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MINING HERITAGE: CHARACTERISTICS. VALUE. POTENTIAL. ROMANIAN TRADITION AND EUROPEAN EXPERIENCE

Abstract. The paper proposes a comparative analysis between different categories of industrial heritage dedicated to mining, concluding on some invariants of these artifacts, which by definition link the underground to the aboveground. Depending on the raw material extracted, mines present specific characteristics, which lead to a specific pattern for each type of extraction. The paper is equally based on the study of international bibliography regarding mining heritage and on personal studies of the author (in-site research and conducted projects). The study presents both unique mining sites from Romania, currently abandoned (gold galleries and mine shafts from the Bucium commune in Apuseni, the Anina coal mine in Banatul Montan), as well as extractions that have benefited from remarkable interventions for the purpose of integration into a tourist circuit (Turda salt pan). The paper also collects strategies for the adaptive re-use of mining sites, based on international examples of good practice, such as mining sites and geoparks in Northern Spain (for example Las Médulas – gold mining), Italy (Sardinia – metal mineral extraction), Belgium (Genk region – former coal mine transformed into a cultural center). These cases are fundamentally similar to Romanian mining sites. The creation of a common database may become a valuable element for the preservation of these sites and their integration into the life of communities and landscape.

Keywords: industrial heritage, extraction, geopark, UNESCO mining site, good practice example

1. Introduction. Argument for preserving mining heritage

The paradigm of the information age has generated the imperceptible replacement of the model of society based on resource exploitation, with

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digital development and the exponential expansion of communication. Industrial artifacts have become vestiges of the past, constituting the multidisciplinary field of industrial archaeology, which aims to preserve and, eventually, revitalize complex industrial sites (buildings, infrastructure, equipment), as well as the knowledge brought by the evolution of technological processes. The mining industry is special as object of study for industrial archaeology, involving direct interaction with natural resources, in the territory, which requires specific approaches and equipment, but also the building of strong, distinctive communities.

Stefan Berger identifies no less than eleven features making mining heritage worth to be preserved. The first three refer to the value of mining archaeology and “how the extraction of raw materials from the earth has been an activity shaping human existence for tens of thousands of years” (Berger 2020: 2-4), to the millenary technological progress obtained through mining industry and to the role brought by the science of mining in the organization of work processes. The author identifies key dates, such as the Xth century, when the blast furnace was invented under the Sung dynasty in China and 1556, the date of the iconic early publication dedicated to mining *De Rerum Metallica* by Georg Agricola. The next four arguments refer to community: mining as generator of large scale migration (as in the case of the discovery of the first major diamond in South Africa, the ‘Eureka Diamond’ in 1866), as producer of «particular forms of working-class culture» (such as happened in 1900, “when Cornish miners in Mexico played, for the first time in Mexico, a game of football”), as a subject of gender (women and children were generally prohibited to work in mines, as happened in 1933 in Japan) and as the need to remember the saddest events related to mining: underground accidents, etc. which happened all over the world. The next three analyzed items are: the importance of the state in the administration of mining industry, the visual history of mining, which became a study field in itself and the consequences of mining exploitation on the environment (and remediation of former extraction sites), an important approach to be analyzed for all types of mining industries. The last approach (11th) refers to the persistence of mining sites in the collective memory, even long after the actual mining activity has ceased. Mining sites are an integral part of the spirit of place and induce the transformation of the territory.

Basing on this Berger's general perspective, the paper moves to a specific view for the situation of mining sites in Romania. The questions guiding the research are: can we talk about a series of invariants in the analysis of mining industries? Do these invariants give us solutions for the future preservation of mining sites? Can we apply in the intervention strategies a series of rules determined by the characteristics of the extracted material?

2. Methodology

The work follows an approach from general to particular, correlating the exploitation of basic underground resources with the evolution of settlements in the territory and with the millenary history and culture of our continent. Three extractive branches are particularized (coal, gold and salt mining), all of which fundamentally generate a way of life and a local culture. The general documentation was carried out by studying reference publications, both books and periodicals, mentioned in the bibliography. The field applied in Romania comes naturally in the continuity of the European situation. The information is extracted both from reference publications, and from the author's personal experience, materialized both through her own research and *in situ* observations, by visiting various mining sites in the country and abroad, by coordinating projects etc. The intention is to provide an overview of the characteristics and values of the mining heritage, as well as the possibilities for its preservation and revitalization in the context of the current community.

3. Results

3.1. Mining in Romania: from underground resources to cultural landscape and location in the territory

It is archaeologically attested that mining activity on the territory of present Romania dates back to Antiquity, before the period of ancient Dacia and its conquest by the Roman Empire (106 AC) (Wollmann 2007: 7). Important

evidence of early mining activity has been identified at several sites in present-day Romania: Căraciu (Hunedoara) for gold (ca. 3800–3700 BC), Corna (Severin) for iron (3000–2600 BC), and the Pianului Valley for copper (3500–2200 BC). During this period, mining developed in a particularly distinctive way across the Romanian territory, especially in relation to gold extraction. The abundance of gold in Dacia was undoubtedly one of the main reasons for the Roman conquest of the region. Even if not all the gold brought by Trajan from Dacia came from local deposits, historical data still highlight the significant development of gold mining in the region. The Roman period introduced the most advanced techniques of the time, marking a true flourishing of the mining industry. Over the 166 years of Roman administration, it is estimated that approximately 500 tons of gold and 950 tons of silver were extracted from the province (Kovacs et al. 2018 41-50).

Mining in Transylvania developed continuously during the Habsburg Empire, the resources here being considered strategic. After the Great Union of 1918, the Romanian state continued investments in this rich region (Rusu Abrudeanu 1933: 292, 303). Technical progress was quickly incorporated to the extraction process. In Transylvania and Maramureș, steam engines and their early prototypes were employed in the mining and metallurgical industries during the nineteenth century, particularly in the areas of Zlatna and Baia Mare.

After World War II, a key moment was the nationalization of the means of production in 1948. During the communist period, the country's industrialization continued, especially in the 1980s, when the industrial infrastructure grew inversely proportional to the efficiency of production. The reference point for evaluating the patrimony is the year 1984, a period marked by peak development in the extractive industry. This moment reflects the significant accumulation of useful mineral resources, with substantial reserves officially approved at that time. For the assessment of the current mining patrimony, the starting point was the most comprehensive and widely recommended database on the subject, titled "Harta Substanțelor Minerale Utile" (Map of Useful Mineral Resources), 2nd edition, published by the Geological Institute of Romania in 1984. Three main categories of accumulations were considered: metallic, non-metallic, and coal (Kovacs et al. 2018: 41-50).

3.2. Coal mining in Europe and in Romania.

Characteristics, problems, opportunities

Coal holds a distinctive place in European energy history, as it was the only fuel to develop a dynamic continental market well before supplies became globalized. In this sense, European coal transnationalism preceded coal colonialism. Early on, Britain became a major exporter, supplying coal to most European countries. British coal powered industrial steam engines, locomotives, and urban gas works across a wide range of cities, from St. Petersburg and Stockholm to Milan and Athens (Bluma et al. 2023: 7).

Subsequently, Germany also rose as an important coal exporter. After gaining independence following the First World War, Poland entered the market as well, further increasing the complexity of intra-European coal trade. In several regions, including the Netherlands and the port cities of northern Germany, strong competition developed between British and Ruhr coal. European coal was so plentiful and inexpensive that, prior to 1914, imports from outside the continent could not compete. As a result, European coal transnationalism prevailed. German coal was desperately needed on the European market after WWII (especially in France), which played a key role in motivating the creation of the European Coal and Steel Community (ECSC) in 1950, which not only reinforced European coal transnationalism but also laid the groundwork for broader political and economic integration in (West) Europe.

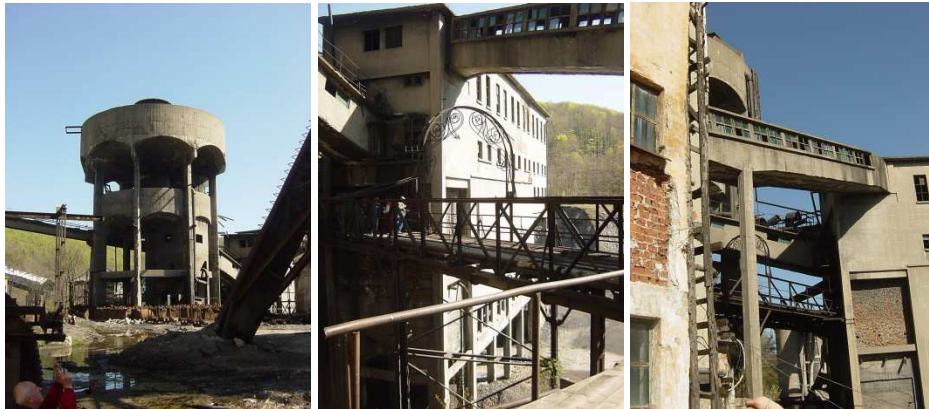
However, by 1956, German coal production had reached its peak, and, unsurprisingly, the cost of intra-European coal began to rise steadily in the following decades. At the same time, transportation costs dropped sharply due to the advent of oil-powered ships, while evolving institutional conditions in the global economy encouraged trade. As a result, coal from distant regions (such as Colombia, South Africa, Australia and the United States) began to compete effectively in European markets (Högselius in Bluma et al. 2023: 38-39).

On the present territory of Romania, in the 19th century, especially in the Western part of the country, coal began to be intensively exploited, together with other mineral resources. At the beginning of the 20th century, Romania had significant coal reserves (even if not the best quality), mainly in the Hunedoara Basin and the Jiu Valley. After World War II, the Romanian

mining sector experienced a period of massive development, accentuated by the economic policies of the communist period.

In Europe coal production was dominated by Britain and Germany, which exported massively to other European countries. Before 1914, European coal was so abundant and cheap that resources from other parts of the world could not compete.

Romania was not a major exporter at the European level, but domestic coal was essential for the development of local industry and electricity. After 1948, with the establishment of the communist regime, coal mining in Romania went through a period of intense industrialization and centralized planning. Coal became the main energy resource, essential for the functioning of heavy industry, the production of electrical and thermal energy, as well as for the metallurgical and chemical industries. The mines in Valea Jiului, Petroșani, Petrila, Lupeni, Vulcan and Anina (Figs. 1, 2, 3) were expanding.



*Figures 1,2,3. The site of the coal mine from Anina, Banatul Montan, Romania, closed in 2006
(Source: photo by the author, 2007)*

However, rapid wear of infrastructure and intensive mining leading to depletion of some deposits. Difficult and dangerous working conditions for miners led several time to tragic accidents, several methan explosions being documented in Valea Jiului between 1960-1980 (Jujan& Svoboda., 2009: 146-48). In the 1990s–2000s, the Romanian government, under pressure from international bodies and due to the energy deficit,

began closing unprofitable mines and gradually reducing the mining workforce. Accession to the EU (2007) brought strict environmental regulations, and polluting coal became less competitive compared to other energy sources. Mine closures continued progressively in the 2010s–2020s, especially in the Jiu Valley, in Petroșani, Petrila and Lupeni.

Today Europe faces the paradigm of “decarbonisation”, in the attempt to protect our environment. “Deep decarbonisation,” or the substantial reduction of carbon dioxide emissions, primarily entails a fundamental transformation of energy systems, expected to take place by the middle of the 21st century. As early as 1990, the German Bundestag’s Enquete Commission on “Protection of Man and the Environment” advocated for an 80 percent reduction in Germany’s greenhouse gas emissions by 2050. In contrast, many other economies continue to depend on coal as an energy source, where it remains a key component of the global energy supply (Bluma et al. 2023: 1).

3.3. Gold Sites in Romania. The complexity of the heritage generated by gold mining

“Just as for thousands of years humanity has been searching for the Fountain of Youth – this eternal dream of people, in order to extract from it a new sap at the expense of a body tired of diseases and numerous wounds – so for thousands of years the same humanity has been working, fighting and toiling to accumulate as much gold as possible, which, having been consecrated since ancient times as the most suitable element of exchange, thanks to its inalterability, uniformity and small volume in relation to its weight, can give man the possibility of satisfying the various needs and desires of life.” (Rusu Abrudeanu 1933: 7). This poetic quotation is extremely significant for the power of gold and the way it changed settlements and communities.

In Europe, native gold has been known since ancient times, initially discovered in Transylvania and later in Salzburg and Carinthia but also in the western part of the continent. An iconic golden exploitation is the one from Las Médulas, El Bierzo region, Spain, dating from Roman times, that is preserved today as a national park (Figs. 4,5).



Figures 4,5. The Roman gold exploitation from Las Medulas, El Bierzo, Spain
(Source: photos by the author, 2013)

Significant amounts of gold can also be found in river sediments. In Europe, rivers such as the Elbe, Danube, Inn, and Rhine (especially the stretch between Basel and Mainz) carry gold, as do Transylvanian rivers like the Mureș, Olt, and Arieș, along with many larger and smaller valleys in the Apuseni Mountains (Rusu Abrudeanu 1933: 7-12).

The Apuseni Mountains, located in present-day Romania, represent the oldest gold-bearing region of Dacia. This area forms a roughly trapezoidal zone with corners at Săcărâmbu (Hunedoara County), Zlatna-Roșia Montană-Abrud (Alba County), and Ofenbaia or Baia de Arieș (Turda County). Gold deposits in this region are primarily associated with secondary and tertiary eruptive rocks, which occur here in abundant quantities (Rusu Abrudeanu 1933: 42). Within the territory of Bucium commune, clear evidence of Roman mining activity can be seen on Frasinul Mountain, which separates the villages of Bucium-Șeasa and Bucium-Muntari, rising prominently near Detunata and the Corabia-Vulcoiu-Boteș massif, east of Bucium-Izbita and south of Bucium-Poeni. The Frasinul workings, after those at Cetatea Mare and Cetatea Mică in the Roșia Montană massif, represent some of the most impressive and extensive underground Roman mining operations (Rusu Abrudeanu 1933: 121-122). The miners' corporation (Collegium Aurorarium) was headquartered in Zlatna.

According to an old local mining law, characterized by small perimeters, in the beginning of the XXth century there were still hundreds of such

exploitations, tiny and primitive, grinding the ore, which they transported downhill on the backs of horses, with the help of stamps that have remained in use (Fig. 7), almost unchanged, since Roman times (Rusu Abrudeanu 1933: 239). On the other hand, mine owners fought to stimulate the insertion of local capital and mining associations were actively involved in the social and cultural life of miners.

Roșia Montană is the most famous mining site of the Apuseni mountains, still preserving a significant quantity of gold and providing great interest for its value as cultural landscape, industrial heritage dating from Antiquity, specific architectural settlement and natural area. Trapezoidal underground galleries are still well preserved today, with a length of 15 km. (Merciu, F.C.&all, 2015: 5-19)

A project of aggressive exploitation by surface mining that producing devastating effects on the environment has been stopped due to civic protests several years ago, now the site of Roșia Montană having achieved the recognition as an UNESCO site (2021). In the last 20 years, several summer schools have been organized in the area of Roșia Montană, studying the complex layers of patrimony of the region.

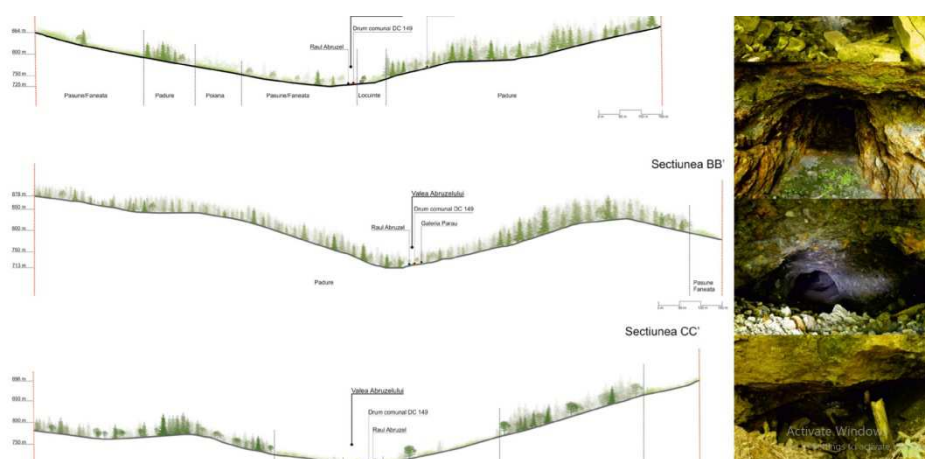


Figure 6. Study of gold mine mouths in the Abruzel valley, Bucium
(Source: study realized at Summer University Bucium, 2015, guided by author)



Figure 7. Domestic gold ore mill (*șteamp*), XIXth century, Bucium, Alba county, Romania
(Source: photo by the author, 2019)



Figure 8. Traditional objects used in mining – *corfă*, basket for carrying ore pieces, *lămpaș* (miner's lamp)
(Source: photo by the author, 2019)

The commune of Bucium, in the neighbourhood of Roșia Montană, is an authentic place in the Apuseni Mountains, privileged for preserving the many layers of mining traditions practiced for millennia. Numerous annual events, called "Summer Universities", have been held in Bucium over the years, since 2009. Within this occasions, numerous components of the local heritage have been inventoried, such as mine shafts, mining galleries (Fig. 6) and interventions in the landscape, to households, gold mills (Fig. 7), furniture, household items (Fig.8), etc. (Dușoiu 2020: 89-92).

3.4. Salt resources. Romanian salt pans

Salt mining in Romania dates back to prehistoric times. Archaeological evidence shows that salt was mined as early as the Neolithic period. During the Dacian and then Roman times, salt mining intensified, as salt was a strategic resource. In the Middle Ages, salt mines were controlled by rulers or royal authorities and represented an important source of income for the state (Albinetz et al. 2018: 5-8). It is known that the term "salary" comes from salt mines, where payment was given in kind. In Transylvania, the mines were administered by the royal authorities of the Kingdom of Hungary, and later by the Habsburg Empire (Albinetz et al. 2018: 5-8). In modern times, mining techniques have developed, and many salt mines have become industrial operations. Today, most are administered by the state-owned company Salrom, and some of them have also been transformed into important tourist and spa sites.

The main salt mines in Romania are located all over the country, the most important exploitations being: Turda Salt Mine – one of the most famous ones, dating from Antiquity, today an important tourist attraction, due to its renovation and architectural setting dating from 2010, Praid Salt Mine – the largest salt mine in Romania and one of the largest in Europe (unfortunately flooded recently following a natural disaster in 2025), Slănic Prahova Salt Mine – known for the Unirea Salt Mine, one of the largest salt mines in Europe, Târgu Ocna Salt Mine – important mine and treatment place for respiratory diseases, Ocna Dej Salt Mine – traditional mine in Transylvania and Ocnele Mari Salt Mine – old mine in the Getic Subcarpathian area.

3.5. Preservation of mining sites. Good practice examples

The mining industry is widely regarded as an important sector; however, the remnants of mining activities – especially those from the industrial era – have long been viewed as unattractive features of the landscape. As a result, efforts have more often focused on removing traces of mining rather than preserving and repurposing them. Nevertheless, these remains frequently embody significant historical and cultural values, reflecting

the technological achievements of past generations as well as the lives, traditions, customs, and beliefs of mining communities. When considered as heritage, however, they present clear contradictions, particularly regarding the definition of heritage values, as well as the economic and environmental risks associated with their use.

Cultural tourism that centers on mining heritage – along with the presentation, preservation, and interpretation of its values and meanings for visitors – is often referred to as mining tourism and can also be viewed as a form of geotourism. However, geotourism differs in that it primarily emphasizes geological and geomorphological features, whereas mining tourism focuses more on the physical remains of mining activities and related heritage. It seems that visitors are mainly attracted by opportunities to take guided tours through underground passages in former or still operational mines, as well as to explore their technical equipment and surface structures. This perspective, however, overlooks many important elements – especially intangible aspects that are also part of mining heritage – making such a definition incomplete. (Jelen 2018: 93-105)

Bianca Radu observed particular features of mining heritage, such as mono-industrial character, location in remote areas and overdependence of the mining company. "Mining communities need to develop projects that strengthen the solidarity among people who originate from different regions. Restructuring strategies should be planned well in advance, even during the profitable stage of the mining activity, to minimize the social impact of mine closure and to prevent migration of young people out of the community." (Radu, 2018: 39-51).

Europe has tried to preserve the memory of its mining sites, if possible, considering the integrality of their values (from connection and relation with landscape to underground systems of galleries, shafts etc. to different types of industrial constructions and infrastructures and to annex buildings and facilities (houses for workers, cultural buildings etc.). Mining regions from Germany, Belgium, France, Scandinavian countries, Spain or Italy have found a new perspective for their future by their transformation into geomineral parks or natural parks, into cultural centers, creative hubs or museums. Some outstanding examples of European mining parks are: the Sardinian Historical and Environmental Geomineral Park (UNESCO site), a huge territory that groups together and identifies eight

areas of Sardinia, Italy, covering a total of 3,500 km² (belonging to 81 different municipalities), presenting a mining tradition coming from the Roman Empire, the natural Park from Las Médulas (UNESCO site), Ponferrada, El Bierzo, Spain (Figs. 4,5), the Cabárceno Natural Park, from Penagos, Santander, Spain, where the mining geopark is combined with a zoological garden, Parque Miniero del Rio Tinto, Huelva, Andalusia, Spain or Geoparkea – the Basque Coast Geopark, situated in Bizcaya, comprising the municipalities of Mutriku, Deba and Zumaya.

Other successful conversions of mining sites, conceived following the concept of adaptive re-use, are the cultural center, creative hub and design academy C-mine, organized in a former coal mine in Genk, Belgium (Figs. 9, 10, 11) and the Museum of Energy from Ponferrada, Spain (Fábrica de la Luz), an exemplary approach showing all the aspects concerning energy : extraction of raw materials, transport, production, distribution, use, maintenance, workers community etc. The arrangement of the Energy Museum in Ponferrada in a former thermal power plant includes media testimonies through which former workers, engineers, administrators, but also former operating equipment are present in the current exhibition space (figs. 12, 13).



*Figures 9,10,11. C-mine Creative Hub, conversion of a former coal mine Genk, Belgium
(Source: photos by the author, 2015)*

Such rehabilitations allow us to draw comparisons of the re-used industrial buildings with sites from other country, still in an abandoned shape (Figs. 14,15,16,17). Such associations are often amazing, showing the extraordinary qualities of unity and coherence that mining sites have worldwide. We discover that industrial heritage (and mining in particular) have developed an own language and a proper message, recognizable everywhere.



Figures 12,13. The Museum of Energy (Fábrica de la Luz), Ponferrada, Spain, in a former central thermal plant, exterior views (Source: photos by the author, 2013)



Figures 14,15. A comparison between the interior space of Fábrica de la Luz (Ponferrada, Spain) and the electric plant of the Anina mines ensemble (Source: photos by the author, 2013/2007)



Figures 16,17. A comparison between the control board of Fábrica de la Luz (Ponferrada, Spain), former plant and control board of the electric plant of the Anina mines ensemble (Source: photos by the author, 2013/2007)

In conclusion, the numerous ingenious architectural and landscape intervention solutions show the potential of former mining sites to regenerate, following and applying the concept of adaptive re-use. In all successful interventions, the tradition and evolution of the community, which is actively involved in the functioning of the new ensemble, are taken into account.

4. Conclusions. Romanian mining heritage – where to?

During a period of more than 15 years dedicated to guiding diploma projects at the Faculty of Architecture and the Faculty of Interior Architecture of UAUIM Bucharest, I had the opportunity to observe the special interest of students in abandoned industrial sites, whose importance in defining the urban fabric and its development, as well as whose regeneration potential they intuitively perceive. In the vast collection of proposals for the regeneration of urban sites throughout Romania, a significant part was dedicated to mining sites: interventions on the Anina mines complex, the Moreni oil platform, the Moinești oil area (Bacau), interventions in the gold-bearing area of the Apuseni Mountains (Roșia Montana, Bucium) etc.

Probably, at this moment the range of reference models for interventions in mining sites on the territory of Romania is limited, the salt mines being perhaps the most attractive spaces of this type from a tourist point of view. Turda Salt Mine, designed around the 2010s by a team of young architects, remains emblematic for the spectacular scenography that can be achieved in the underground space.

We can now turn back to the initial questions dropped by this research: can we talk about a series of invariants in the analysis of mining industries? Definitely, considering the strong personality and identity of this entities of aboveground and underground landscape.

As for the second initial question: do these invariants give us solutions for the future preservation of mining sites?, we should consider the variety of approaches and intervention strategies that we can be found at European level. This multitude of solutions is applicable to sites in Romania: from mining geoparks to thematic museums or conversions that propose a diversity of activities that can highlight industrial spaces

with a strong identity, underground or above ground. Creativity has no limits in choosing the new functions: concerts are organized underground within the Mining Geopark in Sardinia, Italy, where musical events benefit from the special acoustics of the millenary excavated spaces.

An answer to our third research question is needed as well: can we apply in the intervention strategies a series of rules determined by the characteristics of the extracted material? We may consider here technical aspects, in terms of preservation, consolidation and accessibility, but also tradition and communities, who have been constructing their life for centuries around the resources extracted

Dr. Luciano Otelli, director of the Geological-Mining Park of Sardinia, was an engineer with a vast experience in the extraction process of mining and a deep connoisseur of the miner's community. During the 5th International Workshop on Industrial Archaeology held in the Mountain Banat region, Romania, 2007, after presenting the outstanding good practice example generated by the Sardinian experience, he finished his presentation, therefore, with a sad thought:

“Closing a mine is a tragedy because it means the end of an entire culture, a way of life, a way of being.”

We have to keep in mind the responsibility to preserve somehow this culture, way of life and way of being and integrate them into our present reality.

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