

Ancient mines in Valsesia (northeastern Piedmont, Italy): 25 years of historical research and speleological exploration

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Abstract

In the Sesia valley, south of Monte Rosa massif, several metal deposits of varying importance are present; in the past they were subject of mine prospecting and at times intensive exploitation. At the head of the valley (Alagna), some significant Au-bearing quartz veins are in close connection with the main goldfield existing in the neighbouring upper Anzasca valley (Macugnaga), all of them belonging to the broader 'Monte Rosa Gold District'; in the same area, a large Fe-Cu stratified ore is linked to the 'Pietre Verdi' geo-structural domain. In the middle and lower section of the valley, several even if small Ni-Co deposits are genetically related to the ultramafic rocks of the igneous Basic Complex within the Ivrea-Verbano Zone, whose intruded sequence (Kinzigitic Series) also show some interesting iron-rich bodies. These ore deposits boast a centuries-old mining history, the earliest records of which date back to the 13th century AD, although the activity can only be tracked with continuity from the 17th century onwards. The study of the mines in a systematic manner began some twenty-five years ago, involving researchers from various local institutions and university departments with different expertise for a comprehensive and correct approach to the subject. Since then, a series of thorough publications (books and articles) has been produced, largely filling the existing knowledge gaps. At the same time, synergy has been implemented with the Gruppo Speleologico CAI Varallo, who has gained over time great experience in dealing with stability issues in ancient mines and developed techniques to safely progress in an often unsafe environment; in recent years a close cooperation has been also established with the neighbour Gruppo Speleologico CAI Biellese or 3D topographic surveying. At present, almost all the main mining areas in the Valsesia region are catalogued, have full historical documentation and detailed underground surveys.

Keywords: Sesia valley, gold, copper, nickel and iron ore deposits, mining history, underground exploration and survey.

Introduction

Valsesia is located in the north-eastern sector of Piedmont region, south of Monte Rosa massif (Italy), involving a portion of the Alpine range characterised by some unique geological and structural units to which several mineral deposits of varying size and importance are associated.

These deposits have in past times undergone a varied history of mine prospecting and exploitation, developed in some places at least from the 13th century AD, although the activity, based on documentary evidence and mining remains, can only be tracked with continuity and confidence from the 17th century onwards.

For these ore deposits, this article gives a brief overview of their characteristics, the size and development of the underground workings, the related mining history and what has been achieved in the course of speleological exploration.

Metal deposits

Four main groups of metallic mineral deposits can be identified, based on their type as well as specific litho-tectonic association, namely (fig. 1):

- a) Au-bearing Fe-Cu sulphides within quartz-(carbonate) veins belonging to the so called 'Monte Rosa Gold District'.

Individual veins containing disseminations and/or concentrations of sulphides are developed along direction even for kilometers, but discontinuously and with limited thickness (1-2 m), although typically grouped in swarms.

They are located in the uppermost part of the Sesia valley (Alagna: Kreas-Santa Maria, Bors, Jazza, Mud, Salati-Vincent) in close connection with the main goldfield existing in the neighbouring upper Anzasca valley (Macugnaga). Minor irregular veins/stockwork bodies are also hosted along the Canavese Line fault systems in the upper part of the tributary Mastallone valley (Cravagliana-Rimella: Gula l.s.)¹.

- b) Fe-Cu or Mn stratified deposits within the ofiolites l.s. ('Pietre verdi') and quartzites-calcsicists respectively.

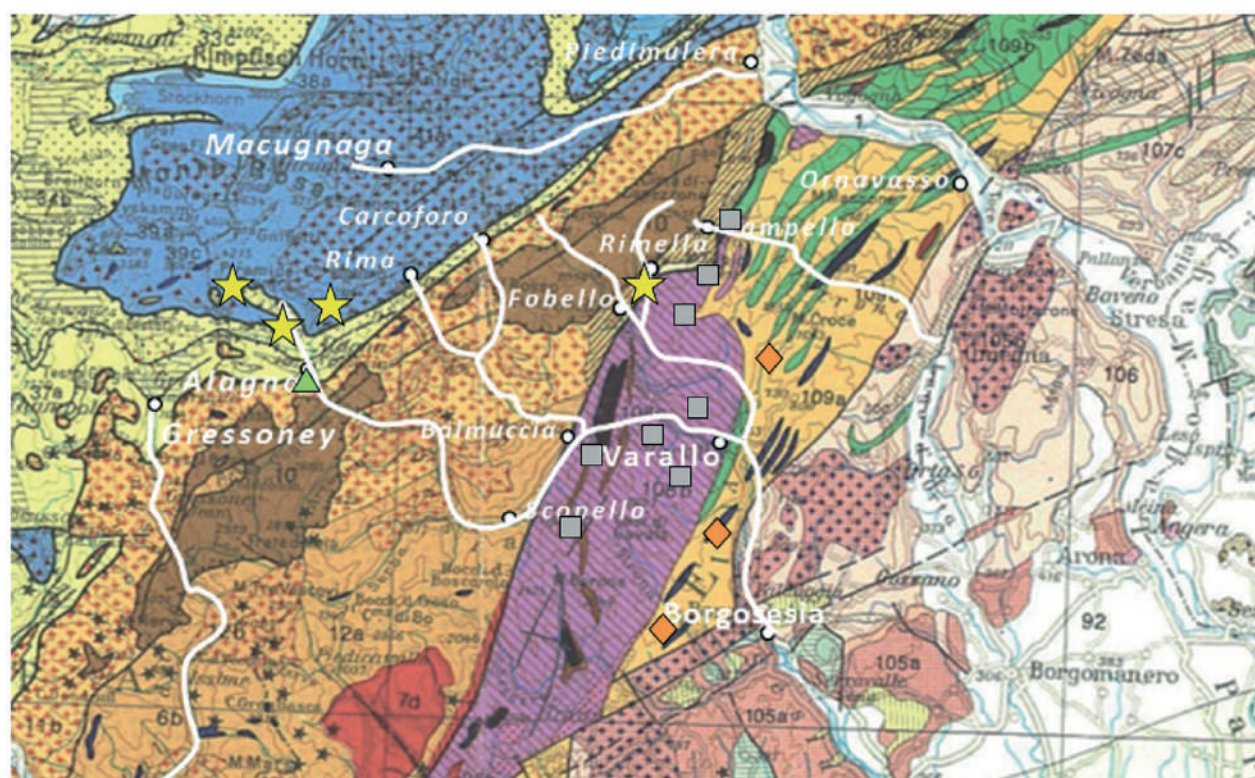
In the important iron-copper deposit located just

¹ At Gula main site, a small type c) sulphide concentration is cross-cut by an Au-bearing stockwork body developed along a tectonic discontinuity.

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Fe-Cu-Au

'Monte Rosa Gold District'



'Calcescisti con Pietre verdi':

- **Fe-Cu** linked to ophiolites
- **Mn** within quartzites-calcescists



Ivrea-Verbano

Fe-Ni-Cu-(Pt)

Mafic-ultramafic rocks



Fe oxides

Silicate marbles and mafic rocks

Alpine Domain (austr.-pennid.)



Monte Rosa Unit



Calcschist-greenstone Unit ('Calcescisti con Pietre verdi')



Eclogitic Micascists



'Gneiss minuti'



2nd dioritic-kinzigitic Zone



Fobello and Rimella Schists

Sesia-Lanzo Unit

South Alpine Domain



Mafic Complex



Kinzigitic Formation



Granitic rocks ('Graniti dei Laghi')



Permian Volcanic Complex

Ivrea-Verbano Zone

(from Bigi et al., *Structural Model of Italy*, CNR, 1990, modified)

Fig. 1 – Geological-structural distribution of ore deposits in Valsesia.

south of of Alagna village (Fabbriche), sulphides are distributed in layers or elongated and/or stretched lenses, from a few mm to some m thick, always concordant with schistosity and very continuous in direction and dip. Minor concentrations of manganese oxides and silicates are present in a higher position inside the same sequence (val d'Otro).

c) Fe-Ni-Cu-(Pt) deposits within the Mafic-ultramafic Complex (Ivrea-Verbano)

They represent a series of numerous but small-sized sulphide deposits characterized by more or less abundant dissemination within the ultramafic levels with local concentrations in the form of small lenses or sulphide-enriched stratoid bodies, generally extended several tens of meters in direction and few meters in thickness. The ultramafic rocks associated to these deposits are located in the basal part of the stratified complex or as discordant offsets across the 'main gabbro'. They are distributed in the lower-middle part of the Sesia valley and its lateral Mastallone valley (Isola di Vocca, Valmaggia, Res, Castello di Gavala, Sella Bassa, Alpe Laghetto, Alpe Cevia).

d) Fe oxide deposits associated with silicate marbles and mafic rocks of the Kinzigitic Series.

These little studied deposits are aligned according to a precise stratigraphic horizon extended in direction for several tens of kilometres from Valsesia to Valdossola. In the tributary Strona valley this sort of deposit consist of iron oxides-rich veins and masses in unclear relationship with the silicate marbles and in close connection with granitic rocks as well as in the proximity of a major fault zone (Ailoche and Postua: Costa del ferro and Venarolo); currently a study is ongoing from the ore geology perspective to clarify its origin and evolution. Similar ore accumulations are to be found in the Sesia valley near Parone (Costa) and Camasco (Ranghetto).

Mining history

The publication of *Alagna e le sue miniere* (AA.VV., 1990) represented the first attempt to properly address the study of mining in Valsesia by means of a multidisciplinary approach integrating different disciplines. The book was the result of an effort to raise awareness for the preservation of the considerable mining heritage in the area: unfortunately, looking at the present remains of the 18th century gold and copper mine buildings, it has yielded very poor results. However, nearly three years of research provided the opportunity to adequately investigate and describe many technical and human aspects related to this important mining area.

Documentary sources give us sporadic activity on gold deposits in the Kreas area from the very end of the 16th century and throughout the 17th. Instead, during the 18th century there was intensive cultivation

under the direct control of the Savoy State on both gold (Kreas-Santa Maria, Bors) and copper deposits (Fabbriche); plants for grinding and an initial metallurgical treatment of the ore were built in the two areas, while in Scopello, halfway down the Valsesia in order to have enough quantities of wood, a large smelter was also erected, where the metallurgical refining process took place. The exploitation peaked for about ten years around 1750-1760 and then sharply declined. Thereafter, mining was fairly reduced and only conducted by inhabitants: some activity from 1785 to 1815 is worth mentioning because it was carried out at the highest altitudes (Salati-Vincent).

During the course of the 19th century, only local seekers performed some mining activity on the gold veins and corporate groups on the copper deposit, but for very short periods. From 1890 there was a new boom for gold only, with the intervention of a company with British capital, but again it lasted about ten years.

Finally, interest in the gold deposits continued to be rather irregular during the 20th century, while on the copper one there was on the contrary a period of intensive exploitation after the Second World War, with the mine that closed in 1981.

Five centuries of mining have left several traces on the Alagna territory both on surface and underground (AA.VV., 1990; Cerri, 2013; Cerri and Fantoni, 2017; Cerri and Nanni, 2019):

- At the main gold sites (Kreas and Santa Maria) the underground development is 3 and 1.2 kilometres respectively on five to six interconnected levels; early works (18th century) have been mostly obliterated by later activity and are largely inaccessible. The other minor mining sites have only a few hundred metres of excavation at most.

These gold mines as a whole are located at an altitude ranging from 1325 to 3080 m a.s.l..

Only one of the many stone structures built in the 18th century for ore processing and to house the workers remains standing and contains the millstones installed by the English company; it has recently been restored for tourism purposes (fig. 2a).

- At the Fabbriche mining site the underground network reaches 15 km on multiple levels for each section of the ore deposit, with the portal located between 1138 and 1378 m a.s.l.. The exploitation in more recent times was only carried out in the deepest portion of the ore deposit (down to 200 m below main adit). In this case early works (18th-19th centuries) have been slightly affected by later ones and mostly reachable (fig. 2b).

With regard the gold veins in the Gula area, some mining activity was discontinuously developed by local seekers during the second half of the 19th century, after which the English company operating in Alagna also intervened here for a few years. After the First World War it was the parish priest of Ferrera (Cravagliana) who undertook some research, but his attempt soon failed. Mining excavations are



Fig. 2 – 2a: Alagna, Santa Maria gold mine, 1728 (Archivio di Stato di Torino Sezioni Riunite, I Archiv., Miniere, m. II; from Cerri R. et al., 1990); 2b: San Giacomo and San Giovanni copper mines, 1725 (Archivio di Stato di Torino, Sezioni Riunite, I Archiv., Miniere, m. II; from Cerri R. et al., 1990).

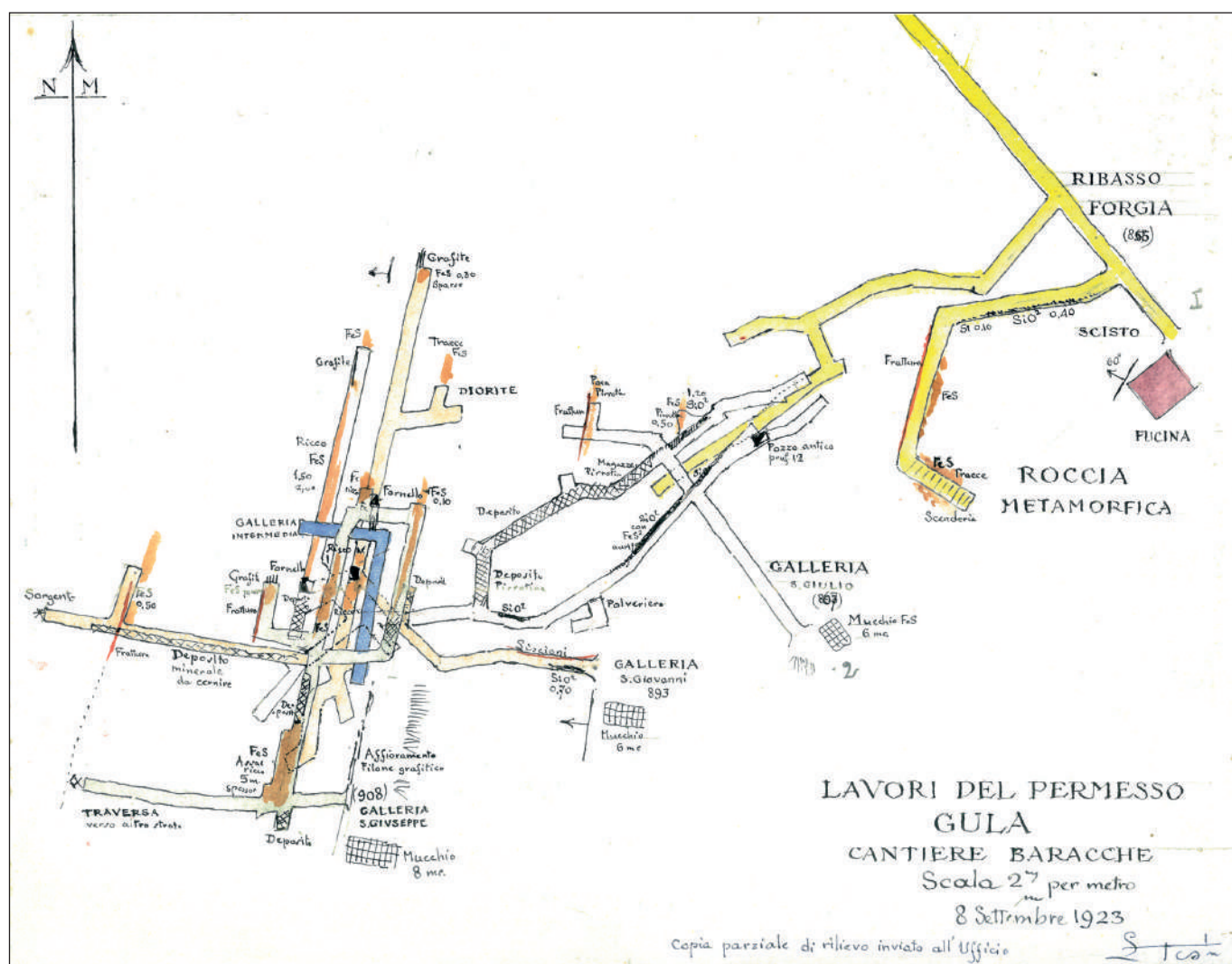


Fig. 3 – Gula nickel mine workplan, 1929 (private archive).

located between from 812 to 985 m a.s.l.; at Gula main site they extend for 1.2 km, on five interconnected levels while at Bocone for few hundred meters on three levels. At the former, location underground works and surface facilities have been recently rearranged and secured to shortly become a tourist site (fig. 3) (Cerri, 2022).

On the many small nickel-cobalt deposits found in the ultrabasic rocks of the Ivrea-Verbano Basic Complex, mining was instead carried out typically in two different periods: the second half of 19th century (1855-1880) and during the autarchy and World War II (1935-1946); in the latter the mines never went into production. The mining works are located at different elevations, the highest being Alpe Laghetto (1850 m a.s.l.); the ones with a well developed underground network are the Isola di Vocca mine (0.6 km on four levels, 542-636 m a.s.l.) and the Valmaggia mine (0.55 km on four levels, 623-721 m a.s.l.) (Fontana 2000, 2003; Testa, 2002).

The mining area that is certainly the most interesting for its long documented history, but also the one that is least known, is Costa del ferro (Ailoché and

Postua). The mining works are situated at an altitude from 509 to 632 m a.s.l. and they result from several periods of activity since the 13th century and up to WWII (Barale, 1987; Cerri, 1990). Open pits and ancient irregular works of supposed medieval age are visible in the highest portion of the mining area, while several interconnected levels for a total of 1.5 km were excavated during the subsequent activity phases.

The underground network has already been fully explored and mapped with a 3-D survey, which is facilitating the ongoing studies: the deposit is currently under investigation from the ore geology perspective to clarify its origin and evolution, while history of mining will be researched soon.

It should be noted that the synergy established with the Gruppo Speleologico CAI Varallo usually involves that historical reports and documents (plans, photographs, etc.) are continuously made available for their underground exploration purposes, while in the case of the Costa del ferro mining area the opposite has occurred (in this case Gruppo Speleologico CAI Biellese is involved). This demonstrates how the study of

mines and their caving exploration can be mutually beneficial.

The newly launched multidisciplinary project dedicated to this mine will involve researchers from various local institutions and university departments with different expertise (ore geologists, mining engineers, mining archaeologists and medieval historians), but also speleologists will be full members of the team. The experience of 25 years of working together will thus be invested in the best possible way.

Underground exploration

The Gruppo Speleologico CAI Varallo has explored and documented many mining sites in the Sesia valley, gaining a great experience in dealing with instability and other problems present in abandoned mines, developing techniques and knowledge to progress as safely as possible in an often unsafe environment. In recent years, there has also been close cooperation with the neighbour Gruppo Speleologico CAI Biellese for 3D topographic surveying.

Referring to the previous paragraphs, below we examine the different mining areas in which the team conducted their exploration and documentation campaigns.

In 2006, the Santo Spirito adit in Kreas area near Alagna was explored, but many problems were experienced inside, due to wall compression stresses and



Fig. 4 – Kreas mine, Santo Spirito adit: the rock compression that has narrowed the tunnel (photo Paolo Testa).



Fig. 5a – Mud mine: the underground works along the main quartz vein (photo Paolo Testa).

the related reduction in space, also because of the presence of timber props, which were overcome in a kind of labyrinthine game, concluded after only eighty meters by a landslide; as of today the entrance is collapsed (fig. 4). In the following years other levels in the same gold mining area were searched and explored: unfortunately, some are obstructed, others are still accessible but inside the rock is rather precarious. In the Stuz area, on the opposite side of the valley, the galleries are quite solid, without timber support structures, some semi-flooded but still accessible, so it was possible to document them photographically and perform the 3D survey.

The exploration of the Mud gold mine was carried out more recently. The levels are connected by shafts, but they have collapsed, despite they are in good conditions and with very few supporting structures. The second level, being flooded, required to create a drainage channel, but this did not prevented us from entering with our boots on. Since the quartz ore body has been almost completely removed, some spectacular galleries are developed within its sharp sloping boundaries (fig. 5a-b).

The Fabbriche copper mine is certainly one of the



Fig. 5b – Mud mine: the quartz vein has been almost completely removed (photo Paolo Testa).

most fascinating in Valsesia, but it is also the most challenging and dangerous we have faced: in addition to crumbling structures where we were forced to walk through, the 77-metre shaft required a lot of work to make it safe again due to the presence of precarious timber structures, some removed, others secured with ropes (figs. 6a, 6b). But the shaft had a lot of dust suspension due to lack of air circulation: we managed to create recirculation again by knocking down a drywall made by the miners. Underneath, we found tunnels with a green-coloured floor (due to the particular rock), which led to the exit of the lower adit, that had unfortunately collapsed, and another with a large sloping staircase limited by a spectacular drystone wall; today this latter area has collapsed and obstructed the gallery.

The inspection of the Gula mine was facilitated by its proximity to the road and the good structural conditions, although we had to cross the stream because the old hanging bridge was destroyed by an avalanche several years ago. In addition to the four levels, the connecting shafts (with no more steps) and two flooded tunnels were explored by diving using underwater caving techniques. These tunnels ended after a few

tens of metres, heading towards the first level, probably abandoned due to the closure of the mine. Numerous photographs and a 3D topographical survey were taken as documentation.

Exploration in the Isola di Vocca mine began in 2002, and have developed intermittently over the years due to its instability: several collapses that occurred between excursions suggested not to continue any further for obvious safety reasons: some levels were documented, but those beyond the collapses were definitively abandoned due to their dangerousness. Recently, the entrance to the second level, the most critical one, has been obstructed during the construction of a road.

The Res mining area is composed by several galleries on both sides of a steep mountain ridge, rather far and difficult to access. The first explorations began in 2010. The tunnel on the south side is quite developed and in fairly good condition, and there are no timber structures inside, but the grooves of the track sleepers where the trolleys used to pass are still evident. A nearby tunnel entrance has collapsed. On the opposite side of the ridge the tunnels are in good conditions and horizontally connected.



Fig. 6a – Fabbriche mine: the beginning of the 77-meter shaft (photo Cristian Gugole).



Fig. 6b – Fabbriche mine: a passageway amidst supporting structures (photo Paolo Testa).



Fig. 7a – Valmaggia mine: a stove still intact (photo Paolo Testa).



Fig. 7b – Valmaggia mine: the first level with deposits also on the ceiling (photo Paolo Testa).



Fig. 8 – Costa del Ferro mine: recent timber support structures in an ancient, enlarged gallery (photo Paolo Testa).

The exploration and documentation of the Valmaggia mine has lasted for long, being the first site we started with in 1998 and hence the most frequented by our group: it has represented a sort of training place to learn and develop new progressing techniques in this new environment for speleologists, also because no maps and plans were available at the beginning. The mine was completely dismantled from all mining equipment, even the metal ladders fixed in the shafts that served as passageways across the four levels, all communicating with each others. The rock is solid and there are no particular compression stresses, although some landslides obstructed part of the tunnels and the adit entrance. Full photographic documentation and a 3D survey is now available (fig. 7a-7b).

The Costa del Ferro iron mining complex, due to the numerous excavations of different ages and scattered over a rather large area, as well as lack of historical documentation, has represented a very interesting and varied area from the exploration point of view, with a mixed environment of very old and intricate underground workings and more regular recent ones, following different ore bodies in a very disturbed and unpredictable geological context (fig. 8). Some of the tunnels have flooded sections due to water flowing through the connecting shafts and because of surface seepage: these zones were overcome by swimming with wetsuits, some of which had many submerged timber support structures.

Conclusions

Modern mining studies ('mining archaeology l.s.') make it possible to identify the different types of techniques used in underground mining and metallurgical processing for extracted ores.

Exploration and surveying by speleological teams are of paramount importance to support mining studies. However, speleological exploration in mines must be carried out in the same way as in caves for the preservation and conservation of mining structures and any remains (tools, etc.). Therefore, dedicated policies must be carefully adopted in the same way they are applied for animal life. It should be remembered that some of these sites have also become winter refuges for bats, mammals that are vital to our ecosystem, and then they should be protected by not frequenting the mines during the winter so as not to interfere with the animal life.

The general recommendation is to promptly report any supposed archaeological finds to those involved in mining history of the area, so that all appropriate procedures for describing and preserving the remains can be put in place.

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