Hypogea 2015

Proceedings of International Congress of Speleology in Artificial Cavities
Italy, Rome, March 11/17 - 2015

EDITORS

Mario Parise
Carla Galeazzi, Roberto Bixio, Carlo Germani

SOCIETA' SPELEOLOGICA ITALIANA
ASSO
ROMA SOTTERRANEA

SARMANOVSKY COPPER MINE

Alexey Gunko
Russian Geographic Society, Naberezhnye Chelny, Russia; gunko.a@mail.ru

Abstract
Industrial development of copper in the Priuralye (Cisurals) area started at the beginning of the XVIII century. At that time, there were thousands excavations on the basis of fields of the cupriferous sandstones. One of largest mines is located 2 km E from Sarmanovo's settlement (Tatarstan, the Russian Federation). The first literary mention of Sarmanovsky mines goes back to the end of the XVIII century. In that book, the mines are excavated thanks to the works of the Swedish prisoners of war, captured in the period of the Northern war (1700–1721). The research of Sarmanovsky mine has been carried out since 1998. Its development is more than 2,1 km. The mine differs from the other excavations of the Priuralye area by the arched cross-section of connecting passages. Thanks to them, the mine is well preserved. There are different levels in the mine. The transition between them is possible on inclined connecting passages and vertical wells, up to 6 m in depth. An average height of connecting passages of the mine is 1,6 m. There are also some sites with rectangular limks among different galleries. This proves that the mine could had been repeatedly exploited between the end of the XVIII and the beginning of the XIX centuries. There are numerous ghosts of the other old excavations near Sarmanovsky mine. Their entrances are destroyed, but can be opened in the long term.
Keywords: copper mine, Russia, Cisurals.

Riassunto
Lo sviluppo industriale del rame nella zona di Priuralye (Cisurali) è iniziato con il XVIII secolo. A quel tempo furono condotte migliaia di escavazioni nelle arenarie ed una delle grandi miniere si trova 2 km ad E dell'insediamento di Sarmanovo (Tatarstan, Federazione Russa). Secondo la prima citazione letteraria sulle miniere di Sarmanovsky (fine del XVIII secolo), le opere minerarie furono eseguite dai prigionieri di guerra svedesi catturati durante la Guerra del Nord (1700-1721). Le indagini sulla miniera di Sarmanovsky hanno evidenziato, dal 1998, che la sua estensione è maggiore di 2,1 km. La miniera si differenzia dalle altre della zona di Priuralye per la presenza di passaggi di collegamento a sezione trasversale arcuata, grazie ai quali la struttura si è ben conservata. La miniera si sviluppa su più livelli. Il passaggio dall'uno all'altro è reso possibile dalla presenza di discenderie e pozzi verticali profondi fino a 6 m. L'altezza media dei passaggi di collegamento è di 1,6 m. Ci sono anche alcune zone con intersezioni di scavo a sezione rettangolare. Tutto questo dimostra che la miniera potrebbe essere stata sfruttata più volte tra la fine del XVIII e gli inizi del XIX secolo. Nella zona si trovano anche numerosi resti di altre vecchie escavazioni vicine alla miniera di Sarmanovsky. Pur se gli ingressi sono stati distrutti, essi potrebbero essere riaperti in futuro.
***Parole chiave**: miniera di rame, Russia, Cisurali.*

Introduction

The copper-mining activity originated in the territory of modern Tatarstan in III–II thousand BC. There were found bronze jewelry, instruments of labor, the weapon, crucibles and stocks of copper ore in the burials of the Prikazansky culture (XVI–IX centuries BC). At the beginning of the XVII century the Moscow state was anxious with creation of its own mining industry. Russian and foreign experts were sent to the Kama river for searching ores.

The Saralinsky plant was founded N of Yelabuga town at the end of the XVII century. However, its activity was stopped soon. The considerable parties of the Swedish prisoners of war, captured during the Northern war, were settled in 1711 across the Kama. There were some mine foremen among them, who found large reserves of ore. With the permission of the administration of Yelabuga town they restored furnaces of Saraylinsky plant and started to make metal. The beginning of active mine working of copper fields belongs to this time, both around the plant and on the meadow part of the Kama (Gunko, 2008).

N. P. Rychkov, the head of one of groups of the academic expedition that visited the Korinsky plant (constructed on the basis of the Saraylinsky one) in 1769, reports about the activity of Swedes in his traveling notes. Semyon Krasilnikov, the owner of the plant, told Rychkov that the Swedish prisoners of war had worked at the plant in the past. The plant was ruined after the Swedes departure, and later, with the mines it took over to his father. Krasilnikov showed the samples of rich copper ores, which, by his words, were got on two mines: Aktazitsky and Akhmetovsky (Rychkov, 1770). They got their names after the nearby villages. Thanks to the reference to the Toyma and the Menzelya rivers, we can easily define the location of these mines.

Sarmanovsky mine

The Akhmetevsky mine was located near Akhmetovo village (nowadays it is Old Akhmetovo village of the Sarmanovsky region of Tatarstan). The height, carrying the local name Ahmet-tau, is located 3 km SE from the village. There is the group of mine workings located E of Sarmanovo village, among them the Sarmanovsky mine, which has got wide popularity in the last decade. In our opinion, most of these mines of Sarmanovsky

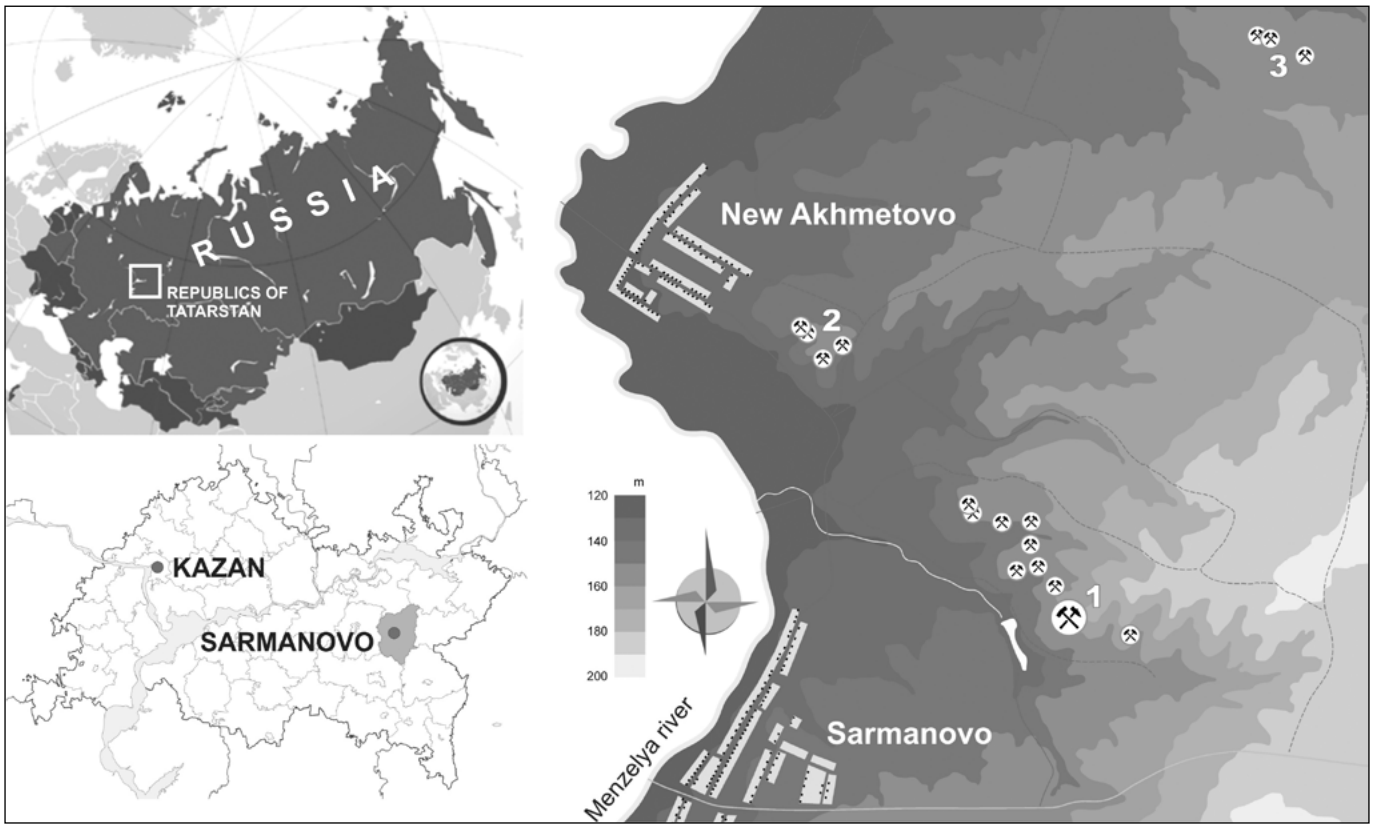


Fig. 1: copper mines near Sarmanovo; 1) Sarmanovsky mine and the group of mines; 2) Akhmetovsky group of mines; 3) Katash-Karansky group of mines.
Fig. 1: miniere di rame vicino Sarmanovo; 1) la miniera di Sarmanovsky e il gruppo di miniere; 2) gruppo di miniere di Akhmetovsky; 3) gruppo di miniere di Katash-Karansky.

group were mentioned as the Akhmetevsky mine by Rychkov (Fig. 1). The Sarmanovsky-1 mine is located 180 m from the equipped Kara Karshi spring, and nowadays, it is the largest one of the available copper mines, developed in the Urals up to the beginning of the XX century.

The mine is well-known to the locals under the name "Bakyr-bazy" that translated from Tatar means "a copper cellar". There are dumps of brood, considerable by the area, on a slope below the mine. They are accurately expressed in a relief, despite active slope processes. The mine research has been carrying out since 1998.

The entrance to the mine till 2003 was the crack, washed away by clay 0,4 x 0,7 m, being in a funnel of 1,2 m in depth. Then, the ditch 1,6 m-deep was dug at the entrance, and its size increased up to 0,9 x 1,0 m. The first 10 m of adit are represented by a low passage between a mine working and an apron of surface soil. Further on, the passage forks and the main system, developed mainly in direction E, begins. The general extent of the mine is 2,1 km (Fig. 2). Based upon density of passages, the mine can be divided into Near and Far parts. The near part is of labyrinth type, and represents the difficult system of crossed adits on two circles. The density of drifts averages 0,2 m/sq.m. Thickness of rocks between passages is less than 0,5m in some places. Mine working width is generally 0,8-1,7 m. There are the expansions, forming small halls, in the mine. Mine working spandrel is arch almost everywhere (Fig. 3). The galleries are rather straightforward and refined (Fig. 3A, B, D). It is interesting to note that the majority of them come to an end with deadlocks with the cut-down niche (Fig. 3D). Depth of niches ranges from 0,2 to 0,5 m. Besides the main one, there were three more entrances in the Near part. The first came along a slope of the S exposition, SE from the modern one. The short grinding ditch and small dump remained. The second entrance, the largest, was 22 m N from the modern one. It had a section of 1,7 x 3,5 m and, most likely, it was the main entrance as the largest part of dumped materials lies under it. The third entrance settled down more to the N, 10 m from the described one, and opened the access to the Bottom gallery. Nowadays these entrances have been brought down.

The bottom gallery is the lowermost horizon of the mine. On an extent of 55 m it is impounded by water. It develops in E direction, for more than 200 m, with width 0,9-1,2 m, and height 1,5-1,8 m (Fig. 3C). The ceiling is vaulted for the whole length. The bottom gallery is the only passage to Distant part.

Distant part is treelike in plan. The Bottom gallery acts as axial for all underground system. There is an intersection 18 m from the impounded site. The small part of it extents near 180 m to the N. Rather large network of passages settles down SE from the intersection. There are two inclined galleries in the mine, which earlier came to the surface. Passages have two circles, with amplitude near 7 m.

In 2001, as a result of blockage, in the branch of one of the drifts it was possible to get into the system of low

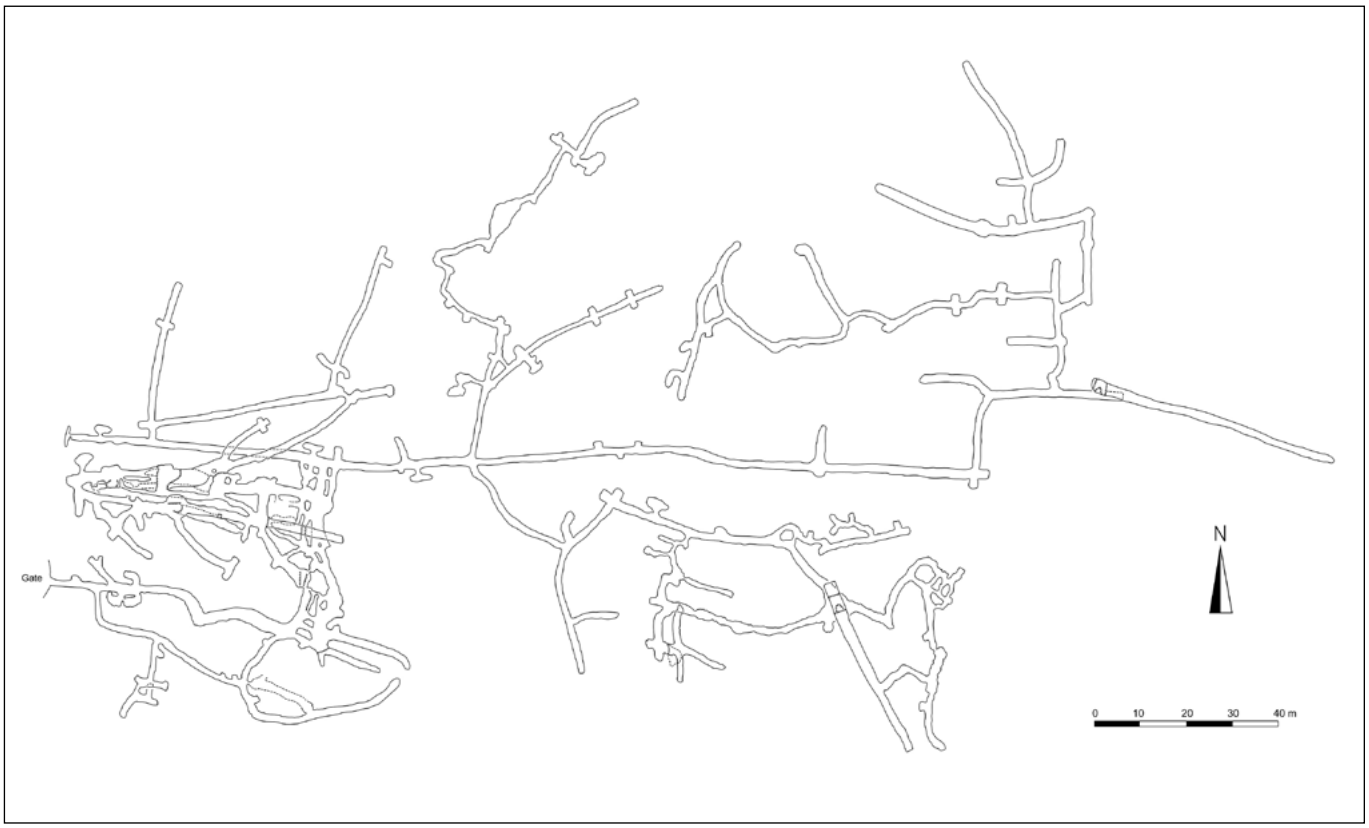


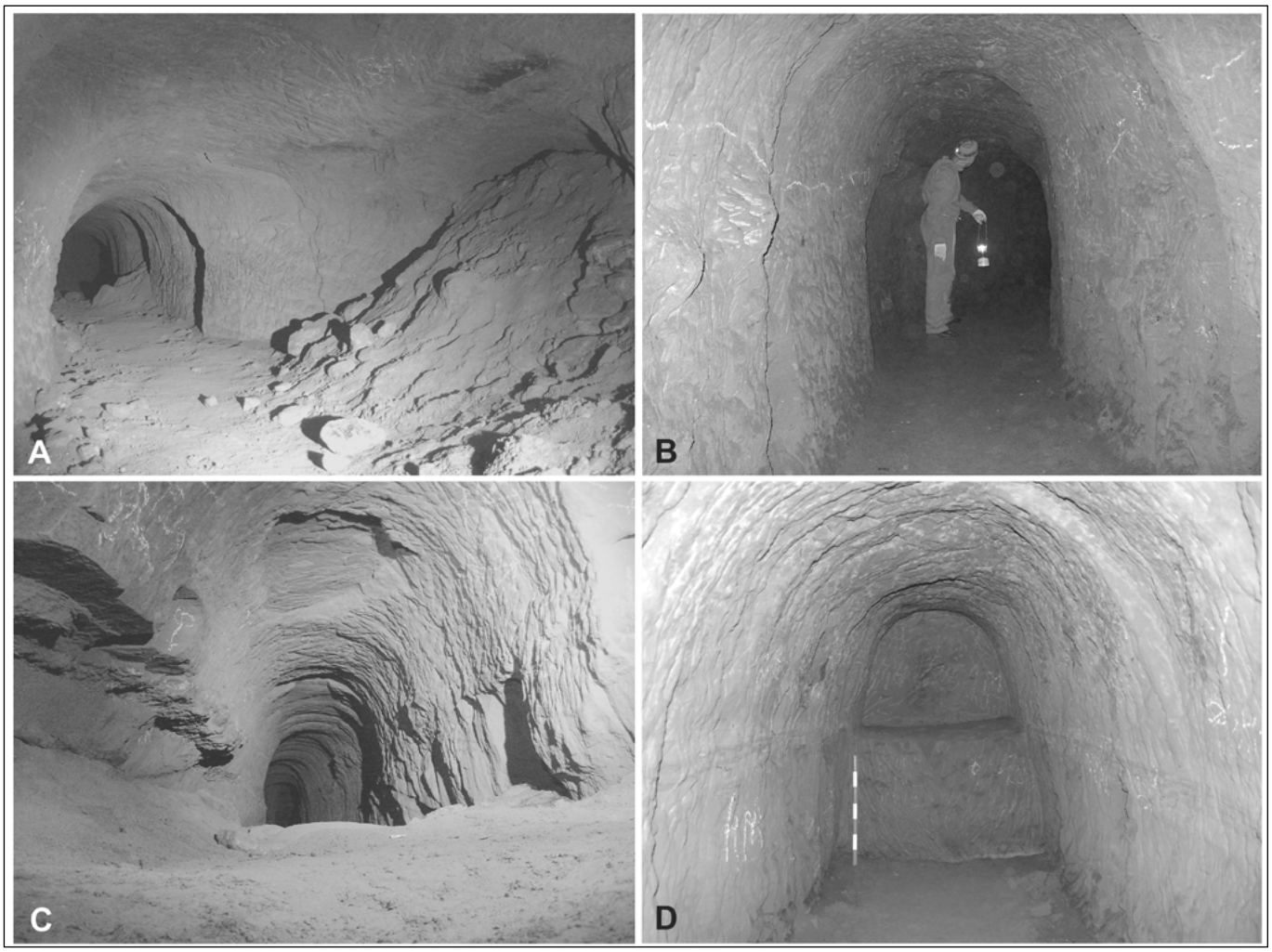
Fig. 2: plan of Sarmanovsky mine.
Fig. 2: planimetria della miniera di Sarmanovsky.

(0,7-1,3 m) wide (to 3 m) passages for a total length of more than 80 m. This is the only place in the mine where the malachite collets remained not developed up to the end. The large system of drifts, with a general extent over 350 m goes to the N at the very end of the Bottom gallery, at the intersection. Its S and E directions are deadlock. Height of passages is 1,5 - 1,9 m, width is 1,2 - 1,8 m. Small crack (0,5 x 0,7 m) in the roof removes the basis of vertical mine (depth 4,5 m) in the SE deadlock drift. It has the size of 0,6 x 0,7 m at the bottom, whilst at the top it is 1,1 x 1,4 m. The section is rectangular. There is a gallery from the top of the mine toward the SE. Average width is 1,2 m, height is 1,6 m, and the ceiling is vaulted. The passage through 60 m comes to an end with a blockage. There was an exit to a surface in the past.

Discussion

There is a question - was the mine really developed with the help of Swedes? We note its unconditional uniqueness for the region - at its mine working the production was conducted without construction fix practically everywhere, but by creation of curved arches. However, there is a number of sites in mine, where wooden timber, nevertheless, was used. In such places the different age of works can be mentioned (imposing of rectangular mine working on arch). During the later period (possibly the end of XVIII - the beginning of the XIX centuries) there was an attempt of repeated mine working. These sites are notable for a flat wide ceiling and active landslide processes. To note uniqueness of arch section for Cisural area, it is necessary to carry out comparison with some other mines in the cupreous sandstones. More than 250 investigated mine working adumbrate about traditional ways of mine working of copper in Cisural area in the XVIII-XIX centuries. As a rule, mine working has rectangular, square or trapezoid sections. Wood was applied for fastening arches. Construction wooden timber was considered as one of the main stages in work. There remained both the remains of timber and lacunas, in which timber was established, in mines. A number of the investigated mine workings of rectangular and square section have no traces of fastening at all that is explained by good stability of the arches and the short period of operation. As for uniqueness of arch section about which we spoke, it is necessary to give some explanations here. Firstly, such way of mine working in itself was well-known not only during the industrial period of mine working of Ural, but also in an extreme antiquity. Secondly, it was applied by miners restrictedly. In Sarmanovsky mine we see that the way of mine working with arch section was the main.

If mine working was conducted by Swedes, having problems in providing mine wooden timber (it needed to be bought at the Bashkir - local population), they could completely refuse mine working of rectangular section. The vaulted section, promoting decrease in load of a roof, relieved of need of fastening by a tree. Such a mine was more similar to the system of passages of the message, than to a mine working. Internal mine trunks, the existence of circles of the



Figs. 3: galleries of Sarmanovsky mine.
Figg. 3: gallerie della miniera di Sarmanovsky.

mine working, difficult inclined transitions – all this indicates the extensive experience available for miners. Accuracy of a joining of one of distant drifts with the mine, punched from the isolated inclined plane of mine working, tells about the participation of experts well familiar with mountain geometry in work. This separate mine working put on a slope of other exposition (above on height) the main entrance to mine, provided steady ventilation of the system. However, the Sarmanovsky mine is a difficult underground complex, at which mine working knowledge and abilities of miners was wonderfully combined.

Conclusion

Near Sarmanovsky mine dumps of other mine working are located. Probably, artifacts, by which we will be able to determine age and mine accessory more precisely, will be found during the research. Nowadays, only one tool, by means of which mining operations were conducted, has been found in one of dumps.

Preparatory works on creation of a museum complex, devoted to copper-mining in Cisural area, has been being conducted in Sarmanovo since 2011. The organization of an underground route more than 350 m long is planned.

References

Gunko A.A., 2008, *The exploration of the old copper mines of XVII-XIX centuries in Tatarstan*. Peshchery (Caves), Perm, 31, pp. 74-89 (in Russian).

Rychkov N.P., 1770, *The Captain Rychkov's Register of his travellings about Russia in 1769-1770 years*. St. Petersburg, pp. 53-55 (in Russian).