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Stone Resources



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Guidelines for assessing non- economic values of ornamental stone resources

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Introduction

Throughout Europe, there are large industrial and cultural landscapes originating from the exploitation of **ornamental stone** through history. Such landscapes may contain a range of potential values; as cultural and industrial heritage, as areas for recreation and tourism, as geological heritage, and as areas for future exploitation of stone.

When viewing the quarry landscape as a whole, it is rather obvious that there are numerous values connected to it: economic, historic, morphologic and even aesthetic. The challenge is to view the multiple values in the quarry landscapes as connected. There are numerous historical remains of quarrying that can be appreciated, but there is also a rich architectural heritage that will need maintenance, and thus newly quarried stone. And, perhaps also the continued production and availability of the ornamental stone quarries in itself is a value beyond the employment and wealth of the producers.

These **Guidelines** address the importance of ornamental stone quarry landscapes and raise the awareness of the needs for sustainable management of such sites.

These **Guidelines** will provide scientific and practical methodologies for documentation, characterisation and assessment of ornamental stone resources and quarry landscapes.

These **Guidelines** build on Eurolithos case studies, which will be referred to in the text below. They can all be downloaded from the [Eurolithos web site](#). Some of the case studies also serve as best practice proposals.

These **Guidelines** only focus non-economic values. The ornamental stone industries are fully competent to assess the economic values. However, the society, through local, regional and national governments and other public institutions, often lack capacities for management of such sites balancing conservation (of historical and nature diversity values) with future exploitation of stone that can be crucial for maintaining architectural heritage. Thus, modern development, such as urban growth, infrastructure development, nature preservation and other more or less urgent use of land, tend to destroy important values related to stone extraction, and sterilize future possibilities for exploitation. These **Guidelines** will hopefully provide some tools for authorities that will help in making good land-use decisions.

The Guidelines are composed of three parts, or phases in the process from identification to value assessment:

- Phase 1: Describing the resource and landscape (features and elements of resource, quarries and use)
- Phase 2: Analysing and identifying values
- Phase 3: Assessing non-economic values

Phase 1: Describing the resource and landscape

Geological resource and quarries

A geological resource is where it is, one cannot move it

Quarries and quarry landscapes are physical features created by man by transforming a geological resource to usable building materials through a long or short historical period

Characterising the geological resource: quality variations, spatial distribution and areas for future exploitation.

For geological information the best source is **official Basic Geological Maps** from the different Geological Surveys across Europe. For ornamental stone quality information, there may be reports about the **ornamental stone** potential in parts of the area in public archives, and in national or European databases covering ornamental stone. In addition, local stone industries may have knowledge of resource quality, including key **physical properties** of rocks such as mineral content and physical properties.

Geological expert knowledge is necessary. Ornamental stone resources must be investigated using special knowledge of this type of resource, with particular emphasis on:

- Lithological homogeneity (colour, texture, mineral composition, quality)
- Dimensions (of extractable blocks, of available resource)
- Fractures and fracture systems that can limit the amount of large blocks to be extracted

It is important to identify early which parts of an ornamental stone resources should be safeguarded for future exploitation.

Geological characterization can depend widely depending on the geology involved. Examples on how to do such characterization are shown in four case studies from [Cyprus](#), [Croatia-Slovenia](#), [Croatia](#), [Portugal](#).

Take-away message: knowledge from both the scientific environment (universities and geological surveys) and from the ornamental stone industry is vital to include in such studies.

Characterizing the physical landscape made by quarrying

Quarry landscapes are often composed of multiple layers from more or less continuous activities through long time. Unlike settlements, the different time layers do not form well stratified layers, but rather a complex system of use, re-use and frequent re-location of material culture. Sometimes, a quarry landscape needs to be “re-discovered”. Quarrying leaves identifiable morphological features, such as extraction areas (depressions in the rock) and spoil heaps (depositions in the landscape from quarrying). In many cases, quarrying requires input of other natural resources used in the production process. Defining the quarried resource as the primary, we can collectively name such secondary resources. These may be stone resources for stone tools, wood for smithies, stone for constructions and roads or grinding stones for food production.

For characterizing such landscapes, historical maps and descriptions may be extremely valuable. Within modern technology, LIDAR and aerial/satellite images are useful tools.

How to describe and characterize quarry landscapes from a technical and morphological view have been employed in several of the EuroLithos case studies, i.e. [Cyprus](#), [Croatia](#), [Romania](#) and [Norway](#).

Take-away message: combining local historical knowledge and modern remote sensing methods can reveal much spatial information about quarry landscapes.

History of exploitation

A quarry landscape can be described as layers of history having an impact on the evolution of civilization

Characterizing historical complexes: time depth of quarrying, layers of exploitation in different periods

A review of the quarrying history is important to establish. Some ornamental stone quarry sites have been active for thousands of years, others only for some decades. Clearly, quarry landscapes that have been active since antiquity display a more complex pattern of values than those starting in 1970. The historical evolution can be described as layers in the landscape, forming “historical complexes”, or layers. For simplicity, we propose a division in Pre-Historic, Antiquity, Medieval, Early Modern, Late Modern and Post Industrial as main categories, but there may be local needs deviating from this. The identification of such layers is important for an overall characterisation of a quarry landscape, and for identifying the categories of archaeological significance.

The identification of historical complexes of stone quarrying has been explored in one case study from [Norway](#). Also, the case studies from [Cyprus](#), [Croatia](#) and [Romania](#) outline historical evolution of quarrying.

Take-away message: combined archaeological and historical knowledge is vital for identifying historical complexes. Historical complexes are useful tools for establishing a differentiated approach balancing conservation with future exploitation.

History of use

Stone quarry landscapes may add value to the sites of use, such as cities, monuments and buildings

Identifying the use of the stone through history

The use of ornamental stone in architecture “as it is” makes it unique compared to other geological resources. Thus, the connection between constructions and the resources is a crucial part of the resources’ intrinsic value. From antiquity to the present day, **ornamental stone** has been used as a traditional building material and it gives a common identity to the cultural landscape of all countries. The “value” of a specific ornamental stone resource is thus strongly dependant of the value of the sites where it has been used.

A survey of where a stone resource has been used and for what purpose during different historical periods is important. Is a particular stone important to the local or regional built heritage? Has it been widely

distributed in the world to be a part of architectural heritage of one or more historical periods? Could it even be a significant part of a world heritage site? Is it important, from the consumption and future restoration needs, that the stone is available in the future?

Also, stone resources can be divided into principal commodities reflecting the purpose of use, such as building stone (used for constructing buildings), utilitarian stone (used for everyday utensils) and ornamental stone (“rare” resources used for embellishment of buildings, sculpture and elite/exclusive objects).

The role of stone resources in shaping important architectural heritage has been explored in several case studies, including [Cyprus](#), [Croatia-Slovenia](#), [Norway](#) and [Romania](#). One particular case study addressed the use of digital tools for [registration of stone types](#) in constructions.

Take-away message: get an overview of the use of the stone resource in question: 1) in the light of historical quarry complexes, and 2) geographically (local, regional, national and international).

Production and future resources

If a building needs to be restored, the lack of authentic ornamental stone material may reduce its value

Identifying the future resources and the sites to exploit them

Most European ornamental stone resources have a “past”, meaning they have been used for constructing architectural heritage or being important in cultural landscapes. Buildings deteriorate, and there may be future needs of authentic replacement material. This is perhaps the most outstanding argument for stimulating future production, from a non-economic viewpoint. Thus, there is need for identifying resources for future exploitation and make efforts to secure that this is possible. In some cases, it is important to consider a particular protection of a resource, for restoration of historic buildings and monuments only.

One good example is the platy limestone deposits in [Croatia-Slovenia](#), traditionally used for roofing. If resources are not available, it will not be possible to maintain this particular heritage. Another example is the Iddefjord granite in [Norway](#), used globally within a narrow period in history, but including many listed sites and buildings.

Take-away message: identify the part of the resource for future exploitation that geologically shows best possible fit with historical use, without destroying significant archaeological or historical values.

Take-away message: secure future exploitation sites within the legal framework needed.

Phase 2: Analysing and identifying values

As Quarry landscape

A quarry landscape may reflect our evolution as civilisations, carrying a significant time depth of historic and archaeological evidence

Identifying and evaluating Quarry landscape values

When viewing the quarry landscape as a hole, it is rather obvious that there are numerous values connected to it: economic, historic, morphologic and even aesthetic. The challenge is to view the multiple values in the quarry landscapes as connected. There are numerous historical remains of quarrying that can be appreciated and documented. Moreover, continued production and availability of the ornamental stone in itself is a value beyond the employment and wealth of the producers.

The analytical challenge is to connect layers in the landscape to particular values, being the local ones (archaeological and historical remains) or the more global ones (quarry sites as representations of steps in human or societal evolution).

Key words for the analyses can be:

- “First of”: first traces of quarrying technology/methods on a global, national or regional scale.
- “Representative”: quarrying remains in one or several historical complexes as representation of human development, i.e. Iron Age or industrial revolution.
- “Communicating”: the presence of sites within a quarry landscape easily displaying the process of quarrying and related technology and infrastructure through one or several historical periods.
- “Afterlife”: the actual use or possibility to use quarry sites as outdoor museums, walking paths, cultural arenas or geoheritage sites.

Analysis of archaeological, historical and geological elements that can aid value assessment of quarries and quarry landscapes. Case studies from [Croatia](#) and [Norway](#) provides examples.

Take-away message: analyse the archaeological, historical and geological elements of a quarry landscape, in the light of the intrinsic significance of those elements, alone or collectively.

As Source for historical heritage

The stones of the pyramids come from somewhere. That somewhere is also a valuable site

Identifying values connected to the use of the stone resources

The heritage stones are building and ornamental stones that have special significance in human culture. These have been utilized over long periods of time for a wide range of uses contributing to the historical fabric of the built environment. The identification of values of the built heritage from a particular stone resource will add to the value of the resource itself.

If constructions made from the stone are considered as national or international value, there is a strong argument that the resource also should carry the same importance.

If the stone resource is among the ones designated or nominated as potential [Global Heritage Stone Resources](#), there are strong arguments for assigning global importance to the resource.

Key words:

- “Listed architecture”: the use of a stone in listed architecture, nationally or globally, is significant knowledge regarding value assessment of a quarry landscape.
- “Geographical distribution”: the spatial extent of use of a stone provides arguments for value assessment.
- “World heritage”: the use of a stone resource in a WHS provides important arguments for international value.
- “Local identity”: cultural landscapes often reflect the local stone resources, for buildings, roads, walls and fences.

An example of digital registration tool for the use of stone in constructions has been provided in one case study.

Take-away message: the value of a quarry landscape or resource is reflected in the historical significance of the constructions where the stone is used.

As intangible heritage (crafts)

Mouth to mouth, from generation to generation, stone quarrymen and masons became better

Identifying important crafts for producing stone

Although technology is taking a leading role in ornamental stone production, there are important exceptions: many places, craft is necessary for producing good quality. Nevertheless, crafts related to stone is neglected and the knowledge is being lost.

Eurolithos recommends documentation of crafts related to stone extraction and processing, particularly those relevant to modern production, alongside modern technology. The documentation should provide knowledge along four steps in the production chain:

- “Extraction phase”: crafts related to the extraction of primary blocks from bedrock
- “Block reduction”: crafts related in the process of reducing primary blocks to smaller sizes (making roughouts)
- “Semi-finishing”: crafts related to the first step of finishing to final product (shaping of fit-to-size)
- “Finishing”: crafts related to the final finishing of products (surface treatment)

Ancient crafts work hand-in-hand with modern technology. See examples and proposed methods from case study in [Norway](#). Moreover, the important role of stone-craft schools, example from [Croatia](#).

Take-away message: step-by-step documentation of traditional crafts involved in stone production at present time, if possible also in previous historical periods.

Phase 3: Assessing values

Value assessment of ornamental stone resources and quarry landscapes can be viewed from different angles:

- The value of the historic landscape in itself
- The value of the sites where the stone has been used
- The value of the crafts involved for extracting the stones
- The value of bordering qualities in the landscapes, such as geoheritage
- The value of future resource exploitation

An attempt to assess values of a quarry landscape from the perspectives written here, was carried out in a [Norwegian case study](#).

The historic landscape

Values are related to archaeology and historical sources. They may be connected to extraction methods, where for example the first known observation of a technology may provide values of global importance.

The connected landscapes (use of stone)

Values are extracted from 1) the importance of the stone by distribution (international/national/regional/local), 2) the use of the stone in listed buildings and monuments and 3) the influence of the stone on local/regional cultural landscapes.

The crafted landscape

Values may be drawn from 1) the longevity of crafts employed in extracting and processing the stone, 2) the uniqueness in such crafts compared globally, 3) the degree of modern uses of traditional crafts in production.

Bordering qualities

Stone quarry landscapes may display other features of value, such as biodiversity created by historic quarrying, or by exposing sites of geoh heritage. In many cases, biodiversity and geoh heritage sites have been assessed and valorised within quarry landscapes, and a calibration of combined value is needed.

Geoh heritage values has been addressed in the [Cyprus case study](#), and a [Portuguese study](#) explored how stone quarrying can take place in a Natura 2000 area. There is always a possibility when interests work together.

Take-away message: the intrinsic value of a quarry/quarry landscape is a function of several lines of analyses. The highest value obtained should be the one carrying implications for final value assessment.

Concluding remarks

When viewing the **ancient and today quarries landscapes** as a hole, it has become clear that one of the key problems with quarry landscapes is not the lack of such sites but how to point at the historical importance of them and thus make selection of sites and parts of sites for protection, or for future exploitation.

Also, it is rather obvious that there are numerous values connected to it: **economic, historic, heritage use and even aesthetic**. The challenge is to view the multiple values in the quarry landscapes as connected.

There are numerous historical remains of quarrying that can be appreciated, but there is also a rich architectural heritage that will need maintenance, and thus newly quarried stone.

The use and valorisation of the ornamental stone resources, along with other factors, in particular the natural heritage, can be an important element of economic improvement for the region, contributing to a better acceptance of the extractive industry. This way, the industry arises not only as a factor of economic development but, corresponding to the current expectations of environmental and social welfare preservation, it also emerges as a factor of identity and self-esteem for the local population.

Aiming to foster the environmental performance of the quarrying activity through the increase of its efficiency and reduction of its impacts, key aspects that were taken into account were: The definition of strategies for the mining sector's sustainable development; The creation of geological and environmental background information regarding the integrated planning of the quarrying areas; The qualitative and quantitative characterization of the hydrogeological conditions and its monitoring, aiming at assessing its vulnerability regarding the extractive industry; The inventory, characterization, and a management proposal of the vast geological and mining heritage encompassing the ornamental stones, aiming at their joint valorisation as identity marks of the region.