Geological and mining heritage : Croatian historical mining sites : [poster]

Hruškova Hasan, Michaela; Maričić, Ana; Mileusnić, Marta

GEOLOGICAL AND MINING HERITAGE
Croatian historical mining sites

GVOZDANSKO

Ore:
limonite and siderite with sulphide phenomena (galenite, pyrite, chalcopyrite, chalcosite, tetrahedrite and bornite)

Metals: Ag, Pb, Cu, Fe

--- Mining takes place as early as Roman and Illyrian times (Fe)

--- **1347** Zrin was awarded to family of Bribir counts who established Zrinski family

Coat of arms of Zrinski family

Nikola III Zrinski

Nikola IV Zrinski

--- **3. 3. 1463** Petar Zrinski was allowed to mine metals by the King Matthias Corvin (Pb, Ag)

--- **1488 the fortress of Gvozdansko** was built

--- **1524** a mint workshop started to emit silver coins

Silver coins from Gvozdansko - talies (Archaeological museum in Zagreb, replicas inv. E21714, Photo: Igor Krajcar)

--- **1530** the mint and mines were leased to Leonard Gruber Samoborski and Mark Stettner Ljubljanski

--- **13. 1. 1578** the Gvozdansko fortress fell under the onslaught of the Ottoman Empire

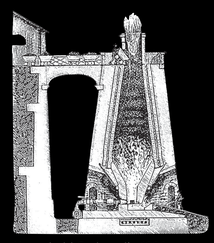
Ferhad Pasha Sokolović

„...and then **Ferhad-Pasha** changed tactics and decided on a night-time attack...just as the onslaught was about to begin, all the torches went out. Fearing the possible trap, he aborted the attack until the next morning. On Monday, the **13th of January 1578**... everything was still. When they entered the main yard, they saw dead bodies of defenders. The harrowing sight impacted Ferhad-Pasha so greatly that he allowed the burrial of the dead according to Christian customs..."

(Kekez: Pad Gvozdanskog 1578. g.)

--- **1707** mining was revived (Ag and Cu), later on the "August mine" was opened in the Gradski potok and it was the largest copper mine in Austrian-Hungarian Empire

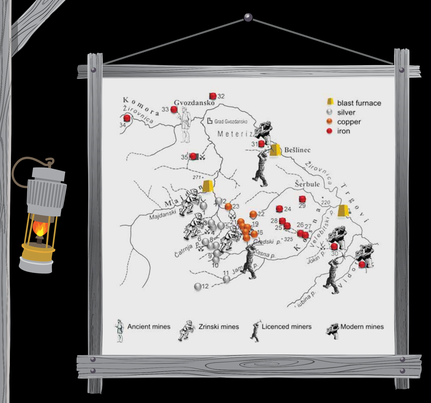
--- **1726** the Imperial Mining Office was located here



Household Cyclopedia 1906

The Bešlinac blast furnace - the state of art of its time

--- **1795** iron production started, processing was carried out on site using blast furnaces in **Trgovi** and **Bešlinac**.

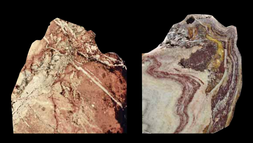


--- **1966** the last mine was closed

RUDE

Ore:
hematite, siderite, chalcopyrite

Industrial mineral: gypsum



Metals: Cu, Fe

--- **It is assumed that the mine existed in Roman times**

Queen and Empress **Barbara Celjska** (1381-1451), "**The Black Queen**", the second wife of the Croatian-Hungarian King Sigismund of Luxembourg, practiced alchemy in the basements of her castle in Samobor. She allegedly produced silver and then gold by transmutation of copper from her mines in Rude.

--- **1481** first record of Copper mining

--- **1530** Leonard Gruber Samoborski mined copper here, and operated in Gvozdansko as well

--- **1582 Ungnad** opened a new shaft, two additional furnaces, two copper forges and employed about 200 people, mostly Germans

--- **1591** the first known miners' strike in Croatian countries broke out here

--- **1587** the Erdödy family possesed the mine

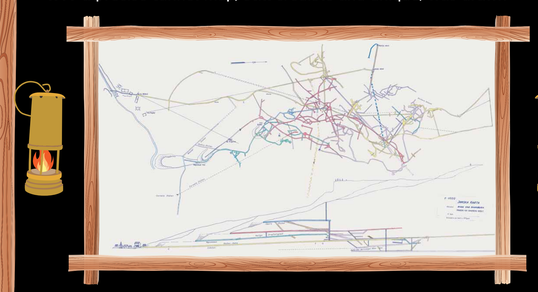
--- **1653** the mine was taken over by the Auersperger family

--- **1698** Croatian nobles and Milan Androk established a Mining Society that managed the mines

--- **1714** the Auersperger family owned the mine once more

--- **1763** the Erdödy family continued to operate the mine

--- **1777** a precise tunnel map, still credible and unique, was drawn



--- **1785** first description of **Rude** mine by **Andrija Pribila** was published

--- **1788** Samobor was the seat of the Mining Substitution Court, a branch of the Mining District Court of Schemnitz (today Banská Štiavnica), run by a mining master (Bergmeister)

--- **1851** the copper ceases to be mined; iron ore and gypsum were excavated

A legend has it that the first miners were the Dwarves – Bergmans a small bearded man dressed in green with yellow skin and snake eyes. They were last seen in the late 19th century digging for gold and other valuable metals.

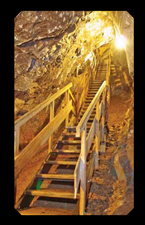
--- **1952 – 1956** last research was conducted reporting the copper and iron ore quantities not feasible

--- **2002** recovery of two artificially connected shafts **Sveto Trojstvo** and **Kokel** after the initiative from **prof. dr. sc. Boris Šinkovec**, the **KUD Oštrc** and locals

Old town Samobor

Greblica or **Miner's cake**, was often the only meal of the miners, a salty thin cake with cheese and walnuts or cheese and green leafy vegetables. Named after a tool for cleaning ashes in old stone ovens.

About 350 meters long shafts are open to visitors as a mining museum in nature.



Photos: R. Ibrišević

One of the oldest European copper and iron ore mines. During the 16th century the copper production was twice the size of the total copper production in England and four times the total production in Norway, and it reached one third of the total production of the famous Swedish mine in Falun.

SOVINJAK

Industrial mineral:
pyritic bauxite

Product:
alum, green vitriol, sulfuric acid, Prussian blue, "terra rosa per pittori"

--- **around 1566 first mining operation started**

--- **1646** first notes on history of vitriol extraction underneath the Sovinjak

--- **1780** Pietro Turini found and described the ore as a Pyrite Aluminoso–Vetriolica and Giovanni Arduino, professor of mineralogy, chemistry and metallurgy, performed first analysis

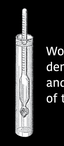
--- **1781** in Koper Turini applied the extraction process proposed by Arduino

--- **1784** mine Minjera and a factory of alum in Sovinjak was opened, the labor force was imported

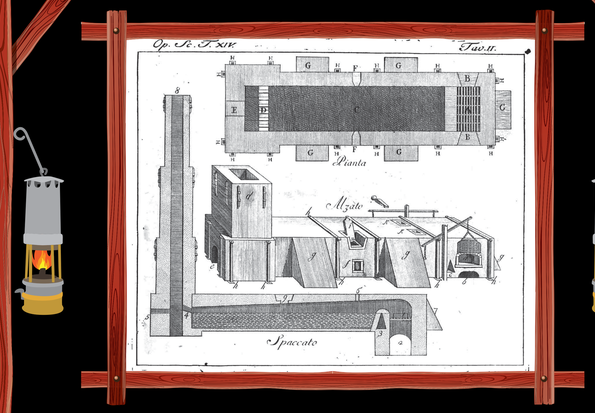
In 1791 (30 years before Bertheir's analysis of bauxite from Les Beaux) Sovinjak's bauxite is analized qualitatively and quantitatively by professor **Arduino.**

--- **1797** Istria joined the Austro-Hungarian Empire, export-import operations were obstructed and Minjera was cut-off of several vital privileges

Excavation was performed by underground mining, shafts still carries the traces of blasting.



Workers were equipped by density-meters (Beaume's scale) and used them for quality control of the processed solutions.



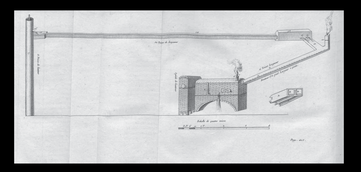
Turini 1782 encouraged professor **Arduino** to find alternative for lead cauldrons used during alum precipitation. In 1790 *forno a riverbero* an "horizontal furnace" was designed and built in Sovinjak. Results were excellent, the consumption of firewood considerably lowered and the purity of alum improved. Based on these results *Eccelentissimi Deputati Alle Miniere* prohibited the use of cauldrons.

--- **1801 Giusepe Maria Socquet** wrote *Sur l'aluminière d'Alun natuerl de Souvignaco en Istria, proince ex-Veneto, et sur les procedes particuliers employés pour son et extraction et sa purification* describing in detail the production in Minjera

--- **1808 Pietro Turini** published his memoirs *Della preparazione dell'allume nella Miniera di San Pietro nel diartimeno dell'Istria* recognized as the first elaborative work on bauxite processing

--- **1823** Minjera declared bankruptcy and in 1863, after a robbery and murder of the factory director Antonio Deperis, the factory was closed

In the most successful times, factory employed about 70 workers (40 miners) and used the services of 350 carriers.



Factory used a unique mechanism for pumping the liquid discharge from leaching which was described by Socquet as an ingenious and innovative process.

RADOBOJ

Industrial mineral:
sulphur in marl

Product: sulphur

In 1811, a farmer named Ambrose was digging a basement for his vineyard cottage. He started a fire in the pit to burn some branches. To his own surprise, he noticed that not only the trees were burning, but the ground was burning as well. So he brought a chunk of the earth to a priest. Unfortunately, his discovery resulted in the confiscation of his land.

--- **1805** Waldstein-Kitaibel's first notes on sulfur in Zagorije

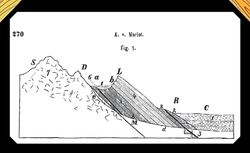
--- **1811** Imperial mine of sulfur was opened

--- **1816** the Mining Substitution Court was transfered here from Rude due to the war

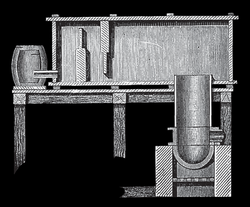
--- **1833** primary school in Radoboj was established by miners

--- **1865** mine was sold to Sonnenberg, Pulzer and Moses

--- **1917** sulfur extraction was stopped



Geological profile after Morlot (1850)



A **Radoboj machine** was a device based on sublimation designed and constructed for cleaning sulfur from marl. (Kišpatić, 1880.)

Friedrich August II, King of Saxony (1797-1854) paid great attention to the natural Sciences. During his trips he often disguised himself not to be recognized. In 1845, he visited Radoboj, where he took a sample of sulfur for his private collection.

(Min 20650 Sy, Senckenberg Naturhistorische Sammlungen, Museum fur Mineralogie und Geologie, Photo: Jana Wazeck)

The Great Exhibition of the Works of Industry of All Nations in 1851

Sulfur from Radoboj has been exhibited at major exhibitions, in 1851 in London at the Great Exhibition of Works of Industry of All Nations and in 1864 in Zagreb at the First Dalmatian-Croatian-Slavonian economic exhibition where it was awarded a silver medal.

Silver medal from 1864

Franz Unger (1800-1870)
-Austrian palaeobotanist
-studied Radoboj fossilised flora for 30 years
-published „Die fossile flora von Radoboj" in 1869.

Oswald Heer (1809-1883)
-Swiss paleobotanist and entomologist
-studied fossilised insects of Radoboj
-published series of books "Die Insektenfauna der Tertiärgebilde von Oeningen und von Radoboj in Croatien"
(1847, 1849, 1853 and 1867).

The oldest fossil of vine leaf in Europe has been found in Radoboj together with other fossils of plants, insects, fish and shellfish. (Croatian Natural History Museum)

Lithemis lejeunecarpenitieri FRASER
(University Liège collection)

Bibio giganteus UNGER
(Croatian Natural History Museum)

Flabellaria maxima UNGER

Quercus palaeococcus UNGER

Cystoseirites communis UNGER

(Universalmuseum Joanneum, Geology & Palaeontology, Graz, Austria)

This activity has received funding from the European Institute of Innovation and Technology (EIT), a body of the European Union, under the Horizon 2020, the EU Framework Programme for Research and Innovation

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