

Better Understanding of Geoheritage Challenges within the Scope of Economic Geology: Toward a New Research Agenda

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Abstract: Recognizing geoheritage, i.e., the entity of unique geological features with heritage value, as a geological resource for society is a relatively novel idea. It is argued that non-industrial exploitation of this resource brings benefits through tourism, eco-/geosystem services, and research and education. Experience-related peculiarities of the contemporary economy can be brought in correspondence with the geoheritage value. This new resource deserves extensive investigation and exploration, just like mineral and energy resources. The scope of economic geology should, consequently, embrace also geoheritage as an economically important geological resource. This requires joint efforts of both economic geologists and experts in geoheritage and nature conservation.

Keywords: geoheritage; experience economy; tourism



Citation: Ruban, D.A.; Ermolaev, V.A.; van Loon, A.J. (Better Understanding of Geoheritage Challenges within the Scope of Economic Geology: Toward a New Research Agenda. *Heritage* **2023**, *6*, 365–373. <https://doi.org/10.3390/heritage6010019>

Academic Editor: Paola Coratza

Received: 3 December 2022

Revised: 27 December 2022

Accepted: 28 December 2022

Published: 30 December 2022



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1. Introduction

The sense of belonging motivates people to conserve the environment [1]. To do this effectively, all components of the environment should be considered. Various gaps in our knowledge affect our understanding of conservation needs [2]. Speaking more generally, the public usually can judge well the society's value of birds or rivers, but their knowledge of geological features tends to be limited. There is also insufficient understanding of the actual links between conservation objects and resource objects. For instance, the geological environment is usually considered a “container” of mineral and energy resources. It was realized only recently that this environment contains also numerous objects worth conservation [3]. Although it is fairly clear how geological heritage conservation (geoconservation) works [4], the idea of coupling conservation and resource exploitation in the geological environment is still only partially clear. This holds particularly for the question of whether geoconservation opposes raw material extraction (conflicting interests and goals) and, if not, how the knowledge of extraction activities can help to conserve it.

Economic geology is vitally important for society regarding the world's demand for subsurface resources. Following Pohl [5], it can be defined as a branch of geoscience, focused on mineral raw materials and mineral deposits, including energy resources. Jébrak [6] characterized the long-lasting development of economic geology that has led to the present theoretical achievements and practical strength of this discipline. Moreover, it is clear that the development of extractive activities fed the growth of the entire earth science from the historical perspective, although jointly with the general intellectual advance of society [7–9]. There are, however, complications: Pohl [5] dealt not only with mineral deposits and related “purely” geological features but also referred to environmental and economic aspects. It should also be remembered in this context that the essence and the scope of economic geology were questioned in the 20th century. Reid [10] paid attention to teaching this

discipline. Flawn [11] stressed the economic aspects of the latter. Mitcham [12] emphasized the justification of economic geology against “purely” practical needs and noted its dependence on individual creativity. Evidently, this “classical” geological discipline is not only about geology but also about economics or, better to say, the wide spectrum of societal problems.

A reason to re-consider the scope of economic geology became apparent recently. The interest in geological heritage (geoheritage) increased since the 1970s [3], and international research took another direction in the 2000s [13]. Geoheritage is now commonly understood as the entity of unique geological features with evident heritage value determined by their rarity, usefulness to scientific knowledge developments, educational activities, tourism, and/or highly aesthetic properties, although exact definitions vary to a certain degree depending on the experts’ vision, researchers’ skills, and personal experiences [14–18].

A tsunami-scale wave of conceptually strong and methodologically deep studies devoted to geoheritage (see definition above), geodiversity (this idea has several alternative definitions, but all of them are related to the diversity and uniqueness of geological landscapes), and geotourism (either geology-based tourism or Earth-focused tourism) started in the 2010s. Hundreds of journal articles with outcomes of these studies are published each year, both in specialized, geoheritage-dedicated and other, often high-reputation, geologic, geographic, environmental, economic, and tourism-dedicated journals [18]. It is important to note that geoheritage is now considered a kind of geological resource and viewed in the framework of geosystem services provision [19–22], i.e., it is a constituent of the geological environment, which can be used by society for various purposes; limiting them to tourism is a mere simplification.

In this theoretical contribution, we emphasize that present-day economic geology should not overlook this new geological resource but, in contrast, place the questions related to geoheritage on its own research agenda. This is crucial because “classical” mineral/energy and “new” geoheritage resources often concern the same geological objects and geologists’/miners’ activities [23–25]. Moreover, the knowledge of economic geology accumulated during decades [6] can serve to strengthen geoheritage studies both theoretically and practically. Indeed, many experts in geoheritage may be aware of these perspectives, but the latter need to be better justified, and the appeal should also be addressed to economic geologists. Although the present contribution focuses on a specific issue, which is uncommon to a significant part of the international research community, this issue is related to such well-known ideas as cultural and other ecosystem services of natural resources, sustainable development, rational use of natural resources, and nature as an aspect of people’s experiences. It also appears that the considered ideas are related to the emerging concept of social geology [26–28].

Essentially, the present contribution is a kind of essay aimed at the conceptual treatment of geoheritage studies as a potentially new field of economic geology. On the basis of the available knowledge, we argue the urgency of the extension of the scope of this discipline. Then, we demonstrate that the fundamental change in the modern economy itself stimulates economic interests in non-industrial geological resources. These considerations lead to the formulation of basic recommendations for geoscientists involved in geoheritage studies and/or investigations of mineral and energy deposits.

2. Arguments for a New Vision: Non-Industrial Interests in Geological Resources

As it stands, economic geology focuses on mineral and energy resources because their industrial use brings material and financial benefits. In order to make clear why and how economic geology should pay attention to geoheritage, the real usefulness of geoheritage resources to society should be clearly explained. At least, benefits must be linked to the recreational and other social use of geological features (Figure 1); such benefits might match well the socio-economic benefits of the restoration economy [29] because recognizing geoheritage as a resource offers a more sustainable view of the geological environment than focusing on only mineral resources. The theory of access [30,31] links access to abilities

(exploration of geoheritage resources in this case) and benefits (importance of geoheritage resources for society).

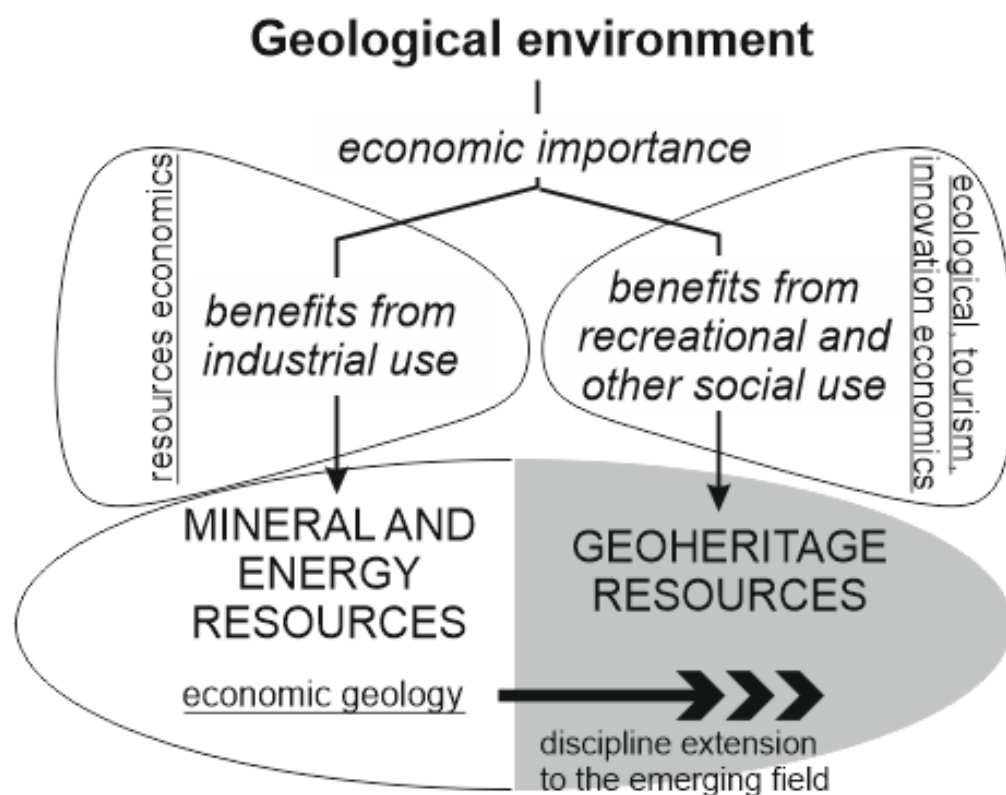


Figure 1. Expansion of economic geology into the space of geoheritage studies.

Geoheritage can be employed as a recreational resource because its uniqueness appeals to the curiosity and aesthetic demands of tourists. Although the social importance of geoheritage goes far beyond the tourism industry, it is the latter that generates direct economic benefits from this resource. Anyway, geotourism has become a global activity with various forms [32–34], the most advanced approach of geoheritage resource exploitation being geopark networks (national, regional, and international), from which particularly the UNESCO Global Geoparks initiative deserves attention because already more than 40 countries exploit their geoheritage this way. Importantly, geoparks do not resemble national parks or biosphere reserves, although they have some aspects in common. Geoparks serve the purpose of local sustainable development [35–37], and some of them (if not many) look like commercial enterprises. The main objective of geoparks is to provide recreational (often coupled with educational and conservational) services. Willingness-to-pay investigations prove the people’s demand for such services [38].

Geoheritage can also be regarded as an ecological resource if its uniqueness implies an exceptional natural state. The famous concept of ecosystem services developed by Costanza et al. [39,40] and linked to natural resources [41] has been adopted for geoheritage, which constitutes the “core” of the so-called “geodiversity”. The latter is a general, almost philosophical, and still debated category used to signify the exceptional natural resource (with emphasis on the geological environment) of civilization growth and progress. Geodiversity is a “channel” by which the geological environment and geoheritage contribute to the achievement of the UN Sustainable Development Goals [42]. Particularly, it has been argued that geodiversity and geoheritage contribute to various eco- and geosystem services [25,43–46]. In other words, these are socio-economic benefits that can be quantified (and “monetized”). Each eco-/geosystem service provided by geoheritage brings its own benefits, and many (if not all) services allow the use of this resource in entrepreneurship and, thus, require creative skills and focus on innovations (some examples are presented

below). It is worth mentioning that cultural frames also matter: the role of entrepreneurship in a given society and the preference of individual versus collective innovation creation should be taken into account to judge these issues comprehensively (for instance, geosystem services would work differently in individualist/atomist and collectivist societies). The related systems and mechanisms are very complex, and we are only at the very beginning of understanding them. It also appears that the contemporary knowledge and its resource value depend too much on the “Western” vision of geoheritage.

Research and education benefit significantly from geoheritage and make it a kind of intellectual resource. Investigations of unique geological features extend our knowledge and, thus, serve the accumulation of intellectual capital. For instance, studies of the so-called Lagerstätten (rich fossil localities representing some key evolutionary, palaeoecological, and taphonomical patterns), which are characteristic examples of geoheritage sites such as the Messel Pit in Germany [47] and Foulden Maar in New Zealand [48], have played an outstanding role in the understanding of the geological and biological evolution [49]. It should also be added that such research attracts funding, i.e., it is related to the academic economy. In addition, geoheritage comprises many “ideal” geological objects (stratotypes, textbook-looking folds, typical mineral localities, etc.), which are perfectly suitable for training the skills of future professionals. Geoheritage-based education has therefore become a powerful instrument for learning geological disciplines and recruiting new geologists to both the academia and the industry, and it is actively promoted on an international scale [15,23,50,51]. The above-mentioned intellectual capital and the advanced skills constitute the foundation for further development of geology and successful geological explorations, which bring their own socio-economic benefits. If so, geoheritage drives innovations in geological research and development.

The above emphasizes the usefulness of geoheritage resources. The related profits, costs, and other economic parameters can be determined with the approaches offered by tourism (recreational aspects), ecology (eco-/geosystem aspects), and innovation economics (research and education aspects) (Figure 1). However, even if these resources are available for a given territory, their valuation requires attention to the properties of the geological environment itself. Such properties as uniqueness, vulnerability to anthropogenic pressure, or color are fully determined by the “purely” geological peculiarities of the areas, which need to be surveyed geologically with specialized methods [3,14,52–56] for the judgment of the availability, amount, and quality of their geoheritage resources. Essentially, this is the same as what economic geologists do with mineral or hydrocarbon occurrences (a comprehensive picture of these activities is offered by Jébrak [6] and Pohl [5]). Mapping, sampling, laboratory analyses, and testing procedures are essential to both mineral and geoheritage resources. A difference is that the value of the former is linked to geological raw materials, whereas the value of the latter is linked to geological information. Nonetheless, both raw materials and unique information are extracted from geological objects, and both are related to the natural peculiarities of these objects.

3. Discussion: Geoheritage Resources in the Era of Experience Economy

Eco- and geosystem services in relation to geoheritage are studied actively [25,43–46]. Importantly, the very idea of them is tied strongly to socio-economic reasons, and these services can be incorporated into the economical models of the extractive industry [25,42]. Socio-economic shifts and the related developments in economic science should also be taken into account.

In their seminal paper, Pine and Gilmore [57] conceptualized the idea of the experience economy, i.e., building economic relationships around people’s experiences, which represent the next generation of commodities after agricultural products, manufactured goods, and services. This idea has been echoed in the studies by Argenton [58], Kemper et al. [59], and Sköld [60], and it appears that the experience economy has dominated the world since the beginning of this century (this appears to be especially the case for the customer generations Y and Z, i.e., the so-called millennials and zoomers).

The experience economy stimulates society's interest in geoh heritage resources because the latter offer not only information but also various experiences. These experiences may be positive (see below), negative (for instance, vandalizing rock outcrops), or indirect (outdoor recreation near a spectacular outcrop or climbing on a highly unique landform). It is beyond the scope of the present essay to review all these geoh heritage-related experiences, but five major types of positive experiences should be noted (Figure 2). Teaching and learning themselves can be enjoyable because they allow people either to spread their knowledge or to acquire new knowledge. Not less demanded experiences can be trying: visitors of geoh heritage sites dedicate their time to mineral or fossil collecting ("hunting") or bathing in thermal springs. One of the most famous examples is the Crater of Diamonds State Park in Arkansas (USA) where visitors can dig for diamond specimens [61,62]. Closely related is such an experience as participating: professionals, amateurs, and the lay public all join research, geoconservation, or geotouristic initiatives on a voluntary basis and enjoy their participation in "something important" being guided by scientists or well-educated amateurs). Another sort of experience is linked to enjoying, which is a broad category comprising such activities as passive viewing of geoh heritage features or painting and filming them. The main cause is the highly aesthetic properties of some geoh heritage features. As known from contemporary tourism research, people's judgments of beauty are not based solely on color and other visual parameters but may be linked to authenticity, uniqueness, and other properties [63].

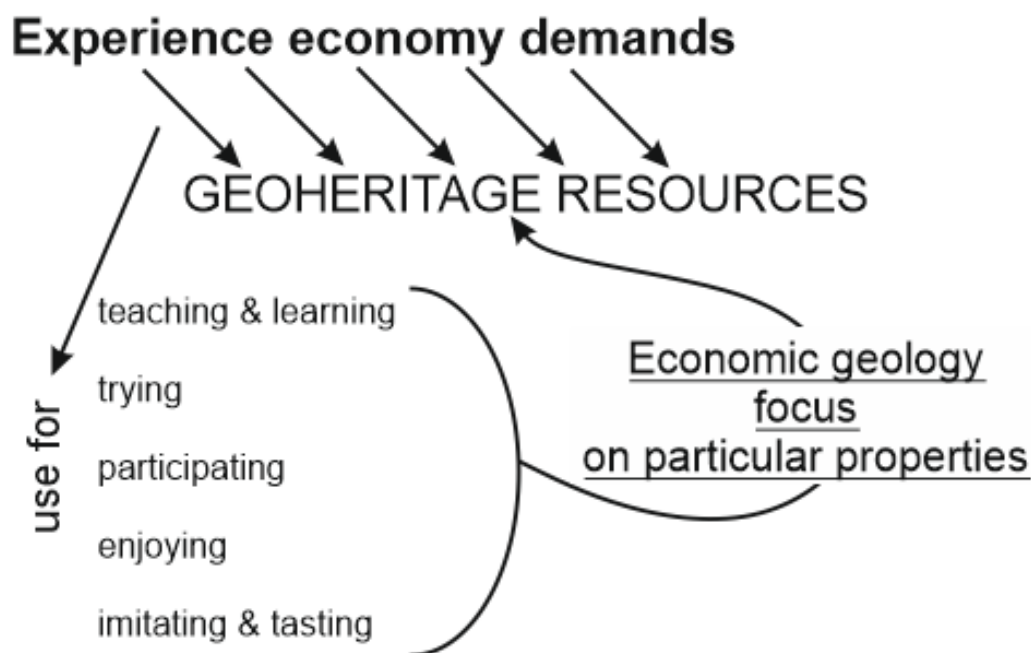


Figure 2. Geoh heritage-related experiences and economic geology.

Additionally, the experience economy leads people even farther, and geoh heritage offers experiences unexpected from the geological environment. These can be labeled as imitating and tasting. Trivial cases are drinking natural water or sitting in a bath with therapeutic mud (peloids). However, there are more possible experiences. The idea of geoproducts that retain links to geoh heritage has become popular [64]. Some artisanal workers inspired by unique geological objects produce related goods (food, souvenirs, etc.) creatively rethinking and imitating geological features, and visitors taste actively geoh heritage with these goods either directly (if edible) or indirectly (if not edible). Two examples can be found in the Kemerovo Region of Russia representing the geological domain of Kuzbass, famous for its outstanding coal resources and their active extraction. Local entrepreneurs produce and sell "coaly" ice cream and "coaly" cakes (gingerbread), as well as black vodka [65]. Their color imitates the color of the Kuzbass's coal. To visitors, these products are excellent

souvenirs, which can be tasted with pleasure (drunk and eaten, respectively). Interestingly, vegetable charcoal is used for color imitation, and, thus, consumption of products with this supplement leaves the impression of “true” coal tasting. Indeed, this strengthens geoheritage-related experience.

The above-mentioned geoheritage-related experiences imply that highly specific properties of the geological environment need investigation to understand which experiences can be provided in each given case. “Standard” geological studies or even usual geoheritage assessments are not enough to deal with these properties and, thus, to comply with new demands of consumers in the era of the experience economy. This means that new exploration tools should be developed and applied for the effective exploitation of geoheritage resources. Principally, this is comparable to the task of economic geology, which needs an innovative, “high-tech” insight into mineral and energy resources, far beyond the “standard” geological surveying.

4. Conclusions and Recommendations

Geoheritage is a new category of geological resources with socio-economic importance. Even though it probably generates less benefits than the exploitation of mineral and energy resources, the scale of the world’s geoheritage exploitation and its potential are impressive, and the present socio-economic transformations (such as the rise of the experience economy) increase the value of geoheritage resources (especially for the countries with rich geology and active inbound and domestic tourist activities). Although these resources differ essentially from industrially important resources which have commonly been within the focus of economic geology, they both need full-scale, specific exploration of the geological environment shaped by the socio-economic needs and aimed at generating benefits (either industrial or not). If so, it appears only logical to discuss the possible extension of the scope of economic geology (Figure 1) and to try putting geoheritage on the research agenda of economic geology.

This proposal leads to five basic recommendations. First, the available geoheritage-related knowledge is already massive and promising, but its state is incomparably less fixed than that of mineral deposits; therefore, it is important that experts in geoheritage be attentive to what can be told to them by economic geologists (the former should not consider themselves as only general geologists, specialists in nature-based tourism, or environmental activists). Second, economic geologists should find some place in their research agenda and forums for geoheritage-focused discussions. This recommendation is aimed, particularly, at the content of academic and industrial journals and conferences. Third, special attention should be paid to in-depth investigations of those properties of the geological environment, which are crucial for generating socio-economic benefits via geoheritage resource exploitation. Fourth, the physical interaction of mineral/energy and geoheritage resources and the benefits of their co-exploitation need examination. Particularly, economic geologists often deal with mineral aggregates and other geological substances with an outstanding uniqueness, and, thus, they are among the first who may recognize the presence of geoheritage at a given locality. Fifth, a more or less comprehensive conceptualization of geoheritage from the economic geologic point of view is desirable. For instance, it is necessary to have a clear idea of how one should delineate geosites, how their value can change within their limits, and how geosites can be classified genetically. All these theoretical advances and practical innovations, as well as the very emergence of a new research agenda, might become possible thanks to the joint, mutually enriching efforts of economic geologists and experts in geoheritage and nature protection.

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

Funding: This research received no external funding.

Data Availability Statement: Not applicable.

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

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