

## OCNELE MARI-OCNIȚA, VÂLCEA COUNTY RESOURCES, EXPLOITATION, RISKS, UTILISATION

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**ABSTRACT.** – **Ocnele Mari-Ocnița. Resources, exploitation, risks, valorization.** In Ocnele Mari Town and its constituent locality - Ocnița, Vâlcea County, following the extraction of a large volume of salt through its underground dissolution, the soil and the breccias covering the salt have become unstable, producing landfalls and landslides that affected the exploitation installations, the transport infrastructure and several homes, during the last decennia, especially in the area of Ocnița locality. In order to avoid major imbalances in this geographic area, following the mining activities, and also in order to reduce the consequences of the pollution triggered by saltwater, the main affected areas-locations have been identified and analyzed. This paper presents the resources existing in the exploitation area, the modifications occurred following the salt mining activities and their effects on: economic efficiency, local population, environmental balance, tourist potential and utilisation.

**Key words:** Ocnele Mari, salt exploitation, pollution risk, mines and fallen galleries, environment, tourist potential and utilisation.

### 1.COORDINATES AND GEOGRAPHIC FEATURES

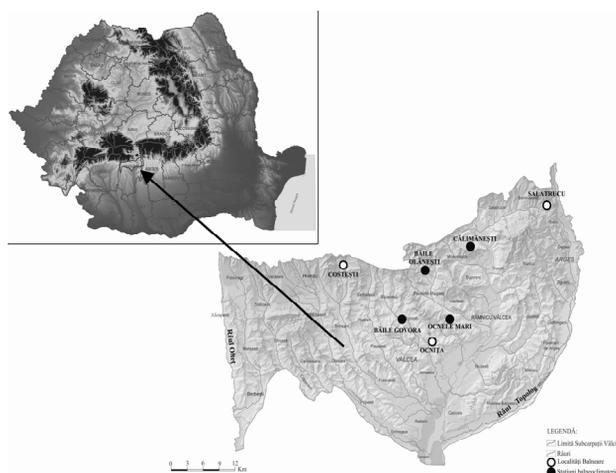
Ocnele Mari Town, including its constituent locality – Ocnița, is situated in the Subcarpathians of Vâlcea. There are about 6 km from Râmnicu Vâlcea Municipality, on the national road DN 67 (from Râmnicu Vâlcea to Horezu) up to Copăcelu, and from here, 8 km on the county road DJ 650 (from Ocnele Mari to Bunești) up to Ocnele Mari (Fig. 1).

*The relief*, specific of the Subcarpathian Hills, is represented by a series of anticlines and synclines oriented east - west, with small structural depressions and relief inversions, also triggered by differential erosion (Govora, Ocnele Mari) within the hypsometric interval of 310-320 m (Badea, L., et al., 1970, Ielenicz M. et al., 2005).

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**Figure. 1.** Geographic setting of Ocnele Mari area

**Geologically and lithologically**, the area under analysis is characterized by Carpathian bedrock, submerged along a fracture line that determined the penetration of the marine waters and the beginning of certain sedimentation cycles that lasted until the beginning of the Quaternary. The lagoon-type lithological facies, represented by conglomerates, sandstone, marls, clays, sands - slightly folded, with anticlines and synclines - has been modelled by erosion, resulting at Ocnele Mari, a *relief inversion*, respectively a *depression in anticlinal fold*, oriented east-north-east to west-south-west sculpted by the Pârâul Sărat.

In the anticlinal fold of Ocnele Mari, there is a salt deposit of *Lower Badenian* age, incorporated in sandstone, marls, clays, sand and gravel, over 7 km long, covering a large area of Ocnele Mari-Ocnișă, where it gets almost 600 m thick and is covered by a saliferous facies (salt breccia), made of grey-blackish shales, sandy marls, slightly-cemented rough sands of Sarmatian age). The salt massive splits into two parts west from Ocnișă, one branch advancing north - west towards Valea Teiușului, along the axis of Pârâul Sărat, and the other advances south - west, up to Băile Govora (L. Badea et al., 1970).

The first indications on the geology of this region date back to the end of the 19<sup>th</sup> century and the beginning of the 20<sup>th</sup> century, and can be found in the works of the researchers who have carried out analyses on the sedimentary formations in Oltenia. The salt from Oltenia, including the salt from Ocnele Mari-Ocnișă, was first investigated between 1982 and 1983 by Gr. Cobălcescu, who identified for the first time the salt deposits and, in detail, by Gh. Munteanu-Murgoci, in 1907, but the size of the deposits was assessed in 1956 (A. Pricăjan, 1985).

The **climate**, corresponding to the geographic position of the area, sheltered by the Carpathian peaks, and to the hypsometric level (300 - 400 m), is a *moderate*

*continental climate* with variations triggered by the four seasons. The average annual temperature is of 9.5°C – the average of the month of July varies between 20 and 22° C, the average temperature in January is between -1 / -2°C and 2<sup>0</sup> C, the average precipitations reach 710 mm / year, winds are weak, the air is rich in forest aerosols and sodium chloride. Thus, the favourable temperatures, salty lakes and the chlorosodic mineral springs have favoured the development of the spa from Ocnele Mari.

**The hydrography** of the Ocnele Mari area is marked by Pârâul Sărat, a rivulet whose springs lie in the north-west, in Dealul Morii, and which throws its waters into the Olt River, about 12 km away from the springs.

But the hydrography of Ocnele Mari - Ocnița area is more significant and more important with the **lakes**. The lakes from Ocnele Mari resulted, in their great majority, after the exploitation of the salt, either, in the beginning, through bell-shaped surface mines, or, later on, through a system of galleries and trapezoidal rooms of different dimensions, or in the last decennia, through the introduction of water in the underground, controlled dissolution and transport of the resulting solution by means of salt pipes to the Sodic Plants (Uzinele Sodice) of Govora and Oltchim-Vâlcea. Beside the lakes formed in the salt mines exploited at the surface from Ocnele Mari and Ocnița (*Lacul Sarat* / The Salty Lake, *Lacul Dulce* / The Sweet Lake), after 1960, following the landfall / compaction processes, the exploitation of the salt and the underground dissolution, there appeared the lakes Ocnița I, II, III, accompanied by landslide processes and the fall of the mine ceilings, which have affected many households and other infrastructure utilities (N.Popescu, Gh.Ciumpileac, M. Ielenicz, 1982) (Fig.2).



**Figure.2.** The lakes formed after the landfalls from Ocnele Mari  
(Source: www.turistinfo.ro)

The hydrochemical type and mineralization degree of the lakes, as a result of the contact with the salt massive, is chlorosodic and hypersaline (173-216 g / l at Ocnele Mari and about 250 g / l at Ocnița). In the lake from Ocnele Mari and in other smaller ones from Ocnița as well, a *therapeutic mud (peloid)* has formed as well, used in balneotherapy (T. Morariu et al., 1968).

Therapeutic muds (*peloids*) have been used in Romania for a long time but scientific studies were carried out only towards the end of the 19<sup>th</sup> century and during the 20<sup>th</sup> century. Thus, in 1931, international classification criteria and therapeutic indications were elaborated, and the term *peloid* was adopted by the International Society of Medical Hydrology and Climatology, which defined it as “*substances appearing in natural conditions under the influence of the geological processes and which, finely divided and mixed with water, are used in medical practice as baths or local procedures*” (N. Teleki et al., 1984).

In the lakes of this area – depending on their depth and the existence at their surface of a fresh water layer coming from precipitations – during the hot season, at depths of 1-1.5 m, a *helio-thermal layer* with balneotherapeutic properties appears, used in summer baths (N. Popescu, Gh. Ciumpileac, M. Ielenicz, 1982, P. Găștescu, B. Driga, Camelia Anghel, 1985).

## 2. CASE STUDY: THE MINES OF OCNELE MARI

After the ground-level exploitation during the Daco-Roman times and during the period of the Romanian Principalities, the exploitation by means of underground mines is considered to date from the beginning of the 18<sup>th</sup> century, when the first mine was opened, on the left side of the Pârâul Sărat, in the place called *Cărpiniș*. Soon after its opening, this mine crushed. It was followed by another mine, nearby, which had the same fate, leading to the appearance of a salty lake, named *Din Brazi*. At the beginning of the 19<sup>th</sup> century, two more mines were opened about 400 meters away from the first mine, out of which salt was extracted for only 15 years, in whose place there appeared the salty lake that still exists to this day, known as *Balta Roșie*. Starting with 1959 up to now, the exploitation of the salt from Ocnele Mari was realized by two methods: *wet* (by kinetic dissolution, in wells) and *dry*. In this place, there were introduced, for the first time, in 1845, the *dry method* using trapezoidal rooms, and, starting with the year 1960, the *wet method*, when the first wells for the salt extraction by dissolution were installed, as a result of the growing demand of salt for the chemical industry from the Sodic Plants of Govora and Olțchim-Vâlcea (Fig. 3).

Between 1968 and 1991, dissolved salt was extracted from Field Two (Țeica Hill) by means of 15 salt wells that produced about 16,400,000 tonnes of salt in solution, resulting into an estimative volume of underground cavities of 9,000,000 m<sup>3</sup>. Because at Ocnele Mari, on the ground level, between the locations of the salt wells, there are civil and industrial buildings, the exploitation method foreseen was based on individual wells, a method requiring the maintaining of some salt cores (pillars) in-between the underground cavities and between the cavities and the surface (ceiling platforms), meant to protect the ground area, in the zone influenced by the cavities appeared through dissolution. The underground cavities resulted



The salt exploitation activities in the underground carried out in *Fields I* and *II* were stopped, in respectively 1974 and 1993. The exploitation in *Fields III* and *IV* takes place through kinetic dissolution, by means of individual wells, and also by two wells working together (I. Onica et al., 2006).

The method of salt exploitation by dissolution used at Ocnele Mari was first applied at Ocna Mureș, in 1951, through the procedure known as *Dima procedure*. Despite all its economic advantages, the salt extraction - by means of wells - as solution at Ocnele Mari, has severe consequences on the environment, for instance those occurred during the last decennia in the *Fields I, II, III* and *IV*, situated in the area of several localities belonging to Ocnele Mari Town. The salt/saltwater exploited at Ocnele Mari is used as a raw material in the chemical industry (Sodic Plants of Govora and Olțchim, Rm. Vâlcea) to manufacture chlorosodic products.

### 3. THE IMPACT OF MINING WORK ON THE ENVIRONMENT

The assessment and determination of the impacts triggered on the lands/environment, by any resource exploitation - in our case, an underground deposit, the salt from Ocnele Mari - can be done by different methods, satellite images and in-situ monitoring, at the ground level and in the underground (Zlotariu, Violeta-Domnica, 2011, S. Arghiuș, 2002). The exploitation activity from Ocnele Mari, at the beginning - by bell-shape mines, and later on by galleries and trapezoidal rooms, by wells using solutions for dissolution, triggered different consequences at the surface of the field. While, in this area, the “ancient” exploitation left behind small depressions after the mining activity was abandoned, occupied by surface waters, resulting in the salty lakes used in balneotherapy (Sarat, Dulce, Doamnei, Covei Lakes), in the 19<sup>th</sup> and 20<sup>th</sup> centuries, the underground exploitations using galleries and trapezoidal rooms determined landfalls of the ceilings and the formation of the lakes *Ocnița I, II* and *III*, after 1968.

The morphology of these lacustrine depressions is continually changing, triggering effects on the nearby areas (Fig. 5).

Regarding the salt exploitation by dissolution from Ocnele Mari-Ocnița, realized by injecting solvent into the wells, after 1960 and until now, according to the monitoring and the studies carried out concerning the underground cavities and the impermeability of the walls, it has been noticed: the loss of the well tightness, and the unification of the cavities, caused by their dissolution in the lower part of the salt mine, by hydraulic fissuration, leading to the decrease of the strength of the surface covering the layers.

Thus, between 2001 and 2006, in *Field II*, which has 6 wells on *Țeica Hill*, a cavity/ cavern, of about 4.5 million m<sup>3</sup>, appeared, affecting an area of about 10 ha and, of course, everything on it, by landslides, landfalls.



**Figure 5.** Evolution of the lake formed by landslide/landfall in *Field II- Țeica Hill*  
(Source: www.ocne.ro)

After these phenomena, in September 2001, by the fall of the ceiling/platform over the cavity, a lake of 7,000 m<sup>2</sup> appeared, three buildings and others from the localities bordering the exploitation (about 350, until 2004) suffered damages and were moved from their place, and the uncontrolled bursting of the saltwater - which, through the Pârâul Sarat, reached the Olt river - determined the setting up of a protection zone both for people and for animals, and the exclusion of the respective areas from the economic circuit. Since the above-mentioned processes also extend to *Fields III and IV*, there are about 400 families affected, who are going to need relocation at the expense of the Ministry of Economy.

#### **4. ACTIONS FOR DIMINISHING THE IMPACT OF THE MINING EXPLOITATION ON THE ENVIRONMENT**

As for the methods that can be used to reduce the alteration of the land at the ground level, the studies carried out suggest several methods (I. Onica, 2001; L. Boachen, 1993):

*The creation of safety pillars* represents the safest method of protecting the ground level and the underground mining works and consists in maintaining in the salt massive some portions of non-extracted salt, to exempt the area from the influence of the exploitation.

*Compact filling.* The data resulted out of the observations made indicate that the maximum subsidence of the surface land is closely connected to the thickness of the salt deposit and to the pressure control method. The maximum subsidence is of about 60-80% of the extracted thickness of the salt deposit, when the mining pressure is used to completely extract the rocks of the ceiling. For a compact filling, like, for example, the hydraulic filling using sand, the maximum subsidence is of only 6-10% of the extracted thickness of the salt deposit. The compact filling extension depends on the applied technological filling procedure and on the type of material used for filling. According to the observations of Whittaker B. N. and

Reddish D. J., in 1993, it appears that in the case of the control of the pressure by means of stacks and if the rocks of the ceiling collapse, the maximum subsidence can reach 90% of the extracted height of the deposit, i.e. for ratios  $w/h$  of or over 1.4 (where:  $w$  is the width of the exploited zone, and  $h$  is the average depth at which the salt deposit lies). Also, for the case of pneumatic filling, the maximum subsidence is around 45%, and for the hydraulic filling, of about 15-20%. The experience in the use of filling indicates that in order to significantly reduce the subsidence, the  $w/h$  ratio must exceed 0.6.

*Partial exploitation* or the exploitation with abandoned pillars is used with good results in coal and ore mines, to reduce the modification of the ground area. In this case, the salt deposit can be extracted between 50 and 60%. If the partial exploitation is combined with a hydraulic filling, the possible maximum subsidence is of 2% of the extracted thickness of the salt deposit, and if it is combined with the landslide of the surrounding rocks, the maximum subsidence is around 3-10%.

*Thes multaneous exploitation of the lamellae* - with a well-determined offset between banks - may reduce the influence on the ground level, which is a specific effect in harmonic banks (I.Onica, 2001).

*Exploitation at certain time intervals.* It is important in the case of partial exploitation. After the exploitation of a portion of a salt deposit, it is necessary for the subsidence to stop or decrease; the remaining portions of the salt deposit are exploited later on, so that the total movement of the land is reactivated after a certain period of time. It is a very efficient method for the protection of the buildings situated at the surface, combined with the lamellae method, and they are the best methods of reducing the cumulated effects triggered by underground excavations (L. Baochen, 1993).

*Harmonic exploitation:* it is one of the most efficient methods of protection of the buildings on the ground level against the destructive effects of the underground exploitation. The method can be practiced when several close layers are simultaneously exploited and when the exploitation is to be done so that the traction deformations of one bank may overlap over the compression ones of the other bank. As they balance each other, the destructive effect on the ground level is reduced to the minimum. The harmonic banks method can be applied to exploit the packages of layers in the safety pillars of the wells or those situated under some surface constructions (L.Baochen, 1993).

## **5. THE SAFETY OF MINING OPERATIONS AND THE ENVIRONMENTAL IMPACT**

The regulations on the closure of the salt mines are presented in the *General Mine Closure Textbook*, based on the Mine Law no. 85 / 2003. According to this

law, there are several stages that need to be followed when exploitation and processing plants are closed. Also, it is mentioned that mining activities shall be realized only within some areas authorized by the competent authority, for this purpose, the exploration shall be carried out based on an exclusive licence granted for any of the mineral resources discovered in an area, on request, to the concerned Romanian or foreign legal persons, and the owner of the exploration licence shall submit to the competent authority biannual and annual reports on the activity carried out and on the expenses pertaining to it etc.

*Salt mining involves a series of public safety and environmental risks and, particularly, a series of risks for the staff of the mining company. According to the international practices, risks can be controlled as follows:*

- The mine has to be maintained in a stable condition from a geo-mechanical perspective, in any situation. A particular attention - in the context of the international standards – needs to be paid to the mine ceiling, to the safety pillars and to the general dimensions of the mine.

- If solid salt is mined, and particularly when it is mined by dissolution, the compatibility with the international standards must be assured, regarding the ceiling dimensions and distances to the salt massive flanks, to avoid, in this way, the disturbance of the ground area.

- To avoid the uncontrolled water or saltwater infiltrations in the salt deposit, a very strict control of the water balance on the salt block level has to be applied. The quality and quantity of water and saltwater present in the infiltrations and exfiltrations has to be controlled very rigorously.

- Salt block exploitation may generate CO<sub>2</sub>, CH<sub>4</sub> and other gases; consequently, it is permanently necessary to monitor and control them.

- The vertical movement monitoring must be carried out within a predetermined network, on the exploitation surface and in the main underground galleries. The monitoring of the convergence processes in the underground rooms is also necessary.

- The monitoring takes into consideration the underground water quality, as it has to observe the allowed limits for discharge.

Also, the mine closure process must have in view the recovery of the environment in the area of these exploitations by: wastes and water management, protection of soil, air quality and biodiversity, access to and sharing of the environmental information, crossborder effects, health and safety. Other settlements regard the following: public auctions, content and format of certain technical documents, authorization of some experts or institutions (for example, protection against explosions).

## 6. THE UTILISATION OF THE SALT DEPOSITS AND THE TOURIST POTENTIAL IN OCNELE MARI

It is well - known that “during the decennia at the turn of the 19<sup>th</sup> century, the salt was used by the local people also as salty water from the salt massifs of Oltenia. The water stored in the abandoned holes of the old-time quarries once present at Ocnele Mari, as well as the water from the freshly excavated salt mines... that collapsed... serves not just for the preparation of food, but also for healing purposes” (A. Pricăjan, 1999).

From the first written mention of Ocnele Mari locality (in whose vicinity, at Cosota, there were discovered, in 1960, the ruins of the Dacian settlement – *Buridava*), its development has been determined by the exploitation of the salt deposit, since the time of the Dacians, i.e. 103 AD.

The first mention of Ocnele Mari locality dates back to the year 1373 (March 13), in a document by which the trade of the salt from Ocnele Mari to the west of the country is forbidden. During the reign of Mircea cel Bătrân of Wallachia, the salt from Ocnele Mari was also used to pay for the building of the strongest Danubian fortress (at that time), namely that of Giurgiu, where it is said that each stone of the fortification cost a salt lump (L. Badea et al., 1970).

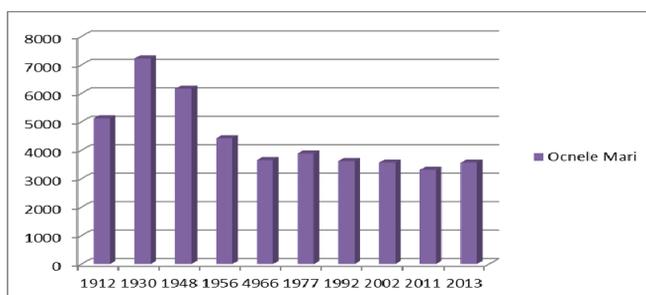
The salt deposit of Ocnele Mari-Ocnița has been known since the times of the Dacians and Romans, but it was exploited more intensely during the following centuries. Numerous documents, issued by the royal offices of Mircea cel Bătrân of Wallachia, Vlad Călugăru, Radu cel Mare, Vlaicu Vodă, Radu Paisie, Simion Movilă etc. mention *Ocna cea Mare* (the Great Salt Mine), and the exploitation and use of the rich deposit. In 1616, Ocnele Mari is known as a “*princely fortified town*” due to its salt trade.

It is in Ocnele Mari that the well-known “*salt road*” set out to the Danubian river ports, this activity representing *the first economic function of the locality*. The second economic function, obvious at present, is the *tourist* one, based on the salty lakes of the abandoned or fallen salt mines, the therapeutic muds (peloid) and the salty springs with balneotherapeutic feature

The balneotherapeutic use of the salty waters dates back to the first half of the 19<sup>th</sup> century (1833) at *Balta Roșie*, a mine mouth about 120 m deep appeared in 1812 by the landfall of the salt mine. The water was chemically analyzed for the first time in 1863.

The development of the salt exploitation at *Ocnele Mari-Ocnița*, as well as the presence of its hydromineral resources beneficial in different medical conditions, have determined a fluctuating evolution of the population, which recorded some moments of growth, between 1912 and 1948, followed by a continuous decrease until 1966. The trend was again rising between 1966 and

1977, and then decreasing until 2001. Then, there came a period marked by an increase of the number of inhabitants, due to the promotion of the existing balneotherapy tourism, which determined an increase of the number of jobs, and implicitly, a higher economic safety for the inhabitants (Fig. 6).



**Figure 6.** Trend of the population number between 1912 and 2013  
(Source: procesed data taken over  
from the Statistical Office of Vâlcea County / DJSV)

The analysis of the ethnic and confessional makeup of Ocnele Mari in the year 2013 highlights a prevalence of the Romanian ethnic citizens correlated with the predominance of the Orthodox religion.

**The balneotherapeutic patrimony** of Ocnele Mari-Ocnița – a patrimony with a long history – constitutes an important source for the development of the tourist function of the area. It includes the helio-thermal salty lakes turned into swimming pools such as *ștrandul fără fund* (the bottomless pool) - Ocnele Mari, the swimming pool from Ocnița, arranged in 1900 by Colonel Dianu, the four mineral springs on the right flank of the rivulet Pârâul Sarat.

The **salt mine** from Ocnele Mari, arranged and included into the tourist circuit in 2009, considered one of the largest in Romania (about 25,000 m<sup>2</sup>), contains playgrounds for children, a cinema, a bar/restaurant, a mini baschetball field, the biggest church in Romania, a salt museum and others.

The saline environment benefits from a constant temperature of 14-15°C and is recommended for the treatment of the respiratory system. To all the above-mentioned, there are associated not only numerous archaeological vestiges, Subcarpathian sceneries with special features, but also places of bitter memories such as former prisons. The first of these prisons disappeared in 1948 by a landslide, as it was placed on top of the collapsed area, and the second, dating from the communist times, held, among many other intellectual protesters against communism, the well-known philosopher, Petre Țuțea. The town also hosts two other tourist sites-the ruins of the *Buridava* fortress - declared a historical monument and a place declared a natural reserve (layers of white-yellowish

Cretaceous chalk present on the ground level) named *Evantaiul (The Fan)* by the local people living nearby. In the year 1948, Ocnele Mari locality was declared a climatotherapeutic and balneotherapeutic resort and in 1960 it was reclassified as town, after having been previously downgraded to the rank of commune (Fig. 7, 8).



**Figure 7.** Evantaiul (The Fan)  
(Source: [www.hoinari.ro](http://www.hoinari.ro))



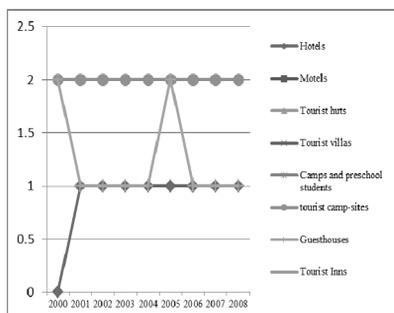
**Figure 8.** Buridava Castrum  
(Source: <http://ro.wikipedia.org>)

The salty lakes from Ocnele Mari (Balta Roșie, Baia Dulce, Baia Sărată, Salinei Lake), several swimming pools with salty water, the mineral springs constitute an important balneotherapeutic potential.

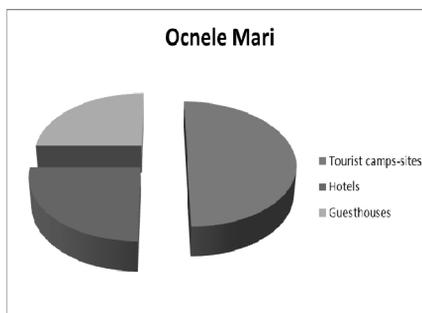
Consequently, the *balneotherapeutic potential*, represented by the concentrated salty mineral water, which comes from the heliothermal lake from the locality, with a mineralization of over 200 g/l, sapropelic mud extracted out of the lake with a content of 51g% water, and a sparing bioclimate, is recommended for: degenerative rheumatism, post-traumatic diseases, peripheral neurological diseases, gynecological and cardiovascular diseases. The above-mentioned affections are cured in the *treatment facility* from **Ocnele Mari – Ocnița**, established in the resort park, consisting of valves, facilities for gynaecologic treatments and mud procedures, installations for hot baths with salty waters, vaginal irrigations using salty water, installations for treatment with hot mud, facilities for helio-therapy, treatment with cold mud followed by open-air baths in swimming pools etc.

Regarding the periods of valorization of the balneotherapeutic resources, *the accommodation infrastructure* has evolved in time, from the lodging places provided by the local people, to those provided by hotels, boarding houses, camping facilities etc. Between 2001 and 2002, a tree-star hotel, numerous boarding houses and leisure houses, 2 camping areas, and 3 surgeries for medical service were built. Also, some of these accommodation structures have small treatment facilities, where clients are efficiently treated (ex. *Buridava Boarding House*, Ocnele Mari). Near the *Salus* swimming pool, situated at the entrance of the

resort, there is a camping area offering a number of 40 camping places, operating seasonally, and 48 places in 9 wooden cabins (Fig. 9, 10).



**Figure 9.** Evolution of the accomodation units (2000-2012)  
(Source: procesed data Taken over from DJSV)



**Figure 10.** Proportion of lodging places (2000-2012)  
(Source: procesed data Taken over from DJSV)

## CONCLUSIONS

The mining industry contributes to a special extent to environmental pollution, by the high quantities of wastes that it produces.

The activities of salt exploitation from Ocnele Mari - through the procedure of kinetic dissolution of the salt by injecting a solvent through wells, which are to some extent spaced in the well fields - trigger negative effects, such as pillar dissolution and unification of the dissolution rooms in the exploitation fields, for example in *Fields I* and *II*, accompanied by landfalls/landslides of the ground level.

Also, in time, associated negative phenomena have occurred, such as: gas emission increase ( $CO_2$ ,  $CH_4$ ), accentuated pollution of the environment by saltwater, damage of the access roads to the salt quarries, soil degradation and decrease of the soil fertility class on the ground level around the salt mine, disturbance of the physico-chemical equilibrium of the soil (triggered by the high salinity). To all the above-mentioned aspects, one can add the financial loss, by the payment of compensations by the State to the owners of the households affected.

To prevent/diminish the negative consequences, it would be necessary to stop the exploitation of the wells existing in *Fields I* and *II* and strictly monitor those in *Fields III* and *IV* which do not raise significant problems and could continue to operate. For the profitable use of the extremely valuable balneotherapeutic potential, investments are needed to modernize and develop the treatment facilities and the tourist infrastructure, accompanied by systematic environmental actions meant to protect the revitalizing natural landscape, so that Ocnele Mari resort may become at least a regionally important spa.

## REFERENCES

1. Anghiuș, S.(2002), *Studiul deplasării suprafeței sub influența exploatării subterane a zăcămintelor de lignit din bazinul Olteniei*, Teză de doctorat, Universitatea Petroșani
2. Badea, L., Rusenescu, Constanța, (1970), *Județul Vâlcea*, Colecția „Județele Patriei”, Institutul de Geografie, Edit.Academiei Române
3. Bendea, H. (2000), *Urmărirea prin metode topografice și cavernometrice a deformațiilor determinate de golurile subterane în perimetrul minier Ocnele Mari*, Teză de doctorat, Universitatea Petroșani
4. Cobălcescu, Gr. (1983), *Formațiunea saliferă sau Secunda Formațiune Mediterană*, în Figuri de geologi români de Ilie,M.,Edit.Științifică,1958
5. Fodor, D., (2006), *Influența industriei miniere asupra mediului*, Buletinul AGIR nr.3/2006
6. Găștescu, P., (1971), *Lacurile din România.Limnologie regională*, Edit.Academiei Române
7. Găștescu, P., Driga, B., Anghel, Camelia (1985), *Noi posibilități în valorificarea lacurilor helioterme din R.S.România*, SCGGG-Geografie, T.XXXII, București
8. Ilgaier, F.K., Brown, T., Johnson, K., Siegel, J., Desautels, J.H. (1997), *Environmental Effects of Mining, Mining Environmental Handbook: Effect of Mining on the Environment and American Environmental Controls on Mining*, Editor Jerrold J. Marcus, Imperial College Press, London
9. Morariu, T., Morariu, E., Savu, Al.(1968), *Lacurile din România. Importanța balneară și turistică*, Edit.Științifică
10. Onica, I., 2001, *Impactul exploatării zăcămintelor de substanțe minerale utile asupra mediului*, Edit. Universitas, Petroșani.
11. Onica I., Cozma E., Goldan, T. (2006), *Degradarea terenului de la suprafață sub influența exploatării subterane*, Buletinul AGIR nr.3/2006
12. Popescu, N., Ciumpileac, Gh., Ielencz, M.(1982), *Valea Sărată și complexul lacustru Ocnia*, SCGGG-Geogr.,XXIX,București
13. Pricăjan, A. (1985), *Substanțele de minerale terapeutice din România*, Edit.Științifică și Enciclopedică, București
14. Pricăjan, A. (1999), *Din trecutul balnear al României*, Edit. Științifică, București
15. Tamaș, C.,(1995), *Istoria Ocnelor Mari*, Edit.Conphys, Râmnicu Vâlcea.
16. Sorocovschi, V.(2005), *Prevenirea riscurilor naturale*, în „Riscuri și catastrofe”, an IV, nr.2, Casa cărții de știință, Cluj-Napoca
17. Sorocovschi, V.(2005), *Prevenirea riscurilor naturale*, în „Riscuri și catastrofe”, an IV, nr.2, Casa cărții de știință, Cluj-Napoca
18. Teleki, N., Munteanu,L., Stoicescu, C., Teodoreanu, Elena, Grigore, L. (1984), *Cura balneoclimaterică în România*, Edit. Sport-Turism, București
19. Teodoreanu, Elena, Gaceu, Ov., (2013), *Turismul balneoclimatic în România*, Edit. Universității Oradea
20. Whittaker, B.N., Reddish, D.J. (1993), *Subsidence Behaviour of Rock Structures*, Comprehensive Rock Engineering Principle, Practice& Projects, ed. J.A. Hudson, Pergamon Press Ltd, Oxford
21. \*\*\*(1994), *Studiu hidrogeologic si geomecanic al perimetrelor de exploatare Ocnele Mari si Ocnita*, S.C. ICPM S.A Cluj-Napoca