

Interactions between geomorphological heritage and cultural landscape of Serra do Alvão: the perspective of cultural geomorphology

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Abstract

Cultural Geomorphology seeks to reveal the multiplicity of dimensions, meanings and values intrinsic to geomorphological heritage while supporting the cultural landscape in its interaction with the historical and archaeological, architectural or immaterial heritage. In this perspective, the concept of geomorphosite includes landforms that stand out for their importance to the shaping of the landscape, its cultural significance or its economic value. This paper presents an inventory of potential geomorphosites, in Serra do Alvão and the Telões-Chaves basin, from the perspective of Cultural Geomorphology, comprising detailed and intermediate forms, as well as structural forms that define the broad lines of the relief. This inventory was based on past and present use value, considering the scientific, educational, environmental, landscape, productive and architectural functions. The inventoried and georeferenced sites were then subject to a qualitative assessment that sought to describe and justify their heritage value.

Keywords: Cultural Geomorphology, Cultural Landscape, Geomorphological Heritage.

1. INTRODUCTION

The landforms decisively influence the bio-geophysical characteristics of the territory and emerge as a structural factor in the organization of human

presence in space. It should be noted, however, that the geomorphology cannot be understood only as the physiographic expression of terrain at a given time, integrating, by contrast, a morphodynamic dimension with respect to the various processes responsible for its evolution, at multiple chronological and geographical scales. There is a constant interaction between geomorphological processes and the behaviour of the hydrological system, the pedogenesis and the ecosystems dynamics, affecting, ultimately, the human occupation of the territory. Thus, the geomorphology is a first order condition of the vast majority of landscapes around the world, influencing soil types, the organization of the river system, surface formations, ecosystems, productive activities, as well as social, economic and cultural development of human communities (KNIGHT, 2000; STANLEY, 2003).

The different definitions associated with the concept of geomorphological heritage reflect different valuation criteria, which stem from the theoretical and methodological framework of each science field and the specific objectives of each research work. The recognition of the importance of an encompassed reading of the plurality of its scientific and cultural meanings led to the expansion of the semantic domain of this concept and the diversification of the criteria used in its inventory, selection and evaluation, attending to the progressive inclusion of ecological, economic and historical-cultural values (PANIZZA and PIACENTE, 2003; REYNARD *et al.*, 2007).

The criteria commonly used in the diagnosis and assessment of geomorphological heritage should be considered in the setting of multidisciplinary analysis. From this point of view, it is questionable the classical division established between the so-called main criteria and supplementary criteria, which relegates to a secondary level the ecological, scenic and cultural values (REYNARD *et al.*, 2007; BRUSCHI and CENDRERO, 2005, 2009). A holistic view of enhancing the natural and cultural heritage of a given territory will surely design to the forefront the landscape, historical and cultural meanings and expressions of a particular geomorphosite (PANIZZA, 2003).

If the specific characteristics of a landform, its process of formation and its morphodynamic are key factors for the assessment of its scientific interest in the field of geosciences; the recognition of its heritage value is a separate issue, open to multiple readings and dependent on a specific historical and sociocultural context. It is the society, through the agents and institutions that represent it, which is responsible for defining those tangible and intangible assets that have significant heritage value while identity reference and to the preservation its collective memory (PRATS, 1997; PRATS and SANTANA, 2005). On the other hand, the division of heritage in its natural and cultural aspect is often unfounded, and does not reflect the "hybrid", complex and multidimensional nature of many assets. The artificiality of this division is particularly evident in the concepts of geomorphological and cultural landscape, since the latter is inseparable from the first (PANIZZA and PIACENTE, 2003; PEREIRA and PEDROSA, 2014).

In the integrated landscape management context, a broader definition of geomorphological heritage concept allows the exploration of the relations between different types of assets and enhances the dialogue between scientific

domains. In addition to the geophysical characteristics, the value of a particular geomorphosites depends, likewise, their role in structuring the biosphere, its interrelation with other heritage on typologies and its potential for research or education (GRAY, 2008; STALLINS, 2006).

Since the nineteenth century, Geography postulates a geosystemic view of landscape, where the role of geomorphology is highlighted. Bertrand, in 1968, points out the systemic nature of the landscape, defining it as the result, in a certain part of space, of the dynamic combination and consequently unstable, of the physical elements or abiotic, organic and man-made, which dialectically interacting with each other makes landscape a single and indivisible whole that evolves continuously and in an integrated manner (BERTRAND, 1968).

In 1992, UNESCO - United Nations Educational, Scientific and Cultural Organization - defines the operational principles for the inclusion of Cultural Landscapes on the World Heritage List. This recognition of the heritage value of cultural landscapes stimulated the interest in understanding their shaping and evolution processes, with an increased focus on combined reading of the environmental and anthropogenic dynamics.

1.1 Objectives

This work focus on the integrated interpretation and reinforcement of the value of cultural landscape and landforms in the Serra do Alvão, mountainous elevation located in northern Portugal. This research aims to in deep the understanding of the contribution of geomorphology for the process of landscape shaping in Serra do Alvão and promote the mutual reinforcement of the value attributed to geomorphological heritage and landscape through its integrated interpretation.

Is presented an analysis of different types of settlement and agro-forestry-pastoral units that marks the cultural landscape of the Serra do Alvão and which show an unmistakable relationship with landforms of intermediate scale. The interpretation of this correlation between the landforms and landscape mosaic allowed substantiate the selection of potential geomorphosites in Serra do Alvão from the perspective of Cultural Geomorphology.

The deeply humanized character of the landscape and the density of historical and archaeological remains and of vernacular heritage witness the process of human appropriation of Serra do Alvão. The evolution of the models of land occupation in different historical periods is reflected in the diversity of settlement patterns, in the agrarian structure, in the construction techniques and production systems. The landscape thus acquires heritage value reflecting the accumulation of successive strategies of interaction between human communities and environmental conditions. A holistic interpretation of the shaping of cultural landscapes cannot dispense the analysis of the importance of landforms while first order conditioner in the strategic choices of land occupation and exploitation of natural resources.

The exploration of the relationship between landscape and cultural heritage and geomorphological heritage has two significant advantages. First, it highlights

the role of elements, features and geomorphological processes in shaping and evolution of the landscape over time. Second, the preservation of geomorphological heritage could benefit directly or indirectly of policies and measures directed to the conservation of landscape and biodiversity (PARKS and MULLIGAN, 2010).

1.2 Study area

Serra do Alvão, a mountain in the north of Portugal, corresponds to a block raised in push-up style (CABRAL, 1995) and is highly complex, whether from the lithological point of view as from a structural point of view. Is part of a structural context dominated by Régua-Chaves-Verin fault. This fault corresponds to a late-hercynian disconnection, belonging to the same fracture system of the accident Manteigas-Vilarica-Bragança, being sub-parallel to it, with general orientation NNE-SSW and located about 60 km west. In an analysis of more detail this elevation is defined by a set of blocks, often separated by faults, fractures and disconnections, conditioned by the behaviour of the Régua-Chaves-Verin fault (BATISTA, 1998; PEREIRA *et al.*, 2000).

Lithologically, it consists of metasedimentary formations, which correspond to autochthonous and sub-autochthonous metasedimentary units and to parautochthonous units of first order thrust plane, as well as by granitic rocks (figure 1) (MARTINS *et al.*, 2009).

The highest surface of the Serra do Alvão, which corresponds to a part of the surface of the Meseta (Iberian Massif) (RIBEIRO, 1979, 2013a, 2013b) is developed between 950 and 1200 meters of altitude. In this slightly undulating plateau stands out some high points, resulting in a large extent of the existence of geological formations with higher erosion resistance. The surface fills the western sector of the mountain presenting itself staggered. The higher grounds correspond to the north and west sector. Tectonics is the main explanatory factor for the separation of the several blocks. The entrenchment of some rivers on fault alignments results in valleys more or less deep and asymmetric.

Also included in the plateau, is developed a lower level which corresponds to part of the fundamental surface. The altitude ranges between 750 and 800 meters, less than about 200 to 300 m regarding the highest surface. The contact between the two surfaces is usually made from fault scarps (MARTINS, 2009), as well as between the latter and the large depressions.

2. METHODOLOGY

The geomorphosites evaluation developed especially since the late twentieth century, being promoted by the expansion of environmental policies and by the advances in territorial planning, resulting in its inclusion in the studies of environmental impact assessment, in figures and planning instruments and more recently in the context of geoconservation and promotion of geomorphological heritage with educational and touristic objectives (REYNARD, 2008).

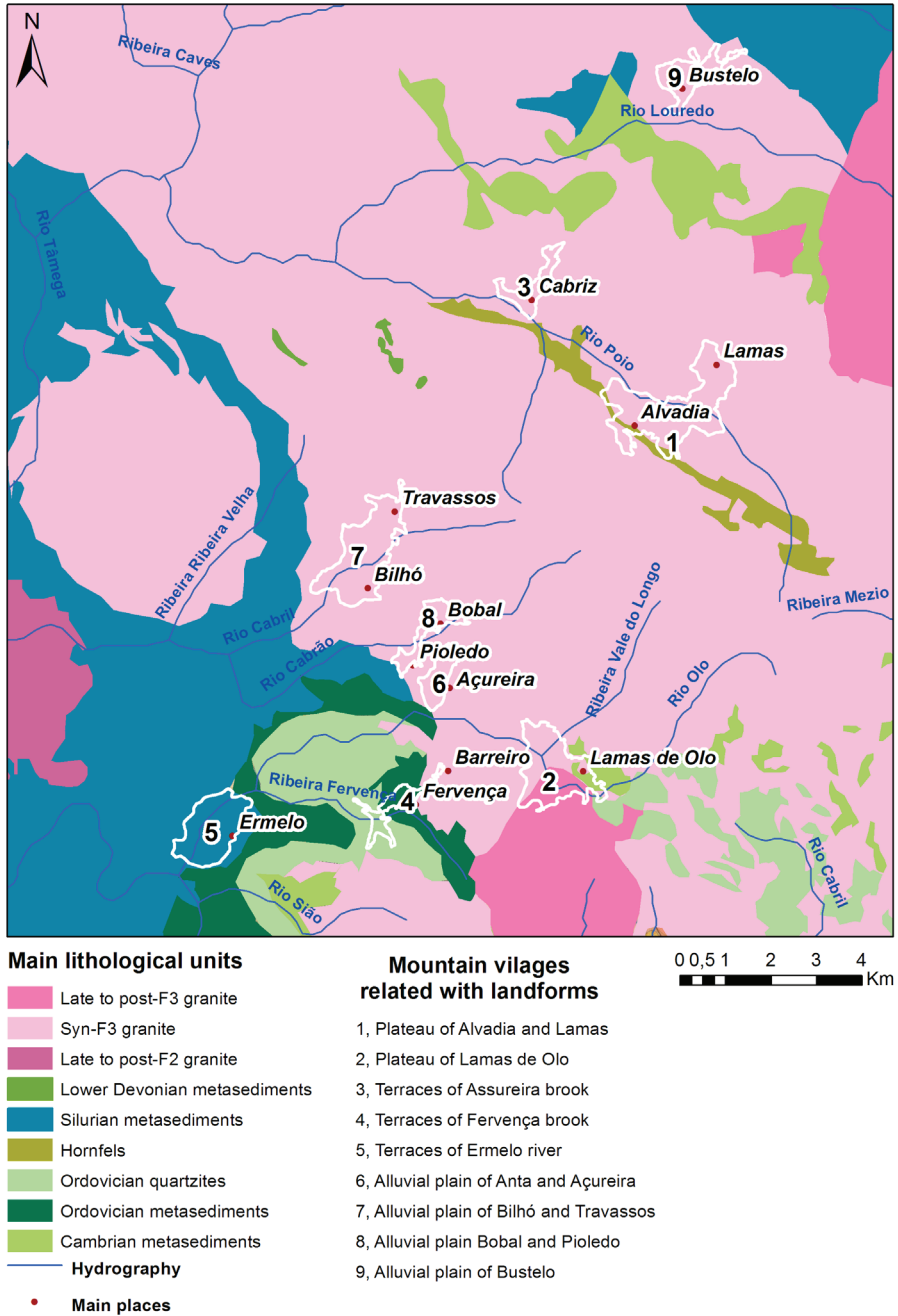


Figure 1. Lithological sketch map of the study area based on the sheet 2 of the Geologic Map of Portugal at 1/ 200.000 scale.

GRANDGIRARD (1999) recommended that the evaluation of the geomorphological heritage is guided by three preliminary questions: "What?", "Why?" and "How?". First, it is necessary to identify the characteristics of the area that will be target of the assessment, with regard to its geographic scale and geomorphologic context, which may be defined, for example, by reference to the morphostructural unit concerned or the prevalence of landforms associated with a particular geological support, as is the case of granitic or karst environments. Second, it is essential to clarify the purpose of the evaluation, establishing its main goals, whether of systematic inventory, of geoconservation or geotouristic promotion. The last question concerns the choice of the assessment method, which must take into account the characteristics of the geomorphological context and the specific objectives of the evaluation (PEREIRA, PEREIRA and ALVES, 2007).

The evaluation of geomorphosites can be carried out based on qualitative or quantitative methodologies (BRUSCHI and CENDRERO, 2009), which are not mutually exclusive, being obvious the advantages of their complementary application. Nevertheless, the most widely used metric systems (BRUSCHI and CENDRERO, 2005; CENDRERO, 2000; HARMON and VILES, 2013; PANIZZA, 2001; REYNARD and PANIZZA, 2005; REYNARD *et al.*, 2007) cannot express by itself the different perspectives of appreciation of geomorphological heritage (HARMON and VILES, 2013). When the quantitative analysis overlaps the interpretative analysis, there is a risk of loss of information, as well as the creation of an apparent security by comparing hardly comparable realities.

This work is grounded on a qualitative analysis and founded on the paradigm of multidimensional and interdisciplinary evaluation of geomorphological heritage, seeking its interpretation and valuing within a geosystemic reading of relations between geomorphology and cultural landscape.

The geomorphological interpretation of the study area, the analysis of the cultural landscape character, based on the land use patterns and on the inventory of the historical and archaeological heritage relevant for understanding landscape evolution, were the support of a reasoned selection of potential geomorphosites. taking as paramount consideration its importance to the shaping of the cultural landscape and the use value at present.

The definition of cultural landscape units is based on the landscape character assessment (SWANWICK *et al.*, 2002; SWANWICK, 2004), methodological approach that aims to identify the characteristics that give an area its "sense of place" and make it distinct from neighbouring areas. Similarly, CORREIA, OLIVEIRA and ABREU (2001) argue that landscape units must have "internal coherence" and "its own character", associated with cultural characteristics. Landscape character is defined as a distinct and recognizable pattern that occur in a consistent and systematic manner. Specific combinations of geological substrate, landforms, soils, vegetation, land use, land ownership and settlement models produce a particular landscape character. At the same time, it is given increasing emphasis on characterization of the "historic landscape" (TURNER, 2006).

The analysis of the influence of geomorphological conditions on the landscape was based on the correlation between morphostructural outline, land use and

settlement patterns. This approach focused on the interpretation of landscape shaping in the light of the interaction between the historical, cultural and environmental conditioning factors, with special emphasis on geomorphology, such as natural accessibility, the distribution of land with agricultural potential, development of forest and shrub areas or even the location of mineralogical resources.

3. RESULTS AND DISCUSSION

The Serra do Alvão corresponds to a space built over millennia, where the imprint of the various communities, peoples and cultures was steeped in the landscape and entered in historical and archaeological record (figure 2) (PEDROSA, 2012, 2013).

Therefore, it is necessary to understand the evolution of its landscape since the occupation of the territory, even at earlier stages to the Neolithic period, in which we are witnessing the gradual replacement of the gatherer societies by the first producing societies. The emergence of agro-pastoralism resulted in the gradual transformation of natural in semi natural ecosystems (AGUIAR and PINTO, 2007).

The reconstruction of the main periods and processes that mark the continuous shaping of Serra do Alvão landscape benefits from its integration within the context of the Peninsular Northwest, since many environmental processes and historical movements take on a similar expression in this territorial framework (MENÉNDEZ DE LUARCA, 2000).

In the mountainous elevations of the Iberian Northwest, the oceanic influence and the little altitude of the mountain ranges, favoured the rapid disappearance of perpetual snow after the last glacial period, verifying the widespread formation of peat bogs (plate 1) and wet heaths. The forest, with a strong predominance of woody angiosperms (*Quercus* sp. *Robur*, *Betula*, *Corylus*, *Fagus*, *Alnus*, *Ulmus*, *Ilex*, *Castanea*, *Fraxinus*, *Fagus*, *Tilia*, *Salix*) and a scarcity of gymnosperms (*Taxus*, *Pinus* sp. *pinaster*, *Pinus* sp. *sylvestris*), were implemented in the areas of lower altitude (Ramil-Rego, *et al.*, 2012: 34-35). The tree colonization reached the entire territory of the Iberian Northwest in the period between 9800 and 8800 cal BP (Muñoz Sobrino, *et al.*, 2007). At the height of its expansion "... the deciduous woods (especially oak, but also mixed woods, hazels, birch)", relegated "conifers formations to small mountain nuclei of eastern and southern areas of the territory" (RAMIL REGO *et al.*, 2011: 42). In Alvão Natural Park are identified still preserved patches of Galician-Portuguese oak, with traces of climax communities of the alliance *Quercion robori-pyrenacae*. In areas of greater Atlantic influence, below 600 meters, and with higher acidity of soils dominate the English oak (*Quercus robur*) (ICNF, 2015).

The specific climatic conditions of these mountains, conducive to the development of peat bogs and shrub communities, limited the rise of the tree limit to the height of 700-600 meters. Thus, moorland (heather) have been an important component of the natural landscape of these territories, which gives them a special scenic and ecological value (IZCO *et al.*, 2001). Thus, the vegetal

landscape on which the first human communities were to act is characterized by a mosaic which consists predominantly of deciduous forests and heather (plate 2), in the areas of higher altitude. Note that in the area classified as Natura 2000 (ICNB, s.d.; Resolução do Conselho de Ministros n. ° 142/97), the wet heather-gorse is a priority habitat, printing a major ecological and landscape mark in the upper floors of the Serra do Alvão.

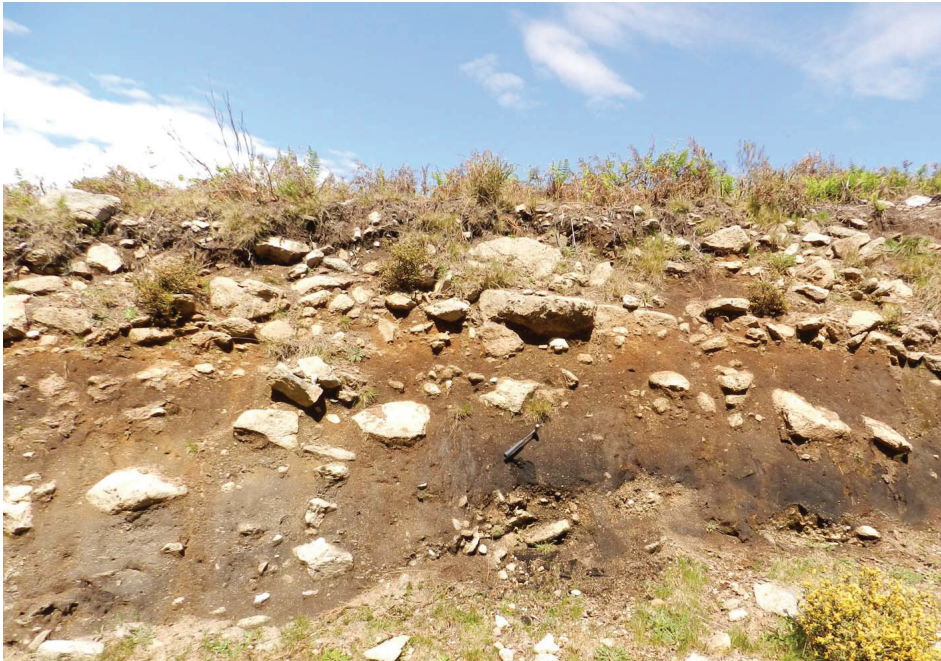


Plate 1. Peat bog remains conserved in a palaeosol on the plateau of Serra do Alvão (photo of the authors).

During the Palaeolithic and Mesolithic, human communities have contributed decisively to the acceleration of the transformation of vegetal landscape (FIGUEIRAL and BETTENCOURT, 2007; MUÑOZ SOBRINO *et al.*, 2007). The first deforestation actions occurred before the Neolithic, aimed at the expansion of herbivorous grazing areas with hunting interest, as well as increasing the visibility and territorial control, and to foster the spread of the shrub and herbaceous species most appreciated in the recollection activities (AGUIAR and PINTO, 2008). However, the spread of slash-and-burnt will have been one of the first responsible for the retreat of forests, which are gradually replaced by shrubs and sub-shrub species adapted to fire (*Erica* sp., heather and *Cistus* sp., rockroses).

It is globally accepted that in this territory, the process of neolithisation, characterized by the passage of hunter-gatherer communities for food production economy will have begun around the 5th millennium BC. Since the 5th millennium BC to the end the 3rd millennium BC follows a global process of self-assertion

and progressive organization of agro-pastoral societies, as well as expansion and structuring of settlement (Jorge, 2000).

In the Middle Neolithic or even during the Late Neolithic, depending on the region, the megalithic monuments began to be used as a way to legitimize the rights of access to arable land, assuming the role of 'territorial markers' of agro-pastoral communities (Jorge, 2000). During the late Neolithic (late 5th and beginning of the 4th millennium BC) is seen a "... *apparent unification of agro-pastoral landscapes, joined by monuments / burial rituals...*" (JORGE, 2000: 61). The areas of high concentration of dolmens often are developed usually near natural passes or ridges (BOADO *et al.*, 1994).



Plate 2. Heather on the plateau of Serra do Alvão (photo of the authors).

During this period, the granitic plateaus, which exist in large number in the Northwest, have been the areas preferably chosen for the development of agriculture, due to the easier mobilization of the soil, compared with the areas of valley bottom and because the period of crop growth coincides with the rise of shepherds and flocks to pastures situated at high altitude. Thus, the retreat of the forest takes place from the plateau to the valley.

At the region of Alto Tâmega, megaliths assume a strong expression. In the area of Serra do Alvão the number of dolmens may have risen to two hundred, mostly concentrated in the parish of Soutelo do Vale, municipality of Vila Pouca de Aguiar (RODRIGUES, 1895). There is the mound of Alto do Catorino, a cultural

heritage building, located in the parish of Soutelo de Aguiar, west of Carrazedo de Alvão, also on the banks of the river Torno. Is located in the centre of the flattened top of a small hill, at an elevation of 971 meters, stands overlooking the dolmen group that develops at the base. Their position highlighted in the landscape allows its viewing at long distance (JORGE, 1987). Equally remarkable is the tumuli set of Chã das Arcas, a National Monument, located in Carrazedo do Alvão in a flat area by the river Torno, are identified five tumuli made of earth and milled stone as well as various props in monolithic granite. Also note the Anta de Alvaldia (figure 1), located about 500 meters from the village of the same name, in the plateau of the Serra do Alvão. Dating to the Chalcolithic period, were found in Vilarinho da Samardã two statues-menhir with anthropomorphic characteristics, within walking distance of a megalithic funerary monument (Alto da Lomba). SOARES (2003) refers to the existence of a large menhir or statue-menhir called Pedra d'Anta (figure 2), at northwest of the village of Alvaldia, placed in a passing area between the plateau and the lower valley of Cerva e Limões.

At the beginning of 3rd millennium, the expansion and technical development of agriculture, with the final implementation of an agro-pastoral economy, "*... will foster the search for fertile valleys, so by registering the first presences below 700 meters height*" (ANDRADE, 1994: 67-68). In the final phase of the Chalcolithic and during the transition to the Early Bronze Age, the settlement pattern is characterized by dispersion of habitats in low and medium altitudes, with often close deployments to valley areas (SANCHES, 1997; BETTENCOURT, 2005, 2009; BETTENCOURT *et al.*, 2007).

The landscape humanization process is intensified in the early and middle Bronze Age (3rd millennium BC), because of the establishment of new settlements, which coexist with the previous ones, located either at high points, either in valley bottom areas, and the emergence of networks of organized settlements in territories that had not previously been occupied permanently. During the Late Bronze Age arise new villages at medium altitude, with locations highlighted on agricultural plains or the coastal platform (BETTENCOURT, 2009).

From the beginning of the first millennium BC, during the transition from the Late Bronze Age to the Iron Age, is witnessed the gradual transformation of settlement models and exploitation of resources, drawing up a new logic land use, often named by the Castro Culture (JORGE, 2000; BETTENCOURT, 2009, 2013; TERESO, 2012) which was to take hold during the second half of the 1st millennium BC. During this period, the occupancy of the valley bottom and the middle slope typical of Late Bronze communities disappear to make way for a concentrated settlement logic of defensive nature. The regional pattern that is defined stands since the Iron Age, characterized by the presence of numerous fortified habitats - the hillforts - implemented in raised areas and of easier defence. Some of these habitats have been founded during the Late Bronze Age, continuing its occupation (BETTENCOURT, 2009, 2013; TERESO, 2012).

A summary analysis of the distribution of traditional hillforts in this region reveals that these are implemented preferably not at higher altitudes, but in places with good defence conditions and well-positioned in relation to the control of the natural accessibility, being almost always in direct dependence of a water

line. Among the criteria and factors that seem to preside at its location there is the proximity to areas in favour of agro-pastoralism, including fertile soils and rangelands, as well as the existence of other resources, including mineral deposits. The hillfort occupation has been instrumental in organizing the mountain regions, responsible for the consolidation of agro-pastoral mountain systems. The development of agriculture and pastoralism takes place in this period in the areas of higher altitude, implying the advance of deforestation by fire (SAMPAIO, 1891; CALDAS, 1991).

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The Alto Tâmega was densely populated (SILVA, 2010; FONTES *et al.*, 2008) during the late Bronze and Iron Age (figure 1). The regional wealth in metallurgical resources justify the large number of villages of different phases of hillfort settlement. In Ribeira de Pena municipality were dug about a dozen Iron Age habitats, most of them placed between 480 and 600 metros of height. In the municipality of Vila Real is noteworthy the fortified enclosure of Cidadelha, classified in 1990 as Property of Public Interest. This Iron Age settlement stands at the top of a small ridge of Serra do Alvão, overlooking the River Avelames, the valley of Vila Pouca de Aguiar and the very village of Cidadelha. Their geo-strategic location gives it a privileged visual dominance over the surrounding territory.

The intense Romanization of the surrounding territory of the Serra do Alvão is proven by numerous epigraphic (BOTELHO, 1907; VASCONCELOS, 1936) and monetary findings (CENTENO, 1979; PARENTE, 1982). The exploitation of gold in Tresminas and Jales have contributed decisively to the dynamism of the Romanization process in this area, also favoured by the proximity of *Aquiae Flaviae* and the Roman road of north - south orientation, linking this Roman city with the Douro region taking advantage of the natural communication axis that crosses the tectonic basin Régua-Verin.

The castle of Aguiar da Pena, located in Telões, Vila Pouca de Aguiar, will have had in its genesis a Roman military fort, built in the first century AD to lookout the important route connection from Chaves to Lamego. Deployed on top of a granite spur, at an elevation of 870 meters, Aguiar da Pena Castle is located in the Alvão plateau limit. Its strategic location gives it an excellent inclusion in the landscape, benefiting from the use of rocky outcrops, difficult access and a

good view. It dominated much of the valley and Vila Pouca, supported by some watchmen surveillance, ensured the dominance of the natural communication route through the Régua-Verin tectonics basin. In medieval ages, this castle may have played an important role during the Christian reconquest of the region (eleventh century) and the formation of Portugal as an independent kingdom. The current structure of Aguiar Castle goes back to the 12th/13th century, with the castle supporting D. Afonso Henriques. He was appointed head of the Medieval Earth of Aguiar (BARROCA and MORAIS, 1986). The archaeological remains allow us to state that there is “... a certain continuity of settlement since the romanization until the thirteenth century, when it turns the massive granting of land letters, really significant and first core documentation for this zone” (BARROCA and MORAIS, 1986).

The trilogy of the *ager*, *saltus* and *mons* of traditional agro-forestry-pastoral areas of the Northwest of Portugal adapted to geomorphological and edaphic constraints of this Medieval Land. The *ager*, the domain of croplands, focuses mainly on the alluvial plain of Vila Pouca de Aguiar and small enclosed valleys, expanding on the most fertile soils, associated with alluvial areas and other types of deposits. Climbing the slopes of the Alvão, the *saltus*, forest plots, often private and fenced, appears alternating with farmland, whose presence decreases as we ascend in altitude. In the higher altitudes of the strands comes *mons* domain, consisting of a combination of shrub communities, forest, and forest areas of collective ownership, the common land. On the top of the plateau reappear agricultural fields and mountain rangelands, interspersed with granite outcrops. In the medieval period, in mountainous areas, the existence of poorer soils, steeper slopes and more adverse weather conditions, stimulated the development of communitarian systems and small private ownership, not controlled by the current tenure systems in most fertile lands, whose holding is made between families who had settled in small population centres (PEDROSA, 2013). Communitarian lands played therefore a very important role in the livelihood of the people, who had not the possibility of obtaining land tenure (DIAS, 1948, 1993; CARVALHO, 2006). The wastelands usually stood up at the end of settlements, after the crop fields and constituted areas that ensured livestock grazing and provided wood for fuel and construction, as well as shrubs for manuring, essential for fertilize the croplands. The basic skeleton of this territorial organization persisted to the present day, despite the reduction in forestry and agriculture. Regarding the reconstruction of the medieval vegetation cover in Terra de Aguiar the place names show the predominance of oak and chestnut (BARROCA and MORAIS, 1986). In terms of cereal production, dominated the rye and millet.

Once presented the synthesis of the key moments of the historical construction of the cultural landscape of the Serra do Alvão, we focus on the analysis of the relationship between forms of relief and the different types of settlement units and agro-pastoral production, in order to select potential geomorphosites of cultural, historical and landscape nature. Four occupation types were identified, closely related to structural lines of terrain and intermediate landforms: plateau occupation, occupation in river depressions, occupation of granite alveoli and occupation in entrenched valleys. The granitic alveoli emerge as a major

deployment area of croplands. These forms evolved from originally closed depressions, due to differential chemical alteration processes, and subsequently emptied by steps, along the drainage channels. Several examples of these types are described in Table 1, being characterized the nature of the distinctive aspects of each delimited landscape unit.

The spatial delimitation of these occupation units (figure 3) was conducted in the Geographic Information System based on the information layers' lithology, morphology, hydrography, as well as land use. The identification and drawing of its limits was founded on the finding of a close relationship between certain landforms and specific deployments of mountain villages and agro-forestry areas. The analysis of this qualitative correlation highlights the importance of the considered intermediate forms for the location of heterogeneous agricultural areas and of temporary cultures, demonstrating the persistence of traditional policultural agriculture. Various strategies of resources utilization as well as of adaptation to the specific soil and morphological conditions must be emphasized. We are referring to the construction of agricultural terraces, especially in the entrenched valley sectors. These are developed in the vicinity of settlements, characterized by the fragmentation of land ownership in small plots, dedicated mostly to a polyculture with little commercial orientation. The village of Ermelo and its associated agricultural area is a prime example. We also highlight the maintenance of the semi-natural pastures, the water-meadows, whose exploitation is only possible thanks to lime watering, especially present in plateau areas, as is the case of Alvadia, Lamas and Lamas de Olo.

At present, the settlement in the Alvão's mountainous area is characterized by the existence of small compact villages, marked by self-sufficiency and solidarity among its inhabitants (MATTOSO, DAVEAU and BELO, 2010). They constitute an essential feature of the current cultural landscape, displaying survival strategies that persist over time. Likewise, this landscape differs by the agro-pastoral mountain systems, which encompass the cultivation area and two distinct but complementary areas: the water-meadows and the wastelands, uncultivated, explored and owned by the community, and of pastoral use (GRAÇA, 1995, 1998).

Poor mountain pastures, of communitarian extensive use, complement permanent irrigated grasslands in relation to cattle grazing, mainly goats and sheep (PIRES *et al.*, 1994; POÇAS *et al.*, 2006). This complex production system, has a great environmental and landscape value that results from its contribution to the maintenance of biodiversity, soil protection and water resources, the preservation of indigenous husbandry productions and even to reduce the risk of spreading fires by introducing discontinuity in forest patches (PEREIRA and SOUSA, 2005; PEDROSA and PEREIRA, 2012; PEDROSA, 2012).

<i>Name</i>	<i>Villages</i>	<i>Area (ha)</i>	<i>Distinctive aspects of landscape character</i>	<i>Relation with geomorphology</i>
<i>Potential geomorphosites exemplary of occupation models in plateau</i>				
Plateau Lamas de Olo	Lamas de Olo	206,75	Heterogeneous agricultural area characterized by the altitude water-meadows	Agricultural and pastoral area implanted in a granitic plateau
Plateau of Alvadia and Lamas	Alvadia Lamas	316,98	Traditional agro-forestry-pastoral system with altitude wetlands	Agricultural and pastoral area implanted in granitic plateau
<i>Potential geomorphosites exemplary of occupation models in areas of river depressions</i>				
Alluvial plain of Bilhó and Travassos	Travassos Bilhó	243,04	Vernacular architecture in granite and slate. Heterogeneous agricultural areas and temporary crops	Depression associated with the Cabril river
Alluvial plain of Anta and Açureira	Anta Açureira	64,18	Villages and agroforestry complex in the base of the granite slope	Tributary of the Olo River - oriented NNE - SSE
<i>Potential geomorphosites exemplary of occupation models in granitic alveoli</i>				
Alluvial plain of Bustelo	Bustelo	99,04	Settlement concentrated on the western side, agricultural use of sedimentary deposition area	Alveoli associated to the stream Ribeira da Ponte
Alluvial plain of Bobal and Pioledo	Bobal Pioledo	72,93	Settlement concentrated in a depression associated with the river valley Vernacular architecture in granite, slate and culm. Agricultural area divided between alluvial deposits and terraces built in the hillsides that close the depression	Alveoli associated to the valey of the Cabrão river
<i>Potential geomorphosites exemplary of occupation models in entrenched valleys</i>				
Terraces in the entrenched valley of the Olo river	Ermelo	178,60	Settlement concentrated in entrenched valley with subsistence agriculture on terraces Shale houses covered by slate	Probable fracture valley, with orientation NNE - SSW, meandering and asymmetrical, with thalweg near the right bank

Terraces of the Assureira river	Cabriz	69,61	Terraces in the entrenched valley and agricultural use of the alluvial plain	Entrenched valley with NNE - SSE orientation of the Assureira river, tributary of the river Poio
Terraces of Fervença	Fervença Barreiro	58,48	Use of the deposition area for the implementation of agricultural terraces	Deposition area of the Fervença and Teixeira streams

Table 1. Potential geomorphosites of cultural, historical and landscape character, illustrative of the relationship between landforms and mountain landscape units.

5. CONCLUSIONS

The landscape organization highlights, in a regional level first reading, the decisive influence of terrain composition behind it. It should be noted, first of all, the dichotomy between the depressions and the mountains, morphological contrast with clear impact on population models and the establishment of productive activities. Refining the scale of analysis, reveals the importance of intermediate landforms such as granitic alveoli, tectonic conditioned valleys and plateau areas. Similarly, the lithological substrate, while conditioning the soil properties and the productive ability of soils, translates into evident landscape contrasts, especially in contact areas between metasedimentary and granites.

The high agricultural potential of soils present in the granitic alveoli is due to the deposition of detrital material resulting from weathering of the in situ rock material and from the erosion of the surrounding slopes, which accumulate in the slaughtered areas while the water lines do not complete their evacuation (SOARES, 2008; FERREIRA, 1979). Moreover, these alveoli have high water availability, provided by the infiltration and retention of water in the granite weathering mantles uphill. The valleys, often conditioned by tectonic, are attractive areas for setting mountain villages and for the development of associated agricultural area, whether their profile will allow the existence of fertile plains on alluvial areas or their entrenchment between steep slopes requires Human ingenuity to search for forms of land use, such as the construction of terraces. Areas of sediment deposition favour the formation of soils with agricultural capacity that may influence the establishment of rural centres in the vicinity, such as the village of Fervença whose agricultural area takes advantage of a valley bottom deposition area (PEDROSA, 2014).

The plateau areas in altitude are frequently exploited by grazing since the soil characteristics do not support agriculture. The villages are smaller and come in smaller number due to the inability of these areas to offer an agro-pastoral production capable of sustaining larger population centres.

This interpretive synthesis of the importance of the forms of relief, especially for an intermediate scale, for shaping the landscape of Serra do Alvão in a centuries-old process allowed to justify the attribution of a historical, cultural and landscape potential of selected geomorphosites according to a qualitative methodology that privileges a holistic and integrated analysis between scientific and historical - cultural values of geomorphological heritage.

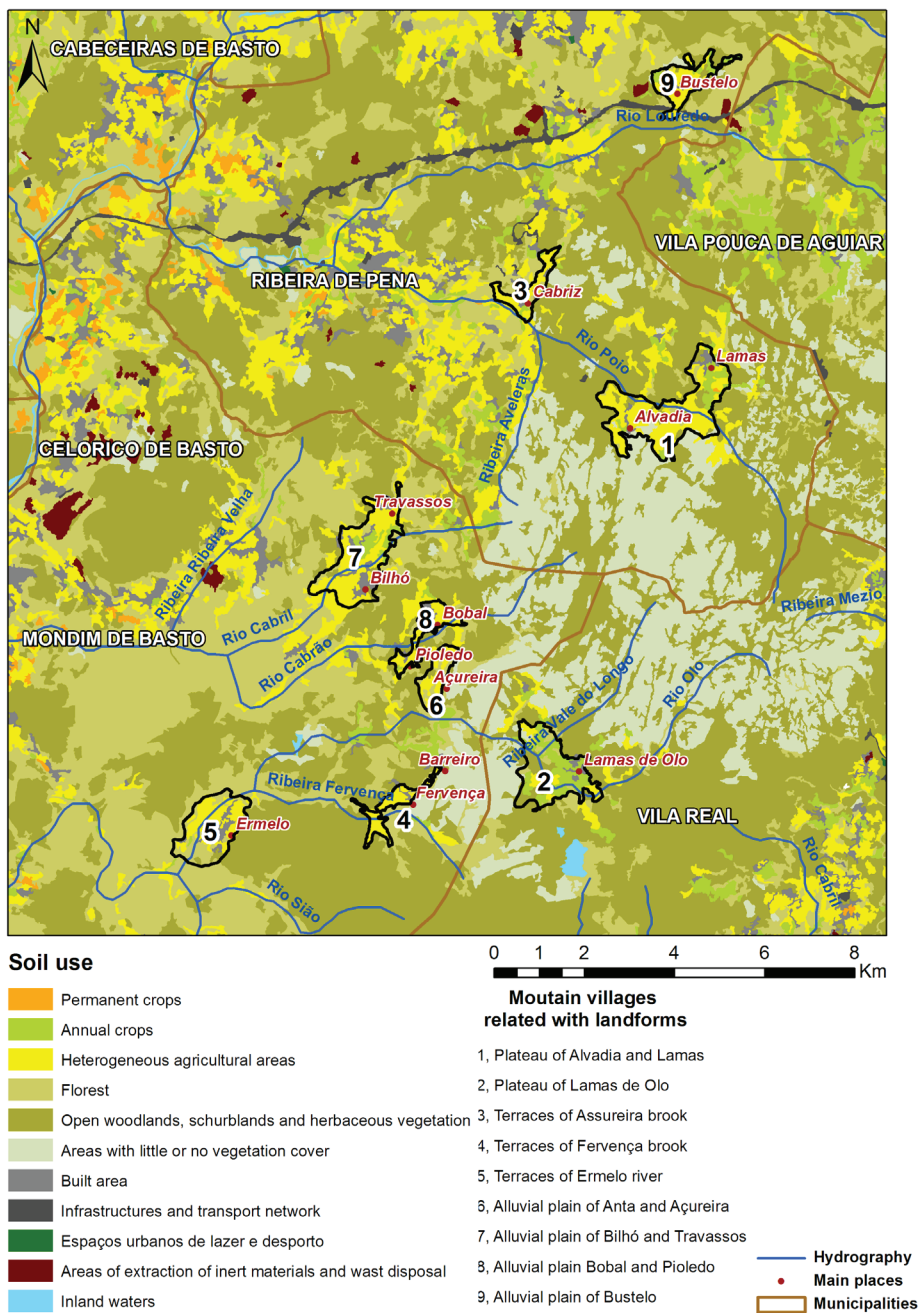


Figure 3. Land use (adapted from COS 2007, DGT) and agro-pastoral units in Serra do Alvão.

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