A brief history of salt mining in Romania

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Salt has been mined in Romania at least from the beginning of the first millenium AD when the province of Dacia was part of the Roman Empire (first and second centuries AD). The Dej district museum in Transylvania displays an old engraving showing slaves working in Roman salt mines of today's Romania.
One proof of the existence of Roman salt mines is in the arrow tips made of silex (flint) found in the old excavations of Costiui and Slatina in the northern province of Maramures as well as well-preserved objects of bronze and urns containing ash found in the salt caverns of Ocna Mures. Old maps found in the archives of the Costiui salt mine show the locations of salt excavations dated around 600 AD with 29 mines identified as pre-dating the year 1900. Eleven such mines have been identified in the Ocna Dej salt mining district alone.
With an enormous volume of salt reserves, Romania is one of the main salt producers in Europe and a permanent supplier of rock salt to many other countries.

1. INTRODUCTION

For centuries three distinct provinces of people speaking Romanian existed: Wallachia, located between the Carpathian mountains and the Danube, Moldova, between the Carpathians and the Dniester river, and Transylvania (or *Ardeal*, *Erdely* in Hungarian), within the Carpathian arch and up to the Tisza river in the northwest. The first two provinces were under the Ottoman Empire's rule for almost five centuries.

The provinces of Moldova and Wallachia were united in 1859 when their people elected the same prince, Alexandru Ioan Cuza, as ruler, and the Ottoman court recognized the autonomous principality of Romania. Complete independence came in 1877, at the end of the Russo-Romanian war against the Turks, and the kingdom of Romania was proclaimed in 1881 under King Carol I of Hohenzollern-Sigmaringen. Transylvania was formally incorporated into Romania after World War I, in 1919, following the Paris Peace Accord. The kingdom of Romania ended in 1948 when King Michael I was forced to abdicate and leave the country by the Communist regime imposed by the Soviets. The Communist regime was overturned in December 1989 by a bloody revolution that again brought freedom to Romanians.

The existence of salt lakes close to the Black Sea is an indication that in earlier times part of the salt for local consumption was extracted by evaporation. However, the abundance of rock salt in outcroppings and an early salt distribution system limited producers' interest in developing these resources. Salt lakes exist all around the country; in fact, some former salt mines that had collapsed are now used as resorts.

For practical purposes, the salt reserves of Romania can be considered unlimited and could easily cover the needs of the entire world for a long period of time. There are over 300 well-known salt deposits in the country, not all of them explored. In fact modern exploratory works have been conducted on only 12 of them, and the reserves calculated exceed 20 billion tonnes.

There are two types of salt deposits: flat-bedded salt deposits, mainly in the exterior (south and east) of the Carpathian arch, and diapiric domes, common in Transylvania, some of them deeper than 2km (Fig. 1).

A well-known *Salt Mountain* is located in Slanic, about 100km north of Bucharest (Fig. 2), next to a salt lake that resulted from a collapsed mine which uncovered it. In fact, inside the salt mountain there is another lake that resulted from the collapse of a mine opened around 1800.

The methods of winning this precious commodity from the huge rock salt bodies have changed in line with the general evolution of civilization and industry. Most probably the first excavations, in pre-Roman times, were superficial, possibly from the outcropped tip of the salt body. Later on the excavations went underground, taking various shapes. For instance, one often-used cross-sectional shape of the underground salt mine ("ocna", in old

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Romanian) was ogival (bell-like) which, for centuries, offered the best rock stability. Elaborate protection of the access shaft against water infiltration was a skill developed by generations of salt miners. How else can we explain that some of these mines lasted for centuries (St. Joseph in Ocna Dej 100 years; Water Mine and Kuruc Mine in Costiui 178 years and 317 years, respectively)? The depth and size of these old salt mines advanced along with the progress made in the hoisting of salt – initially through manpower, then by horsepower.

The old mining method with a single cavern (ogive) changed into a room and pillar method around 1777 in the northern province of Maramures – possibly based on the development of the salt mining methods in the not too far away Wieliczka Salt Mine in Poland.

For many years salt was extracted, distributed, and sold in blocks (lumps) that was then ground in households or used for cattle. Mining methods were perfected to extract large slabs of salt, minimizing the amount of grain salt produced and which was difficult to pack and transport.

The word "ocna" (meaning salt excavation), probably derived from a Slavic dialect and also appearing in Hungarian, has become a common name for several mining districts that maintain it to this day. Because salt mining was for years done by slaves or detainees, the current connotation of "ocna" is synonymous with a place of forced labor.

2. ROMAN PERIOD

When the Roman army crossed the famous bridge over the Danube river at the beginning of the modern era and, after fierce battles, conquered what was to become the furthest north-east part of the Roman empire, they found a rich land and culture. They also found rock salt, most probably blocks of salt cut in regular shapes. It is documented that the special salt rations given to early Roman soldiers were known as "salarium argentum," the forerunner of the English word salary.

The kingdom of Dacia (sometimes called "Dacia Felix") was known of as early as the second century BC. Described by historians as "formidable warriors," the Dacians represented a challenge for the Roman empire.

The Romans' first attempt to conquer the well-protected territory of Dacia and the brave army under the Dacian ruler Decebal failed, but a stronger army under the Emperor Trajan finally conquered it in 106 AD. Roman colonists were sent to the new province, and Rome developed its infrastructure considerably, building roads, bridges and a great wall, its remains still visible from the present Black Sea port of Constanta across the Dobrogea to the Danube river. The Romanized population acquired the Latin language and identity. However, between 256 and 275 AD the Romans were driven out of Dacia by the Goths.

The existence of salt mining operations in the Roman province of Dacia is documented by Roman inscriptions on monuments found in the area. Such inscriptions mention *Collegium Salinariorum* located in Turda, not far from Cluj, representing an association of salt operators – those who administered *salinaes* (the name given salt mines by the Romans and adopted by Romanians). The word *salinaes* was assimilated in the modern Romanian language and is widely used to identify either an actual salt mining operation or a salt-water body that results after a salt mine collapses. Remnants of Roman salt excavations (silex arrows, brass tools, and ash urns) have been found in many districts – particularly in Transylvania (Ocna Sibiu, Ocna Sugatag, Costiui, Ocna Mures, Cojocna, Sic, Ocna Dej, Chiusa, Domnesti, Slatina, Martinis), but also in the southern province of Walachia (Ocnele Mari).

Since a good number of salt deposits outcrop, and others are at shallow depths (not more than 1m), it is considered that the first Roman salt mines consisted of engineered "holes," similar to water wells supported by timber or rocks, tapping into the salt bed and allowing the hoisting of salt into crates or skin holders.

A technical report of the Cluj Mining District, dated 1879, mentions remains of Roman salt excavations along Devil's Creek in Ocna Dej, where salt outcrops are still visible today. On the northern side of Cabdic Hill there are areas indicating the existence of possible mining works in a terrace-like arrangement.

Gold mining was known during Roman times in the Transylvanian Alps, around today's mining districts of Brad-Deva. It is conceivable that an exchange of information and possible tools trade took place between those districts and salt mines.

Salt was probably also mined during Roman times in the provinces of Wallachia and Moldova; however, few documents or findings can be referenced.

3. MEDIEVAL ERA

Considering the lack of accessible salt deposits in neighboring countries, salt mining activity probably never ceased on the territory of today's Romania. Old maps found in the archives of Salina Costiui, in the northern district of Maramures, show sites of old salt works dated around 600 AD. In fact, 29 mining sites are listed as pre-1900. Similarly, 11 mining sites have been identified in Ocna Dej as dating since before 1900.

There are ample documents related to the rights and privileges of mining salt at the beginning of the second millenium, particularly in Transylvania. Such documents confirm the existence of salt mining operations in 1211 and, specifically, in 1236 at Ocna Dej, 1269 at Turda, 1291 at Cojocna and Sic, 1326 at Ocna Sibiu, and 1353 at Costiui and Ocna Sugatag, as mentioned in a royal document. Certain old documents talk about the good salt quality of most of the operations – with one exception (Cojocna). Documents mention that in 1291 King Andrew II of Hungary in a proclamation to the township of Turda established the legal rights of salt miners in the districts of Ocna Dej, Trei Scaune, Praid, and Cojocna. In the case of Salina Praid, it is estimated that salt mining started around 1200 and continued for five centuries in open cut. This estimate is based on findings uncovered during excavations made in 1950 for the foundation of a new hoist installation. These excavations uncovered an area of 117m², and clear signs of mining activities could be seen. Open-pit salt mining operations around Praid lasted until around 1700, when mining moved entirely underground, and excavations took the "ogiva" bell shape that provided good rock support and, therefore, stability. The salt was hoisted by an elaborate system called "crivac," powered by horses; in Praid, this type of system was still in use in the middle of the 20th century.

As for the Ocna Dej mine, there are written documents dated around 1245 when King Bela IV of Hungary gave the mine to his "faithful, obedient subordinate" Laszlo, proclaiming that the township and its salt mines were to be considered as "privileged" by succeeding kings of Hungary.

Two monographs on the Transylvanian salt operations were written in 1765 by I. Friedvalski and in 1780 by F. Fichtel – the latter containing a detailed map of all known salt operations.

Salt mining does not have as long a history in the provinces of Wallachia and Moldova. The existence of salt water lakes around Telega-Doftana and Teisani, on the southern slopes of the Carpathian mountains, might be indications of old mining excavations although no confirmation has been found.

A document issued in 1373 by the king of Hungary prohibits the importation of salt from Wallachia, proving that such salt mines were in existence there at that time. According to old documents, salt mines were in existence in 1380 at Targu Ocna, in Moldova, as well as in 1408 at Ocnele Mari, 1517 at Ocnita, 1562 at Telega, 1577 at Gura Vitioarei, 1682 at Teisani, and 1685 at Slanic Prahova, in Wallachia. Other documents reconfirm the existence of salt mining activities in 1529 at Ocnele Mari and Targu Ocna.

An interesting travel report written by Paul of Aleppo after visiting the Romanian provinces (around 1660) mentions salt mining but without giving specific locations.

A document dated 20 April 1685, confirms that Mihai Cantacuzino, brother of Serban Cantacuzino, ruler of Wallachia, bought from the owners of Slanic half of their property. Six years later Mihai Cantacuzino opened a new "ocna," as stated by a document dated 5 July 1791. Three years later, in 1694, he bought the other half of the land in order to expand his mining works. In 1713 he donated his land in Slanic together with the salt works to the Coltea Monastery, in Bucharest, which opened new salt mines and administered them through 1864.

Other districts where salt was temporarily mined (but without clear documentation) include Gurghiu, Sovata, and Rupea in Transylvania and Valea Sarii (Salt Valley) and Ocnita in Wallachia.

Clear drawings exist of Ocna Mare, Ocna Mica, St. Ignatio, St. Nepomuce – all in the Ocna Sugatag district. The shape of the "ocna" was sometimes irregular, depending on salt quality and the need to ensure the best protection against water infiltration. Once the excavation reached a certain diameter at the base, the walls were cut almost vertical, and the excavation continued to considerable depths. Ocna Appafy in the district of Costiui reached a total depth of 100m and a diameter of approximately 69m.

The life of an "ocna" depended directly on salt quality and market demand plus the limitations dictated by its depth and hoisting means. It is

documented that Ocna St. Joseph South in Ocna Dej district lasted 17 years, Ocna Joseph I only 4 years, Maria 5 years, Nicholas and St. Trinity of Costiui 3 years. On the other hand, others lasted for centuries, as mentioned earlier, (Ocna St. Joseph in the Ocna Dej district lasted exactly 100 years, Ocna of Water 178 years, and Kuruc Ocna 317 years – the latter two in the district of Costiui).

4. 18TH AND 19TH CENTURIES

In the 17th century the Ottomans tightened their hold on the Romanian provinces, imposing severe political and economic restrictions. Wallachia and Moldova were administered through the Phanariot system of Ottoman-appointed rulers, usually members of Greek families from Constantinople who, among other things, tried to impose Greek as the official language. Seeking relief from Ottoman rule, Romanian political leaders turned to Russia for help, and after the Turks' defeat in 1812, Russia seized a chunk of Moldova (Bessarabia) as reward.

Salina Cacica in northern Moldova opened in 1790 (and has the reputation of having been visited by Empress Marie-Thérèse of Austria-Hungary). Salina Cacica was the first mine in Romania to apply solution mining and solar evaporation.

At the end of the 19th century a chemical plant was built in Uioara, using the Solvay process. This led to the first solution mining at Ocna Mures, with an initial daily production of 45m³/day of concentrated brine, growing gradually to 70, then 150, and up to 500m³/day around 1920. To achieve the required brine capacity, the old mines were flooded with water from the Mures river, and the concentrated brine was pumped out. Later on special, multi-level dissolution basins were created underground. Dissolution could not be well controlled and, after several years, the mines collapsed, creating a large lake in the middle of the town of Ocna Mures.

In 1940, using advancements from the Romanian oil industry, the first boreholes were drilled for salt dissolution – initially in experimental caverns and later on with large industrial capacities. Along with the dramatic increase in capacity at Ocna Mures, more solution mining operations were started in the 1950s and 1960s at Ocnele Mari, Targu Ocna, and Cacica, reaching a combined capacity in excess of 3 million tonnes.

Competition and safety played a major role in the closure of several salt mining operations, including Gura Vitioarei (1705), Teisani (1774), Ocnita (1774), and Doftana (1901), all near Slanic as well as Cojocna (1852), Ocna Sibiu (1931), Turda (1932), and Costiui (1933). However, seven salt mines have continued to operate to date.

5. MODERN TIMES

The shape and size of salt excavations changed over time and in step with technology. Around 1850 excavations transitioned from the "ocna" and ogival room to the trapezoidal-shape room (starting in the northern mines). An exchange of information may have taken place between these mining enterprises and those in neighboring Poland, particularly the Wieliczka mine. The room-and-pillar method used by the Wieliczka mine was recommended for the salt mines of northern Romania in 1777 by the Polish engineer Jozsef Groszschmied. This method was soon adopted by other salt operations in the Romanian provinces (1845 in Ocnele Mari, 1860 in Slanic, 1865 in Doftana, and 1870 in Targu Ocna). There are some indications that initially descending walls were started at 45°, but some mines subsided, leading to the more conservative 60° angle.

In 1845, when the modernization of the Ocnele Mari in Wallachia was started, an Austrian engineer by the name of Karl Voith was hired. Later on, Karol Karacsony, the manager of Salina Ocna Dej, was hired to modernize the operations at Salina Slanic. He based his design of the Sistematica mine on the exploratory drilling works conducted between 1857 and 1861. This represented a totally new concept: the layout was in the form of a T-shape for the two main rooms, with two shafts equipped with horse-drawn hoisting installations.

The location of Sistematica was not a lucky one due to strong water infiltration that led to its closure after only 10 years in operation. A new mining field was opened in 1868, consisting of 4 rooms with a total length of 515m. These rooms were started by a 4-m-wide, 2-m-high tunnel, followed by slanted walls enlarging the rooms to between 40 and 50m and having an ogival shape. A new shaft was sunk in 1878, and on 20 January 1881 a new hoisting machine, powered by a Cockerill-Seraing (Belgium) steam engine was inaugurated, marking the transition to the mechanized hoisting system.

In 1887, in the eastern part of St. Joseph mine, new rooms were started with a trapezoidal shape cross-section. Rectangular rooms were opened in the

western part of the mine; however, they had to be abandoned due to water infiltration.

In 1860, one year after the unification of the Romanian provinces of Wallachia and Moldova, salt mining administration was assigned to the Ministry of Finance, which had a special department of the state-owned salt mines. Later on salt administration (together with tobacco administration) was transferred to a more powerful and autonomous monopoly ("Regia Autonoma a Monopolurilor Statului"). This organizational structure was maintained until after World War II when the Communist regime came to power. (In fact some old mines were used for many years as storage for bales of tobacco).

Due to the flooding of the Doftana salt mine in 1901, the demand for salt from the nearby Salina Slanic increased tremendously, leading to an exploration program that allowed the opening of a new mine in 1912. This mine was opened by a new shaft equipped with a modern hoisting machine powered by a steam engine and using a flat rope of aloe fibre. The new mine consisted of six rooms of trapezoidal shape, with a ceiling width of 12m and 60°-walls, to a maximum room width of 37m. This mine was connected to the existing Principatele Unite mine to allow for good ventilation (Figures 3, 4).

In 1928 Belgian engineer Maurice Bodart, director of the Solvay company in Brussels, was contracted to make recommendations for the modernization of Romanian salt mines.

Bodart visited all Romanian salt operations and wrote a report recommending that only three mines be kept in operation, but that their output be increased to at least 500 tonnes per shift each in order to allow for modernization cost recovery. His report included safety recommendations as well, based on German and French mining experience:

- Mines should be at least 50m from a river or creek
- A safety berm of at least 70° toward the salt body
- Avoidance of mining openings underneath main roads
- Safety pillars between rooms of at least 15-30m in Uioara and 25m in Slanic

Based on Bodart's report, the first salt under-cutting machines were introduced in the Romanian salt mining, replacing for the first time the manual effort of cutting blocks of salt and allowing a major increase in productivity.

During 1936-1937, under the leadership of professor M. Stamatiu, an expert in salt rock mechanics, a new mining field was designed underneath the existing mines as a second horizon. Sinking the shafts and opening the new mine took four years. The mine consisted of 14 rooms of trapezoidal shape, with the following dimensions:

Ceiling opening – 10m

- Walls angle – 60°
- Room width at base – 35m
- Total room height – 50m

This mine was in operation until 1970 when a new horizon was opened with a fully mechanized small room-and-pillar method.

6. SALT TRANSPORTATION, TRADE AND DISTRIBUTION

Numerous writings reference the transportation of salt from mines to various consumers using an elaborate distribution system along dedicated "salt roads" (some of them following the old Roman-built roads). Salt transportation was typically by horse-drawn wagons along well-established, dedicated, and secure routes, similar to those found in other European countries (Straube). Streets named "Drumul Sarii" ("Salt Road") are common in many Romanian cities and towns.

Salt caravans consisted of 10 to 12 wagons. Their drivers had to be self-sufficient in case of mishap along the way. Caravans received special privileges from the government (such as the right to trespass on private properties along the dedicated route and the right for animal watering and pasture). Caravans stopped at inns along the way for accommodation and food and, when necessary, for repair. Over time some of these inns became tourist attractions and have survived to date.

After unloading their salt freight, on their way back, caravans carried grains (such as wheat and corn) and flour, but it is said they also were used to carry mail and exchange news.

Salt mine operators stocked salt in stores in each county seat and in major Romanian cities. Salt merchants represented various salt mine operators, purchasing exclusive trading rights. Some independent, private distributors operated especially along the railways and were allowed a 20% discount.

Romania exported salt to neighboring countries that did not have known, outcropping salt deposits. The Danube river and the Black Sea facilitated the export of salt. Several ports on the lower Danube were used until recently. Smaller rivers were used for salt transportation as well (for example, the Mures and Tisza rivers both flow through Hungary and into the Danube).

Written records show that 12-million "oca" (ca. 6 million kg or 8,000 horse-wagon loads) of salt was exported from Wallachia alone in 1836 on the Danube river).

Interestingly, salt in Transylvania was more expensive that salt in the other two Romanian provinces, leading to instances of salt smuggling through the Carpathian mountain passes.

According to historic documents, during the reign of Alexander Ipsilante in Wallachia in the early 19th century, salt was used in barter in exchange for fish and grains.

When railroads came to Romania, some of the new routes were along the traditional salt roads. For example, the railroad from Buda to Slanic (serving the Slanic salt mine) was inaugurated in 1883, soon after the main railroad to Bucharest was opened. This can only be explained by the increased demand for salt from this mine due to its proximity to the expanding capital and to the Danube. In 1920 the Slanic mine produced 43,431 tonnes of salt, out of which 3,030 tonnes were exported. In 1930 production was 93,919 tonnes, with 38,024 tonnes exported; in 1938 production reached 134,098 tonnes, with 55,863 tonnes exported; and in 1960 208,096 tonnes, with 74,574 tonnes exported. Total Romanian production in 1938 was 368,000 tonnes, 840 Kt in 1959, and 1.045 Mt in 1960. In 1962 total export consisted of over 120,000 tonnes of salt blocks plus smaller quantities of ground salt (both in bulk and in bags).

Romanian salt has traditionally been exported to Yugoslavia, Bulgaria, Hungary, Czechoslovakia, Greece. More recently, occasional exports have been made to Japan, India, Uruguay, and the United States, among others. Total export in 1960 was over 188 Kt.

7. OWNERSHIP AND MONOPOLY

In the past, in all provinces, salt deposits belonged to the ruler of the province who leased them for operation to various entrepreneurs. The ruler prohibited illegal mining of any salt, even from an outcrop (with few exceptions). Landowners did not have the right to mine salt underneath their properties without special permission. For example, in 1685 the inhabitants of Slanic collectively owned land that was found to contain a rich salt deposit; they sold part of the land to the brother of the Wallachian ruler, who easily obtained exclusive rights to mine the salt. The landowner, however, was paid only 1/10 as "dijma" (compensation) in salt lumps and 1/3 of ground salt, which he could then sell at the price established by the government.

Through the "Regulamentul Organic" (charter) of 1831, salt became a state monopoly. In 1834 the first state-owned salt company ("Eforia Ocnelor") was created. After only two years the system was changed back to leasing the salt mines, which lasted through 1861, when a new state-owned salt company (Administration of the State Monopolies or RMS) was created. In 1929, several years after the re-unification of all Romanian provinces, the Autonomous House of State Monopolies (CAM) was created, an independent government agency that lasted through the World War II years. In 1959 responsibility for salt mining, administration, and trade was transferred to the Ministry of Food Industries, but two years later, in 1952, it was transferred to the Ministry of Chemical Industry, then in 1961 to the Ministry of Mines, Oil, and Geology. Throughout this time, salt mining, processing, and distribution were conducted by a state-owned corporation with limited autonomy. Currently still a state-owned company, Societatea Nationala a Sarii S.A. (SALROM), is part of the Romanian Ministry of Industries and Trade and is a member of the European Salt Producers Association (ESPA).

During the over 40 years of the Communist regime and its centralized economy, Romanian salt mining was modernized and production capacity increased significantly, reaching over 5 million tonnes in the mid 1980s. Main factors contributing to this development include:

- The existence of COMECON, the common Communist market that provided a pre-planned distribution of resources and products to participating countries. This enabled Romania to become an almost-exclusive supplier of salt to

the neighboring countries of Bulgaria, Yugoslavia, Hungary, and Czechoslovakia.

- An extravagant development of the chemical industry in the hope of opening export markets.
- The ambitious dedication of a group of young managers and engineers who seized the opportunity to implement their ideas and make the salt industry a showcase for the outside world.

Currently, total production is at about half capacity as the industry is faced with the challenge of an open market, both domestically and for export, with limited resources and strong competition for development funding. The political situation in the Balkans, particularly the embargo on Yugoslavia, the conflict in Kosovo and, as a consequence, the restrictions imposed on traffic on the Danube have severely impacted Romania's salt industry.

As salt mining in Romania passes the two-millenium landmark it is the author's conviction it will not only survive but find new ways and reasons to expand. The salt mines of Romania are located in some of the most beautiful parts of the country and are mostly open to visitors. Some mines even house sanatoriums for treatments of asthma, rheumatism, and other medical conditions as well as chapels, museums, or even micro-light model aeromodel flying competitions.

Today salt mine visitors are still welcomed with the traditional Romanian hospitality of "bread and salt."

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Figure 1 - Map of Romania and Location of Salt Mines

Figure 2 - Salt Mountain of Slanic

Figure 3 - Bench Salt Winning

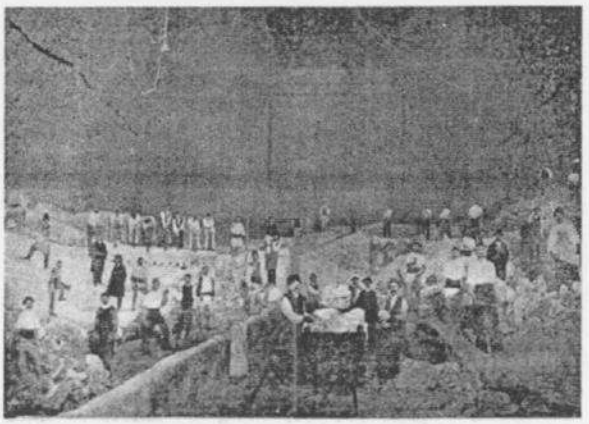

Figure 4 – Salt Mining in Large Trapezoidal Rooms