass could have been considered sufficient. It would be supplied in a controlled manner by two major production areas, probably by recycling a stock of silver present since Roman antiquity in the empire and in the *Barbaricum* (Bompaire, 2023, 466–469) and, possibly, by various imports, whose existence would have to be confirmed and, if necessary, their importance measured. I am thinking in particular of the mines of Andalusia, but also of the Atlas Mountains, the Arabian Peninsula and, more generally, the Middle East (Carbognon-Trillo-Figueroa, 1929; Granada Minon, 2008; Naismith, 2023, 25–46; Pérez Macias, 2020; Sarah, 2014).

## The rise of the year 1000

How was it possible to move from such exclusive production to the simultaneous exploitation of almost all of Europe's silver deposits? The powerful mining boom that occurred in most mining areas at the turn of the 10th and 11th centuries could indeed reveal a major change in the structures of the medieval West. Placing this boom in the 11th century is a relatively recent historiographical achievement. It had previously been fixed in the 12th century, at the time when mentions of mines in written documents were multiplying (Blanchard, 2001b, 529–550; Gimpel, 1975, 43–48; Spufford, 1988, 354–358). However, these early documents were more a revelation of existing work than a record of new discoveries. For the most part, they are claims or coups d'état provoked by various powers in order to monopolise the fruits of growth. The most important example is the constitution drawn up by Frederick Barbarossa at the Diet of Roncaglia in 1158, with the aim of recovering a certain amount of revenue that he had lost at that time, particularly in Italy (Appelt et al., 1979, 28–29, n. 237; Brühl, 1971).

Rereading these documents has therefore led to changes in interpretation, but this chronological change is mainly due to advances in archaeology, whether the data come from mines, workshops or peat bogs. The most striking example in the south of France is found in Mont-Lozère. While written documentation mentions the mines in the diocese of Mende for the first time in 1170, archaeological (slag) and palaeoenvironmental (lead contamination of peat bogs) research has identified a much earlier and massive origin, in the first half of the 11th century (Ploquin et al., 2010). Elsewhere, and even if radiocarbon dating is still rare because the remains of the first mines are more difficult to identify, we observe a clear trend towards recovery in the 11th century: in the Massif-Central, the Alps, Tuscany, the Vosges and more generally in the Germanic massifs (Bartels & Klappauf, 2012, 144–148; Bruttini, 2014, 279–291; Gauthier et al., 2015; Minvielle Larousse, 2023, 216–219).

Moving the European mining boom from the 12th to the 11th century has two consequences: it can be seen as part of the acceleration of medieval growth (cf. Franceschi, 2017), and it can be linked to the monetary explosion that took place at the same time (Naismith, 2023, 317–391). The situation at the time was particularly favourable: good knowledge of the deposits due to land clearance and the expansion of the occupation; increased demand linked to demographics and construction sites. However, these conditions were favourable for several centuries without the deposits being exploited. It therefore seems that other factors, specific to the 10th–11th centuries, may have had a triggering effect. The first may have been the abandonment of the Melle mines in the 10th century and the decline of silver mining in the Harz region in the 11th century. The second may be related to the fragmentation of the former Carolingian empire. Here again, supply markets could have shrunk, making the exploitation of local deposits economically attractive once more. The third is the fragmentation of the monetary system, a break with Carolingian centralization—particularly that resulting from the Edict of Pitre (Lafaurie, 1980). The pace at which mints were created varies slightly



from region to region, but the monetary landscape of Europe was transformed from the second half of the 10th century. Only Italy maintained imperial continuity, with the same number of mints and coins issued in the name of the king or emperor, before gradual fragmentation occurred in the second half of the 12th century (Bianchi & Rovelli, 2017, 119–120; Rovelli, 2010).

The question raised by this correlation between mining and coinage is that of the trigger. Was it the increase in production that led to the development of local mints, or was it the end of monetary centralization that led to the development of mining? While Peter Spufford argues in favour of the first hypothesis, that of supply (Spufford, 1988, 74–75), Rory Naismith argues for the second, that of demand (Naismith, 2023, 28). Without taking a general position in this debate, the case of the south of France supports the demand hypothesis. The increase in the number of currencies preceded the current mining boom by half a century (Bompaire, 2002, 107–108, 258–279; Minvielle Larousse, 2023, 223–224). The emancipation of the heirs to public power (counts, viscounts, bishops) would have been one, if not the main, trigger for the mining boom of the 11th century, but it would not have been enough if the economic climate had not been so favourable to the exploitation of local deposits. It would therefore have been a combination of fragmentary factors that led European companies to reopen their mines, many of which had been abandoned nine centuries earlier. The question remains open, however, because it depends very much on the regional context. In Italy, for example, the link between monetary fragmentation and the mining boom is less clear because the new mints were opened later. Either mining was still sporadic in the 11th century and only intensified in the 12th century, or other development factors need to be identified in addition to the acceleration of growth and expansion of the occupation.

## THE SOCIAL PROBLEM

So far, I have avoided the social problem, the question of who was involved. This is a key question because it determines the production of written documents and our understanding of the economic choices made in the production and trading of metals.

### The model of aristocratic dirigisme

Given the gaps in our documentation, it is difficult to approach this question other than through models (Hodges, 2009, 1–18). Silver production generally relied on the initiative and control of elites, essentially sovereign powers in the early Middle Ages due to the monetary use of silver. Public authorities, then private ones from the 10th and 11th centuries, were responsible for the development of mining, the control of the production process and even the *incastellamento*, for reasons of economic prestige (revenue) or symbolic prestige (coinage). This model is regularly found in mining historiography, taken for granted or presented as a certain or probable principle, with varying degrees of nuance (e.g., Bailly-Maitre & Poisson, 2007, 7; Bianchi & Rovelli, 2017, 137; Cortese, 2023; Naismith, 2023, 31). For the early Middle Ages, the probabilities are based on the well-documented monetary centralization of the Carolingians and on various correlations with the places where the silver deposits are found, namely tax donations of land, territorial expansion of public or aristocratic powers, and first settlements.

But this model has become so entrenched that it was no longer called into question, either in its principle or in its detail (except very recently, see the conclusions of Giovanna Bianchi; Bianchi, 2022, 239). For example, the role of those in power is never specified: are they able to raise taxes, supervise, direct production and participate in the work via their dependents or their investments? If we go back to the article on which it is largely based, about the case of the

Rocca San Silvestro in Tuscany, it was indeed mentioned with other possible models: (1) direct management, (2) concessions with royalties paid by landowners, (3) concessions with levies paid by public or private authorities, (4) salaried employment, and (5) free exploitation (Francovich & Wickham, 1994). The case study being a *castrum* built in the 11th century, during a process of *incastellamento*, seignorial dirigisme was favoured. This led to the construction of a *castrum* in the heart of a mining basin, the construction of smelters within the walls of the *castrum* and the assumption that the powers that be had the capacity to collect all the ores mined in the surrounding area, implying that these powers also played a leading role in the metals trade. The Rocca San Silvestro thus becomes the archetype of a 'feudal mode of production'. However, the authors remain cautious and keep the other models as possibilities to be evaluated in the course of further research.

I think, therefore, that it would be appropriate to broaden the debate, especially since this model has its weaknesses. First, recent research tends to show that it was the mining and metallurgy of iron, rather than silver, that was the mainstay of the 10th and 11th centuries (Bianchi, 2022, 148–159, 169; Rovelli, 2023b, 132). Second, and maybe more importantly, I think there is no evidence of a monopoly on the smelting of ores or the commercialization of metals. The presence of metallurgical workshops in the *castra* could just as easily have been linked to the processing of royalties that the castellans were able to collect in ore. Indeed, seignorial control over certain aspects of production was not incompatible with mining, which was based on the granting of mining concessions to associations of miners free to take their own initiatives and organize their work. This was, in fact, the most common way of producing silver, as attested by written documents from the late 12th century (e.g., Menant, 1987, 786–787). If we can distinguish between domination and exploitation of the mines, other initiatives are conceivable.

## The bottom-up growth hypothesis

These initiatives could have come from some of the *laboratores*, from those who cleared the lands where the deposits were located, from those who colonized the lands and the foothills, from those who invested the surpluses or from those who specialized in production. The context is that of medieval economic growth, which began in the seventh century and accelerated in the 11th, the key element of which was the intensification and diversification of work (Arnoux, 2012; Toubert, 2004). To support this, we can draw on some empirical data. The dynamism of these actors (whether farmers, small landowners, craftsmen or traders) can be seen in the associations they form to build and use the means of production. From the end of the eighth century, examples of common saltworks were discovered in Alsace (Stoclet, 1993, 427), while others were leased by the abbey of Prüm at the beginning of the ninth century (Verhulst, 2002, 81). Elsewhere, mill shares were regularly exchanged between tenants in the 10th century (Bonnassie, 1975, 459–464; Portass, 2022, 27–28). In other words, the structure of productive societies that we know so well from the central Middle Ages is older. It is therefore possible that the first medieval silver mines were also the fruit of these small associations, although this does not prevent them from being controlled in various ways by aristocratic, monastic or sovereign powers. On the other hand, the initiative of exploitation would be shared or even reversed.

This model may reasonably correspond to the mining operations of the central Middle Ages (Minvielle Larousse, 2023, 224–229). In the absence of documentation, however, it is more difficult to extend it to Carolingian workings, but the hypothesis is defensible (Ludwig, 2006, 238–244). The fact that the *Gesta Dagoberti* indicates that Melle's lead was subject to payment of a *cens* is consistent with a delegation or concession of the work (Krusch, 1888, 419, no. 40), as is the mention of *cens* and tributes for mines (*metallis*) in the *Ordinatio imperii* of

817 (Boretius, 1883, 272, no. 12). Nor would there have been any incompatibility with previous operating conditions. In the silver- and goldmines of the Roman Empire, work was most often carried out by private entrepreneurs who formed companies (Domergue, 2008, 190–208). If they worked on public properties, they could be under a lease with the publicans or under the control of tax agents. Aside from the rare case of direct state mining, private contractors were a constant feature of mining during the Republic and the Empire. Moreover, they remained at the centre of production until the fourth century, considering that the *metallarii* of the Theodosian Code were entrepreneurs and not workers (Freu, 2012; see also Cherchi, 2016). It would therefore be surprising if these entrepreneurs were completely absent from the mines of the Middle Ages, even if they were more dependent and even if they were in a more central position both before and after. In this sense, we observe important continuities between ancient and medieval norms and practices (e.g., Pfeifer, 2002).

## The role of archaeology

Beyond the theoretical debate, how can we make a significant empirical contribution to this problem? In addition to documentary discoveries, archaeology constitutes the main means of establishing the link between antiquity and the Middle Ages. It makes it possible to construct the same frame of reference over time without privileging the aristocratic viewpoint (Wickham, 2005, 544). The forms that mines take are not only the result of geological or technical constraints, or even the economic choices of miners, but also are shaped by the collective organization of work. A mine owned by the state and managed according to a centralized logic by its subordinates will not take the same form as one leased or transferred to groups of entrepreneurs who extract and process their materials independently.

Although this social interpretation can be complex when mining works are carried out over a long period, this type of structure has been observed in both ancient (Domergue, 2008, 205–206) and medieval mines (Asrih, 2018, 68–72). On the surface, regular alignments of shafts or pits are markers of the segmentation of veins into concessions. They can be complemented, at least in Central Europe, by similar alignments of dwellings or workshops located near the pits and dedicated to different companies (Doležel, 2020, 90–95; Hrubý et al., 2021, 373–374). Underground, there are distinct mining areas, each with an access gallery or shaft (Hemker, 2013, 234; Minvielle Larousse, 2023, 156–158). These few examples are archaeological markers of social organization. They make it possible to work with documentary sources where they exist (variants, discrepancies between norm and practice, etc.) and to assume social structures where they are lacking. In Melle, an archaeological operation has already revealed such markers, which suggest that the deposit was divided into concessions. Mining waste was contained around two shafts, corresponding to a parcel of land contemporary with metal extraction (Bonnamour & Marconnet, 2014). In the same way that archaeology contributed significantly to redefining the technical and economic references of the early Middle Ages, it could once again play an important role in rereading and refining their social structures.

## CONCLUSIONS

Why, then, did early medieval European societies not invest as much in mining as they had in the preceding and following centuries? When he wrote his letter to Bergantino, Cassiodorus's opening question was rhetorical. In retrospect, the question is much more concrete. The few occurrences in the south of France and elsewhere, including some in the high mountains, show that it was not a question of ignorance: neither of the terrain, nor of the potential, nor, I would

add, of the techniques, taking into account the work they had been able to accomplish in Melle and the Harz.

Based on this observation, a first proposal can be formulated. So far, with one exception, all the mines from which early medieval dates have been obtained have also been found to have significant central medieval recoveries. In other words, early medieval miners had not completely exhausted the deposits, as Roman miners were assumed to have done when they abandoned many mines in the late first century CE. If mines were exhausted, it was the societies of the central centuries of the Middle Ages which were responsible. Even with the current lack of documentary evidence, it is reasonable to assume that early medieval societies did not choose to exploit every deposit available to them. Consequently, the metal stocks they had at their disposal could suffice. The question now is to determine the proportion of newly produced metals compared with imported metals and recycled metals from Roman antiquity.

I say that societies should be as inclusive as possible. My second proposal is to reverse the habit of only considering the role of the ruling powers in the production of silver. It is not a question of excluding them, but of considering them as one of the social groups concerned, and of shifting the questions towards the relationships they maintained with others. The two hypotheses that I put forward—that of a selective mining logic in the Carolingian period and that of an unbridled mining boom from the 11th century—cannot in fact be explained by a single driving force or cause.

I would like to conclude with a proposal that calls for a return to the sources. The current state of research calls for the utmost caution when it comes to attributing and, even more so, measuring activity. It renders hypotheses provisional, whether formulated on the basis of empirical data or theoretical models and makes the identification of sources particularly delicate. In order to overcome all the problems discussed in this article, it will be necessary to carry out ambitious field surveys in mines and workshops. Perhaps these surveys should even precede or at least accompany provenance studies, since the conditions for answering their questions have not yet been met. By field research, I primarily mean excavations. This will allow us to date the work, contextualize the materials and read the remains from a social perspective.

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## DATA AVAILABILITY STATEMENT

Data sharing is not applicable to this article as no new data were created or analyzed in this study.

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