Valorisation of extractive sites through a didactic and touristic network: the case study of Piedmont

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Short note

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ABSTRACT

The aim of the work presented in this short note is to collect and complete an existing dataset of Piedmont mining heritage and suggest a network of potential sites to be valorised in terms of touristic and didactic uses.
Firstly, all known abandoned quarry and mine sites were analysed and represented using GIS. Based on this data, several criteria were taken into account to select pilot sites of interest to create the touristic network: the representativeness of the exploited materials in social and economic traditions of Piedmont, the accessibility, the attractiveness and the stability of the area. In order to deep into stability evaluation, quantitative (Bieniawsky) and qualitative description of the rock mass representing the ore body were carried out (particularly in case of underground sites).
Based on those criteria, some pilot site was selected suggesting itineraries network for a touristic purposes. Finally, a standard form for each selected pilot site was realised.

KEY-WORDS: industrial tourism, Regione Piemonte, mining heritage.

INTRODUCTION

Mining and quarries sites have played a primary role in the evolution of industry and in social, economic and cultural transformation, and are therefore to be regarded as a historical memory of the past. These sites were considered a source of sustenance for many families and a reason of development for the territory. Industrial and heritage tourism starts from this concept and aims to valorise abandoned exploited sites.

In considering these sites, attention is not only focused on the extractive site, but include everything related to the communities that gravitated around it.

Industrial tourism, in mining or quarry sites, offers visitors the opportunity to see and learn about the scientific, economic and social significance of the site. Particular attention has to be payed about mining tools, devices and technologies, minerals and rocks, geological history, technologies applied in the exploitation and processing of the natural resources, and social paths and transformations of the landscape (Rybár and Hvizdák, 2010). The main challenge is to make these sites usable and appealing, assuring accessibility and mitigating the risk connected to the frequent low stability of the site due to abandoned condition and degradation.

STUDY AREA

Geographical and geological setting

The study area covers the entire Piedmont region. The geographical position and geodynamic context of the region allowed, indeed, the development of a prosperous mining activity over the centuries. The region is directly connected to Europe via the Alps and was the site of raw materials trade from the Roman period up to the Savoy domination. In addition, Piedmont region has a complex geological setting and, for this reason, it represents a source of raw materials related to different lithologies and uses.

Thanks to the geodynamic evolution that involved portions of the continental crust and oceanic zones, many mineralisations have been formed and it is now possible to detect a high geodiversity in terms of both structures and lithologies. The lithologies from the Paleozoic to the Quaternary period came from portions of continental and oceanic crust, which include volcanic and plutonic

rocks, metamorphic rocks as well as sedimentary rocks. Starting with rocks outcropping along the Alpine arc, we find rocks belonging to different sector of the Alps:

- external part of the chain, with polymetamorphic basement rocks of Variscan age, with Carboniferous and Permian sedimentary succession and intrusive bodies, subsequently covered by Mesozoic and Cenozoic sedimentary deposit.
- internal part of the chain, with continental crustal rocks and portions of Miocene mantle of Pre-Varisic to Varisic age, with juxtaposed Permian volcanoclastic deposits and later Mesozoic sedimentary cover.
- central part of the chain, with rocks belonging to both continental crust portions and oceanic units of the Ligurian-Piedmontse domain.

In lowland and hill sector, in addition to outcropping units of continental and oceanic crust, we find Cenozoic and Quaternary synorogenic basins, closely connected with many deposits of quarried raw materials.

The geodynamic evolution of the region is also responsible for a morphological heterogeneity, favoring different type of quarries and various methods of exploitation, accordingly to the material to be exploited (Piana et al., 2017).

Principal materials exploited

According to the national regulation (Royal Law n.1443/1927), exploitation in Piedmont develops in quarry and mine sites depending on the geomaterials, respectively considered of first or second categories. .

In Piedmont, the main exploited materials of first category (mine) are:

- mineral and thermal waters, widespread throughout the region (ARPA Piemonte, n.d.);
- asbestos minerals in areas where serpentinised or amphibolised metamorphic rocks are present (Piana et al., 2022);
- gold, in the northern portion of the region;
- talc, concentrated in the Chisone and Germanasca valleys (Miniere d'Italia, n.d.);
- iron, concentrated in mineralisations linked to the presence of Oligocene plutons in the provinces of Biella and Turin (Costa et al., 2017);
- marl for concrete, in area of the Monferrato hills (Barale et al., 2020);
- kaolin and refractory earths, disseminated in central-northern areas of the region (Miniere d'Italia, n.d.);
- nickel, confined to northern areas of Piedmont;
- olivine, exploited in the peridotitic bodies of Finero and Baldissero.

The main materials of second category (exploited in quarries) in Piedmont include in Piedmont:

- industrial minerals (quartz, gypsum, clay, limestone for concrete, …) widespread throughout all Piedmont territory;
- ornamental stones, mainly quarried in the provinces of Verbano-Cusio-Ossola, Novara and Cuneo;
- aggregates, mainly quarried in the plan area of the Piedmont (fluvial and fluvio-glacial deposits) or, locally, in mountain sites, (carbonate rock mass or gravitative or alluvial fan deposits) (DPAE, 2004).

MATERIALS AND METHODS

Database creation

The first step of the research was the collection of data about abandoned mines and quarries sites to be organized in a proper database. The data comes from:

- Smart Ground Project, that was developed in the Horizon 2020 program, dealing with the high request of specific raw materials. The project aim to propose a strategy for the recovery of this elements and the recycling of waste materials by mapping old and recent mining sites and dumps (Dino et al., 2017);
- ReMi network, consisting in a data base of abandoned mining areas in Italy for their valorisation. It was created by ISPRA with data collected from 1870 to 2006 (AA.VV., 2006);
- Cadastre of artificial cavities, which contains scientific and historical information on artificial cavities in Piedmont (AA.VV., 2002)
- Census of quarries of Piedmont, including hystorical quarries exploiting materials (ornamental stones), with historical, architectural and artistic interest (Barale et al., 2020).

The collected data were integrated in a unique database with specific attribute useful to the next step of the reasearch (Municipality, Region, Country, Local name code, East UTM (WGS84), North UTM (WGS84), Zone, Landfill typology, Relevant elements or minerals contained, Ore dressing residues, Mine status, Year of mine closure, Last mine operating company, Last period of mine exploitation, Last period of landfilling, Landfill volume, Landfill mass, Analyses available, Source of the analyses, Environmental risk, Mineral deposit type, Main commodity, Ore mineralogy, Host rock, Mining activity type, Processing activity type, Presence of mine dumps environmental rehabilitation).

Chose of pilot sites

Starting from the database created, a number of pilot sites were selected in reason of their attractiveness for tourism purposes. The criteria of the choise are: historical, cultural and scientific interest, accessibility, location, lithology and ore body features, stability and geological hazards. In order to evaluate the selected criteria, different source of data were used: aerial pictures, geological map (1:250000 scale), geomorphological map, urbanistic territorial planning and bibliographic sources.

Characterization of pilot sites

Based on the specific features and criticism of selected pilot sites, additional investigations were carried out with a primary

focus on the underground environment were the rock mass was geomechanically analised in order to verify the existence of potential kinematisms.

Primarly, discontinuities, water flow and collapses where mapped and classified in the selected sites.

Secondly, geomechanical surveying were performed using the Rock Mass Rating method of Bieniawski (Bieniawski, 1973), finally the Test of Markland was applied about potential kinematic mechanism definition.

In underground environment it was also created a 3D model indicating the more instable sectors.

RESULTS

According to the selected criteria and the described methodology (Fig. 1), eight sites were selected for further valorisation study.

There are four mine and four quarry sites: the two iron mines of Traversella and Brosso, the gold mine of Pestarena, the uranium mine of Peveragno, the gypsum quarry of Murisengo and the quarries of Ornavasso, Cesana and Frabosa Soprana where white, green and black marble, respectively, were exploited (Fig. 2).

They are distributed in the territory of Piedmont and represent an examples of different mining context, considering the type of material, the excavation techniques and the potential recovery.

Each site has an easy access, through short walks and, in some cases, directly by car. For each site a specific card was produced, describing geological and geomorphological setting, accessibility of the site and peculiarities of extractive site, from mineralogical setting to hystorical framework and mining details. Furthermore, in all the sites a thematic itinerary was proposed considering the potentialities of the territory.

The most relevant case studies are those of the Traversella mine, in the province of Turin, and the Murisegno quarry, in the province of Alessandria.

The Traversella mine exploited magnetite skarn-type mineralisations, related to the Traversella Oligocene Pluton formation (Nimis, 2014; Ridley, 2013). Iron has been exploited since the Roman times up to the mid-20th century, developping 70 km of tunnels, arranged in five levels.

A tourist circuit is already partially active. It starts at the Mining Museum, located inside the industrial buildings where both diffuse and uncommon minerals are currently exhibited. Moreover, it is still possible to observe some of the technologies that have influenced the history of mining, such as the magnetic sorter, invented in

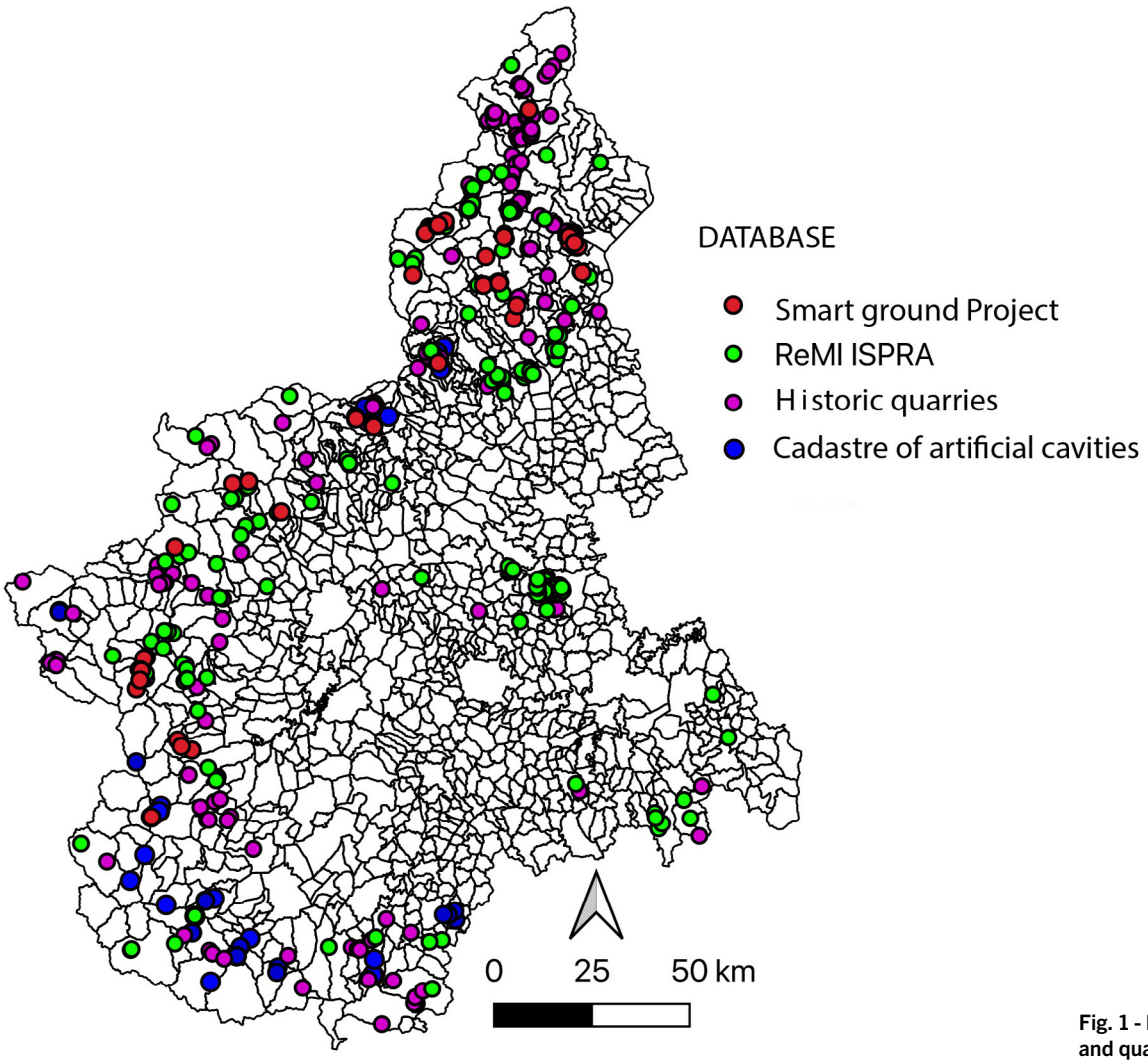

Fig. 1 - Database of former mines and quarrie of Piedmont.

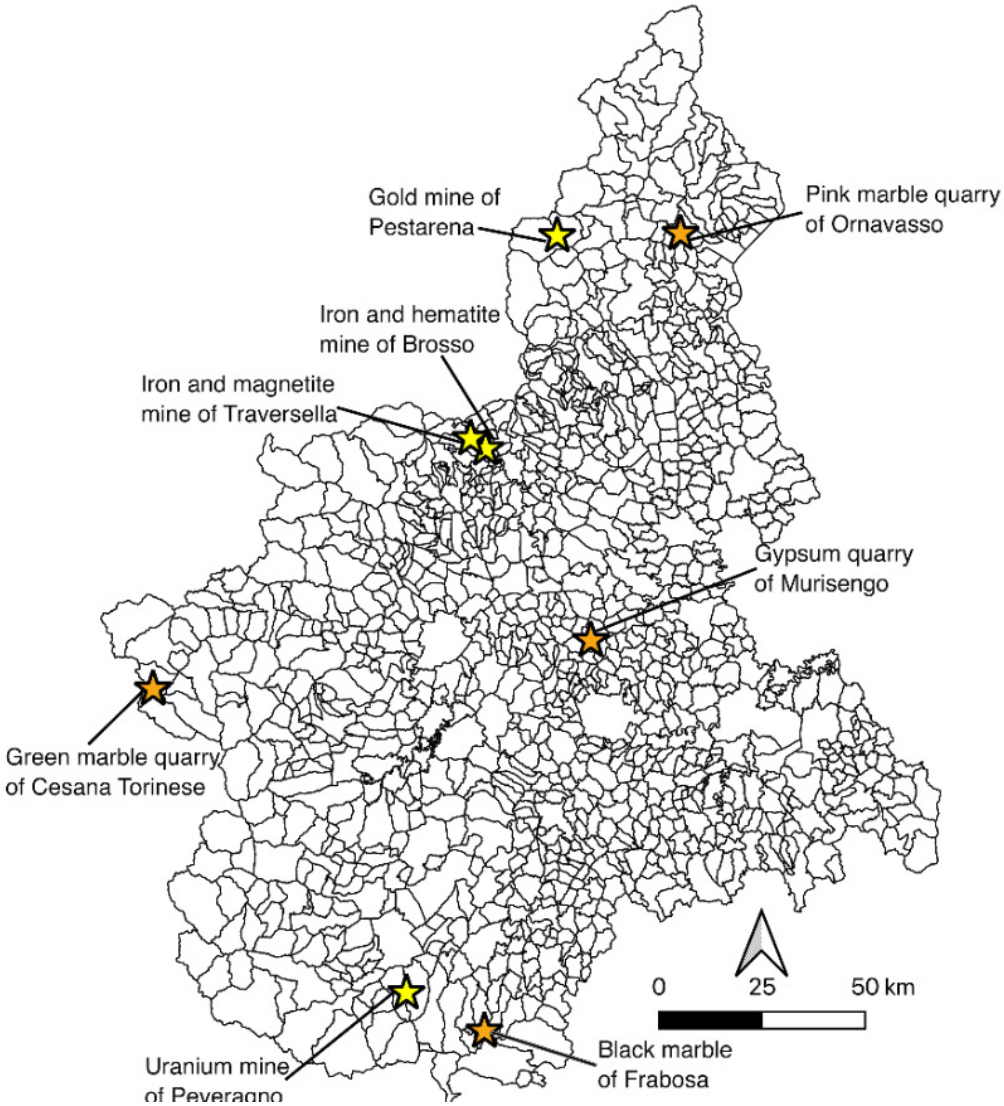

Fig. 2 - Pilot sites for a proposal of touristic network.

1854. Through the museum there is also the possibility to visit one of the many tunnels of the Traversella mining complex, the Bracco Giorgio tunnel. The extension of the circuit was evaluated in this study by including the Bertolino tunnel (Fig. 3).

The Murisengo quarry is located in the Monferrato hills. In this site gypsum from the Valle Versa chaotic unit is exploited, representing one of the youngest term of the Tertiary Piedmont sedimentary Basin succession (Dela Pierre et al., 2003). Gypsum is still mined in underground pit, using the chamber-pillar scheme (Fig. 4). The project of a touristic recovery is confined in the first three levels where the exploitation is already finished. After the field mapping of the main geological and geomechanical features, a 3D model was created to define the most stable areas to dedicate for tourism or educational purposes.

Fig. 3 - Bertolino tunnel in Traversella mine.

CONCLUSION

In Piedmont, some mining and quarry has been already proposed for tourism, but most of them are still unknown or isolated from other touristic purposes. Other mining sites could be valorized and integrated in an organic network.

Fig. 4 - Camber and pillar structure inside San Pietro Pratonuovo quarry, Murisengo.

In this study a proposal for a touristic network of abandoned or partly still in activity mining sites was developed, according to the suggestion of the regional law (l.r n. 23/2016). The need to create an organic system is fundamental in order to develop the tourism in the region, to create visibility to the single initiative and promote policies of touristic re-use in order to expand the network. Moreover, the musealisation of different sites offers a more articulated choice of recreational activities, to attract a bigger numbers of users and, at the same time, guaranteeing sustainable management for locals and regional organisers.

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