



Geodiversity and Sense of Place: Local Identity Geological Elements in Portuguese Municipal Heraldry

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Abstract

The concept of geodiversity is extensively used in geoconservation and geoheritage contexts. Its cultural value, i.e. the value attributed by society to aspects of the abiotic natural environment because of its historical, emotional or community importance, is widely recognised. One important manifestation of the cultural value of geodiversity is the strong bond experienced by humans when interacting with their natural physical environment. These ties to native geodiversity contribute to their sense of place. But how to adequately measure the importance of local abiotic nature in the making of the place identity of a given human community? In this work, municipal heraldry, a widespread and unbiased expression of local identity, is used to empirically show the contribution of geodiversity for the creation of a sense of place in Portuguese local communities. After all, what better display of identity than heraldry? Therefore, in this paper, based on Portuguese contemporary civic symbols, an attempt is made to assess the relative importance of geodiversity in originating place identity based on its representations in municipal emblems. As it turns out, geodiversity depictions are present in 56.2% of the Portuguese municipal coats of arms, corresponding to 18.5% of all the charges represented in municipal insignia. Only the representation of biological elements is more common than that of natural abiotic features, present in 74.4% of the coats of arms and corresponding to 29.6% of all representations. This objectively testifies the importance of geodiversity in the development of place attachment in Portuguese local communities. One could venture to say that even more so than such identity elements as architectural landmarks, local economic activities, historical events, etc., also widely represented in municipal symbols, but in a lesser degree. For humans, the question of “who we are” is inextricably linked to “where we are”, and based on this work, it may be shown that in Portugal geodiversity is a significant part of “who we are”.

Keywords Geodiversity · Rivers · Ocean · Place attachment · Civic emblems · Municipalities · Portugal

Introduction

The term geodiversity was originally devised in 1993, first in German and then in Australian publications dealing with the geoconservation of landforms and geological sites (Sharples 1993; Wiedenbein 1993). It was subsequently used by e.g. Kiernan (Kiernan 1994) and Dixon (Dixon 1995), both in works dealing with the geoconservation of Australian geological sites. In Sharples' (1993) formulation, geodiversity corresponded to “the diversity of earth features and systems”.

Since the early 1990s, the concept—retaining its basic initial core—has evolved, becoming more inclusive. Presently, it is used to define and unify all abiotic nature, i.e. the natural variety of geological, geomorphological and soil features, including their assemblages, relationships, properties and systems (Gray 2004; Gray 2008a). The physical elements that constitute our planet, rocks, fossils, mineral, groundwater, glacial ice, landforms, volcanos, soils, ocean basins, etc., are all part of geodiversity.

Some authors consider the concept problematic and its use potentially detrimental to geoconservation, a mere “copy-cat word to catch the glamour of the well-established concept of biodiversity” (Ollier 2012: p. 59), even though advocacy for protecting the diversity of landforms was occurring before the adoption of the Convention on Biodiversity at the Rio Earth Summit in 1992 (Gray 2008b; Kiernan 1991). Nevertheless, many others find the term geodiversity meaningful and useful

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in geoconservation and geoheritage contexts. Consequently, geodiversity has gained in acceptance and usage among the scientific community over the years (e.g. (Azevêdo 2006; Brilha 2005; Brilha et al. 2018; Burek 2001; Gray et al. 2013; Guthrie 2003; Johansson 2000; Kiernan 1997; Manosso and Nóbrega 2016; Silva 2017; Stanley 2002)).

Among geodiversity's many values so far recognised and classified, Gray (Gray 2004) mentions the cultural value, i.e. the value attributed by society to aspects of the physical natural environment as a result of its social, spiritual, historical or community importance. As noted by Gray (Gray 2004), one important manifestation of the cultural value of geodiversity is the strong bond experienced by human communities all over the globe, both past and present, when interacting with aspects of their physical environment. These emotional and social ties to native geodiversity provide humans with a feeling of belongingness, of local identity; in other words, they contribute to their sense of place.

The concept of cultural elements and natural features together generating local identity is easy to grasp. On the other hand, the actual importance of said elements and features in the process of originating a sense of place is complicated to measure. The question arises of how to adequately quantify the impact of local religious beliefs and historical events, or local landforms and indigenous vegetation in the making of the sense of place of a given human community. Avelar et al. (Avelar et al. 2015) collected socio-environmental data on the perceptions of local communities about the environmental, economic and cultural importance of regional geodiversity in a coastal area in Rio de Janeiro (Brazil) by means of questionnaires. However, tackling these issues comprehensively would require entering deeply into the realm of Environmental Psychology, a goal way beyond the scope of this work.

In trying to find an unbiased, widespread and readily available expression of local identity that could be used to objectively show the contribution of local abiotic nature for the creation of a sense of place in Portuguese communities, municipal coats of arms were identified as one possible indicator. What is a better display of identity than heraldry? Coats of arms are by definition identity symbols. They are visual designs constructed with motifs that, in addition to heraldic symbols, often depict, among others, biological elements (animals, plants, bones, shells, etc.) and geological and geomorphological features (mountains, fossils, rivers, cliffs, volcanos, etc.).

Any emblem is created to visually mark an individual or a community and distinguish them from other individuals or similar groups (Chistiakov 2013). In personal or family heraldry, especially in the Middle Ages, the images composed on coats of arms were more often intended to convey a feeling of power and strength, frequently in military terms (Groebner 2004). However, in the case of municipal heraldry, the main focus is on local identity. Municipal coats of arms are designed to be a visual expression of regional autonomy and

individuality, one that would be easy to identify and to interpret (Fig. 1). This is achieved by the representation of religious and heraldic symbols relevant to the local communities, but more often by evoking local historic events, relevant human activities, agricultural or industrial and natural and cultural landmarks.

In this paper, based on Portuguese contemporary civic heraldry, an attempt is made to assess the relative importance of geodiversity in originating a sense of place based on its representations in municipal coats of arms, vis-à-vis other local identity elements such as architectural landmarks, economic activities, religion and biological elements.

The purpose of this work is not to discuss Portuguese municipal heraldry in itself, far from it, nor to show quantitatively, i.e. precisely, numerically, how important geodiversity is in this context. Having in mind the somehow subjective character of the data analysed, heraldic symbols, that would be a rather complex, if not plainly foolish, endeavour. The aim of this paper is to try to establish how relevant natural abiotic features are for the generation of place attachment relative to other components of local identity, using elements explicitly depicted in Portuguese municipal coats of arms.

Geodiversity and Sense of Place

The occupation of a certain territory—be it natural or built—is central to human existence. Survival requires access to natural resources, both biological and mineral. Therefore, as stressed by Gray (Gray 2004), human communities experience a strong connection with their natural physical environment, valuing these ties for a variety of reasons, from economical to aesthetical and from cultural to religious (see also (Kiernan 2015)). These bonds, in addition to personal and community ties, give humans identity and a sense of place.

The variety of elements that mix together in the process of shaping one's identity is astounding, ranging from cultural to genetic ones, and from social to individual characteristics, not forgetting the ones having to do with the built environment (i.e. the human-made surroundings that create the context for human activity) and the natural setting. As soon as the connection between one person or a group of persons and a place—urban or natural—develops, people start to identify themselves (Qazimi 2014).

Adams (Adams 1998) stressed the fact that the physical and biological elements that make up natural settings are, of course, real, i.e. their existence is independent of our constructs, desires and expectations. However, he also noted that the way in which humans commonly comprehend the various natural features, how they decipher and assimilate them, is the result of the values and concepts that most people associate with those features, not an expression of their inherent natural properties. Hence, landscape—as we perceive it—is a cultural

Fig. 1 Geodiversity and cultural elements portrayed in Portuguese municipal heraldry: the case of the coat of arms of the city of Almada, across the river from the capital of Portugal, Lisbon. 1—The river Tagus, represented in the base of the shield by a Barry wavy argent and azure (i.e. silver and blue). 2—The riverine cliffs of Almada. 3—The castle, now a fortress, of Almada situated on top of the cliff. View of the river Tagus seen from the castle of Lisbon by Rocchini (Rocchini 1868)



construction, and humans tend to value geodiversity elements because they are basic components of that construction (Adams 1996; Adams 1998). Shamai et al. (Shamai et al. 2012) also pointed out that the variety of feelings experienced by people towards a place is strongly culturally related. Therefore, tackling the issue of sense of place, one must have in mind that the formation of a local identity entails an important element of emotional relationship with our surroundings, both natural and urban, significantly shifting this discussion towards the field of Environmental Psychology.

Sense of place is a rather vague notion. From the point of view of Environmental Psychology, there is an array of concepts referring to people's emotions about the place they live in. More often, sense of place is used as an overarching category agglutinating such constructs as place attachment, place identity, sense of community, national identity and regional or local awareness (e.g. (Domingues et al. 2017; Shamai and Qazrin 1991)). Moreover, as pointed out by May (May 1970), the concept of place itself is dimensionless, i.e. it may apply to a variety of scales, ranging from an individual home to any region of the planet, to a build environment as well as to a natural setting.

Eisenhauer et al. (Eisenhauer et al. 2000) demonstrated that humans develop a type of attachment to some places of the natural world that constitutes a special sense of place, one that entails emotional connections with and intense caring for those locales and landscapes. They found that the two main reasons, almost equal in importance, leading to a sense of place were associated either to family and social ties or to natural context (landscape). Eisenhauer et al. (Eisenhauer et al. 2000) stated that interviewees in their study evoked the natural setting by expressing feelings generated by the physical uniqueness of the area, including animals in nature, the landscapes, the physical characteristics of the environment, the weather and geological features. In a similar study, Kaltenborn (Kaltenborn 1997) reached the conclusion that a range of characteristics, including the natural and cultural settings, family and social interactions, local history and

traditions, are all central in the development of emotional ties with places. Interestingly, this same set of aspects in general—including religion in the category of cultural settings and social interactions—is the one more often depicted in Portuguese municipal coats of arms (Fig. 2), underpinning the role of civic heraldry as a symbol of local identity.

Therefore, it is not surprising that, as noted (Dixon and Durrheim 2000), when it comes to identity issues, the question of “who we are” is often intimately associated to the question of “where we are”. This idea is captured in Proshansky's (Proshansky 1978) environmental psychological concept of place identity, characterising identity aspects linked to place in urban settings (Lappegard 2007). Proshansky (Proshansky 1978) defines place identity as the “dimensions of self that define the individual's personal identity in relation to the physical environment by means of a complex pattern of conscious and unconscious ideas”, beliefs, feelings, values, etc. Although originally developed for the build environment, the concept of place identity has since been expanded to the physical and geographical context of the city and to natural settings beyond it. After all, by producing emotional bonds, experiences of the natural environment stimulate place identity (Hinds and Sparks 2008; Kiernan 2015; Manzo 2003; Proshansky 1978). Moreover, as noted by Gordon (Gordon 2012), geological features and places often inspire a sense of wonder that is frequently conveyed through artistic expression: literature, painting, photography, etc. This sense of wonder also creates links with cultural roots and sense of place (White 2003).

Expanding on Proshansky's (Proshansky 1978) concept of place identity, a family is not merely a mother, a father and siblings; it is also a place called “home”. Consequently, our human society, our human environment, is not only the people around us; it is also the physical context, both built and natural, that frame our existence. In this sense, build and natural environments are inextricable of humanity, not merely its setting. Who we are, who we became, is also determined by where we live.

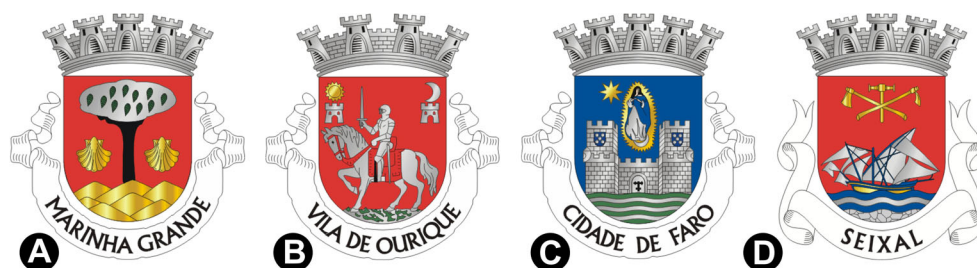


Fig. 2 Heraldry as a symbol of local identity. Examples of elements depicted in civic coats of arms that generate a sense of place. **a** Natural setting: the sand dunes of coastal Marinha Grande. **b** Local history: the mediaeval knight on a terrace (terrado) vert and argent (i.e. green and silver) in base evoking the 1139 Battle of Ourique opposing Portuguese forces and the Almoravid moors that back then ruled southern Iberian Peninsula. **c** Cultural setting, religious and urban: Our Lady protecting the

castle/city of Faro. The green waves—barry wavy argent and vert—represent the sea. **d** Local traditions and economical activities: the ship-building tools and the muleta, the traditional fishing boat of Seixal. In Portuguese, Seixal means a place with abundant pebbles (seixo means pebble). The pebbles—an allusion to the name of the city—are depicted in the coat of arms, below the representation of the river, the barry wavy argent and azure

Gray (Gray 2004), elaborating on the topic of sense of place and the importance of the physical environment for human society, pointed out that e.g. agricultural communities—the vast majority of present-day human societies—are dependent on soil quality and have long valued the material on which their living depends. However, based on the arguments explored above, one could also view this matter from a distinct perspective, not contradictory with this one, but complementary: without soil, would agriculture have been developed in the first place?

Neither mankind as a biological entity, nor human culture itself, exists independent from nature. Take the example of the Portuguese culture, a society clearly shaped by the proximity to the Atlantic Ocean, the mild weather and a diet marked by the abundance of fish. It would be practically impossible for the Portuguese culture to have arisen in the mountainous regions of the Andean Plateau or in the far north-eastern Siberian tundra, as it would be equally challenging to give rise to the Andean or the Chukchi cultures on the sunny shores of Western Iberia (e.g. (Silva 2017)).

In the face of multiple, overlapping meanings of place attachment that have developed in different psychological disciplines, Raymond et al. (Raymond et al. 2010) attempted to develop an integrated model combining its defining aspects: personal, community and natural environment. This model—depicted in Fig. 3—merges conceptually and empirically the many ways

in which place attachment or sense of place have been examined. In it, the natural environment is an essential element. Geodiversity is fundamental in natural environments; therefore, it is also crucial in the cultural process of generating place attachment, or place identity (sensu (Proshansky 1978)), i.e. a sense of place (sensu (Gray 2004; Gray 2008a)).

Portuguese Municipal Heraldry, a Brief Introduction

Civic heraldry has a long history in Portugal. The first documented reference to the flag and emblem of Lisbon, the capital of Portugal, dates back to 1385, and the sigillographic representation of its insignia is even older, known from a wax seal dated 1233 (Fragoso 2002; Fragoso 2003; Matos 2001; Seixas 2012). Back then, the municipal shield of Lisbon already featured the traditional nautical element, the navigating “nau”, an early ocean-going sailing ship, and the two crows sitting on opposite sides of the vessel, a reference to Saint Vincent, the patron saint of the city. Both these elements—together with a third one, a natural abiotic feature, the ocean—are present, to this day, in Lisbon’s coat of arms (Fig. 4). However, the oldest documented Portuguese civic emblem is that of Castelo

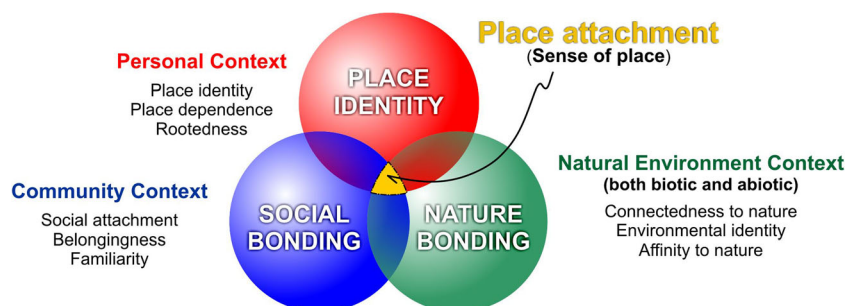


Fig. 3 Conceptual model of place attachment as the interaction of personal context, community context and natural environment context, showing the importance of geodiversity elements—an inherent part of the

natural environment—in the generation of a sense of place. For further explanation of the concepts plotted in the model, please refer to Raymond et al. (Raymond et al. 2010)

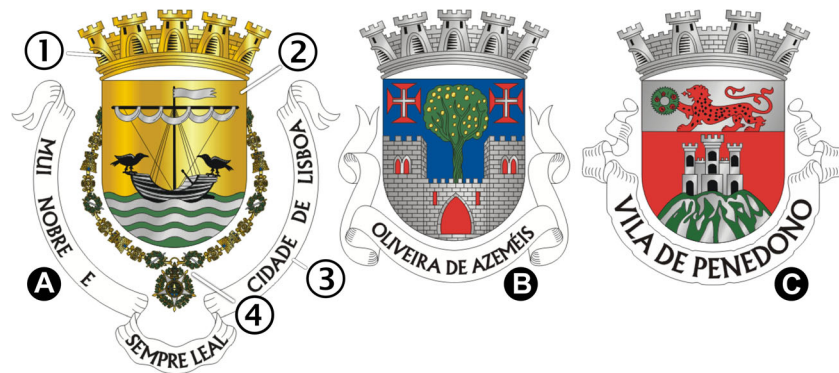


Fig. 4 Coats of arms of selected Portuguese municipalities: **a** Lisbon, exhibiting a golden mural crown with five towers, symbol of the capital city. **b** Oliveira de Azeméis, with a silver mural crown with five towers, symbol of city. **c** Penedono, with a silver mural crown with four towers,

symbol of town. 1—Mural crown, representing the city walls and towers. 2—Round bottom shield typical of Portuguese heraldry. 3—Banderole with motto and legend. 4—Honorific order

Mendo, a municipality now extinct, dated 1202 (Barroca 2001; Lancaster e Távora 1983).

Until the early twentieth century, there was neither a fixed graphic model, nor a universally accepted set of rules governing Portuguese municipal symbols. In a way, it was a situation akin to that reported by Chistiakov (Chistiakov 2013) for the post-Soviet Russian Federation regional heraldry in the early 1990s, when—in a period of relative freedom of creativity—designing new emblems for the Russian autonomous republics had not yet been turned into a business, and centralised regulation and control by federal organs were still not implemented.

Originally, Portuguese municipal arms were created by autonomous civic authorities with little interference from central power. Apart from being emblems of local power, municipal coats of arms were also important symbols of civic autonomy, and this independence was reflected in the early diversity and fluidity of designs, even within the same municipality. In extreme circumstances, as in the case of the capital city of Portugal during the Portuguese Civil War, from 1828 to 1834, the design of the traditional municipal symbols and especially their colours were fashioned to the ideological inclination of those promoting them (Seixas 2010, 2012).

Changes in the insignia of Lisbon occurred again in the early twentieth century, after the Republican Revolution of 1910. The new militantly laic republican regime did not approve of the presence of religious references, in this case, the Vincentian crows, regarded as bordering superstition, in the city emblem, and suppressed them. For a brief period, only the navigating “nau”, by then transformed into a Roman galley, remained in the emblem of Lisbon (Fragoso 2002; Fragoso 2003). The adoption of this new design for the shield of Lisbon in circa 1920, interrupting a continuous graphic tradition of almost seven centuries, triggered a movement that culminated with the reform, revision and regulation of Portuguese municipal heraldry 10 years later (Seixas 2012).

The first set of universal rules governing Portuguese municipal heraldry and vexillology was issued in 1930. According to the new guidelines, municipal insignias had to be approved by the Heraldic Commission of the Association of Portuguese Archaeologists (Matos 2001; Morais-Alexandre 2006). Starting from that year, municipal coats of arms were gradually renewed to conform with the standardised rules. In most cases, the traditional designs of the existing coats of arms were preserved, occasionally with slight alterations in the tinctures and charges to comply with the newly created heraldic guidelines. However, in some cases, the adjustment to the new rules resulted in significant changes, with radically new elements being introduced. Furthermore, those municipalities that did not yet possess heraldic symbols were granted coats of arms compliant with the new instructions. In 1991, an updated heraldic standard was issued governing the creation, the composition and the use of heraldic symbols of civic authorities and administrative public institutions. This updated set of regulations did not dispute, nor change the heraldic municipal symbols approved or created under the law of 1930.

Portuguese civic heraldic rules do not include any restrictions to the use of specific symbols, nor stipulate any elements—religious, military, professional, natural, etc.—that should not be represented in municipal coats of arms. One may argue that the 1930 and the 1991 standardisation of municipal heraldry in Portugal, allied with the fact that the social, political and historical context of the newly created symbols is significantly different from the traditional ones, led to a change in heraldic imagery. This is simply to say that heraldic designs, as everything else, evolve. Whilst the old-style municipal emblems tended to include more erudite connotations, with common references to significant historical events and figures as well as to religious themes, the new coats of arms created after 1930 tended to be—in this case, very appropriately—more down-to-earth, including references to economical activities and professional occupations or local

cultural and natural landmarks. Sometimes—both in traditional and more recent coats of arms—there is even a direct and somehow ironic onomastic relationship between the name of the municipality, the toponym and the motif depicted in the coat of arms, i.e. canting arms. Just two examples, one geological and one biological; the coat of arms of Penedono (penedo in Portuguese means crag, rock) shows a castle, the representation of the town, on top of a crag, and the city of Oliveira de Azeméis (oliveira in Portuguese stands for olive tree) shows an olive tree on top of a castle (Fig. 4).

In conclusion, Portuguese municipal coats of arms, be it more traditional and erudite or more contemporaneous and mundane, as also emphasised by Chistiakov (Chistiakov 2013) for the post-Soviet regional heraldry of the Russian Federation, may be regarded as visual representations created by the rightful civic authorities of a given region to act as emblems of local identity conceived exactly as they intended. This premise allied to the fact that there are no legal restrictions to the use of any symbols is crucial for this work.

Geological Elements in Coats of Arms

Preamble

As Morais-Alexandre (Morais-Alexandre 2006) emphasised, the graphic materialisation of a blazon is not mandatory. It should be noted that, for instance, the Heraldic Commission of the Portuguese Association of Archaeologists passes sentences on the blazon of the municipal coats of arms, on the formal description of a coat of arms in such a manner that an accurate drawing may be made from it, not on the actual design of the elements represented in them (José Bênard Guedes in (Morais-Alexandre 2006)). And yet, as Menéndez Pidal de Navascués (Menéndez Pidal de Navascués 1993) pointed out, heraldry, as a semantic medium bearing a message, rests upon the representations graphically depicted in the coats of arms. These images, not their description, act as a complex code of communication between the people that issue the message, the ones exhibiting the coat of arms, and those that read them, the ones that receive the message. Heraldry, as noted by Seixas (Seixas 2012), is essentially a form of visual culture. A coat of arms is a type of pictorial identification. Therefore, the images used in heraldry are paramount. In the apt words of Andreas Corelli, the enigmatic character in Carlos Ruiz Zafón's novel "The Angel's Game", what actually confers effectiveness to communication is the form, not the content. Yet, the actual representations in the coats of arms are a theme seldom addressed by heraldry scholars. They more commonly tend to analyse said representations as symbols and abstractions, rather than as actual images of people, characters, animals and objects or as the depictions—albeit highly stylised—of real natural features.

Heraldry has also been the subject of discussion and analysis from an artistic and aesthetic point of view, covering both its blazon and its plastic execution (Morais-Alexandre 2006; Pye 1986), but more often coats of arms are discussed as a whole, its individual elements seen as mere graphic components of the bigger picture. There are exceptions, though. Studies were published on the importance of e.g. plants (Kenk 1963; Stavrescu-Bedivan and Şchiopu 2011), animals, including mythological beasts (Pantens-Van den Bergen 1993; Stavrescu-Bedivan and Şchiopu 2011; Vassilieva-Codognet 2013; Will 2016) and garments in heraldry (Morais-Alexandre 1988). However, works focusing on the analysis of natural abiotic elements portrayed in civic coats of arms are exceedingly rare (Martín Escorza 2009), and those using them to address issues of sense of place, to our knowledge, are non-existent.

Representations of Abiotic Natural Features in Coats of Arms

The link between heraldry and geological practice, namely the use of "Conventional Signs, to express Objects in Geology and Physical Geography" is closer than one could probably imagine. Byerley (Byerley 1832) suggested that: "In heraldry we have lines and dots, which perfectly designate the colours to be blazoned on a shield: why should we not employ a similar method to designate the different [geologic] formations?" In heraldry, these lines and dots are used to express tinctures, the limited palette of colours and patterns used in the coats of arms. On the other hand, the emblems, images or devices represented within the field of an escutcheon in a coat of arms are termed charges.

Figurative charges depicting natural objects are frequent. They include animals, plants, fruits, leaves, etc. Geological and geomorphological features, such as hills, mounts, terraces (i.e. land, soil, the ground) and even volcanos and crystals are also common. However, rivers are probably the most recurrent abiotic natural feature illustrated in civic coats of arms. Often represented by a barry wavy argent and azure (Fig. 1), but not exclusively, rivers may be seen in the coats of arms of municipalities and administrative regions from all over the world, from Portugal (e.g. Seixal, Fig. 2d) to the Russian Federation (Kaluga Oblast) and from the Netherlands (Zeeland) to Australia (Western Australia). Associated with water, the waves of the sea or the ocean are sometimes painted on the base of the shield in modern heraldry. In this case, at least in Portuguese civic heraldry, a barry wavy argent and vert is most commonly used. In other heraldic traditions, it is azure instead of vert. That is the case for Lisbon, Portugal (Fig. 4a), the Kamchatka Oblast (Russian Federation) (Fig. 5a), Wolphaartsdijk (Netherlands) and the British Indian Ocean Territory.

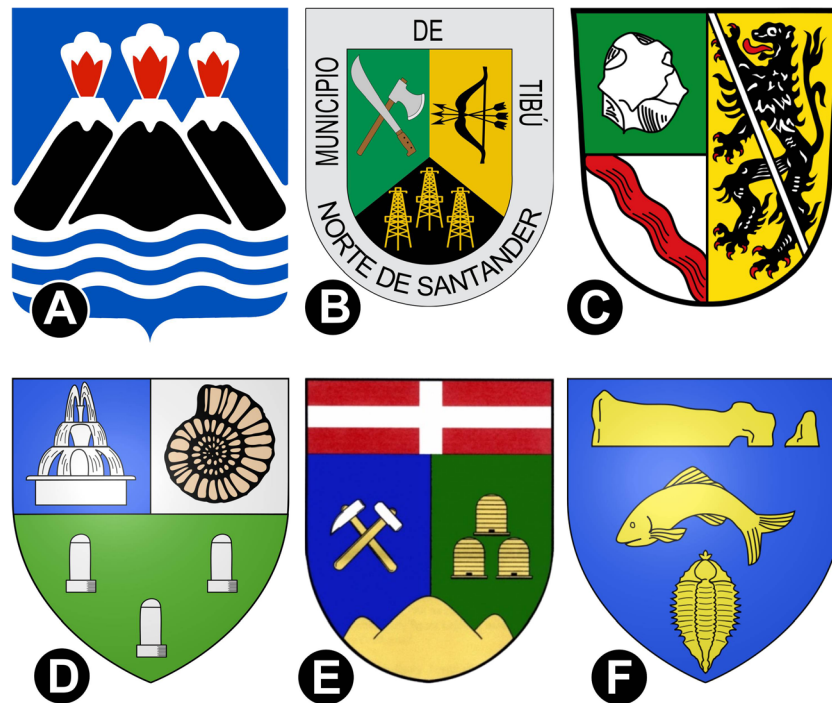


Fig. 5 Examples of geological charges in civic heraldry of the world: **a** Volcanos and the sea in the coat of arms of the Kamchatka Oblast (Russian Federation). **b** Oil fields in the shield of Tibú (Colombia). **c** A rock and a river in the arms of Steinwiesen (Germany). In the upper dexter quarter, the canting image of a stone on a green meadow (stein—stone, wise—meadow), and in the lower quarter, the representation of the Rodach river. **d** Thermal water represented by a naturalistic fountain in

the upper dexter quarter and the fossil of an ammonite in opposite sinister quarter, Tercis-les-Bains (France). **e** Triple mountain or (i.e. gold) on the base of the shield and mining tools, hammer and pick, in the dexter half, Včelákov (Czech Republic). **f** A characteristic rock formation, on top, the Rocher Percé, and, in the base, the fossil of a trilobite in the shield of Percé (Canada)

However, the diversity of geological features and natural abiotic elements represented in civic heraldry is truly astounding, ranging from fossils, characteristic rock formations (e.g. the Rocher Percé of Percé, Fig. 5f) and mineral waters (Tercis-les-Bains, Fig. 5d) to volcanos (Kamchatka, Fig. 5a), mountains (Včelákov, Fig. 5e), rocks (Steinwiesen, Fig. 5c) and crystals (Val di Vizze, Italy) and even icebergs (Ilulissat, Greenland, Denmark) and oil fields (Tibú, Fig. 5b). Related but not quite geological natural features are the representations of mining tools, hammers and picks (again, Včelákov, Fig. 5e). Fossils in municipal symbols are also common. Ammonites are by far the most represented ones (Tercis-les-Bains, Fig. 5d), closely followed by trilobites (Percé, Fig. 5f, and Arouca, Portugal) and the fossils of plants (fossil ferns in the coat of arms of Champagne-sur-Oise, France).

In Portuguese municipal heraldry, as elsewhere in the world, rivers, including creeks and rivulets, are the most commonly depicted geodiversity element. Portugal being a coastal country, the ocean is also a frequent presence in civic heraldry. Other geological elements or features represented are as follows: terraces, hills and mounts, crags and cliffs, water (both drinking mineral water and thermal water), islands and islets, volcanos, dunes, rock salt, pebbles and snow. There is also one representation of clouds. In total, 14 different natural abiotic elements are represented in Portuguese municipal arms.

There are other geodiversity elements present in Portuguese civic heraldry. That is the case of the stone represented in the mural crowns of each municipal coat of arms (Fig. 4), the construction materials of the architectural landmarks depicted, castles, bridges, etc., and even the heraldic tinctures referred to as metals, or (gold) and argent (silver). It is also the case of the metals in various tools or the gems in jewellery items depicted in some of the civic insignia (e.g. the ruby golden ring of Cantanhede). These elements, however, have not been taken into consideration in the present work because they are indirect references to geodiversity. In heraldic representations, they are a reminder of the crucial importance of geological resources for humankind, but not clear references to distinctive local geological features.

Occasionally, geodiversity heraldic charges are illustrated in the escutcheon in such a way that the coat of arms almost takes the form of a naturalistic, albeit stylised, representation of the core physical features of the municipal territory, again exacerbating the local sense of place. The coats of arms of Almada (Fig. 1), Lajes do Pico, an oceanic island displaying an impressive volcanic edifice (Fig. 6), and Penedono, a small mediaeval town featuring a towering castle on top of a crag (Fig. 4c), are good examples of this. This type of stylised naturalistic representation is not exclusive to Portugal. The coat of arms of Swansea, Wales, shows a castle, representing the mediaeval

Fig. 6 The Island of Pico seen from the town of Horta (Faial Island, Azores) and the coat of arms of the town of Lajes do Pico. The Pico volcano, its top shrouded by clouds, rises prominently above the surface of the ocean. The town is located on the opposite side of Pico Island



fortifications of the town, upon blue and white wavy bars representing the sea, Swansea being a port town. Another example is the coat of arms of the Republic of Seychelles, depicting the islands, the ocean, the characteristic Aldabra giant tortoise (*Testudo gigantea*) and a sailing schooner.

Geodiversity Representations in Portuguese Municipal Heraldry

For this work, the coats of arms of the 308 Portuguese municipalities (278 in mainland Portugal, 19 in the Azores archipelago and 11 in the Madeira islands) were reviewed. The various representations and emblems portrayed in their escutcheons as charges were catalogued and quantified. For the sole purpose of this study, the charges were organised in eight broad sets: geodiversity elements; biodiversity elements; architectural elements (castles, towers, bridges, etc.); heraldic symbols (e.g. crowns, fleurs-de-lis, bezants, etc.), religious and mythological motifs (including crosses, liturgical chalices, representations of the holy virgin, etc.), human figures (more often with historical meaning, including body parts, mostly arms and hands holding weapons), astronomical elements (sun, moon, stars) and economical and professional motifs (e.g. boats, machinery, tools, weapons and musical instruments).

It should be noted that this work is not a study on Portuguese heraldry. Therefore, these sets do not correspond to heraldic categories of any kind. They were created with the sole objective of organising the types of images and symbols present in Portuguese civic coats of arms from a strictly graphic standpoint. The focus here is on what is actually being depicted (be it of a biological element, a geodiversity feature or a work tool), not on what it would ultimately signify, nor what its transcendental message would be. This means that e.g. the representations of roses, being parts of plants, are quantified in the category “biodiversity elements”, not in the category “religious motifs”, as symbols of the divinely infused virtue of charity. Continuing to use the rose as an example, the fact remains that a biological element has been chosen

to convey the idea of charity and what is being evaluated here is the type of elements depicted (to convey any kind of idea), not their intended meaning. On the other hand, a Latin cross, the representation of Our Lady and a crown of thorns are included in the category “religious motifs”.

In Portuguese municipal heraldry, 56.2% of all coats of arms (173 from a total of 308) include some kind of representation of an abiotic natural feature (Fig. 7a). Geodiversity accounts for 19.2% of all presences in all the coats of arms (Fig. 7c). Rivers and creeks, as elsewhere in the world, are the most common geodiversity element (Fig. 7b). They are present in 34.1% of the municipal coats of arms (105 upon 308) and account for 48.6% of all geodiversity representations (216 in total). The sea or the ocean is represented in 11.7% of the municipal symbols (36 out of 308), corresponding to 16.7% of all natural abiotic features represented. Terraces (i.e. the ground, land, soil) are the third most common element, present in 23 shields (in 7.5% of the shields, making 10.6% of all geodiversity representations). Combined, rivers, the ocean and terraces occur in 53.3% of all the shields (in 164 upon 308) and account for 75.9% of all the geodiversity representations (164 out of 216). The importance of all abiotic natural elements identified is presented in Fig. 7b.

When compared with the remainder of the sets of representations, geodiversity elements rank number two. The most figured set is the one including biodiversity elements, present in 229 coats of arms (in 74.4% of them). One should have in mind that, frequently, each shield displays images belonging to more than one set of charges and more than one image of each set. Heraldic symbols (present in 133 coats of arms) rank third and architectural elements, fourth (132 shields). If we take into consideration all the representations in all the municipal coats of arms, the relative importance of biodiversity elements grows from 25.4% (with 229 presences in shields out of 900 presences in total) to 29.6% (354 representations out of 1197). However, the overall picture does no change. Geodiversity remains the second most represented set (18.5% of all representations, 222 out of 1197 in all coats of

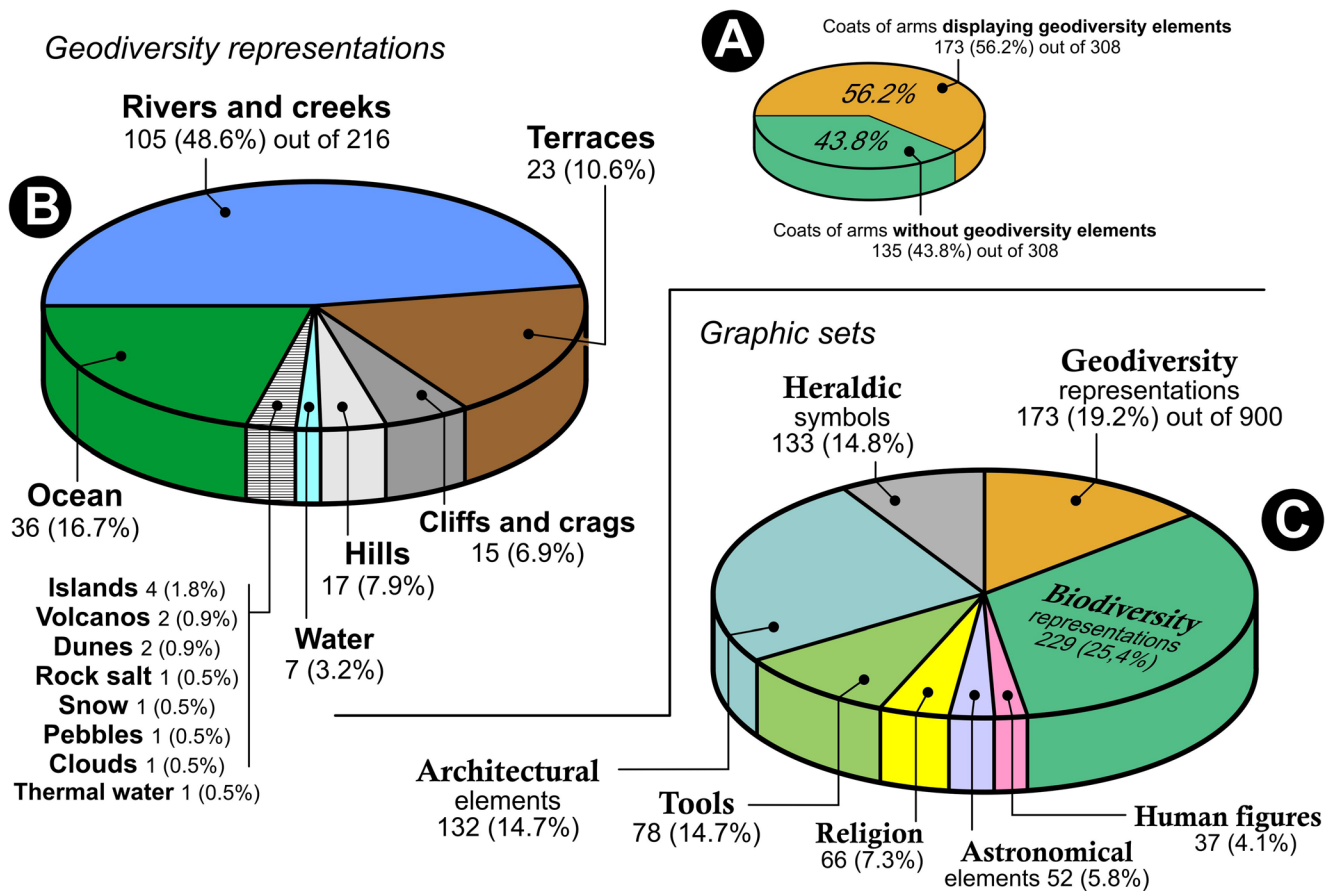


Fig. 7 Quantitative appraisal of geodiversity representations in Portuguese municipal heraldry: **a** Overall importance of geodiversity representations in the coats of arms. The number of municipal shields bearing such representations and (in brackets) percentage in relation to the total number of coats or arms (308 shields). **b** Natural abiotic features represented in Portuguese municipal coats of arms. The overall number of such depictions and (in brackets) percentage in relation to the total number of geodiversity representations (216 representations) in 308

coats of arms. **c** Importance of geodiversity elements in relation to the remaining sets of charges identified in this work. The number of shields bearing such elements and (in brackets) percentage in relation to the total number of presences of the various sets (900 presences) in the totality of the coats of arms. Note that, frequently, each shield displays representations belonging to more than one set of charges and more than one image of each set. For clarification of the sets of charges, please refer to the text



Fig. 8 The Fonte da Bica salt works in Rio Maior—the only fully operational inland terrestrial salt exploitation still active in the Iberian Peninsula—and the coat of arms of the city depicting the characteristic salt pyramids. Rio Maior is a landlocked municipality, located 30 km inland. The salt is extracted from NaCl-saturated underground water

resulting from the dissolution of rock salt from the Lower Jurassic, Hettangian, Dagorda claystone Formation, an evaporitic unit locally associated with a shallow diapir (Calado and Brandão 2009; Eggenkamp et al. 2013)

arms), heraldic symbols the third (15%), architectural elements the fourth (11.9%) and so on, with human figures occupying the last place with only 4.3% of all representations.

Based on the data presented above, it becomes clear that natural abiotic features rank prominently among the representations in Portuguese civic insignia. The importance of geodiversity in the construction of a sense of place at regional level is, therefore, clearly relevant. As underlined before, the physical natural environment is a fundamental element of local identity, and this is graphically stated in a very obvious way in more than half of the Portuguese municipal coats of arms.

Moreover, the graphic representation of heraldic, religious, military and biological elements in coats of arms frequently assumes a symbolic role. Roses depicted in Portuguese coats of arms are not actually roses, but a symbol of charity. A lion is not really a lion—lions are not native to Portugal—but a symbol of courage and gallantry. A dog is not an animal, in itself, but a well-known emblem of fidelity, and a scallop shell is not shellfish, but the emblem of St. James or the canting symbol of the family Vieira (vieira means scallop in Portuguese). And, of course, unicorns are not real. On the other hand, the representations of natural abiotic elements have, literally, a more “down-to-earth” function. They almost always represent natural features—the ocean, rivers, crags, sand dunes, volcanos (Fig. 6)—or geological resources—thermal water, rock salt (Fig. 8)—that truly occur within the territory of the municipality, characterising its abiotic context and its landscape, and, therefore, generating a bond with the local physical environment, the basis of place attachment.

Conclusion: Geodiversity, Heraldry and Sense of Place

The construction of a sense of place is a fundamental trait of being human. “Who we are” and “where we are” are as inextricable as the two faces of the same coin. As demonstrated above, geodiversity representations play a relevant role in Portuguese civic heraldry, present in more than half of the municipal coats of arms. Only the representation of biological elements is more common than that of natural abiotic features. This fact objectively testifies the importance of abiotic natural elements in the development of place attachment and local identity in Portuguese communities, even more so than such identity elements as architectural landmarks, economic activities, religion and historical events (more often represented by human figures), also commonly represented in municipal symbols, but in a lesser degree.

Generating place attachment is one of geodiversity’s values; therefore, this topic is also relevant from the perspective of the benefits (goods and services) that society gains from abiotic nature, with an emphasis on its wider utilitarian and cultural values rather than on the scientific ones, as discussed in the works of Gray (Gray 2011) and Gray et al. (Gray et al. 2013).

In this context, the abiotic natural features of a given territory depicted in civic coats of arms may be categorised as providers of a sense of place within the frame of the “abiotic ecosystems services” model proposed by Gray (Gray 2011) and matured in Gray et al. (Gray et al. 2013), an aspect contemplated in their topic “18. Cultural, spiritual and historic meaning”, within the cultural abiotic ecosystem services category. Moreover, regional geodiversity plays a fundamental role as a source of inspiration for the graphic design of Portuguese municipal coats of arms. Having in mind that heraldry also has an artistic side to it, within this frame, regional geodiversity also qualifies as a provider of artistic inspiration for the creation of municipal insignia. Consequently, local geodiversity generating this phenomenon—rivers, volcanos, dunes, cliffs, etc.—falls into the category of “Cultural Abiotic Ecosystem Services, 19. Artistic inspiration”, described in Gray et al. (Gray et al. 2013).

From a geoconservation perspective, as stressed by Gordon (Gordon 2012), if people have a deeper awareness and connection with geodiversity through more meaningful and closer experiences, they are more likely to value it and to get involved in its protection. In other words, these representations in municipal symbols may be used to increase the public’s awareness of the geodiversity that originated them, increasing the social fruition and appreciation of abiotic nature, both potentially leading the public to take action and influence political decisions supporting geoconservation, as discussed in Pena dos Reis and Henriques (Pena dos Reis and Henriques 2009).

Furthermore, the example of geodiversity representations in Portuguese municipal heraldry is a fine illustration of the fact that, apart from supporting biological diversity, geodiversity (hand in hand with biodiversity) also plays a central role in generating cultural diversity; different shields display different features, locally relevant features, generating a variety of designs and differentiating one municipality from the other. Municipal coats of arms bearing geodiversity representations are a compelling way of demonstrating to the public the crucial role of geological diversity in shaping the cultural setting of human communities. Alongside urban geological aspects and decorative arts elements (e.g. the “rudist tiles” of (Silva 2017)), municipal coats of arms have been used successfully to help popularise geology in the Portuguese cities of Lisbon and Almada (Silva 2009; Silva 2016) to show the role of geodiversity as a source of artistic inspiration, local identity and cultural diversity and consequently to boost the public’s awareness of the various values of geological diversity.

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