Geoconservation Research

Short Communication

# New Mineral Discovery Geosites: Valuing for Geoconservation Purposes

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## Abstract

**Discovery of new minerals contributes substantially to the geoscience development. Localities where such discoveries have been made appear to be unique, and they deserve recognition as new mineral discovery geological heritage sites (NMD geosites). Valuing the latter is a complex procedure. Generally, it appears sensible to accept that NMD geosites are of national importance by definition. Finding several new minerals in one locality (multi-NMD geosite) increases the geosite rank from national to global (examples can be found in northwest Iran and southwest Russia). The 'spirit of novelty' is the essential characteristic of NMD geosites, which helps to attract visitors. Because of the permanent changes in the mineralogical knowledge, validity of some minerals can be disproved later. For such cases, the category of the historical NMD geosites can be applied. Recognition of NMD geosites is the only first, and the foremost, step in their protection from various damages (related to mining and uncontrolled sample collection).**

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## Introduction

Geological conservation (geoconservation) has started to spread globally since three decades ago or so, and it remains actively grown nowadays. The 'philosophy' of this activity, as well as the fundamental principles of the relevant scientific investigations, are summarized in the works of Black (1985), Wimbledon (1996), Prosser et al. (2006), Ruban (2010, 2017), Ruban & Kuo (2010), Henriques et al. (2011), Wimbledon & Smith-Meyer (2012), Erikstad (2013), Gray (2013), Prosser (2013), Brilha (2016), Thomas (2016), Henriques & Brilha (2017), and Reynard & Brilha (2017). Numerous and highly-diverse geological heritage sites (geosites) have been established in many countries. Moreover, geosites and geosite groups have been involved for creation of geoparks. It has been realized that some geosites are more valuable to the society than the others, i.e., different geosites deserve different levels of conservation. Indeed, this does not mean that some (e. g. less valuable) geosites do not require adequate conservation. However, geosite value determines the level (local/municipal, regional/provincial, national, and international) at which geosites should be conserved.

Regarding the afore-mentioned argument, an important question is how to determine the value of the geosites. Although some general criteria can be employed, it appears to be logical to implement intrinsic criteria relevant to the particular type of the geological heritage. For instance, global stratotypes (GSSP) of the stages of the geologic time scale are stratigraphical geosites of the highest value. But what about other geological objects? Each year, new minerals are discovered, and the International Mineralogical Association (IMA) and its Commission on New Minerals, Nomenclature and Classification (IMA CNMNC) coordinate the relevant improvement of mineral nomenclature. Undoubtedly, places where new minerals are discovered appear to be very important to researchers and society as essential and unique manifestations of the mineral diversity. In this brief paper, geosites representing new mineral discoveries (NMD geosites) are considered in regard to their by-definition value and some relevant issues.

## Literature review

Mineralogical type of geological heritage and geosites is recognized formally or informally in the available classifications (e.g., Serrano & Ruiz-Flano 2007; Ruban 2010; Ruban & Kuo 2010; Bradbury 2014; Brilha 2016). Surprisingly, the relevant knowledge is not well conceptualized.

Brocx and Semeniuk (2010) discussed the general questions relevant to geoheritage importance of crystals. Cairncross (2011) addressed the very geoconservation aspects of minerals. Particularly, he suggested

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that mineral rarity, commonly considered as a conservation criterion, can be understood very differently (e.g., abundance rarity, habit rarity, association rarity, etc.). Bradbury (2014) recognized mineral species and assemblages as a theme of the chemical class of natural geodiversity. According to this specialist, the noted theme can be further subdivided into several types, namely silicate, oxide or hydroxide, sulphide or sulphate, other mineral, and mineral assemblage. He also regarded pseudominerals as a separate theme within the same class. Finally, Hatipoglu (2010) gave a representative example of how to recognize and evaluate localities exhibiting one specific mineral (his example is a Turkish geosite with unique gem-quality diaspore).

One 'cavity' in the conceptual understanding of mineralogical geosites is linked to their evaluation in regard to the societal importance. However, there are two (at least) works that contribute to this issue. First, Brocx and Semeniuk (2010) noted that the type locality of Iceland spar in Iceland is a potentially high-ranked geological heritage. Second, Rolfo et al. (2015) emphasized on the outstanding importance of a geosite in the Cottian Alps of Italy that results from earlier the discovery of a new mineral, namely carlosturanite. Generally, it appears to be very sensible to distinguish NMD geosites as a particular category of geosites.

## Method

This study is based on the conceptual analysis of the idea of NMD localities as potential geosites. First, it is demonstrated that these localities should be recognized as geosites and that they require geoconservation activities. Second, the value of NMD geosites is a subject of special analysis. Third, factors limiting the value of NMD geosites have to be taken into account. The IMA list of valid minerals (see http://www.ima-mineralogy.org/Minlist.htm) is used as an essential source of factual information; moreover, some representative examples from Iran and Russia (Fig. 1) are employed for illustration of some issues linked to NMD geosites.


Figure 1. Examples of multi-NMD geosites in northwest Iran (A) and southwest Russia (B).

## Results

Two main arguments for the idea that NMD localities should be recognized as geosites are as follows. First, such localities have played outstanding role in the development of geosciences. Finding new mineral in nature extends our understanding of the Earth's diversity and complexity. Although the number of new minerals discovered per year may reach a few dozens (according to the latest version of the IMA list – see http://www.ima-mineralogy.org/Minlist.htm), each single discovery is really important because the total number of minerals is limited: now it is between 5000–5500 (depending on the permanently changing mineralogical nomenclature). Second, NMD localities provide unique opportunity for further research. Each new mineral reflects particular geological environment and particular geological process, the knowledge of which has to be detalized. Newly-discovered minerals are by definition rare (the most common minerals were discovered already and used by the humankind in the historical or even prehistorical past). If so, new mineral discovery localities are main target objects for in-depth research linked to such rare minerals.

Despite the high importance of NMD geosites for geoscience research, the total number of minerals with the known discovery localities and the number of new minerals discovered per year are both relatively large (according to the latest version of the IMA list – see http://www.ima-mineralogy.org/Minlist.htm). If so, abundance of NMD localities in the world is significant, which in fact decreases uniqueness of each given locality. Therefore, the status of NMD geosite cannot itself indicate its global value. However, the NMD geosites are not so abundant to be just local or regional. Not only small but also large territories do not possess such geosites at all. If so, a logical solution is to accept that the NMD geosites are always valuable on a national scale and require relevant conservation. Although some countries (like Russia or the USA) boast the presence of numerous NMD localities, many others do not. Moreover, discovery of each new mineral often reflects success and potential of a national research system which stimulates national heritage-linked honor in turn.

Two important factors can be regarded as limiting the value of the NMD geosites. First, new minerals are often identified in tiny little grains or aggregates that are visible only in microscope and are rare in host rocks. Second, small size of new mineral grains does not permit geosite visitors to judge of aesthetic properties of a new mineral; indeed, not all minerals have significant aesthetic properties. However, the limiting impact of these factors is partly only apparent because of the established fact that the very novelty of attraction site stimulates interest of its visitors (Kirillova et al. 2014). If geosites are established originally to demonstrate something absolutely new and if they are promoted so, their 'spirit of novelty' will recompense (at least, partly) the small size and aesthetic 'invisibility' of the new minerals.

It should be stressed that by definition, the national value of NMD geosites is the minimal expected. Uniqueness of geosites is not determined by only abundance of displayed features in geological environment. There may be very different kinds of mineral rarity (Cairncross 2011) to increase the geosite value. Being a mineralogical geosite does not mean the mineralogical features only exist there. The presence of some other phenomena (e.g., structural, metamorphic, etc.) enhances the geosite value. Finally, more than one new mineral can be found in some localities, which increases their uniqueness. For instance, three new minerals were reported from the Barika ore deposit in the northwestern part of Iran (Fig. 1A), namely arsenquatrandorite, barikaite, and ferdowsiite (Makovicky et al. 2013; Topa et al. 2013), and this is more than a quarter of all new minerals discovered in Iran (according to the latest version of the IMA list– see http://www.ima-mineralogy.org/Minlist.htm). Undoubtedly, this locality is potentially a NMD geosite, the official status of which is to be assigned according to the nationally-adopted legal procedures. The other example is the upper Chegem caldera in the southwest of Russia (Fig. 1B). The detailed studies of ignimbrites found there have allowed to find several new minerals, including edgrewite, fluorchegemite, and some others (Galuskin et al. 2012; Galuskina et al. 2015). This locality so rich in unique mineralogical formations deserves to be designated as a NMD geosite (the Russian legislation permits assigning the official status of objects of geological heritage). Evidently, the geosites both should not

be valued as national but as global because of the multiple discoveries of the new minerals. It is suggested to distinguish such localities as multi-NMD geosites.

## Discussion

Two significant problems are linked to the NMD geosites. The first problem is permanent changes in the official nomenclature of minerals. Some minerals are excluded as invalid whereas others are re-grouped in classifications. For instance, Pasero et al. (2010) suggested significant revision in the apatite supergroup of minerals. If any earlier-discovered mineral is proven to be invalid or merged with the other mineral, what does this mean for the status and value of the relevant NMD geosite? The strength of this problem can be minimized partly with a delayed geosite recognition approach. First of all, a new mineral should officially be proven by the IMA CNMNC and included into the IMA list. Only then, its NMD locality can be recognized as a geosite. However, changes in the mineralogical nomenclature are possible even later. In such cases, it is not sensible to question the status and value of a given NMD geosite because these has anyway contributed to the development of geoscience research. In stratigraphy, historical stratotypes of systems and stages are still judged as precious sources of information despite that they did not serve previously as global standards. Similarly, it is suggested to distinguish a sub-category of historical NMD geosites (Fig. 2). In the case of only new mineral establishment by evident mistake or fraud, the relevant NMD geosite has to lose its heritage status.

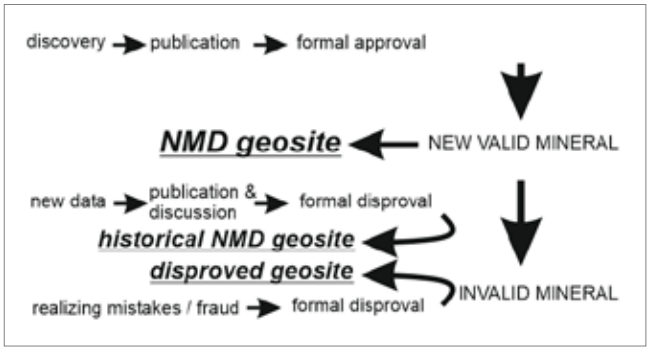


Figure 2. Relevance of NMD geosite designation to new mineral approval/disproval.

The second problem is the possible discovery of a new mineral in any operating mine or quarry. Establishment of NMD geosite in this case faces with restricted access to the site (for instance, because of safety issues or 'simple' unwillingness of mining industry leaders to open their operating site to researchers and tourists), as well as with danger of full extraction of the new mineral together with the ore. Although relevant disputes can be resolved differently depending on each real situation (e.g., Ruban & Kuo 2010), two common issues should be addressed. First, the industrial importance of a given locality and, especially, ore-bearing new minerals increase the public interest in visiting a geosite because this makes the social importance of new mineral discovery more 'evident'. This is a good opportunity for geotourism development, which may be also interesting to some mining companies (for extra income or better image). Second, the very geosite status may help protect natural occurrence of a new mineral from mining-linked destruction or full extraction.

Undoubtedly, recognition of a given NMD geosite is only the first step in its protection from various possible damages due to industrial exploitation, geological landscape modification after mine/quarry closure (restoration), and over-collecting by amateurs and commercial mineral dealers. However, this step is very important because it permits to obtain arguments for finding support for further conservation procedures. After new mineral is formally proven and the NMD geosite is established, a workable documentation should be provided to state to the authorities in order to initiate the de-facto conservation; site demarcation and public information should follow later. As NMD geosites constitute national geoheritage (see above) and, thus, these are relevant to what may be called 'national proud', it is sensible to propose that the government should develop and adopt rules for their adequate conservation. The conclusion about the national (at least) value of NMD geosites made in the present paper indicates on how to fill the gap between the 'Ideal World' of proper geoconservation and 'Real World' of mining industry disinterest and amateur/commercial mineral dealer vandalism.

## Conclusion

Three general conclusions can be made on the basis of the considerations presented in this paper. First, NMD geosites should be distinguished as a particular category of geosites. Second, NMD geosites have, at minimum, the national rank. Third, neither changes in the mineralogical nomenclature, nor new mineral occurrence on actively mined areas must limit establishment of NMD geosites. This paper also stresses the necessity of detailed classification of the mineralogical geoheritage types. For instance, high-value mineral occurrences (if they do not bear new minerals) have to be classified for better description in the future, which will facilitate their subsequent conservation.

Further research should be aimed at examination of the existing geoconservation practices in NMD localities. Moreover, it is of special interest to understand how NMD geosites can be employed for the purposes of geopark creation.

## Conflict of Interest

Authors declare that they have no competing interest

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## References

- Black G.P (1985). Geological conservation and the Nature Conservation Council. Geological Curator 4:217-220.

- Bradbury J (2014). A keyed classification of natural geodiversity for land management and nature conservation purposes. Proceedings of the Geologists' Association 125:329-349.

- Brilha J (2016). Inventory and quantitative assessment of geosites and geodiversity sites: a review. Geoheritage 8:119-134.

- Brocx M & Semeniuk V (2010). The geoheritage significance of crystals. Geology Today 26:216-225.

- Cairncross B (2011). The National Heritage Resource Act (1999): Can legislation protect South Africa's rare geoheritage resources? Resources Policy 36:204-213.

- Erikstad E (2013). Geoheritage and geodiversity management - the questions for tomorrow. Proceedings of the Geologists' Association 124:713-719.

- Galuskin E.V, Lazić B, Armbruster T, Galuskina I.O, Pertsev N.N,

Gazeev V.M, Wlodyka R, Dulski M, Dzierzanowski P, Zadov A.E & Dubrovinsky L.S (2012). Edgrewite Ca9(SiO4)4F2-hydroxyledgrewite Ca9(SiO4)4(OH)2, a new series of calcium humite-group minerals from altered xenoliths in the ignimbrite of Upper Chegem caldera, Northern Caucasus, Kabardino-Balkaria, Russia. American Mineralogist 97:1998-2006.

- Galuskina I.O, Kruger B, Galuskin E.V, Armbruster T, Gazeev V.M, Wlodyka R, Dulski M & Dzierzanowski P (2015). Fluorchegemite, Ca7(SiO4)3F2, a new mineral from the edgrewite-bearing endoskarn zone of an altered xenolith in ignimbrites from upper Chegem Caldera, Northern Caucasus, Kabardino-Balkaria, Russia: Occurrence, crystal structure, and new data on the mineral assemblages. Canadian Mineralogist 53:325-344.

- Gray M (2013). Geodiversity. Valuing and Conserving Abiotic Nature. Chichester: Wiley-Blackwell.

10. Hatipoglu M (2010). Gem-Quality diaspore crystals as an important element of the geoheritage of Turkey. Geoheritage 2:1-13.

- Henriques M.H & Brilha J (2017). UNESCO Global Geoparks: a strategy towards global understanding and sustainability. Episodes 40:349-355.

- Henriques M.H, Pena dos Reis R, Brilha J & Mota T (2011). Geoconservation as an Emerging Geoscience. Geoheritage 3:117-128.

13. Kirillova K, Fu X, Lehto X & Cai L (2014). What makes a destination beautiful? Dimensions of tourist aesthetic judgment. Tourism Management 42:282-293.

- Makovicky E, Topa D, Tajeddin H, Putz H & Zagler G (2013). Ferdowsiite: A new mineral from the Barika ore deposit, Iran. Canadian Mineralogist 51:727-734.

- Pasero M, Kampf A.R, Ferraris C, Pekov I.V, Rakovan J & White T.J (2010). Nomenclature of the apatite supergroup minerals. European Journal of Mineralogy 22:163-179.

- Prosser C.D (2013). Our rich and varied geoconservation portfolio: the foundation for the future. Proceedings of the Geologists' Association 124:568-580.

- Prosser C, Murphy M & Larwood J (2006). Geological conservation: a guide to good practice. Peterborough: English Nature.

- Reynard E & Brilha J (2017). Geoheritage: Assessment, Protection, and Management. Amsterdam: Elsevier.

- Rolfo F, Benna P, Cadoppi P, Castelli D, Favero-Longo S.E., Giardino M, Balestro G, Belluso E, Borghi A, Camara F, Compagnoni R, Ferrando S, Festa A, Forno M.G, Giacometti F, Gianotti F, Groppo C, Lombardo B, Mosca P, Perrone G, Piervittori R, Rebay G & Rossetti P (2015). The Monviso Massif and the Cottian Alps as symbols of the Alpine chain and geological heritage in Piemonte, Italy. Geoheritage 7:65-84.

- Ruban D.A (2010). Quantification of geodiversity and its loss. Proceedings of the Geologists' Association 121:326-333.

- Ruban D.A (2017). Geodiversity as a precious national resource: A note on the role of geoparks. Resources Policy 53:103-108.

- Ruban D.A & Kuo I (2010). Essentials of geological heritage site (geosite) management: a conceptual assessment of interests and conflicts. Natura Nascosta 41:16-31.

- Serrano E & Ruiz-Flano P (2007). Geodiversity. A theoretical and applied concept. Geographica Helvetica 62:140-147.

- Thomas M.F (2016). New keywords in the geosciences - some conceptual and scientific issues. Revista do Instituto Geologico, Sao Paolo 37:1-12.

- Topa D, Makovicky E, Tajedin H, Putz H & Zagler G (2013). Barikaite, Pb10Ag3(Sb8As11)Σ19S40, a new member of the sartorite homologous series. Mineralogical Magazine 77:3039-3046.

- Wimbledon W.A.P (1996). Geosites - a new conservation initiative. Episodes 19:87-88.

- Wimbledon W.A.P & Smith-Meyer S (Eds) (2012). Geoheritage in Europe and its conservation. Oslo: ProGEO.