Geoheritage Meaning of Artificial Objects: Reporting Two New Examples from Russia

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Abstract: Geoheritage is not necessarily linked genetically to “purely” geological processes. Investigations in two urban areas of Russia allowed us to find essentially artificial objects demonstrating certain geological uniqueness. The huge balls sculptured from rapakivi granite and installed in Saint Petersburg represent cultural, historical, and stone heritage. These are also artificial megaclasts with perfect sphericity. The coal waste heaps situated in Shakhty and its vicinity represent industrial, historical, and urban heritage. These are also artificial landforms creating a kind of pseudo-mountainous landscape. These examples permit us to question the importance of the co-occurrence of heritage categories for geosite assessment.

Keywords: artificial landform; geosite; megaclast; rapakivi granite; Russian South; saint petersburg; soviet legacy

1. Introduction

Geoheritage is an important resource [1–3]. Several specialists have argued that it is tied to cultural, historical, archaeological, and other categories of heritage. Particularly, Cárdenes et al. [4] showed the connections between geological and industrial heritage and regional history; Ezquerro and Simón [5] related geoheritage to music; Gordon [6] put geoheritage into the context of cultural landscapes; Górska-Zabielska [7] demonstrated that a university’s rock garden can be considered as geosite; Kubalíková [8] realized the cultural ecosystem services of geodiversity; Moroni et al. [9] linked geological and archaeological heritage; Pásková et al. [10] analyzed culture–geology interplay in geoparks; and Prosser [11] explained that quarry-based geosites establish cultural connections. Despite the accumulation of all these lines of evidence, two gaps are yet to be filled. On the one hand, a bigger number of “ordinary” examples linking geoheritage to other contexts need to be reported. Notably, peculiarities of countries and regions make the cultural frame of geoheritage very different. On the other hand, essentially artificial heritage features, which can be interpreted as geoheritage, are still poorly-known. This may not only include mines or tunnels created to modify the geological environment or natural stones used in buildings, but also objects significantly less related to geology. We should take into account that “boundaries” (or transitions) between geological domains and cultural sphere are broad, not fixed, and very transient. If so, the opposition between geological and non-geological heritage is questionable, at least. Even the word “artificial” is used in this paper with certain caution.

The objective of the present, essentially descriptive and interpretation-based paper is to report two new examples of artificial objects with geoheritage meaning from Russia. These
have been “discovered” in the course of the authors’ trips. Although this country boasts an outstanding richness of unique geological (including geomorphological) features [12–16], they are documented only fragmentary, and they are known significantly less than the famous cultural and historical heritage [17–26]. The presence of the latter makes Russia especially important to finding artificial objects, which may also be geologically unique.

The reported examples seem to be rather “ordinary” and represent heritage, which is not restricted to the only geology–culture nexus. In contrast, each of them can be put into several heritage contexts, which are revealed in this paper. Both examples, in spite of their evident differences, refer to the same class of multi-dimension heritage, and these seem to be very representative and demonstrate how artificial objects also boast geoheritage meaning and the latter is not only linked to use of natural materials, but this meaning results from human activity. Although these examples are selected rather randomly (due to the authors’ research experience) and there may be other geologically unique artificial objects [27], both are characterized to contribute to accumulation of the evidence about new forms of geoheritage, which is not necessarily found in the field or museums. In other words, both examples serve the same purpose. It also seems that reporting new geosites, both “ordinary” and exceptional, is an essential procedure in geoheritage studies like reporting new fossils in palaeontology. This is especially true in regard to how poor the geoheritage knowledge from many countries and regions still is. Thus, each new portion of geoheritage, including the considered examples, deserves proper description to be communicated to the international research community. Generally, the present paper serves two purposes, namely reporting new geoheritage localities from Russia and arguing for the geoheritage designation to essentially artificial objects.

2. Material and Method

The present study is based on information about two objects located in the different parts of Russia (Figure 1a). The first are granite balls, which are a part of the famous architectural ensemble in the historical part of the city of Saint Petersburg in the Russian Northwest. This city is an international tourist destination, and its cultural and historical heritage comprises the main attractions [28–30]. The study object is essentially cultural. The second object is a group of coal waste heaps, which constitute the legacy of the mining industry development in and around Shakhty in the Russian South. This territory has been one of the most important coal-producing regions of the country for about a century [31–33]. The study object is essentially industrial.

The sites of both objects were visited, and the related literature was surveyed in order to gather appropriate information for subsequent characterization. The latter is based on a simple, three-step approach. First, as these are essentially artificial objects, their affinity to various categories of heritage is established on the basis of the gathered information. Second, the geoheritage value is argued via demonstrating geological uniqueness in each given case. Third, each object is assessed in regard to its uniqueness, which can be established for each category of heritage to which a given object is assigned. According to Ruban et al. [34], the uniqueness of objects can be local, regional, national, and international. It depends on the spatial scale upon which the object is unique. For instance, if a given object is a part of archaeological heritage, and none (or very few) archaeological features of the same kind are found within a country, but they are numerous in the rest of the world, this is national archaeological uniqueness. All noted procedures are based on qualitative interpretations, but the subjectivity of judgments is minimized as possible.
3. Granite Balls from Saint Petersburg

Saint Petersburg is a large city in the northwestern part of Russia (Figure 1a) with a population of ~5.4 million of people. It was founded in 1703 and remained the capital of the Russian Empire until its disappearance. The local geology is dominated by the Precambrian crystalline basement and the Lower Paleozoic deposits. Particularly, Precambrian granitoids are common in the nearby Baltic Shield. The city concentrates a huge amount of cultural and historical heritage. Among them is the architectural ensemble on the Spit of Vasilievsky Island washed by the channels of the Neva River in the very center of the city, and this is an element of the larger UNESCO World Heritage Site [35]. This ensemble was projected by the French architect Jean-François Thomas de Thomon in the beginning of the 19th century. Near the very edge of the quay along the Neva River, there are two stone balls sculpted by Samson K. Sukhanov from the Precambrian rapakivi granite (sometimes, the material is labeled erroneously as marble). These granite balls are impressive in size, and they are considered in the present study. They are located in the very center of the city (Figure 1b), and are easily accessible from the Vasilievsky Island, which is the biggest island of Saint Petersburg (they are situated at the eastern side of the Birzhevaya Square).

The granite balls from Saint Petersburg can be assigned to several categories of heritage (Figure 2). They can be judged as the object of cultural (sensu stricto) heritage due to being a part of the architectural ensemble on the Spit of Vasilievsky Island [36]. The balls are not only two of many elements of the UNESCO World Heritage Site designated to outline the highly-unique architecture [35], but they are also the object marking changes in the public space dynamics in Saint Petersburg [37]. Moreover, these granite balls belong to historical heritage because they are a part of the architectural object symbolizing the Russian Empire’s
Thomon in the beginning of the 19th century. Near the very edge of the quay along the Neva River, there are two stone balls sculpted by Samson K. Sukhanov from the rapakivi granite. These granite balls are impressive in size, and they are considered in the present study. They are located in the very center of the city (Figure 1b), and are easily accessible from the eastern side of the Birzhevaya Square).

The granite balls from Saint Petersburg can be assigned to several categories of heritage (Figure 2). They can be judged as the object of cultural (sensu stricto) heritage due to being a part of the architectural ensemble on the Spit of Vasilievsky Island [36]. The granite balls from Saint Petersburg are unique from a geological point of view. These are man-made megaclasts, which provide evidence of this lesser-known category of megaclasts, and their shape is too ideal to be registered as any natural megaclast. This interpretation appears to be novel because the previous workers (e.g., [45, 46]) focused on rapakivi granites of Saint Petersburg as stone heritage, which is not the same as geoheritage. These balls are ideal for an explanation of what man-made megaclasts and ideal, textbook-like megaclasts are. Nonetheless, the possibility to observe

The study object is also part of the city’s stone heritage. This category of heritage is well-recognized in the world [40–42]. Rapakivi granites, from which the balls are sculptured, are rocks with outstanding aesthetic properties, and, thus, these were often used for historical buildings and monuments in Saint Petersburg to form a significant portion of its stone heritage [43–46]. Apparently, the widespread use of this highly-specific rock in the city stresses its stone heritage value. Importantly, this heritage differs from geoheritage, if even they are related strongly.

The granite balls are essentially artificial objects located in an urban area, and their relation to geoheritage is unclear at the first glance. Some indirect relation can be established through only stone heritage value. However, the size and the shape of these balls should be taken into account. Their diameter reaches 1 m, and their shape exemplifies an ideal sphere. Their composition from rapakivi granite—a natural rock with specific, well-visible structure and representative of intrusive body—should also be noted. Megaclast studies are an important direction of the modern geological research [47–50]. According to the classification by Bruno and Ruban [51], megaclasts are rock particles >1 m in size, and the granite balls from Saint Petersburg can be classified as megaclasts (more specifically, as fine blocks). As for the shape, the classification by Blott and Pye [52] implies that these balls boast perfect circularity (in two dimensions) and perfect sphericity (in three dimensions), i.e., the balls demonstrate the upper limit of the important properties of rock particles. The geological uniqueness of the granite balls as megaclasts is related to their specific (fully artificial) origin and very unusual shape. The majority of megaclasts are linked to coastal zones or colluvial accumulations on mountains slopes, and their shapes are almost always irregular [49, 53]. Therefore, the granite balls from Saint Petersburg are unique from a geological point of view. These are man-made megaclasts, which provide evidence of this lesser-known category of megaclasts, and their shape is too ideal to be registered as any natural megaclast. This interpretation appears to be novel because the previous workers (e.g., [45, 46]) focused on rapakivi granites of Saint Petersburg as stone heritage, which is not the same as geoheritage. These balls are ideal for an explanation of what man-made megaclasts and ideal, textbook-like megaclasts are. Nonetheless, the possibility to observe
typical peculiarities of rapakivi granites with their unusual structure in these balls adds a certain geological value to them.

From four heritage categories established for the study object (Figure 2), the most valuable is the cultural heritage due to its affinity to the UNESCO World Heritage Site (however, the granite balls are not the only elements of this site that encompass huge architectural ensembles). The historical and stone heritage seems to be only local because there are many other objects of this kind in Saint Petersburg. As for the geoheritage, its high value is undisputable—this is a highly-unique example of man-made megaclasts with perfect sphericity. Moreover, the composition of megaclasts from rapakivi granites appears to be rare. The national geological uniqueness can be established tentatively.

4. Coal Waste Heaps from Shakhty

Shakhty is a small city in the southwestern part of Russia (Figure 1a), with a population of ~0.25 million of people. It was founded in the beginning of the 19th century and became a town in 1881. This city has remained an important center of the Russian coal industry (its economy has diversified since the 1990s), and it is located in the “core” of the nationally important coal-mining region called as the Eastern Donbass. The local geology is dominated by thick coal-bearing Carboniferous deposits formed in a lengthy rift basin, which is one of the biggest and most economically important (partly historically) coal basins of Europe. These deposits were deformed tectonically in the course of basin inversion and compression. Shakhty is a typical industrial city that grew actively in the mid-20th century. Several objects of cultural heritage (chiefly not very old, but historical buildings) are ranked regionally. Nonetheless, the city and the territory around it boasts numerous notable industrial objects (many were abandoned together with the decline of the coal industry), the most spectacular among which are tall coal waste heaps dominating the local landscape. They were formed due to massive storage of coal-mining waste—chiefly debris of parent rocks accumulated in the course of coal extraction in numerous deep mines [54]. The coal waste heaps concentrate on an area, which includes the urban area of Shakhty and its vicinities (Figure 1c). All of them are easily accessible from the principal (federal) road leading from Moscow to Rostov-on-Don and crossing the considered area.

The coal waste heaps from Shakhty can be assigned to several categories of heritage (Figure 3). Evidently, they constitute industrial heritage representing the century-long coal mining industry in the Eastern Donbass [54–56], and the size of the object adequately reflects the scale and the importance of this industry and the degree of industrial perturbation of the natural landscape. Closely related is historical heritage. In fact, the coal industry of the Eastern Donbass flourished in the times of the ex-USSR [55,56], and its development was a part of the so-called “Industrialization”—an initiative of outstanding industrial advancement in the late 1920s–1930s, which required a lot of effort from the Soviet society and changed it dramatically [57,58]. If so, the coal waste heaps represent a very typical Soviet legacy. The same object can also be classified as urban heritage. Coal waste heaps are located in urbanized areas and even directly in the city. Their formation coincided with the urban growth and influenced on the urban planning. The city and its vicinity demonstrate very specific organization, which is typical to settlements grown in areas with active mining.
The coal waste heaps are essentially industrial objects from an urbanized area. One can trace their indirect relation to geoheritage through the mining activity; these heaps represent the scale of human influence on the geological environment. However, a direct relation can also be established. The coal waste heaps are artificial landforms (their number is not counted, but it exceeds a hundred in the Rostov Region), with a height of several dozens of meters, conical or sub-conical, and always very regularly shaped (sometimes with a flat surface on the top), with a characteristic brown or red color (due to oxidized iron sulfides). According to Szabó [59], they can be attributed to both montanogenic and industrogenic types of geomorphic intervention of humans. These landforms seem to be really peculiar not only due to their size, shape, and color, but also because they change the natural landscape and influence on the perception of physical geography. A typical hilly steppe plain looks like a mountainous domain. The heritage relevance of artificial landforms has been demonstrated in several cases (including areas affected by the mining industry) [60–62], and, thus, it is reasonable to judge the coal waste heaps from Shakhty as a piece of geoheritage (geomorphological heritage in this case), which proves the power of man as “mountain” builder (montanogenic activity [59]).

The heritage categories established for the study object (Figure 3) are chiefly regional by their uniqueness. Industrial heritage is representative for only Shakhty because the other objects in this category can be found in several cities and towns of the Russian South, including the big cities of Rostov-on-Don and Volgograd. However, this concentration of the coal-industry heritage is typical to only Shakhty. The mining-related Soviet legacy is common in contemporary Russia, although the coal waste heaps seem to be unique in this regard to the Russian South. Urban heritage determined by the influence of mining activity on urban planning is very characteristic for this city of the Russian South. As for the geoheritage, artificial landforms are known from the other parts of the world [63,64], but such a pseudo-mountainous landscape is only seen in Shakhty and its vicinity is unique on a national scale.

5. Discussion

The two considered objects boast comparable complexity (a combination of four heritage categories; see Figures 2 and 3). Generally, this means that they are important, multi-dimension heritage objects and need careful management, i.e., conservation and
tourism-related promotion. Apparently, their multi-dimensionality itself is valuable. The granite balls from Saint Petersburg are conserved as a UNESCO World Heritage Site, and the recognition of their geological value does not require any additional action. In contrast, the coal waste heaps from Shakhty are not conserved; moreover, these are thought to be barriers for urban planning and sources of environmental pollution, i.e., risks for their modification and even erasure exist, which will mean the loss of some precious heritage of the Russian South. As for the tourism promotion, the geological uniqueness of the granite balls creates premise for additional touristic attractiveness, which can be facilitated by communicating the related information during guided excursions and in printed and on-line touristic materials (brochures and web-pages). The pseudo-mountainous landscape of Shakhty and its vicinity needs special geotouristic exploration and exploitation. The activities in the Ruhr region of Germany [65] and the Upper Silesia of Poland [66] can provide a lot of examples and templates to be followed in the Eastern Donbass of Russia. Moreover, there are also other geotouristic options in these areas, where mining activities were strongly linked to the local socio-economic development [67,68].

The methodology of geosite assessment is a subject of strong debate [34,69–72]. Although the proposed approaches tend to focus on “purely” the geological, geoheritage, and technical characteristics of objects, their cultural frame is also considered. For instance, Brilha [69] specified additional points (scores) to be given to the geosites boasting ecological or cultural values, Kubalikova et al. [70] suggested to increase the value for the presence of historical, archaeological, architectonic, and artistic aspects, and Warowna et al. [72] proposed to measure semi-quantitatively the cultural value and the presence of cultural attractions. The outcomes of the present study stress that the various heritage co-occurring with geoheritage cannot be ignored.

It is sensible to distinguish three situations. In one situation, a unique geological feature is located very close to a unique cultural (historical, industrial, etc.) feature. Essentially, these are different features, one of which is natural and the other is artificial. In another situation, there is a single natural feature with different heritage meanings, both geological and other (as noted above, the “boundaries” between them is always challenging to establish). Finally, there may be situation (it matches both reported examples) when a single artificial feature has both geological and other meanings. It is unclear whether the diversity of heritage features is equal to the diversity of heritage meanings and whether the natural versus artificial origin of geosites increases or decreases their value. These questions are almost philosophical and many arguments pro et contra can be presented depending on the subjective preferences. To avoid this uncertainty, it is proposed to not count artificial features and meanings when geoheritage is assessed, but to undertake (if necessary for the purposes of conservation or tourism) a separate heritage assessment, when both geological and other categories of heritage are judged cumulatively in regard to their uniqueness. Nonetheless, further debates on this methodological issue are required.

The undertaken investigation implies that despite their apparent simplicity, the qualitative interpretations of the geology-related heritage are highly-complex. Indeed, these may be simplified with some methodological standardization, but the latter also requires solid ground. Apparently, geoheritage studies have already reached a threshold, after which their theoretical and philosophical advancement is required. This is demonstrated by some recent studies [73–75]. A correct understanding of such objects as reported in this paper requires proper understanding of what are heritage in general and its particular manifestations, whether they are objective or relational, and how people’s preferences, attitudes, and perceptions influence the value of multi-dimension heritage.

6. Conclusions

The granite balls from Saint Petersburg and the coal waste heaps from Shakhty (together with many other features) constitute a separate class of unique man-made geological and geomorphological objects. Their geoheritage value is linked to not the material they consist of, but to their geological uniqueness of their artificial essence. The granite balls from
Saint Petersburg belong to geoheritage because these are man-made megaclasts, which are too ideal to be found in nature, and the coal waste heaps from Shakhty belong to geoheritage because these are pseudo-mountains. The representation of rapakivi granites and coal mining activity is less important in these cases, respectively. The findings imply that geoheritage can be tied closely to the other kinds of heritage (cultural, stone, industrial, etc.), but these need to be distinguished. For instance, rapakivi granite in the considered balls is stone heritage, whereas the megaclast interpretation of these balls makes them geoheritage. Undoubtedly, state-of-the-art, almost philosophical interpretations are necessary for such judgments, and this is a challenging but important perspective for the modern geoheritage research.

Both of the “ordinary” objects seem to be representative to this class and, thus, highlight an important direction of further investigations. There are three important perspectives for the latter. The first is the development of a more or less universal approach for them semi-quantitative assessment of artificial objects with geoheritage meaning. The second perspective is linked to studying the perception of multi-dimensional geoheritage by both visitors and locals. Expectedly, realizing the geoheritage value of artificial objects would contribute to their overall heritage judgments, but this heavily depends on the basic geological preparedness of the people. The third opportunity is linked to realizing the full diversity of artificial objects with geoheritage meaning and classifying them properly. Numerous reports like the present one from various parts of the world are necessary to achieve this task.

More generally, the described examples stress the importance of collaboration between experts in different heritage categories, which would enable finding more geoheritage beyond the geological environment, such as cultural and other types of heritage. For instance, cooperation between geologists and historians would fill an important gap in the knowledge of the links between national history, stone use and mining, and artificial geoheritage creation.

Author Contributions: Conceptualization, D.A.R.; methodology, A.V.M. and D.A.R.; investigation, A.V.M.; writing—original draft preparation, D.A.R. and V.A.E.; writing—review and editing, D.A.R. All authors have read and agreed to the published version of the manuscript.

Funding: This research received no external funding.

Institutional Review Board Statement: Not applicable.

Informed Consent Statement: Not applicable.

Data Availability Statement: Not applicable.

Acknowledgments: We thank the editor and the reviewers for their thorough consideration of our paper and helpful recommendations.

Conflicts of Interest: The authors declare no conflict of interest.

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