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Land use planning and safeguarding of mineral resources: the case of Portugal

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ABSTRACT

An analysis of the Portuguese spatial planning policy framework and a sample of municipal master plans reveals that mineral resources are addressed within the context of extractive activities, not as natural resources worthy of safeguarding for extraction when society needs them. The approach to mineral safeguarding involves delimiting areas for the exploitation of geological resources on zoning maps and ensuring the compatibility of uses between agricultural and forestry areas with mineral extraction activities. However, practice shows that this is not adhered to in most master plans, allowing to conclude that the current legislative framework and practice severely restrict access to mineral resources.

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Introduction

The sustainability of European industry requires sustainable and environmentally friendly extractive activity in Europe, so that European Union (EU) industry does not depend entirely on foreign sources and, consequently, overcomes the risks of outsourcing. This is the core idea of the Raw Materials Initiative (European Commission, 2008), after decades without a European policy for mineral resources. One of the pillars of this initiative focuses on the supply of mineral resources from domestic sources and highlights the importance of ensuring access to them, which points to the role of land use planning (LUP) for mineral policy. For the first time it formally acknowledged the existence of many uncharacterized and unexplored mineral deposits in Europe and an existing economic and regulatory climate that, combined with a growing land use competition, limits the exploitation of the known deposits (European Commission, 2014).

Beyond the crucial role of environmental policy in the exploration and exploitation of mineral resources, Gugerell *et al.* (2020) note that mineral resource governance is embedded in two policy fields: mineral policy and spatial planning policy. This has relevance because spatial planning interconnects several competing land uses, such as urban development, infrastructure development and nature protection, amongst others, that may have a limiting effect on the available area for exploration and exploitation of mineral resources. Furthermore, spatial planning also links all of this to a social will that, although advocating a sustainable

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society, tends to be averse to all types of extractive activities, especially minerals. This is broadcast almost daily through the media, being also the subject of several studies (Badera & Kocoń, 2015; Mateus, 2020; Lesser *et al.*, 2021; Dall-Orsoletta *et al.*, 2025).

In this context, the supply of mineral raw materials from domestic sources to European industry is at risk, calling for the need for minerals safeguarding (Wrighton *et al.*, 2014), which is a recent aspect of mineral resource governance that integrates mineral and spatial planning policies (Endl *et al.,* 2020, 2023; Gugerell *et al.*, 2020; Wårell, 2021).

Mineral resources safeguarding, also referred to as minerals safeguarding, is a concept that emerged within spatial planning legislation in the United Kingdom. Since 2006, it has been implemented through official guidance at all relevant levels of the planning system (Wrighton *et al.*, 2014). It was long time ago recognized by Pendock (1984), who noted that to secure the long-term supply of mineral resources to society there is a need to protect mineral resources from being sterilised during the LUP process, i.e. the loss of the option to exploit them. Minerals safeguarding should not be interpreted literally, but rather as a LUP procedure to ensure that areas containing mineral deposits are not needlessly occupied by other uses that may prevent their future extraction, including the places for installing mining/quarrying infrastructure (Knepper, 2002; Wrighton *et al.*, 2014). The word 'needlessly' plays a crucial role in this definition, as it calls for a fair weighing of the interests at stake during the decision-making process.

Furthermore, it is widely accepted that mineral deposits with an already known economic value are those that will supply the society in a near future, and many of the areas where they occur are already protected by some kind of land use easement (e.g. mining concessions). Hence, the medium- to long-term supply of the society depends on the undiscovered or poorly defined resources (Nickless *et al.*, 2015; Meinert *et al.*, 2016; Herrington, 2024; Reich & Simon, 2025), which will only be mineable if the areas where they occur are also protected from unnecessary sterilisation. This means that areas currently containing non-economic and/or not yet enough studied resources, and promising target areas should also be considered in LUP in addition to known mineral deposits (Carvalho et al., 2019, 2021).

The criteria for defining which European mineral deposits deserve to be safeguarded and how to integrate mineral and spatial planning policies with a view to safeguarding these deposits were topics widely discussed in two relatively recent European projects: Minatura2020 – Mineral Deposits of Public Importance (https://cordis.europa.eu/project/id/642139) and Minland – Mineral Resources in Sustainable Land-Use Planning (https://cordis.europa.eu/project/id/776679). Several results have been achieved regarding the need to safeguard mineral deposits in Europe, which is to say, the need to ensure that mining companies have access to the European territory where mineral deposits occur (Kot-Niewiadomska *et al.*, 2021; Wårell, 2021; Nieć *et al.*, 2022) or there are reasonable prospects for their occurrence (Mateus *et al.*, 2017; Carvalho et al., 2019, 2021).

The EU has been suffering consecutive losses of strategic autonomy and competitiveness since the beginning of the century (Youngs, 2010; European Economic and Social Committee and CEPS, 2023; Draghi, 2024), which were exposed to public opinion with Russia's invasion of Ukraine. These losses refer to military defence issues, but also to the most varied fields of economic policy that are currently covered by the Green Deal umbrella. However, although not yet fully and frontally assumed, all these policies,

including the environmental and social ones, are mostly based on a common strategic basis: the need to ensure the supply of mineral raw materials.

The recently approved Critical Raw Materials Act (European Parliament and Council, 2024) reflects the EU's acknowledgement that the soft policies aimed at promoting the supply of mineral raw materials from endogenous European sources, over the last two decades, have failed. An illustrative example is the set of countless recommendations that have accompanied the periodic raw materials' criticality assessments carried out in Europe since 2010 (e.g. European Commission, 2010, 2020).

Portugal is one of the EU countries where there are strong expectations for the extraction of Li ore, as well as other raw materials to support the energy transition in Europe (Draghi, 2024). Therefore, being important to know to what extent these resources are available for mining exploitation, the main objective of this paper is to verify how mineral resources are safeguarded in the Portuguese LUP practice.

Methods and data

To analyse whether and how mineral resources are safeguarded in the Portuguese LUP practice, a two-fold method approach was needed: first, to become familiar with mining and spatial planning legislations and verify how they relate to each other; second, to obtain data allowing an analysis of the current safeguarding practice and how it complies with legislation.

Data on legislation were obtained directly from current legislative documents. Details and an analytical summary are presented in the next section of this article. The method used to analyse LUP practice, is presented in the following section. It is based on a sample of LUP executive documents at the municipal level.

The legislative framework for minerals and spatial planning in Portugal

To understand the current mineral resource governance practice in Portugal, a compilation (Table 1) and analysis of the existing legislation for mineral resources and spatial planning was made, focused on identifying the existing interconnections between them and the provisions relevant for the safeguarding of minerals. It is important to note that in the Portuguese legislative framework, a Law is a legislative act issued by Parliament, while a Decree-Law is issued by the government. Furthermore, although this article refers specifically to mineral resources, Portuguese legislative acts mainly refer to the broader concept of geological resources, and for this reason geological resources are often mentioned in this paper interchangeably.

Findings in mineral resources legislation

The ownership of mineral resources

Law 54/2015 is the Portuguese mining act. Following the Portuguese Constitution, among geological resources, the mining act distinguishes public domain from private domain mineral resources. The public domain minerals, i.e. stated owned mineral resources, are designated as Mineral Deposits and correspond to mineral occurrences which, due to their rarity, high specific value or importance in the application of the

Table 1. The legislative framework for mineral resources and spatial planning in Portugal.

Mineral Resources Legislation	
Law 54/2015	General Law that establishes the legal regime for the exploration and exploitation of geological resources – The Mining Act.
Decree-Law 30/2021	Following Law 54/2015, establishes specific rules for the exploration and exploitation of Mineral Deposits (i.e. state-owned mineral deposits).
Law 10/2022	Amendments to the Decree-Law 30/2021 made by Portuguese Parliament.
Decree-Law 270/2001	Establishes specific rules for the exploration and exploitation of Mineral Masses (i.e. private owned mineral deposits).
Decree-Law 340/2007	Amendments to Decree-Law 270/2001
Spatial Planning Policy and Land-Use Planning Legislation	
Law 31/2014	General Law establishing the policy for territory, spatial planning and urbanism – The Spatial Planning Act.
Law 99/2019	National Programme for the Spatial Planning Policy (PNPOT): Top legal tool for the national spatial planning system, defining objectives and strategic options, and establishing the model for the organization of the territory. It stands as the strategic framework for other spatial planning programmes and plans.
Decree-Law 80/2015	In line with Law 31/2014, it establishes the legal regime and rules for the spatial planning tools.
Regulatory Decree 15/2015	Following Decree-Law 80/2015, it details the criteria for the classification and categorization of the land.
Ordinance 277/2015	Rules the establishment, composition, and functioning of the advisory committees for the preparation and review of the intermunicipal master plans and the municipal master plans (PDM).

substances contained therein in industrial processes, are of special economic interest. Decree-Law 30/2021 specifies that Mineral Deposits are the economically relevant occurrences of mineral substances that can be used to obtain metals, semi-metals, non-metals and radioactive substances contained therein. In addition, this Decree-Law informs that the occurrences of rare earth elements, precious and semi-precious stones, talc, chalk, coals, graphite, diatomite, barite, pyrites, phosphates, asbestos, lithium minerals, quartz, beryl, micas, feldspars and feldspathoids, silica sands, special clays (kaolin, bentonite, refractory clays, ball clays and fibrous clays), and evaporites are also Mineral Deposits. All the other mineral occurrences are private assets and are called Mineral Masses (e.g. red clays, sand and gravel, limestones, and granites).

Besides mineral resources, Law 54/2015 also refers to other geological resources: natural mineral waters, industrial mineral waters and geothermal resources are the property of the Portuguese State and therefore concessions can be granted for their exploitation, while spring waters are private assets for which licenses for their exploitation can be issued.

Granting rights over the public domain minerals

According to Law 54/2015 and details in Decree-Law 30/2021, the granting of rights over the state-owned minerals can take several forms, all of them subject to an administrative contract between the Portuguese State and the private party:

- Voluntary one-year preliminary land evaluation of the existing mineral resources.
- Exploration permitting with a maximum duration of 5 years. It may be the initiative of a private party or can be initiated through a public tender by the government. When requested by a private party, the granting of this right is accompanied by an

administrative easement for the use of the requested area, but exploration activities are not allowed in the beds and banks of waterbodies and respective protection perimeters, nor within a 1 km perimeter around urban and rural agglomerations, unless a specific authorization is granted annually. When the exploration permitting process is a government initiative, the Portuguese mining authority (DGEG – Directorate-General for Energy and Geology) defines the areas to be prospected and submits them to a public tender. Of the areas designated for competition, all environmentally protected areas (natural parks, Natura 2000 network, Ramsar sites, etc.) are excluded.

- Voluntary Experimental Extraction permitting. It is issued for a maximum period of five years and may be preceded by an environmental impact assessment procedure. This permit also implies an administrative easement for the use of the requested area.
- Exploitation permit (Mining Concession). It can be granted for a maximum of 90 years and only to those who discovered the resources in one of the previous stages and, again, before issuing a mining concession, consultations with other authorities are mandatory. The granting of a mining concession depends on the existing provisions in land use planning tools, administrative easements and public utility restrictions, and must comply with the conditions imposed by an environmental impact assessment. The holders of a concession may require an administrative easement for the exploitation of the resources, and the concession contract itself may include provisions for the exclusive use of land.

Before being granted, all these rights are publicly disclosed so that interested parties can express their opinions.

Granting rights to privately owned minerals

The granting of rights over the private domain minerals is subject to a licensing procedure, which can only be issued to the owner of the land or to whom has a lease agreement with the owner. Still according to the mining act and details in Decree-Law 270/2001 and respective amendments (Decree-Law 340/2007), there are two types of licenses:

- Voluntary exploration permit – one-year validity, but with the possibility to be extended one more year. Issuing an exploration license depends on the compatibility provisions in the land use planning tools.
- Exploitation Permit (License) – four years' validity, but renewable for similar periods of time. In an initial stage, it depends on a formal consent from the land use planning authority and, in a final stage, on the approval and conditions imposed by an environmental impact assessment procedure, which, once again, assesses whether the area required for extraction complies with the provisions of spatial planning tools. After approval of the license, administrative easements may be imposed on the exploitation area to protect the mineral resources.

Integration with land use planning policy

According to the Mining Act, the granting of exploitation rights implies the compatibility with the provisions of the spatial planning tools, administrative easements and public utility restrictions, as well as with the legal regime for environmental impact assessment.

For spatial planning purposes, the Mining Act specifies that the geological resources policy should be expressed by sectoral programmes according to the law 31/2014. It also specifies that intermunicipal and municipal land use plans must include provisions for the integration of the areas for the exploitation of geological resources and that these plans must respect the existing sectoral programmes for geological resources. Although it has been in effect for ten years, no sectoral program for geological resources has been developed to date.

Findings in spatial planning legislation

The spatial planning framework

It is reasonable to assert that the foundations of Portugal's current spatial planning framework began to take shape in the late 1980s, following the country's accession to the European Economic Community and the subsequent adoption of its guidelines, along with the implementation of spatial planning tools (Bailoa, 2017). Since then, spatial planning policy has undergone a progressive transformation, strongly shaped by European policy frameworks, which have exerted a decisive influence on territorial development strategies and the structuring of planning processes (Bailoa, 2017; Medeiros, 2019).

Law 31/2014 is a cornerstone in the Portuguese spatial planning policy framework, as it establishes the principles for public policy on territory management, land-use planning and urbanism, as well as a hierarchical network of spatial planning tools consisting of programmes and plans, the most decisive ones being presented in Table 2. The programmes bind the public entities and establish the

Table 2. Main spatial planning tools of the Portuguese land management system (nuts and LAU refer to regional divisions of EU member states for statistical purposes).

	Name	Scope	Description
Programmes	PNPOT National program for territorial planning policy.	National (NUTS I)	In line with European development options, PNPOT establishes strategic options for the organization of the national territory, its structuring model, and major public investment options with significant territorial impact.
	Sectoral Programmes	National (NUTS I)	Sectoral programmes establish the territorial effect resulting from public policies of the different sectors of the State's central administration, such as in the field of defence and public security, risk prevention, and nature conservation.
	Special Programmes	National (NUTS I)	Special programs aim the protection of public interests and resources of national relevance. For that purpose, they establish safeguarding regimes for natural resources through measures defining the permitted, conditioned, and prohibited land use actions, which will prevail over land use municipal plans. Special programmes include shoreline programmes, nature protected areas programmes, dams of public water programmes, and estuary programmes.
	PROT Regional program for territorial planning	Regional (NUTS II)	Like PNPOT, regional programs are strategic in nature but adapted to the specificities of each region. They are the strategic framework for the preparation of intermunicipal programmes and plans, as well as municipal plans.
Plans	PDM Municipal Master Plan	Municipal (LAU 1)	In line with the regional strategy and the options taken at local level, namely the development strategy and local territorial model, the PDM establishes the land use regime (i.e. the occupation, use, and transformation of land) and the respective execution.

strategic framework for territory development, its programmatic guidelines, and define the spatial effect of national policies to be considered at each planning level. The plans, on the other hand, bind public entities, private parties and individuals by establishing concrete options and actions in terms of planning and organization of the territory, as well as defining the way it will be used.

Optional intermunicipal programmes and plans, as well as urban plans and detail plans, also do exist aiming the strategic management and planning of intermunicipal communities, and the detailed planning of specific urban or rural areas.

The classification of the land

According to the general law (Law 31/2014), land is classified as rural land or urban land within the scope of intermunicipal and municipal plans. Rural land is land with recognized suitability for i) agricultural, livestock or forestry use; ii) the conservation, valorisation and exploitation of natural resources, geological resources or energy resources; iii) cultural, touristic-related, and risk protection uses, even if occupied by infrastructures; and iv) land which is not classified as urban. On the other hand, urban land is the land that is totally or partially urbanized or built on. It is worth noting that geological resources are not considered to be natural resources, as they are taken separately along with energy resources.

The qualification of the rural land

The qualification systematics for rural land comes from Decree-Law 80/2015. It specifies that the qualification is carried out through zoning of land into categories of dominant use, namely the following:

- Agricultural areas.
- Forest areas.
- Areas for the exploitation of energy and geological resources.
- Areas allocated to industrial activities directly linked to the aforementioned uses.
- Natural areas and those of cultural and scenic value.
- Areas intended for infrastructures or other types of human occupation, if they do not imply a classification as urban land (e.g. rural agglomerations, cultural areas).

The criteria for this zoning according to dominant uses is established by the Regulatory Decree 15/2015, which also details a little more, the above-mentioned land categories. Essentially, the criteria refer to the need to comply with the options taken in the territorial programs that are in force, the prevention of natural and anthropogenic risks, and respect for the current dominant use while developing the multifunctional use of the land. This regulatory decree also allows the division of the categories into subcategories.

The municipal master plan (PDM)

The municipal master plan is the most important spatial planning tool because, being mandatory, it defines the strategic framework for the development of the respective

municipality and the corresponding spatial organization model through the classification and qualification of land. According to Decree-Law 80/2015, it also establishes the rules for the use and occupation of the land, considering the strategies drawn up at national and regional levels, as well as the existing sectoral programmes (e.g. National Water Plan and Natura 2000 Network Sectoral Plan), special programmes (e.g. programmes for public water reservoirs and programmes for each nature protected area), and all the existing easements and public utility restrictions from which the National Agricultural Reserve and the National Ecological Reserve are most relevant due to the vast areas they encompass.

Decree-Law 80/2015 establishes that each PDM must ensure the necessary compatibilities with all these programmes, easements and restrictions. Therefore, the PDM is a heavy and hard planning tool that congregates a wide range of studies and analyses at the municipal level, which represents in depth knowledge and capacity building for the municipality. Decree-Law 80/2015 specifies that each PDM consists of:

- A regulation document.
- A land use planning map (i.e. a zoning map) depicting the classification and qualification of the land at 1:25000 scale, as well as the areas respecting special and sectoral programmes.
- A map of easements and public utility restrictions (Map of Constraints), that may constitute limitations or impediments to any specific form of land use.

The Zoning Map is the graphic document that reflects many of the strategic land-use options. Since the PDM must necessarily be aligned with higher-level programs, particularly those that have a direct influence on land use, in practice this means that the first areas to be considered in the zoning are those covered by the sectoral and special programmes in force.

Besides initial studies for the biophysical, social and economic characterization of the municipal territory, these main documents are supported by a general report, an environmental report resulting from a strategic environmental assessment, an execution programme, and a financing program. In the final stage of the PDM elaboration, each municipality submits the most relevant documentation to public discussion.

Land use planning practice for minerals in Portugal

In the context of spatial planning tools, mineral resources are not differentiated from other geological resources and are addressed together with energy resources. For the sake of simplicity, we refer only to geological resources.

Currently, all the 278 municipalities of Portugal mainland have their respective PDM in force. The majority (62.8%) have already gone through a first revision process and a minor part (5.8%) through a second revision. The legislation does not establish a validity period for the PDM, but states that each one must be revised when changes in environmental, socioeconomic, and cultural conditions determine modifications to the current LUP model.

The PDM revision procedure is equivalent to the elaboration of a new plan. Due to its complexity, PDM revision procedures are usually very slow and lengthy, with an

average time of 9 years (Cavaco *et al.*, 2021). It involves the constitution of an Advisory Committee, whose composition is regulated by Ordinance no. 277/2015 (Table 1), and the elaboration of a proposal by a multidisciplinary technical team. Typically, this multidisciplinary technical team involves two distinct groups: i) one group consists of municipal officials and politicians who are tasked with establishing and providing guidelines for the plan, and ii) other group is a spatial planning consulting firm, which is hired to develop and present the PDM proposal based on the guidelines received from the public officials. All produced documents are assessed by the advisory committee. A strategic environmental assessment runs parallel to the preparation of the proposal.

Within the Advisory Committee, the topic of geological resources is assigned to the Portuguese mining authority (DGEG), which is responsible for providing data relating to the mining easements in force and assessing the documentation that integrates the PDM proposal. Mining easements to be considered are the areas allocated to concessions and licenses for the extraction of mineral, water, and geothermal resources, as well as the temporary areas allocated to the exploration and experimental exploitation of geological resources. These mining easements are delineated on the Map of Constraints of each PDM.

Decree-Law 80/2015 and Regulatory Decree 15/2015 replicate Law 31/2014 regarding the criteria for the classification of land as rural land, one of which is the recognized aptitude for the conservation, valorisation and exploitation of geological resources. When it comes to the qualification of the rural land, these legislative acts have a slightly different approach to that of the spatial planning act. They state that the municipal land-use plans must delimit and regulate the areas allocated to the exploitation of geological resources, integrating them into a category called Areas for the Exploitation of Geological Resources (AEGR).

This subtle variation in the terminology between the recognized aptitude for the conservation, valorisation and exploitation of geological resources (a geological suitability criterion) used to classify land as rural and the one used to integrate land into the AEGR category raises the question of whether this category includes all the areas with recognized aptitude for the exploitation of geological resources or only those where extraction actually takes place. As will be discussed later, this has serious implications for the interpretations made by the multidisciplinary teams involved in the PDM revision processes, with severe consequences for minerals safeguarding.

Unlike the recommendation for other land categories, these regulatory documents specify that the rules for this land-use category must ensure the minimization of environmental impacts, compatibility of uses, and landscape restoration.

Geological resources and, consequently, the narrower group of mineral resources, are also addressed in two other land-use categories, namely the agricultural and forest areas, for which compatibility with the exploitation of geological resources is foreseen.

Indirectly related to geological resources, Law 31/2014 also addresses the concession for the use and exploitation of public domain assets as well as the administrative easements. It establishes that the Portuguese state may enter into concession contracts for the private use of public domain assets. This legally frames the concessions for the exploitation of state-owned mineral deposits and the establishment of administrative easements to both public and private domain minerals.

Methodology for municipal master plans analysis

To understand how mineral resources are currently safeguarded in LUP, data provided by the PDM in force were collected from a sample obtained from the National Territorial Information System (https://snit-sgt.dgterritorio.gov.pt/igt) and the municipalities' websites.

As the most recent legislation for land classification and categorisation dates from 2015, the sampling focused on PDMs whose revision is later (year 2016) and up to the data collection deadline established for this work (end of March 2025). This deadline was established because the number of PDMs under revision is constantly being updated, making it necessary to limit the sampling process. In general, in the municipalities considered, the second revision process of the PDM was carried out, more rarely the third revision. All changes and modifications subsequent to the PDMs' revisions were always considered, until the established deadline. For statistical purposes, it was considered the 2023 subdivision of Portugal into 7 regions (NUTS II): North, Central, West and Tagus Valley, Greater Lisbon, Setúbal Peninsula, Alentejo, and Algarve. For the sake of simplicity, the West and Tagus Valley, Greater Lisbon, and Setúbal Peninsula regions are here taken as a whole under the obsolete but well-known name Lisbon and Tagus Valley region.

Under the aforementioned conditions, information was obtained on 57 municipalities out of a total of 278 in mainland Portugal, with the following distribution: 19 in the North region out of a total of 86; 11 in the Central region out of a total of 77; 9 in the Lisbon and Tagus Valley region out of a total of 52; 15 in the Alentejo region out of a total of 47; and 3 in the Algarve region out of a total of 16.

The PDM of each municipality was characterized by a set of parameters relating to the qualification of rural land that were taken from the respective zoning maps and regulatory documents. The respective maps of constraints were also used. The type of mineral resources present in each municipality was not taken into consideration.

The analysis of the zoning map of each PDM focused on verifying how the AEGR were outlined considering the following:

- Have the AEGR been delimited?
- Are the AEGR equal to or larger than the licensed mining areas delimited in the Map of Constraints?
- Have the AEGR been delimited as a single land category or do they include subcategories?

As shown previously, national spatial planning legislation, particularly that of a regulatory nature, does not have straightforward provisions for minerals safeguarding. However, assuming that ensuring the compatibility of rural land with the extractive industry means that access to mineral resources (their safeguarding) is also guaranteed, the analysis of the PDM regulations focused on verifying this compatibility for categories of rural land other than the AEGR. Of these, agricultural and forest areas, for which the legislation provides for compatibility with mineral extraction (Regulatory Decree 15/2015), and natural and landscape areas are the most important due to the large areas they occupy. The analysis carried out considered the following variables:

Table 3. Subcategories of agricultural and forest areas within the PDMs.

	Description
Agricultural Areas	
Undifferentiated Agricultural areas (UA)	No subcategories are defined.
Agricultural Production areas (AP)	Areas with high capacity for use and agricultural suitability.
Other Agricultural areas (OA)	Areas of dominant agricultural use, which may include priority areas for nature conservation. They can have roles related to livestock farming, forestry and grazing, and can also be areas of multiple use.
Forest Areas	
Undifferentiated Forest areas (UF)	No subcategories are defined.
Forest Production areas (FP)	Areas whose privileged objective is forestry.
Forest Conservation areas (FC)	Forest areas that are important for the recovery and conservation of natural habitats and landscapes.
Mixed Forest areas (MF)	Various combinations of forest areas with agricultural and grazing areas.
Forest Protection areas (FPR)	Forest areas under any protection regime (e.g. Natura 2000, natural park) or with high ecological, landscape, or recreational values that require strict safeguarding conditions.

- Addressing/ignoring geological resources in the objectives and strategic options of the municipality.
- Presence/absence of specific clauses regarding the AEGR.
- Exploitation of geological resources allowed/forbidden in natural and landscape categories of land.
- Exploitation of geological resources allowed/forbidden in agricultural land categories, which were subcategorized as Undifferentiated Agricultural areas (UA), Agricultural Production areas (AP), Agricultural Conservation areas (AC), and Other Agricultural areas (OA) (Table 3).
- Exploitation of geological resources allowed/forbidden in forest land categories, subcategorized as Undifferentiated Forest areas (UF), Forest Production areas (FP), Forest Conservation areas (FC), Mixed Forest areas (MF), and Forest Protection areas (FPR) (Table 3).

Results and discussion

The results obtained by a simple statistical analysis of the collected data allowed some straightforward interpretations on the way in which the AEGR were delimited in the zoning maps.

AEGR were not outlined in about one quarter of the zoning maps, which is a significant value, even considering that the sample includes five municipalities dominated by urban space (Aveiro, Porto, Matosinhos, Maia, and Espinho) (Figure 1(a)). If not delimiting AEGR is understandable for these municipalities, in the remaining this may stem from political will or simply from a lack of awareness about the existence of mineral resources – both on the part of the team responsible for the PDM and the entities that make up the Advisory Committee.

When comparing the AEGR with the granted mining areas outlined in the Map of Constraints, Figure 1(b)) shows that for most of the analysed municipalities (71%) the

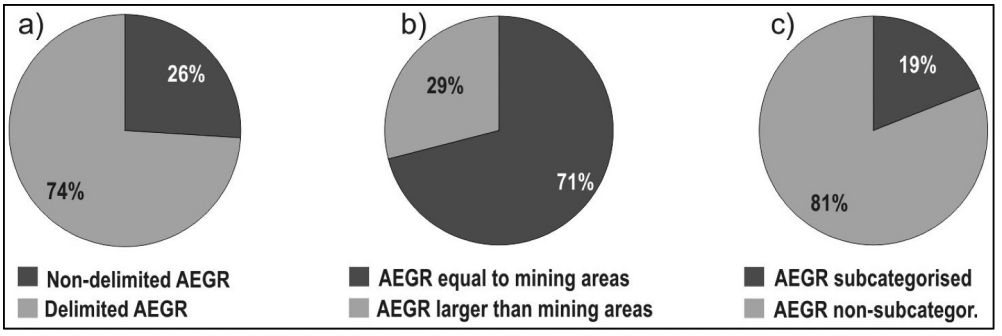

Figure 1. Delimitation of the areas for the exploitation of geological resources in the PDM zoning maps. (a) Delimitation versus non-delimitation of the AEGR; (b) size of the AEGR in relation to the licensed mining areas delimited on the Map of Constraints; (c) subcategorization versus non-subcategorization of the AEGR.

areas are identical on both maps. Once again, this may be the result of simple political will to confine the extractive industry to these areas to prevent its development into larger areas or even other locations. Another possible interpretation, which seems more plausible, is the one that answers a question previously raised about the concrete meaning of the AEGR, which is in line with Karka (2026) statements about the limited uptake of mining industry in the Greek spatial planning due to planners' unfamiliarity with extraction activities and the current trend of social opposition to mining. Indeed, the findings suggest that both municipal officers and politicians interpret AEGRs in an overly restrictive manner, viewing them solely as areas where extraction currently occurs (as the name seems to indicate), rather than as areas with recognized suitability for the valorisation and exploitation of geological resources, which is a key criterion for classifying land as rural. Consequently, AEGRs defined in such a narrow way cannot be regarded as contributing to the safeguarding of mineral resources.

Most of the AEGR were outlined in the zoning maps as simple non-subcategorized areas (Figure 1(c)). This may be a result of municipalities not requesting specialized support on mineral resources, or it may simply be the result of choosing not to consider it. If these non-subcategorised AEGR are equal to the areas already granted for exploitation, then, once again, they do not serve minerals safeguarding.

The Regulation is one of the most important documents of each PDM. In addition to the regulatory provisions, it generally begins by presenting the municipality's development objectives and strategies. Therefore, the significance of mineral resources for municipalities can be expressed by their reference in this regulatory document. However, for the 57 analysed regulations, only 6 of them (≈10%) address minerals in the respective objectives or development strategies.

Regarding the compatibility of other categories of rural land with the exploitation of minerals, which is to say regarding the safeguarding of minerals, the analysis of the PDM's regulations yielded interesting results. For the natural and landscape areas the result is quite simple and instructive: the extraction of mineral resources in these areas is

subject to very strict environmental restrictions and is only allowed in 5% of the analysed PDM.

A large part of natural and landscape areas corresponds to regions covered by some type of nature protection regime (e.g. Natura 2000 Network, nature parks, National Ecological Reserve), which, in Portugal, do not follow the guidelines developed by the European Commission for the Natura 2000 Network decision-making framework, which underlines that there is no automatic exclusion of mineral extraction activities in or near Natura 2000 areas (European Commission and Directorate-General for Environment, 2011; Olmeda & Barov, 2019). As a matter of fact, the special and sectoral programs for nature protection include provisions for a ban on mineral extraction in most protected areas, which PDMs are required to comply with. Very recently, the situation has been aggravated by the introduction of specific legislation for certain sites of the Natura 2000 Network that, in addition to prohibiting the extraction of mineral resources, also requires PDM to prohibit exploration activities (e.g. Decree-Law 73/2025 relating to the classification of the Valongo Special Area of Conservation (SAC) (PTCON0024)). Consequently, it can be inferred that the natural and landscape areas within the limited number of PDMs currently permitting mineral extraction either exclude areas subject to nature protection regimes or, alternatively, need to adapt to the sectoral and special programs that have come into force in the meantime.

Regarding the agricultural and forest areas, Figure 2 shows the distribution of cases in which they are compatible with the exploitation of geological resources, according to the subcategories presented in Table 3. As in each PDM agricultural and forest areas can be subdivided into several subcategories, the number of registered cases exceeds the total number of PDMs analysed. Despite some variation in the compatibility of each of these subcategories with the extractive industry, what is important to highlight is that compatibility is largely not accepted.

In addition, the study carried out also made it possible to verify other limitations to the safeguarding of mineral resources. In a significant number of PDMs, the respective regulation establishes the compatibility of all rural land with extractive activities, but a detailed analysis shows that this compatibility applies only to land identified as having

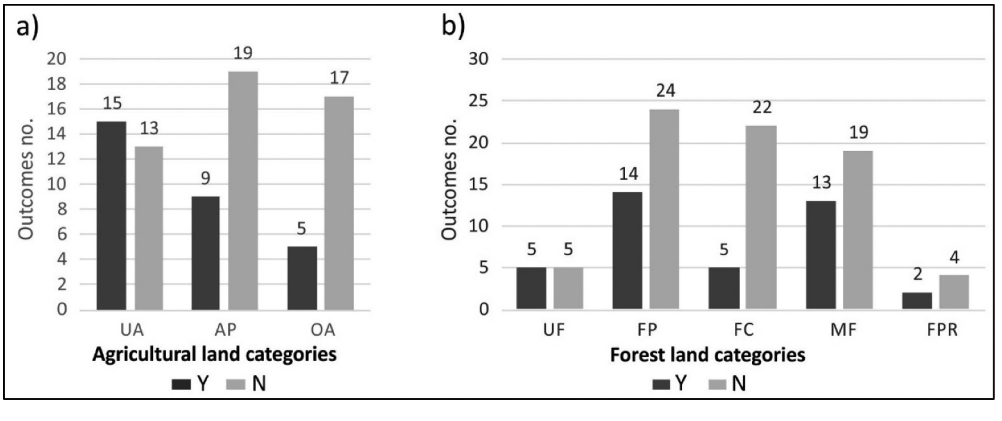

Figure 2. Compatibility of agricultural (a) and forest (b) land categories and their respective subcategories with the extractive industry (Y – Compatible; N – Non-compatible).

mining potential, but not assigned to a specific land-use category, or, if classified as a subcategory of AEGR, it does not impose land-use restrictions. For the agricultural and forest areas where compatibility with mineral extraction is assured, usually this is strongly conditioned by special authorization from the municipal council or the national nature conservation authority or even only considered in cases of national strategic interest.

Given that the legislation specifically states that agricultural and forest areas are compatible with the exploitation of geological resources, a conclusion that can be drawn from the results is that these PDMs are in an irregular situation, particularly those who do not consider any compatibility with mineral extraction. Such discrepancies cannot be attributed to a mere lack of legal awareness, as that is not acceptable. This can be attributed to a failure of oversight during the PDM revision process, possibly representing a strategic omission to avoid activities characterized by high levels of social resistance or public contestation. Just as political will or uninformed political advice can be the reasons for not delimiting the AEGR or for their restriction to existing legally settled mining areas, aimed at preventing their expansion or the emergence of new ones, a similar situation may be observed in the present case. Indeed, considering the prevailing bad social reputation of mineral extraction activities, it may be easier, from a political point of view, to ratify a PDM that omits minerals safeguarding measures than the other way around.

Implications of policies for the exploration and extraction of minerals in Portugal

The integration of mineral resources into spatial planning policy is a 'wicked' problem (Metlay & Sarewitz, 2012; Endl, 2017), i.e. for which there are no right or wrong solutions, but only good or bad options. The way this integration occurs within the Portuguese legislative framework seems to be a bad option, as mineral resources are not considered on an equal footing with other resources.

There are several aspects of the legislation that allow to verify this unequal treatment between geological resources and other territorial values:

- Although geological resources are natural resources, the general law still follows the *European Spatial Development Perspective* from the 1990s (European Commission, 1999) by distinguishing them from other natural resources.
- In the absence of a dedicated sectoral policy for geological resources, legal spatial planning framework prioritizes land use values associated with established sectoral or special policies when assessing competing interests. Therefore, when outlining a PDM zoning map, the areas that may be considered to integrate the AEGR are already conditioned by those related to sectoral or special policies. If some of these policies considered the compatibility of uses with the extractive industry, this issue would be mitigated. However, the management of LUP competing interests is characterized by a siloed approach, with limited interdepartmental interactions, resulting in inadequate measures for minerals safeguarding. As shown previously, most rural land categorised as natural and landscape area prohibits mineral extraction, and the EU's recommendation to ensure the sustainable development of

extractive activities even in protected areas to meet the current demand for mineral raw materials is not followed in any way.

- Geological resources are judged in terms of the activities that make them available to society, rather than their intrinsic value as natural assets. Current legislation reinforces this perspective by establishing that geological resources should be considered under a land-use category called Areas for the Exploitation of Geological Resources, confirming Doss (2008) observation that geological resources are often a neglected component of comprehensive natural resources management, being typically addressed within the limited scope of resource extraction.
- Because of this, the areas designated for the exploitation of geological resources are considered disruptions to the use of the land. This is demonstrated by the fact that this category of rural land is the only one for which the legislation establishes the need to minimize environmental impacts and implement landscape recovery measures. Nothing is said, for example, about the need for more sustainable agricultural practices, when it is known that agriculture is one of the main sources of soil and aquifer pollution (Nuruzzaman *et al.*, 2025).

All the above-mentioned aspects have several consequences for the municipal LUP practice, where ensuring the access to land for mineral activities is not the general rule, but the exception.

As pointed out before, there is a problem in interpreting which type of areas should be included in the category Areas for the Exploitation of Geological Resources (AEGR). As Regulatory Decree 15/2015 specifies that rural land to be included in this category is that allocated to the exploitation of geological resources, the technical teams involved in the PDM revision processes tend to consider that only the areas legally granted for extraction should be included in this category. Therefore, when thinking on safeguarding the access to mineral resources, this land use category only safeguards the access to minerals that have already been discovered, which results in an inconsistency: if they have been discovered, evaluated and their extraction licensed, it is because accessibility to them was already assured.

When attention is focused on mining laws, it is noteworthy that Decree-Law 30/2021 (amended by Law 10/2022), which regulates the exploration and exploitation of public domain minerals, includes provisions for the safeguarding of areas already protected by other legal instruments, thus preventing further acquisition of knowledge about mineral occurrences. These provisions relate to the prohibition of exploration activities in urban and rural agglomerations, in and around superficial water bodies, and in protected areas. Truly, the ban of mineral exploration from protected areas is only applied when the initiative for the exploration permitting process comes from a DGEG's public tender. However, this is a sign that any proposal to ban mineral exploration will be accepted by DGEG during the exploration permitting procedures resulting from a private sector initiative. As most of the environmentally protected areas already prohibit mineral extraction, it is expected that the respective management bodies will propose a ban on mineral exploration too, when consulted by DGEG. As mentioned before, very recent legislation is already imposing the ban of mineral exploration activities in nature protected areas, which corresponds to a form of political censorship regarding the acquisition of geological knowledge about Portugal. Again, if the European Commission has

developed guidelines to prevent an automatic exclusion of mining in or near the Natura 2000 Network sites, what is the reasoning behind banning mineral exploration? Even in the absence of these guidelines, what could be the reason for banning mineral exploration in protected areas or anywhere else in Portugal, knowing that no mining operation can take place without first undergoing an environmental impact assessment, which may prohibit the development of the mining operation? A straightforward explanation may reside simply in the influence of political decision-making.

Now, if the mining legislation paves the way for mineral exploration to be excluded from protected areas and if the interpretation of the LUP legislation regarding the AEGR is the restrictive one, the only land use categories in which accessibility to minerals is legally guaranteed for the discovery of mineral deposits are the agricultural and forest areas. However, as the results obtained in this study demonstrate, compatibility with the extractive industry is not guaranteed in most of these areas. Therefore, there is no justification for mineral exploration investments when it is known that the extraction of any discovered mineral deposits will not be allowed.

Conclusions

In Portugal, both mining and spatial planning legislation address mineral resources within the broader group of geological resources. Their extraction can be carried out under a mining concession (mine) if they are state-owned resources, or a license (quarry) if they are private-owned resources, but, in both cases, it depends on the results of an environment impact assessment procedure.

Minerals safeguarding is a concept to be applied during LUP and can be understood in several ways, all of them aiming to make minerals available to society when needed: (i) The protection of mineral resources from being unnecessarily sterilised during the LUP process, i.e. preventing the loss of the option to exploit them, and (ii) ensure that the mining sector has access to the places where mineral resources occur or are strongly expected to occur.

The Portuguese spatial planning legislation framework distinguishes urban from rural land and establishes formal land use categories for the latter. Municipal master plans (PDM) are the executive spatial planning tools in which the land-use categories are depicted in zoning maps. The rural land-use policy is focused on the management of the so-called dominant uses, therefore, not open to disruptions that could lead to new forms of development. It is a ten-year-old legislation reflecting a rationale for minerals that prevails since the end of the last century: within spatial planning, mineral extraction is regarded as a disruption in land use.

In spatial planning, mineral resources are not considered on their own, i.e. as a natural wealth that deserves to be safeguarded, but rather addressed through extractive activity in two distinct ways: the delimitation of a land use category called Areas for the Exploitation of Geological Resources (AEGR) and the acknowledgment of the compatibility of other land-use categories with the exploitation of minerals. In any case, this is how the safeguarding of minerals can be carried out in the Portuguese spatial planning framework. In a broad sense, the AEGR correspond to areas with recognised suitability for the valorisation and exploitation of geological resources. However, in most cases, the spatial planners responsible for drawing up the PDM zoning maps interpret this land use category as

corresponding only to areas for which extraction permits have been issued, not extending it to places where other mineral resources exist or may exist.

The compatibility of some land-use categories with the extractive industry is a way to safeguard mineral resources, because if they can be extracted, it is because access to them is ensured. The legislation explicitly foresees this compatibility for agricultural and forest areas, but practice shows that this is not fulfilled in most PDMs.

Thus, for municipalities where the AEGR were considered equivalent to areas legally granted for mining and the compatibility of agricultural and forestry areas with the extractive industry is not assured, all remaining mineral resources are sterilized and there is no possibility for new mining operations.

From the mining industry point of view, the only areas available for mineral exploration in Portugal are those included in the AEGR, but not yet granted for extraction, and the agricultural and forest land use categories for which compatibility with minerals extraction has been assured. Outside these areas, investments in mineral exploration are not justified, because even if mineral deposits are discovered, their extraction is prohibited by the PDM without a prior assessment of the possible impacts on the environment and society.

If there is an intention to take advantage of Portugal's mineral wealth, what was demonstrated by this paper points to the need for a change in the Portuguese spatial planning and minerals legislative framework, as they are unfavourable to the extraction and even exploration of minerals. Furthermore, this change is urgent, otherwise the national exploration programme envisaged under the Critical Raw Materials Act will risks irrelevance, as land-access restrictions will likely discourage investments in detailed exploration activities by private operators. If these findings also apply to other European Union member states, it is very likely that the CRM Act's target to produce at least 10% of critical raw materials in Europe will not be achieved.

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