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DOCTORAL THESIS

SUMMARY

THE GEOMORPHOSITES ON SALT FROM TRANSYLVANIA DEPRESSION AND TOURISM AND THEIR TOURISTIC VALUE

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SUMMARY

INTRODUCTION 1

1. TRANSYLVANIA DEPRESSION: GEOGRAPHIC LOCATION, BORDERS AND GENESIS 3

1.1. Geographic location of Transylvania Depression 3

1.2. Transylvania Depression borders 4

1.3. Genesis and evolution of Transylvania Depression 6

2. SALT IN TRANSYLVANIA DEPRESSION 12

2.1. History of the research on salt deposits from Transylvania Depression 14

2.2. Salt genesis from Transylvania Depression 16

2.3. The tectonic of salt 19

2.4. The evolution of salt exploitation methods in Transylvania Depression 21

2.4.1. Surface exploitation method of salt 23

2.4.2. Bell chamber exploitation method 31

2.4.3. Systematic exploitation method 38

2.4.4. Exploitation with chambers and small pillars method 41

2.4.5. The method of salt exploitation in diluted solution 43

3. METHODOLOGY 45

3.1. Geosites and geomorphosites – concept and content 45

3.2. Short history of geomorphosites researches 49

3.3. Evaluation methods of geomorphosites 51

3.3.1. Coratza and Giusti method 52

3.3.2. Serrano and Gonzales-Trueba method 54

3.3.3. Bruschi şi Cendrero method 55

3.3.4. Pereira method 56

3.3.5. Reynard method 58

3.3.6. Pralong (2005), Cocean (2011) method 59

3.4. Mapping methods of geomorphosites 62

4. THE MORPHOLOGY OF SALIFEROUS AREAS FROM TRANSYLVANIA DEPRESSION 65

4.1. The morphology of Ocna Dej saliferous area 69

4.2. The morphology of Turda saliferous area 74

4.3. The morphology of Cojocna saliferous area 82

4.4. The morphology of Ocna Mureş saliferous area 84

4.5. The morphology of Ocna Sibiului saliferous area 88

4.6. The morphology of Praid saliferous area 98

4.7. The morphology of Sovata saliferous area 108

4.8. The morphology of Jabeniţa saliferous area 118

5. EVALUATION OF THE GEOMORPHOSITES ON SALT FROM TRANSYLVANIA DEPRESSION 122

5.1. Evaluation method of geomorphosites on salt 122

5.2. Evaluation of geomorphosites on salt from Ocna Dej 130

5.3. Evaluation of geomorphosites on salt from Turda 133

5.4. Evaluation of geomorphosites on salt from Cojocna 138

5.5. Evaluation of geomorphosites on salt from Ocna Mureş 140

5.6. Evaluation of geomorphosites on salt from Ocna Sibiului..... 142
5.7. Evaluation of geomorphosites on salt from Praid……..... 144
5.8. Evaluation of geomorphosites on salt from Sovata..... 150
5.9. Evaluation of geomorphosites on salt from Jabeniţa..... 154
5.10 Short hierarchization of geomorphosites on salt from Transylvania Depression …….....…… 156
6. TOURISTIC VALUE OF THE GEOMORPHOSITES ON SALT FROM TRANSYLVANIA DEPRESSION..... 159
6.1. Touristiv value of the geomorphosites on salt from Ocna Dej..... 160
6.2. Touristiv value of the geomorphosites on salt from Turda…..... 164
6.3. Touristiv value of the geomorphosites on salt from Cojocna..... 171
6.4. Touristiv value of the geomorphosites on salt from Ocna Mureş..... 173
6.5. Touristiv value of the geomorphosites on salt from Ocna Sibiului..... 176
6.6. Touristiv value of the geomorphosites on salt from Praid……..... 180
6.7. Touristiv value of the geomorphosites on salt from Sovata..... 189
6.8. Touristiv value of the geomorphosites on salt from Jabeniţa..... 194
CONCLUSIONS..... 197
REFERENCES..... 200

INTRODUCTION

The paper studies the landforms on salt from Transylvania Depression and they're capitalization in tourism, in a new perspective, through geomorphosites. By this approach, the landforms with special appearence are identified and evaluated, which by themselves or together with other bioecologic or cultural elements, form objects of natural heritage.

There are studies currently that deal with the therapeutical value of salt waters and saliferous microclimate. The objectives of the paper are to emphasize also other values of the landforms on salt, like theirs landscape, scientific and educational potencial. This could influence the development of new touristic activities in the saliferous areas.

The geomorphosites where evaluated based on a method consisting in 3 parts, which pursued to evaluate the most detailed and accurate geomorphological values, like the estetic, ecologic, scientific, cultural and touristic.

For a better understanding and a better touristic promovation of the geomorphosites on salt, we have made a series of cartographic representations, which set out the main geomorphological and touristic elements, for each saliferous area in part.

In the paper we have selected and analised geomorfosites from eight saliferous areas of Transylvania Depression, the most representative from the touristic point of view.

Key words: Transylvania Depression, salt, geomorphosites, tourism.

1. TRANSYLVANIA DEPRESSION: GEOGRAPHIC LOCATION, BORDERS AND GENESIS

Transylvanian Depression has formed during the Alpine cycle orogenesis and it is the largest diving morphological area from Romania. It is located in the center of the country, being surrounded by the Carpathian Mountains, this being the reason why it has received the "intra-Carpathian depression" attribute (Mihailescu, 1963).

Transylvanian Depression is borderd in the north-western and partial in the northern part by the Meseş, Ţicău and Preluca Mountains, in the western part by Trascău, The Big Mountain and the Gilău Mountains and in the southern part by the Făgăraş, Cândrel and Şureanu Mountains.

The south-eastern and eastern border is composed of the Perşani, Harghita and Gurghiu Mountains, and in the northern and northeastern part, the depression is bordered by the crystalline mountains Rodnei and Perşanilor and by the volcanic mountains Ţibleş and Bârgău (Irimuş, 1998).

The genesis of the Transylvanian Depression is closely related to the genesis of the Carpathian Mountains which surrounds it.

The paleogeographical evolution of the Transylvanian Depression was done in three phases: the pre-Badenian or pre-depressionary Phase, the Badenian-Pannonian Phase also known as the bassinary Phase and the post-Badenian Phase (Irimuş, 1998).

During the *pre-depressionary Phase (pre-Badenian),* after the subhercinic movements, the first outline of the Transylvanian Depression appeared.

Defining it as an individual unit has been made after its fragmentation, on a system of faults and fractures, of the Transylvanian-Pannonian plate during its travel to the Eastern Carpathians curvature.

The *Badenian Phase* is a fundamental step in defining the geographical identity of the Transylvanian Depression, this being, otherwise, the stage that interest us most, because during this period the salt has acccumulated, this being the main subject of the study. It began with the transgression of the Badenian deposits over the older formations, the first deposited formation being the *Ciceu-Giurgesti* one (Smith, 1970), followed by the *Dej formation* (Smith, 1970) which includes the *"Dej Tuff Complex"* (Moisescu and Popescu, 1967) composed of tuffs, tuffite, clay and marls. The Dej tuff is spread throughout the entire Transylvanian Basin, beein the evaporits support, from which salt is the most important one.

The salt age from the Transylvanian Basin is Badenian – Wielician, and from a tectonic point of view it appears in three forms: salt lenses, diapirs and salt domes.

At the end of the Badenian a series of tectonic events took place which have emphasized the morphological and tectonic unevenness between the Carpathian frame and the depression (Irimuş, 1998).

Following the withdrawal of the Sarmatian brackish waters, the organic material was sedimented as sapropelic mud, leading to the formation of methane gas deposits, accumulated in domes or brahianticlines (Mészáros and Mac, 1995).

The Basin phase ended with the submission of the pannonian deposits represented by bedrocks and sandstones with volcanic tuffs levels and molluscan fauna specific to milded sea waters, after which it began to gradually clogging the Transylvanian Depression.

During post-Pannonian phase (glypto-genetic) the Carpathians lift continues and also a slight lifting of the depressions building structure. During the same period takes place the outlining of the freshwater systems and mass movements from anticlines and brahianticlines to the synclines and brahianticlines (Irimus, 1998).

2. SALT IN TRANSYLVANIA DEPRESSION

In Transylvania Depression, salt is present in a significant percentage, both solid in the lithosphere and dissolved in the hydrosphere.

The most discussed issues by researchers in the fields of geology and geography are: the origins of salt, its “moving” mechanism and the way that it takes its shape. Over the time several hypotheses, to explain these processes, were developed.

A *first hypothesis* is the *marine-lagoon origin* of salt, issued by Bischoff (1847), who believes that marine waters concentrated in lagoons that communicated with other seas just on the surface, in the depth they are separated by some thresholds. This hypothesis was supported and discussed over the years by many other researchers. Ochsenius (1877) called this thresholds "bars", from where "bar theory", and believes that sea water could not pass by them only in certain periods (Draganescu, 1997). Because of this lagoon, waters did not mix completely with the sea water, resulting the concentration, precipitation and deposition of salts according to the degree of solubility.

According to Paucă (1967), marine salts began to settle into a system of lagoons with different sizes and low depths, duet o an arid climate, slow subsidence of the bottom of the lagoons, and the presence of a large barrier system. The role of the small intermittent lagoons was "to retain from the sea water, at low concentrations, but at high temperatures, calcium carbonates and magnesium, which are deposited as dolomite" (Paucă, 1967), in the big transylvanian lagoon (represented by the Transylvanian and Maramures Basin) bringing water just loaded with sodium, potassium and magnesium, which through the cooling process filled it only with rock salt (fig. 1).

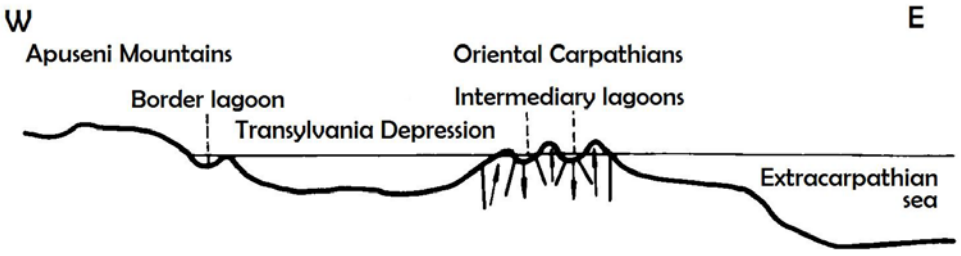

Fig. 1. Intermediary lagoon configuration (M. Paucă, 1967)

Bet on the investigations carried by Dragoş (1969) he concludes that salt is deposited transgressive on a premiocen landscape inside a marine basin, to depths of several hundred meters, isolated from the ocean by a high threshold. This hypothesis was resumed and recently supported by a number of publications from researchers as Peryt et al. (2002, 2006), Krézsek şi Filipescu (2005).

Tectonic hypothesis belongs to Mrazec (1927) and is the most plausible explanation of how salt massives evoleved in the Romanian Subcarpathians, the author calling the process of underpushing „diapirism" and he believes that the nature of this process is exclusively tectonic.

Isostatic hypothesis argues that raising of the salt takes place on tectonic fault lines, due to its high elasticity and its lower weight compared with that of the covering layers pressing on it.

Salt tectonic processes are defined by movement of masses of rock salt from the earth crust. Tectonic development conditions are: the presence of sufficiently thick layers, positive difference between the average specific weight of rock above the salt and specific gravity of the salt, uneven load distribution over the salt.

Salt acts as a plastic material. Under the action of tectonic forces, it is moving from its original position, migrating to areas less loaded, causing a thickening of the salt layers (anticlines or brahianticlines). Salt accumulation push sedimentary layer from above and sometimes pierces it, creating diapirs with piercing kernels.

Due to diapiric folds from Transylvania Depression, the diapirism occurs in various forms, generating several tipes of tectonic folds: salt massives, found in the est and west sides of the basin, elongated anticlines and synclines diapirs, short isolated folds and salt lenses situated in the north and south sides of the basin.

Other studies on the salt from Transylvania were carried out by: Hauer şi Stache (1863), Posepňy (1867), Koch (1900), Mrazec (1907,1916, 1932), Athanasiu (1913, 1914, 1915), Voiteşti (1922, 1924), Maxim (1929, 1930, 1936, 1943, 1961, 1962), Stamatiu (1943), Iorgulescu et. al. (1962), Ionescu şi Zârnovan (1966); Stoica (1966), Paucă (1967), Ciupagea et al. (1969, 1970); Bucur (1970, 1971), , Atudorei et. al. (1971), Visarion (1972); Stoica and Gherasie (1981), Giuvulescu (1982), Mârza (1985, 1991); and more recen tones are the studies of: Mészáros (1989, 1991, 1995, 1997), Balintoni (1998, 2002), Irimuş (1998, 2006), Petrescu (1994, 2003, 2006), Filipescu (1994, 1996, 2002), Krézsek (2005, 2006), and many others.

Salt has played and still plays a very important role in the development of human society, proven by the mining „marks" left since ancient times. Evidences about salt mining in Romania are among the oldest in the world. Salt mining methods have evolved over time from mining pit to exploitation through dilution.

Transylvanian mining methods can be divided into: open pit mining, bell-shaped mining, systematic mining, mining of rooms with square or rectangular pillars and exploitation in solution (Drăgănescu şi Drăgănescu, 2001).

Today, in Transylvanian Depression, longer perates only the mine fields from Praid and Ocna Dej, dry extraction, and Ocna Mures extracts through solution.

3. METHODOLOGY

A new direction of relief investigation with broad applications meanings, and whose focus is on direct ratio of relief and its tourism recovery, is the geomorphosites and geosites.

Geomorphosites are defined as *" landforms and geomorphological processes that have acquired a landscape / aesthetic, scientific, cultural / historical and / or social / economic value due to human perception or its exploitation "* (Panizza şi Piacente, 1993, 2003).

The first reference about geomorphosites appears in 1960 in the UK (Watson and Slaymaker, 1966), but this new study direction takes a special amplitude from the 90s. Inventory and evaluation of geomorphosites becomes the main concern of many geologists and geomorphologists from Italy, Spain, Switzerland, UK, Portugal and since 2000s also among geomorphologists from Romania. The delimitation of the field of study, defining concepts, develop and propose methods for assessing and mapping geomorphosites, became the subject of study for many geologists and geomorphologists as : Reynard, (2004, 2005, 2007, 2009), Pralong (2004), Panizza, (2001), Panizza şi Piacente (2003),Wimbledon, (1996), Grandgirard (1997,1999), Avanzini şi colab. (2002), Serrano (2002). Bertacchini et al, (1996), Piacente (2001), Carton et al. (1994, 2005), Castaldini et al. (2005). Among the romanian geographers, with studies towards this area we can note Ilieş and Josan (2007, 2008, 2009) from the University of Oradea and Comănescu with Dobre (2009) from the University of Bucureşti.

From the methods of assessment, six of them stand, the ones from the IAG workgroup. These methods have been proposed by Coratza and Giusti in 2003 (Modena şi Reggio Emilia University), Bruschi and Cendrero in 2005 (University from Cantabria), Serrano and Trueba in 2005 (Valladolid University), Reynard in 2007(Lausanne University), Pereira in 2006

(Minho University) and Pralong in 2005.

About geomorphosites mapping method, precious information are given by Carton et al (2005) and Castaldini (2005), proposing simplified maps, easy to read by the tourists uninitiated in earth sciences.

4. THE MORPHOLOGY OF SALIFEROUS AREAS FROM TRANSYLVANIA

The salt formations from the Transylvanian Depression, on which the method of inventory and assessment of the geomorphosites have been applied, are: Praid, Sovata, Turda, Ocna Mureş, Ocna Dejului, Ocna Sibiului, Cojocna and Jabeniţa (fig. 12). The reason these eight areas were chosen and not others saliferous areas within Transylvanian Depression is their tourist importance and usefulness, already known for more than a century.

Ocna Dej deposit is located in the northwestern part of Transylvanian Basin, 3,5 km southwest of the Dej city, and is quartered in Badenian age deposits. The salt rock belongs to Ocna Dej formation, which orders the continuity of sedimentation over the Dej Formation, and develops as lens, involving in its diapir raising intercalations of carbonate clays, clays and tuffs.

The salt exploitations from here are very old, traces of exploitation, from Roman and the Middle Ages times have been found. By the last 180 years, the operation continued without interruption.

The most significantly implications of the presence of salt on the landscape morphology in Ocna Dejului saliferous area are occurrences and development of instability phenomena, both underground and on the surface, in the area of influence of underground voids, resulted from operating activities of salt. Thus, near these operations appeared subsidence depressions.

Instability phenomena, widespread in the Ocna Dejului area, are caused, mainly, by high gradient slopes, geological structure, respectively, the presence of impermeable marls and clays, covered with high permeability rocks and the presence of groundwater near surface.

Salt massifs from Turda, on the backs of which are salt lakes, are located in the north-eastern extremity of the Turda town, near the Apuseni mountain block, contact with sedimentary basin, situation that is felt in the region geological structure and morphology (Maxim, 1943).

First massif, is the one from Salt Bath (Roman) area, situated on the left bank of Arieş, overlaps on the northeastern extremity of the Ocna Mures - Turda anticline, geographically located over the area of Turda Salt Baths micro-depression, 2 km north-east from the town center.

Turda - Salt Valley salt deposit is located about 1,2 km north-west of Turda Baths deposit , and is developed on the Mihăieşti – Ploscoş anticline, in Salt Valley, north of Ocnei Hill (Mera, 2007).

Turda – Bath microdepression is combe type, elongated oval shaped, in accordance with the orientation and configuration of the salt massif that has carved. It was sculpted by the action of Arieş erosion and by dissolution processes carried out by the infiltration waters. Finalization of current morphological aspect was made by dissolving processes, settlement, collapse, landslides, land denudation processes and of course anthropic activities.

About Ocnei Salt Massif, it presents, mostly, the appearance of a lens oriented northeast - southwest, along the Salt Valley, close to Treasure Hill.

Concerning these two areas (Salt Baths and Salt Valley), strong erosion and dissolution phenomena occurred in the Pleistocene, when it was carved in salt massif, Bath Salt microplateau, respectively Salt Valley. Following these processes, resulted a specific landscape of the areas with salt deposits, characterized by flat and absolutely horizontal bottom of the Salt Valley and Salt Bath microplateau.

Roman Lakes (Bottomless Lake, Roman Lake, Nightingale Lake, Cichi Lake) are placed on an alignment oriented VVS - SE - NW, and are located in the Salt Baths microplateau. Lakes depth is between 5 and 17 m, and salinity varies from one lake to another. On the bottom of the lakes are accumulations of black and gray-blak mud.

Salt lakes, grouped under the generic name "Ocnei Lakes", total of 6, are located in the southern extremity of Salt Valley. The main lakes are: Carolina, Durgău, Sweet, Ocnei, Round and Sulfide. Lakes in this area have depths between 2 and 36 m and different degrees of salinity.

Cojocna Salt Baths region is located at the transition from the Transylvanian Plain in the highlands of Feleac, on a diapir structure, that takes place on the Ocna Dej - Săcălaia - Sic - Gădălin - Cojocna - Turda - Ocna Mureş alignment. Cojocna salt massif is situated in a land depression, which is actually an old area of streams confluence, today, mostly drained. The only permanent watercourse that crosses the area is Salt Creek, who individualized a

microplateau with flat bottom and steep slopes, cuesta type, occupied by the hearth village (Alexe, 2007).

Mining of salt deposit from Cojocna are quite old, and occurrence of the groundwater to the surface led to the drowning of mines and subsequent formation of the salt lakes.

Durgău Lake is the most important lake from Cojocna, is an antroposalted lake that was formed after the collapse of the ceiling of two bell type neighboring mines.

Ștrand Lake is the oldest antroposalted lake from Cojocna, and was formed from the collapse of a bell type mine which was located at the base of the western slope of the Cojocna microplateau (***, 2005).

Salt massif from Ocna Mures is situated on the left bank of the Mureş and stands out in the axial Ocna Dej - Sacălaia - Sic - Gădălin - Cojocna - Turda - Ocna Mureş anticline. Massif back is curled and karstificated, and the deposit bed is easily vaulted.

Direct contact of the salt rock with the quartered waters in the aquifer from the outcrops area of the deposit, led to the development of the shallow karst phenomena, on the backs of salt, and further to collapse of alluvial deposits, to the creation of a wide diving river bed (***, 1997).

Genesis of the lake complex from Ocna Mures has an anthropic nature. Lakes from here are the result of repeated crumbling and collapses of the ceiling of the old mining galleries, and water filling of the voids formed. The degradation of the salt massif from Ocna Mureş was developed and accelerated, mainly, by irrational exploitation of salt deposits to which were added natural conditions like high porosity of the salt and the presence of an increased number of sandstone and marl-clay intercalations.

Salt deposit from Ocna Sibiului is located at the southern end of the Ohaba - Prisaca - Ocna Sibiu anticline, and is one of the oldest exploited salt massif from Transylvanian Depression.

Erosion exerted by Târnava Mare, who, in the geological past, flowed over the salt massif gave rise to a dolinar microplateau, buttonhole type. Its edges are steep, cuesta-looking, and are attacked by gully erosion and landslides (Balteş şi Nistor, 1986). Inside, microplateau presents a chaotic landscape, the result of karstification processes of the salt massif combined with fracture systems.

Salt massif erosion facilitated the early exploitation of the deposit, and in the holes resulted by the collapse of these abandoned mines current antroposalted lakes were formed. Carstosaline lakes were formed in sinkholes resulted from compaction of the salt roof or

collapse of caverns, generated by the karstification processes of the salt massif surface by the groundwaters and infiltration waters (Pânzaru, 1982).

Lacustrine complex currently includes a total of 14 lakes, all of them located in the eastern part of the village on the salt massif. From all 14 lakes, only 2 of them are carstosaline, the remaining 12 being antroposalted. To be analyzed more easily, lakes were divided in three areas: lakes from the Ștrand Bathing Complex (Horea L., Cloşca L., Crişan L.), lakes from Station Park (Bottomless L., Canvas L., Cats L.) and outer lakes (Ocnita-Avram Iancu L., Mud L., Black L., Swallow L., Auster L., Gura Mine L., Brâncoveanu L., Green L.).

Praid Basin is located on the eastern frame of the Transylvanian Basin, at the base of Gurghiu Mountains, forming a well-defined micro-region called "Salt Mines Zone". Salt massif from Praid has the shape of a discordant diapir column that penetrates Mio-Pliocene blanket from nearby and comes to the surface. Salt Hill, the local name "Behind Salt '(576m), covers the largest deposit of salt in the country, the one from Praid, whose" roots "are buried up to 2.7 to 3 km deep.

Current appereance of the relief represents, above all, the expression derived ratios from morphogenetic and geodynamic factors , against the background of structural evolution and lithological composition.

In the salt massif area from Praid, salt karst phenomena are present with sinkholes, polje, fissures, dissolution funnels and clints. The main factor conditioning salt karst formation is sweet or slightly salty water, which causes the dissolution process. Salt rock is the extremly subject of karstification, dissolution process being very fast, due to cracks, fissures and planes of stratification, which are pathways for infiltration waters. Salt karst has a fast evolution, dissolution and water advancing goes to saturation, then will persist only the dynamic action resulted from flow energy. Slowly, water will leave the flow area and will adopt the ways of the underground circulation. Thus, the exokarst (clints, sinkholes, fissures), from the beginning of the process will evolve into forms of endokarst (sinkholes, flues, depth fissures, small caves, potholes) (Fig. 2).

Snails Hill is located in the eastern side of the Praid Basin and covers an area of 1.5 hectares. This carbonate deposit is considered the largest occurrence of aragonite from Romania, being Geological Reservation since 1980 (Horvath I., 1998).

Postvoulcanic phenomena in the area took place in the form of gaseous emissions, giving rise to different carbonated and mineral springs. These ascending springs, containing,

as dissolved form, carbonate and mineral substances, on their way to the surface, have formed, by deposition, epithermal deposits of aragonite.

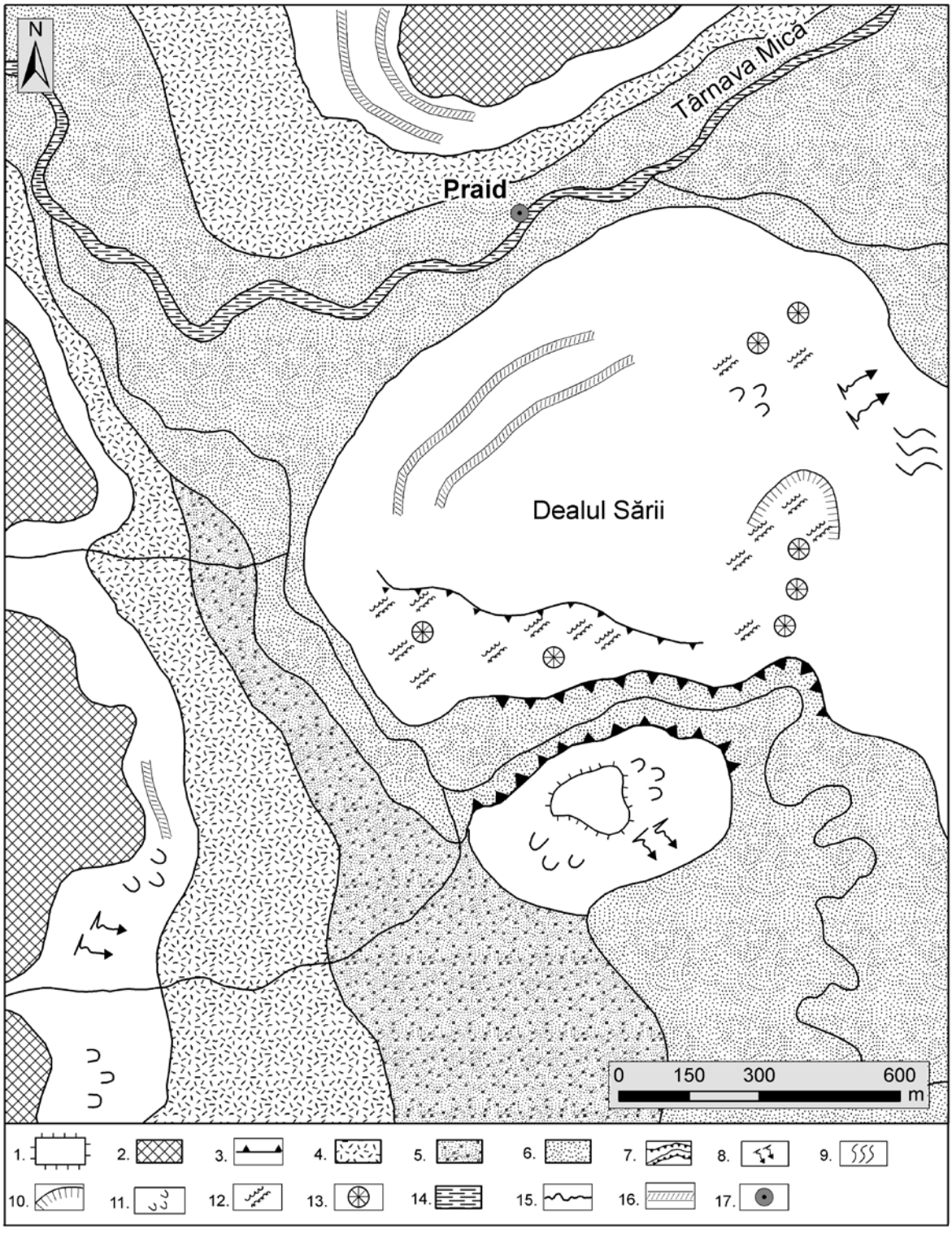

Fig. 2. Praid – Salt Hill – General Geomorphological Map

1. structural – erosive mark ; 2. erosion level; 3. detachment ravine; 4. glacis; 5. terrace; 6. meadow; 7. defile; 8. gully erosion; 9. ravines; 10. erosion basin; 11. Surface sliding; 12. clints; 13. sinkholes; 14. main river; 15. Secondary river; 16. agroterrace; 17. locality

Sovata fits to Praid – Sovata depression, modeled as "anticline valley " and spreads along the Săcădat and Corund valleys , showing areas of narrowing and widening.

A particular importance in stratigraphy and tectonic of Sovata Depression, has the salt massif, of which are genetically related the salted lakes and in the end the health resort.

Carstosalin salt lakes, formed by salt dissolution and compaction of the surface material are Ursu, Aluniş, Red and Green lakes, being drained by Salt Creek. To them, can be added isolated bassins that have in origin dissolution and compaction sinkholes: Blackbird Lake and Snakes Lake, now they are an eutrophic swamp, and Paraschiva Lake.

Dynamic, is very accelerated in the whole Sovata depressions, and influences the evolution of water basins and their elements.

Salt cliffs appear, here too, in daylight, especially in several landslides and sinkholes around the beautiful Bear Lake.

Dissolution process is particularly active and affects, further, both major surfaces of the slope, dispoiled by the clay material, and some lakes. Massif degradation is quite intense, because the dissolution exerted by freshwaters. Contemporary morphodynamics is printed by the surface erosion, mass movements and riverbed erosion. Daylight appreance of the salt, condition, also, the formation of microrelief on salt: clints and dissolution micro-sinkholes.

Salt deposit from Jabenita is located in the Jabenita village, Solovăstru commune, Mureş County. Salt massif is situated in the center of the eastern diapir alignment, namely on the west side of the anticline lifting of Ilimbav-Benţid-Gurghiu foundation. Jabenita salt body is one of the largest in Transylvania Depression, salt thickness in its central part reaching about 2000 m.

Salt deposit appears to daylight under Gurghiu river terrace deposits, over an area of about 1 km^2. On the right bank of the river, we see numerous landslides, drawn from Sânioară and Ciculeu (Piculeu) hills, which crossed over the river terrace and major riverbed, until the river Gurghiu (Sfâriac, 1966).

Antroposalted lake from Jabeniţa, called Bălţi Lake, was formed in a mouth of a saline, opened and operated by the Romans. Due to the presence of this lake, Jabeniţa developed as a balneo-climateric resort of local interest.

5. EVALUATION OF THE GEOMORPHOSITES ON SALT FROM TRANSYLVANIA DEPRESSION

The landform chosen for its evaluation as geomorphosite must meet, in addition to special geomorphological features, also useful functions assigned by scientists.

Usually geomorphosites don't have a standard size (Reynard, 2004b), which also applies to the salt geomorphosites from the Transylvanian Depression. Some of the geomorphosites are very small, with a surface less than an metric hectare (ex: Snails Hill from Praid). Other ones are larger, with a surface larger then several hectares (ex. Dealul Sarii).

From the structural point of view, geomorphosites are simple, complex geomorphosites and sistem geomorphosites.

The geomorphologic interest of *simple geomorphosites* it's reprezented by its shape (ex: Lacul Ursu din Sovata). *Complex geomorphosites* include a number of interrelated items of interest which single analyzed can not be considered geomorphosites. *Sistem geomorphosites* are larger , in their structure being included smaller sites.

In terms of the elements which form the geomorphosites on salt from Transylvanian Depression, two major categories can be seen: geomorphosites with landscape value (ex: Dealul Sării, Salina Turda) and geomorphosites with hydrographic or hydro-geomorphosites (ex: Lacul Ursu, Sibiu lake complex).

Analyzing existing methods for evaluating morphotouristic potential, I chose to use Pralong's method, improved by Gabriela Cocea.

In this method of evaluation the intrinsic values were separated from the values derived from them. Thus in the first part are evaluated geomorphological, aesthetic and ecological values. In turn, this values are evaluated quantitatively through some criterias. Geomorphological value is evaluated based on landform genesis, dynamics, the diversity of the interest elements (geomorphology, stratigraphy, etc.), the geosite's degree of conservation and its rarity on a national and international level, etc. The underlying evaluation criteria for geomorphosites, in terms of estetics are: geomorphosite's physiognomy, color, vertical development, landscape attractiveness and visibility (if is visible by itself or from a belvedere point). Ecological value refers to the relevance of flora, fauna and current protection status of the geomorphosite.

Mentioned values resultes from the amount indices assign to own characteristics, the formula for the geomorphological value, Vst1 is:

Vst1 = Vst1a + Vst1b + Vst1c + Vst1d + Vst1e

The functional value formula is:

Vst = *Vst1* + *Vst2* + *Vst3*

Where: Vst – structural value

Vst1 – geomorphologic value;

Vst2 – estetic value;

Vst3 – ecologic value.

Additional values or structural values, which derives from functional values, are those assigned by man: the scientific value, cultural value and tourist value. Scientific value is evaluated based on the following criterias: scientific representation, scientific awareness, representativnes of geomorphological processes and pedagogical interest, interest in paleogeographic and formative resources. Cultural value takes into account the historical importance (presence of remains), archaeological (site's age), religious (presence of churches), artistic (number of representations in literature, painting, graphics, photography), architectural and cultural association with certain events. Tourist value will be measured by the number of specific tourism activities that can be practiced, the geomorphosites tourism potential at different levels, accesability, accommodation infrastructure, facilities, services and the distance from geomorphosite, distance from modern centers with complex services, socio-economic conditions of the region (considering size of urban centers within a radius of 50 km), current state of tourism exploitation and geomorphosites promovation.

As in the previous case values that make up the functional value, is the sum of the specific criteria, and functional value has the following formula:

Vfn = Vfn*1* + Vfn*2* + Vfn*3*

Where: Vfn – functional value or additional value;

Vfn1 – scientific value;

Vfn2 – cultural value;

Vfn3 – turism value;

Another aspect to be considered are the restrictive or negative criteria acting on the tourism and aestetic potential of the morphosite. Restrictive value results from the sum of these criteria:

$$\mathbf{Vr} = Vr1 + Vr2 + Vr3$$

Where : Vr – restrictive value;

Vr1 – vulnerability to natural processes

Vr2 – antropic activities

Vr3 – inaestetic elements

To calculate the total value VT of the geomorphosite I summed structural value (Vst) with functional value (Vfn), from the amount of which decreases restrictive values (Vr):

$$\mathbf{VT} = Vst + Vfn - Vr$$

In this paper, 14 geomorphosites on salt from Transylvani Depressiona have been identified and evaluated by this method.

After the scores received the most important geomorphosite from almost all points of view (geomorphological, aesthetic, scientific) is Dealul Sării or Cheile Corundului from Praid (tab. 1).

Tab. 1. *Geomorphosites assessment sheet*

<table>
<tr><td>Name</td><td colspan="3">„Salt Hill” (Corund Gorge)</td></tr>
<tr><td>Index No.</td><td colspan="2">S9</td><td rowspan="8">  </td></tr>
<tr><td>Location</td><td colspan="2">Praid Basin, Gurghiu Mountains</td></tr>
<tr><td>TAU</td><td colspan="2">Praid commune, Harghita county</td></tr>
<tr><td>Tipology</td><td colspan="2">Complex geomorphosite</td></tr>
<tr><td>Value total</td><td colspan="2">27.25</td></tr>
<tr><td>Structural V.</td><td colspan="2">11</td></tr>
<tr><td>Functional V.</td><td colspan="2">16.75</td></tr>
<tr><td>Restrictive V.</td><td colspan="2">0.5</td></tr>
<tr><td colspan="4">STRUCTURAL VALUE</td></tr>
<tr><td>Type</td><td>Point</td><td colspan="2">JUSTIFICATION</td></tr>
</table>

Geomorphologic	4.5	- In the genesis of geomorphosite many factors were involvede such as tectonics, lithology, climate and hidrology, in the three phases of its development (sedimentation of salt, diapirism and gorge formation) (1p) - Landforms dinamics is accelerated (1p) - Brings together more than 5 elements of interest: the salt massive, the created gorges, ditches, sinkholes, winding valleys, salted lakes, small potholes, pond with sapropelic mud (1 p) - Less affected geomorphosite (0.75p) - National unique geomorphosite 0.75p)
Estetic	4.25	- It has a unique physiognomy given by the nipple-shaped salt rocks, also karst forms appearing on the surface and the gorges formed in the salt massive (1p) - Colorful rock salt, the vegetation and water form a chromatic puzzle (0.75p) - Altimetric contrast due to landform energy of the slopes (25 – 100 m as against the river) (0.5p) - Protected geomorphosite because of its flowerfull lansdscape on the salt surface (1p) - Can be percieved in a panorama (1p)
Ecologic	2.25	- Presentes of halophilic plants: *Limonium gmelini*, " Marsh-rosemary ", purple colored, *Salicornea herbacea* (salted grass purple or green), *Aster tripolium* (Sea Aster), *Spergularia salina*, *Salsola soda* (salted grass), *Artemisia salina* (Fairy shrimp), *Plantago maritima* şi *Statice gmelini* (salted flower). (0.75p) - Presences of specific biotopes common deciduous forest fauna (0.5p) - It is a protected area – "Salt Mountain - Praid" Reservation(1p)
FUNCTIONAL VALUE		
Type	Point	JUSTIFICATION
Scientific	4.5	- The geomorphosite is scientifically nationally representative (0.75p) - More than 5 papers have been written about it in national journals (0.75p) - It is a very good example of the dissolution process and a good educational resource (1p) - The geomorphosite is great paleogeographic interest for the evolution of Transylvania Basin and Praid Basin (1p) - Addressing polyvalent in geography and geology (1p)
Cultural	4	- Historical artifacts defining for the region, represented by mining tools and documents attesting the Roman settlements (0.75p) - The existence of "castrum salis" archeologic site from Sărăţeni proves the industrial exploitation of salt since Roman times (0.75p) - Touristic religious objectives are represented by Roman-Catholic churches, 200 years old (0.5p) - Presences in artworks: photo albums and photography (0.5p) - More than three cultural events are held in the surrounding area, the most significant is The Miners Fanfare from Praid (1 p) - Traditional Architecture specific to Sekler's Land(0.5)

Tourism	8.25	- 4-5 touristic activitie can be practiced: recreational tourism, SPA activities, geoturism, ecoturism, scientific turism(0.75p) - Road access is possible up to 200 m from the geomorphosite, unpaved road (0.5p) - 2 km from Praid, 8 km from Sovata and 25 km from Odorheiul Secuiesc (1p) - 25 km from a center of urban services (Odorheiul Secuiesc) (0.5p) - Is a landmark of national interest because of its potential attractiveness (0.75p) - There are modern facilities and services 2 km from the geomorphosite, in Praid (0.75p) - The "Salt Hill" can be visited at any season of the year (1p) - There is no set visiting times, so you can visit it at any day time (1p) - It has many accommodation facilities in hotels, villas and pensions, expecially in Praid and Sovata (1 pct) - Complex tourism promovation nationally and internationally, especially dedicated to tourists from Hungary (1 p)
RESTRICTIVE VALUES		
Point	JUSTIFICATION	
0.5	- The site is partially vulnerable to crumbling and intensive disolution (0.25p) - Presence of domestic waste on the banks of Corund river (0.25p)	

6. TOURISTIC VALUE OF GEOMORPHOSITES ON SALT FROM TRANSYLVANIAN DEPERSSION

In terms of forms and types of tourism generated by the relief on salt and its components, for this study, the most common are therapeutical tourism, cultural tourism, recreation tourism, and in the evaluation of the geomorphosites on salt we consider the scientific tourism, educational tourism and geotourism too.

Ocna Dej has on its surface a complex thereapeutical potential, gathered on a small area, consisting of sodium chloro-water lakes, salty clays and sapropelic mud with therapeutic character. On the top of the Cabdic Hill, on the former Roman salt mines, is a sodium chlorine water lake (Cabdic Lake or Toroc Lake) and, below, on the slope, are located two vegeto-mineral mud lakes.

In 2005, through a PHARE program, Dej City Hall managed to attract European funds to develop this area, and started the arrangement of Toroc Spa Park. Arrangement works around the lake, started in 2006, and in May 15th 2010 was officially opened Toroc Spa Park.

Another attraction of Ocnei Dej is Ocna Dej Salt Mine where, started with 2000, besides operating activities are possible tourists visits in Transylvania Mine, where has been decorated a chapel.

The existence of salt massif and exploatation of this richness, over several centuries, created in the north-eastern of Turda city, a specific landscape. Turda Salt Baths resort is located above the former salt mine galleries, roman or medieval exploitation, wich along the karstification processes of the salt massif and as well landslides, have favored the formation of numerous lakes, at different stages of evolution. Some lakes, particularly those antroposalted, located on former salt mines are used by the population for therapeutic or leisure. Over 15 antroposalted lakes were identified (including the current pool, which is also called "Roman Lake")

Salt Baths area has been used as a microresort since 1834, and the first arrangements were made between 1834-1837. Starting with these year up to these days, Turda Salt Baths microresort have passed trough several development stages: beaches covered with wood have been made at the The Pool also called Roman Lake, changing cabins, warm bath in the tubs, a hotel has been build. After the Second World War, new accommodation were built, a restaurant and even a zoo have been made, important tourist attraction point of that time.

In the same period with Salt Baths, **Durgău Lake** aroused interest. After 1930, in about the same time with upgrades from the Roman Lake of Salt Baths, Ocna lake from Durgău is arranged with cabins on the western shore of the lake and by arranging benches to water access.

In January 1991, the "Turism Arieşul" S.A. company was established, which finished the constructions of the hotel from Turda Salt Bath and constructed a therapeutical tretament SPA. This SPA offers a wide range of therapeutical procedures and it is open all year.

Another tourist attraction is Turda Salt mine, openned for tourism in 1992. The Salt mine was closed in 2008 for an extensive modernization process through a PHARE project won in 2005. It was reintroduced in tourist circuit in January 2010.

The Salt mine is now equipped with a new treatment base, in which is valued the Salt mines specific microclimate. The former exploitation chambers received a new look and extended functionality. In Rudolf chamber is now a concert hall, sport yard, bowling, mini-golf, an elevator and a observation wheel. In Terezia chamber boat dock was build, allowing tourists to take a trip on the saline lake.

Cojocna Salt Baths are located in Cojocna village, 340 meters altitude, developed around two big saline lakes, created from the collapse of old salt mines.

Current baths dates from the early nineteenth century. In the evolution of Cojocna area, the balneary utilities have been developed around the lakes, as result of exploitations since 1912. This utilities are: therapeutic basis, pavilion, restaurant and a hotel with 56 beds.

Today, there is a a swimming pool open from spring to autum, daily between 10-19 o'clock. Besides the lakes, at Cojocna Salt Baths is a sport yard, parking, a complex of saunas and a solarium.

Being so close to Cluj-Napoca city, the accommodation and camping are rarely used.

Cojocna Salt Baths were opened in 2010, after a modernization that lasted two years, from PHARE funds worthing 2.4 million euros.

Ocna Mureş has a special touristic interest, because of the salted lakes located on the salt massive. Here, the tourist capitalization on salted waters started since Roman times fact proven by the existence of ,,Salinae" baths. At the beginning of the nineteenth century a modern treatment basis was build. Two indoor pools for women and men, bathing cabins and in the park, an outdoor swimming pool is constructed. Water used was extracted from deep depth lakes formed in the former roman mines.

Decline of Ocna Mureş Salt Baths started about two decades ago. Although the lake complex is very well positioned in the middle of Ocna Mureş, the salty waters of the lakes cannot be used for bathing in the future, because of the pollution, resulted from the waste and the fuel that is used in brine concentration. Ocna Mureş only way to grow again as a resort, would be to refurbish the old-treatment basis and the salt water to be extracted from deep depths, in order to be pomped in the therapeutic lakes from above.

Accommodation units in Ocna Mures are few, being confined to a hotel and two to three pensions.

Ocna Sibiului resort is situated at the eastern end of the village, on the way from Sibiu. Use of salt waters from lakes, for baths, is known since the sixteenth century. The first arrangements were also made around the lakes Horia, Cloşca and Crişan, where they built one bathroom house with 4 cabins and the house on stilts (Voicu-Vedea and Fanache, 1983). The official opening of the cold baths took place in1846, September 2nd.

Facilities around Brâncoveanu Lake begin in 1947. The official opening of warm baths, took place in 1858, on June 20th, and Ocna Sibiu became a permanent resort.

Between 1906 and 1909, have been built the current spa complex, consisting of a central building and establishment of baths. It includes facilities for warm baths, aerosols, mud packings and pools for bathing. In 1948 it was proclaimed as permanent resort.

The resort is entering in a period of stagnation or even said degradation, in the late '90s.

Ocna Sibiu City Hall received in 2010, 4.5 million from PHARE funds and another 3.5 million of government funds for rehabilitation and modernization of Salted Lakes Complex and Ocna Sibiu resort.

Praid is located in a region of the most attractive and wealthy in therapeutic factors. This are the reasons that led to the development of health tourism.

Praid salt baths are composed by two establishments: *outdoors salt water swimming pool and warm salty bath in tubs.*

Initially, salt baths were built to harness thermo-mineral waters intercepted by ACEX 401/ 1949 probe.

Since 1992, probes flow decreased to such an extent that was impossible to supply the salt bath with this water. So they had to come with another solution.

Inside the salt bath at hot tubs, salt water is heated with the help of a boiler. Iodinated salt water has a calming, relaxing physically and mentally effect, inflammatory, vasodilator, sterilizing the skin and mucous membranes and healing scars.

In 1952, opens in Praid the "hydrothermal saline swimming pool". Currently, the swimming pool is fed with salt water pumped from the mine. This is infiltration water has meteoric origin, and acquires its NaCl content via the mountain of salt and the stationing in underground sump. From this sump, salt water is pumped to the surface and is transported via a pipeline to the bath establishment, at a distance of approximately 1.8 km. Salt baths operates seasonally, from June 1st to October 15th annually.

In Praid, not just salt water has value in therapy but also microclimate that has formed inside the Salt mine.

Initially, the treatment base was installed, in 1960, in the old mine in trapezoidal shape, Gheorghe Doja. After 20 years, in 1980, horizon 50 was arranged for tourist and therapeutic purposes, operating in the former rectangular rooms that work even today.

The horizon for visiting and treatment, with an area of 9400 m², have been arranged with several elements to diversify activities here, such as: playgrounds, meeting rooms for patients, ecumenical chapel, internet, museum, library, souvenir shop, a medical station. Recently, before the waiting room for the exit, were arranged a wine cellar, a cafeteria and an exhibition of works of art (paintings and sculptures in salt).

Other special atractions of Praid are Corund Gorges and Snails Hill.

Corund Gorges lie in the south west of Salt Hill and are the only gorges carved in salt, in our country. Here can be found those “salt rocks from Praid”, famous in tourism, since the late eighteenth century. On the salt mountain slopes can be observed karst formations: clints, sinkholes, avens, globular concretions, which are constantly changing. On the right bank of Corund river, there are ponds with sapropelic mud and thermal springs.

Snails Hill is located in the southern part of the Praid Basin and is a geological reserve of aragonite lenses resulted from salt and limestone waters sediments deposition.

To the carbonate deposits base, a mineral water spring comes to the surface bubbling hydrocarbon gas smell. Spring is dominated arround by turquoise green color deposits, carbonate, ferruginous and highly salted.

Sovata, permanent resort, was first mentioned as a healing place in a document of 1597, but only in 1850 as a resort.

Sovata reputation is due to Ursu (Bear lake), Aluniş, Verde, Negru, Roşu, Mierlei and Şerpilor Lakes, with chlorinated and sodium waters, presenting the helyothermic effect. Since 1900, Sovata has become a tourist center, and started on the long road of privatization.

Sovata treatments have become famous all over. The resort is indicated for the treatment of gynecological diseases, but also for degenerative, inflammatory and rheumatic, post-traumatic conditions, diseases of the peripheral nervous system, endocrine disorders and cardiovascular disease.

The resort has multiple features, hot baths, in pools or bath tubs, with salty mineral water taken from the lakes, hot mud packing, pools for kinesiology, installations for electrotherapy and hydrotherapy, saunas, physiotherapy, beaches on Ursu Lake and Aluniş Lake.

Lakes are open only during the summer season, between June and September, but the treatment resorts works throughout the all year.

Possibilities for accommodation in this resort are multiple. Sovata has 1200 beds in nine hotels, 100 beds in inns and motels, 100 seats in campgrounds and cabins, 1 000 beds in 50 villas, 300 beds in 3 camps for students and preschool students, 150 beds in 25 pensions and countless other places in private homes.

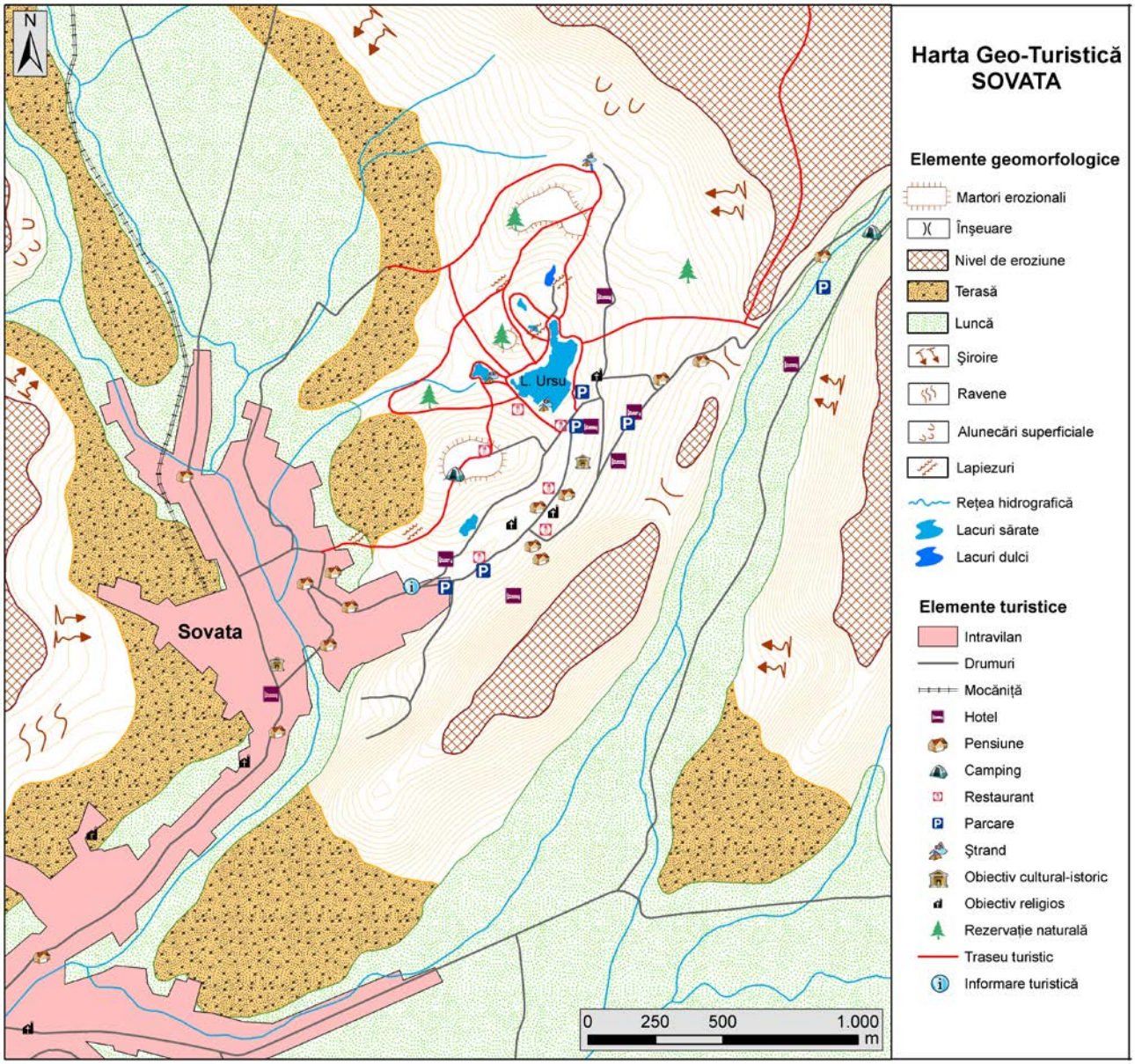

Fig. 3. Geo-touristic map of Sovata

Jabeniţa is a resort with old traditions, founded around the year 1800 (at the same time with Sovata), highly valued because of its water and the quality of existing mud.

Bălţi Lake has formed into a Roman salt mine, in the years 1935 - 1936, the lake had 70 m deep. This depth seems to be greatly reduced during the war because many objects and materials thrown into the lake. Separating beams and floors soaked with water hampered by banks washed by rains and by various objects from the bottom, have widened. Jabeniţa Salt Baths micro-resort was founded in 1997 on an area of about 4 hectares, in a quiet area with a wonderful landscape. Bălţi Lake is now an attraction for tourists and residents of surrounding

areas, modernization and development works carried out here, made it accessible to all, both as a place for recreation and as a basis for treatment of a various diseases.

CONCLUSIONS

The paper, titled *"Geomorphosites on salt from Transylvanian Depression and their touristic value"* approaches an interdisciplinary problem and proposes an analysis of how the morphology of the landforms on salt, through its landscape and scientific valences, can influence a better and more varied tourism development in saliferous areas.

The aims of this study, assumed, in the first instance, studying the stages of evolution of the Transylvanian Depression and salt deposit formation in it.

Salt tectonics or diapirism, defined by tectonic processes related to salt mass movements in the earth crust, has significantly influenced the morphology from Transylvanian Depression.

After analyzing several evaluation methods, the best known in the methodology, I concluded that none of them meets fully the goal of evaluating geomorphosites on salt. However the closest to what I wanted to highlight in this study, was the method proposed by Pralong, but the improved version made by Cocean.

To this method I added some criteria and I removed those that were not relevant to this study.

Evaluation method was applied to the 14 identified geomorfophites, and the final scores made possible a brief comparative analysis of them in terms of the main types of values, resulting in geomorphosite with predominent characteristics: ecological, scientific, aesthetic, cultural and tourist.

By taking a new approach of study on landforms on salt, from the geomorphosites perspective, I offered a different valence in resizing economic, touristic and teritorial impact on salt resources. Thus, salt is not only an economic and tourism resource , but also a local, regional and national development factor.

By evaluating the salt geomorphosites, I have highlighted, besides the curative value of salted waters and salt mine microclimate, the aestetic value of saliferous areas, historic and cultural elements which became complementary to the landscape, in an full evaluation of the resources.

The landscape spectrum is completed by the traditions and customs related to the salt in the area.

Geomorphosites represent an important resource for geotourism. This could be sustained by creating thematic tours, tours of the salt lakes, the salt mines and even on salt karst formations.

In the future, for better conservation of the geomorphosites on salt, I consider to be necessary to perform a management of their use for tourism.

The method proposed in this study will allow identification and evaluation of other geomorphosites on salt from subcarpathian regions of Romania.

BIBLIOGRAFIE:

1. Atudorei, C., Bocanete, E., Miclea, P., Cercetarea, (1971), *Cercetarea, exploatarea şi valorificarea sării,* Edit. Tehnică, Bucureşti
2. Athanasiu, S., (1915), *Discuţie asupra vârstei formaţiunii salifere din România*, Dări de Seamă ale Șed. Inst. Geol. Rom., vol. V (1913-1914), Bucureşti,
3. Avanzini, M., Carton, A., Sepp, R., Tomasoni, R., (2002), *First census of geosites in the province of Trento,* Procedings Geomorphological Sites: research, assessment and improvement, Modena, Italia.
4. Balintoni, I., Meszaros, N., Györfi, I., (1998), *La Transylvanie, depresion et bassins,* Studia Universitatis Babes-Bolyai, seria Geologia, XLIII, nr. 1, Cluj-Napoca, pg. 43-58.
5. Balintoni, I., Petrescu, I., (2002), *A hypothesis on the transylvanian halite genesis*. Studia Univ. Babeş-Bolyai, Geologia, Special issue 1, p. 51-61, Cluj-Napoca;
6. Bertacchini, Milena, Bettelli, G., Bonazzi, U., Capedri, S., Capitani, M., Castaldini, D., Conti, S., Corradini, D., Fioroni, C., Fontana, D., Fregni, P., Gasperi, G., Giusti, C., Marchetti, M., Panini, F., Pellegrini, M., Piacente, Sandra, Rossi, A., Soldati, M., Tosatti, G., (1996), *I beni geologici della Provincia di Modena*, edit. Artioli, Modena.
7. Carton, A., Cavallin, A., Francavilla, F., Mantovani, F., Panizza, M., Pellegrini, G. B., Tellini, C., con la collaborazione di Bini, A., Castaldini, D., Giorgi, G., Floris, B., Marchetti, M., Soldati M., Surian, N., (1994), *Ricerche ambientali per l'individuazione e la valutazione dei beni geomorfologici.* Metodi ed esempi, Il Quaternario, 7(1), pg. 365-372;
8. Carton, A., Coratza, Paola, Marchetti, M., (2005), Guidelines for geomorphological sites mapping: examples from Italy, Gémorphologie: relief, processus, environnement, nr. 3, pg. 209-218
9. Castaldini, D., Valdati, J., Ilieş Dorina Camelia, Chiriac, C., Bertogna, Isabella (2005), *Geo - Tourist map of the natural riserve of Salse di Nirano (Modena Apennines, Northen Italy),* Il Quaternario, Italian Journal of Quaternary Science, 18/1, pg. 245-255
10. Ciupagea, D., Paucă, M., Ichim, Tr., (1970), *Geologia Depresiunii Transilvaniei*, edit. Academiei Republicii Socialiste Române, Bucureşti

11. Comănescu, Laura, Dobre, R., (2009), *Inventoring, Evaluating and Tourism Valuating the Geomorphosites from the Central Sector of the Ceahlău National Park,* GeoJournal of Tourism and Geosites Year II, no. 1, vol. 3, pag. 86-96
12. Comănescu, Laura, Nedelea, Al., Dobre, R., (2009), *Inventoring and evaluation of geomorphosites in the Bucegi Mountains*, Forum Geografic. Studii şi cercetări de geografie şi protecţia mediului, anul 8, nr. 8, pg. 38-43, Craiova.
13. Coratza, Paola, Giusti, Cecilia, (2005), *Methodological Proposal for the Assessment of the Scientific Quality of Geomorphosites,* Il Quaternario, Geomorphological Sites and Geodiversity, 18/ 1, pg. 307-314
14. Dragoş, V., (1969), *Contribuţii la cunoaşterea genezei evaporitelor din Bazinul Transilvaniei,* Studii şi Cercet. de Geol., Geofiz., Geogr., seria Geologie, 14/1, pg. 163 – 180, Bucureşti.
15. Drăgănescu, L., (1997), *Originea sării şi geneza masivelor de sare*, Ploieşti
16. Drăgănescu, L., Drăgănescu, S., (2001), *The History of the Evolution of Salt Working Methods in Romania*, from Antiquity to the Present, 17th International Mining Congress and Exhibition of Turkey, Turcia, pg. 627-633.
17. Filipescu, S., (1994), *Microfauna in the Neogene Deposits close to the salt diapir of Turda – Valea Sărată (West Transylvanian Basin).* In: "The Miocene from the Transylvanian Basin", p. 139 –145, Cluj-Napoca;
18. Filipescu, S., (1996), *Stratigraphy of the Neogene from the western border of the Transylvanian Basin,* Studia Univ. Babeş-Bolyai, Geol.-Geogr., XLI, 2, p. 3 –78, Cluj-Napoca.
19. Filipescu, S., (2002), *Cenozoic Lithostratigraphic Units in Transylvania.* Field Trip Guide, 4th Regional Meeting of IFAA, 75-92, Cluj-Napoca;
20. Givulescu, R., (1982), *Câteva consideraţii asupra climatului din Badenian în legătură cu formarea sării* din R.S.România, Nymphaea, X, p. 23 – 30, Oradea.
21. Grandgirard, V., (1995), *Méthode pour la réalisation d'un inventaire de géotopes géomorphologiques*, În UKPIK, Cahiers de l'Institut de Géographie de l'Université de Fribourg, 10, pg. 121–137.
22. Grandgirard, V., (1997), *Géomorphologie, protection de la nature et gestion du paysage*, Thèse de doctorat, Université de Fribourg, Faculté des sciences.
23. Grandgirard, V., (1999), *L'evaluation des geotopes,* Geologia Insubrica, nr.4, pg. 59-66.

24. Hauer, Fr., Stache, G., (1863), *Geologie Siebenbürgens*, edit. Braumüller, Viena, 637p;
25. Ilieş, Dorina Camelia, Josan, N., (2007), *Preliminary contribution to the investigation of the geosites from Apuseni Mountains (Romania),* Revista de geomorfologie, vol. 9, pg. 53-59
26. Ilieş, Dorina Camelia, Josan, N., (2008), *Some aspects regarding the genesis of geosites,* GeoJournal of Tourism and Geosites Year I, nr. 1, vol. 1, pag. 7-12, Oradea
27. Ilieş, Dorina Camelia, Josan, N., (2009a), *Geosites-Geomorphosites and Relief,* GeoJournal of Tourism and Geosites Year II, no. 1, vol. 3, pag. 78-85, Oradea
28. Ilieş, Dorina Camelia, Josan, N., (2009b), *Geosituri şi geopeisaje*, edit. Universităţii din Oradea, Oradea
29. Iorgulescu, T., Niculescu, N. I., Peneş Maria, (1962), *Vârsta unor masive de sare din R.P.R,* edit. Academiei Republici Populare Române, Bucureşti.
30. Irimuş, I. A., (1998), *Relieful pe domuri şi cute diapire în Depresiunea Transilvaniei*, edit. Presa Universitară Clujeană, Cluj-Napoca.
31. Irimuş, I. A., (2006), *Hazarde şi riscuri asociate în aria cutelor diapire din Depresiunea Transilvaniei*, edit. Casa Cărţii de Ştiinţă, Cluj-Napoca.
32. Koch, A., (1900), *Die Tertiärbildungen des Beckens der Siebenbürgische Landestheile.* II Theil. Neogene Abtheilung, 370 p., Budapest.
33. Krézsek, C., Filipescu, S., (2005), *Middle to Late Miocene sequence stratigraphy of the Transylvanian Basin (Romania),* Tectonophysics, edit. Elsevier, pg. 437-463 Amsterdam
34. Krézsek C., Bally A.W., (2006), *The Transylvanian Basin (Romania) and its relation to the Carpathian fold and thrust belt: Insights in gravitational salt tectonics,* Marine and Petroleum Geology, nr. 23, p. 405–442, edit. Elsevier, Amsterdam.
35. Maxim, I. Al., (1929), *Contribuţii la explicarea fenomenului de încălzire al apelor lacurilor sărate din Transilvania.I. Lacurile de la Sovata*., Rev. Muz. Min.-Geol. Al Univ. Din Cluj la Timişoara, vol. III/1, p. 121-153, Cluj;
36. Maxim, I. Al., (1931), *Contrubuţiuni la explicarea fenomenului de încălzire al apelor lacurilor sărate din Transilvania (II). Lacurile de la Ocna Sibiului,* Rev. Muzeului Geologic-Mineralogic al Univ. din Cluj, vol. III, nr. 1, Cluj-Napoca, pg. 47-111

37. Maxim, I. Al., (1943), *Contribuţii la explicarea fenomenului de încălzire al apelor lacurilor sărate din Transilvania. III. Lacurile sărate de la Turda*. Rev. Muz. Min.-Geol. al Univ. din Cluj, VII/1-2, p. 209-321, Cluj;
38. Maxim, I. Al., (1961), *Cîteva observaţii asupra aspectelor morfologice ale locurilor de apariţie a masivelor de sare din Transilvania (I)*, Studia Univ. „Babeş-Bolyai", II/1, pg. 21 – 33, Cluj;
39. Maxim, I. Al., (1962), *Cîteva observaţii asupra aspectelor morfologice ale locurilor de apariţie a masivelor de sare din Transilvania (II)*, Studia Univ. „Babeş-Bolyai", nr.1, pg. 17 – 38, Cluj;
40. Mârza, I., Niţă, P., (1985), *O nouă viziune promovată de tectonica globală, pentru explicarea originii maselor mari de halogenuri, cu referire la Depresiunea Transilvaniei.* Mine. Petrol. Gaze, 36/12, pg. 682 – 683, Bucureşti.
41. Mârza, I., Ghergari, L., Mészáros, N., (1991), *L'étude de tuf de Dej dans son extremite occidentale d'affleurement*, The volcanic tuffs from the Transylvanian Basin, pg. 183-189, Cluj-Napoca.
42. Mészáros, N., (1991), *Nannofossil Zones in the Paleogene and Miocene Deposits of the Transylvanian Basin*, Proced. IV. INA Conf., Knihovnicka ZPN, 14b/2, p. 87 - 92, Prague.
43. Mészáros, N., Mac, I., (1995), *Paleogeografia României*, curs litografiat Universitatea "Babes-Bolyai", Facultatea de Geografie, Cluj-Napoca.
44. Mészáros, N., (1997), *Regiunile salifere din Bazinul Transilvaniei. Mediu ambient şi potrivnic*, în Studii şi cercetări (Şt. Naturii), nr. 3, Bistriţa, pg. 41-45
45. Mészáros, N., Nicorici, E., Filipescu, S., (1989), *Le nannoplancton des dépots néogenes saliféres traversés par les forages executés aux environs de la ville Turda.* Studia Univ. Babeş-Bolyai, Geol.-Geogr., XXXIV, 2, p. 61 - 65, Cluj-Napoca.
46. Mihăilescu, V., (1963), *Carpaţii Sud-Estici*, edit. Ştiinţifică, Bucureşti.
47. Moisescu, V., Popescu, G., (1967), *Studiul stratigrafic al formaţiunilor paleogene şi miocene din regiunea Chinteni – Baciu – Sînpaul (nord – vestul Transilvaniei).* St. Cerc. Geol. Geof. Geogr., ser. Geol., 12, 1, p. 211 – 224, Bucureşti.
48. Mrazec, L., (1907), *Despre cute cu sâmbure de străpungere.* Bull. Soc. Şt. Bucureşti. Vol. XVI, p. 6-8;
49. Mrazec, L., (1916), *Asupra vârstei Saliferului*. D.S. ale Şed. Inst. Geol. al Rom., IV(1915), p. 22-24, Bucureşti;

50. Mrazec, L., (1932), *Comsidération sur l'órigine des dépressions internes des Carpathes Roumaines,* Bull. Soc. Géol. Roum., nr. 1, Bucureşti.
51. Ochsenius, K., (1877), *Die Bildung der Steinsalzlager und ihrer Mutterlaugensalze*, Halle
52. Panizza M., (2001), *Geomorphosites: Concepts, methods, and examples of geomorphological survey*. Chinese Science Bulletin, vol 46, pag. 4-5
53. Panizza, M., (2003), *I geomorfositi in un paesaggio culturale integrato*, In: Piacente, Sandra, Poli, G., La Memoria della Terra, la Terra della Memoria, L'Inchiostroblu, Bologna, pg. 23-27.
54. Panizza, M., Piacente, Sandra, (1993), *Geomorphological assets evaluation,* Zeitschr fur Geomorphologie, N, F, Bd 87, pg. 13-18.
55. Panizza, M., Piacente, Sandra, (2003), *Geomorfologia cultural*, Edit. Pitagora, Bologna
56. Paucă, M., (1967), *Contribuţii la geneza zăcămintelor de săruri miocene din România*, D.S. Inst. Geol., LIII/2, Bucureşti.
57. Pereira P. (2006), *Património geomorfológico: conceptualização, avaliação e divulgação. Aplicação ao Parque Natural de Montesinho.* PhD Thesis, Departmento de Ciências da Terra, Universidade do Minho, 370 p, Portugal
58. Pereira, P., Pereira, D., Alves, Maria Isabel Caetano, (2007), *Geomorphosite assessment in Montesinho Natural Park (Portugal),* Geographica Helvetica, nr. 3, pg. 159-168.
59. Peryt, T. M., (2006), *The beginning, development and termination of the Middle Miocene Badenian salinity crisis in Central Paratethys*, Sedimentary Geology.
60. Peryt, T. M., Szaran, Janina, Jasionowski, M., Halas, S., Peryt, Danuta, Poberezhskyy, A., Karoli, S., Wojtowicz, A., (2002), *S and O isotope composition of the Badenian (Middle Miocene) sulphates in the Carpathian foredeep,* Geologica Carpathica, vol. 53, nr. 6, pg. 391-398, Bratislava
61. Petrescu, I., (1994), *Palynological aproach to the lower Miocene formations (facies of the Sînmihai Beds) in NW Transylvania (Romania),* The Miocene from the Transylvanian Basin, p.19-28, Cluj-Napoca;
62. Petrescu, I., Balintoni, I., Bican-Brişan Nicoleta, Bedelean, N., Horváth, I., Mera, O., Laszloffi, F., Balica, C., (2003), *Exploatarea sării, producţia, întrebuinţări, piaţa sării*

şi impactul acestora asupra mediului, Environment & Progress, Cluj-Napoca, pg. 407-417.

63. Petrescu, I., Bican-Brişan, Nicoleta, Costea, D., (2006), *Zăcământul de sare de la Ocna Sibiului: caracteristici geologo-tectonice, geneză şi impact asupra mediului*, Environment and Progress, nr. 6, pg. 374-379, Cluj-Napoca
64. Popescu, Gh., (1970), *Planktonic Foraminiferal Zonation in the Dej Tuff Complex.* Rev. Roum. Geol., Geogr., Ser. Geologie, 14, 2, p.189 – 203, Bucureşti.
65. Posepňy, Fr., (1867), *Studien aus dem Salinengebiet Siebenbürgens*, Iahrt, d. k. Reichsansalt, 1, vol. XVII, Viena.
66. Pralong, J. P., (2004), *Le géotourisme dans les régions de Crans-Montana-Sierre (Valais, CH) et de Chamonix-Mont-Blanc (Haute-Savoie, F)*, In: Reynard E., Pralong J.-P. (Eds.). Paysages géomorphologiques, Institut de Géographie, Travaux et Recherches, nr. 27, Lausanne, pg. 225-241.
67. Pralong, J. P., (2005), *A method for assessing tourist potential and use of geomorphological sites*, Géomorphologie: relief, processus, environnement, nr. 3, 189-196;
68. Reynard, E. (2004a), *Géotopes, géo(morpho)sites et paysages géomorphologiques*, Paysages géomorphologiques, Séminaire de 3ème cycle CUSO 2003, Université de Lausanne, Institut de géographie, Travaux et Recherches nr 27, pg. 124-136, Lausanne.
69. Reynard, E., (2004b), *La géomorphologie et la création des paysages*, In: Reynard E., Pralong J.-P. (Eds.), Paysages géomorphologiques, Institut de Géographie, Travaux et Recherches, nr. 27, pg. 9-20, Lausanne.
70. Reynard, E., (2005), *Geomorphosites and landscapes*, Géomorphologie: relief, processus, environnement, nr. 3, pg. 181-188
71. Reynard, E., (2006), *Fiche d'inventaire des géomorphosites*, Université de Lausanne, Institut de Géographie, raport nepublicat, 8 pagini
72. Reynard, E., Panizza, M., (2005), *Geomorphosites: definition, assessment and mapping*, Géomorphologie: relief, processus, environnement, vol. 3, pag. 177-180
73. Reynard, E., Fontana, Georgia, Kozlik, L., Scapozza, C., (2007), *A method for assessing «scientific» and «additional values» of geomorphosites*, Geographica Helvetica, vol. 62, nr. 3, pg. 148-158, Lausanne.

74. Reynard, E., Coratza Paola, Regolini-Bissig, G., (2009), *Geomorphosites,* Edit. Dr. Friedrich Pfeil, München
75. Săndulescu, M., Visarion. M., (1978), *Consideration sur le structure tectonique du subasment de la Dépression Transylvanie,* D.S. Inst. Geol. Geofiz., LXIV (1976-1977), pg. 153-173, Bucureşti.
76. Serrano, E., Gonzáles-Trueba, J. J., (2005), *Assessment of geomorphosites in natural protected areas: the Picos de Europa National Park (Spain),* Géomorphologie: relief, processus , environnement, nr. 3, pg. 197-208
77. Stamatiu, M., (1943), *Istoricul metodelor de exploatare a zăcămintelor de sare din România*, Analele Academiei Române, Memoriile Secţiunilor Ştiinţifice, seria III, tomul XVIII, Bucureşti, pg. 581-642.
78. Stoica, C., Gherasie, I., (1981), *Sarea şi sărurile de potasiu şi magneziu din România,* edit. Tehnică, 248 p., Bucureşti.
79. Voiteşti, I.P., (1922), Considerations sur la geologie du sel des massifs des regions carpathiques roumaines. Congres Inter. De Geologie, XIII-e session, Bruxelles;
80. Voiteşti, I.P., (1924), *Raporturile geologice între zăcămintele de sare şi cele de petrol.* Cu o hartă a manifestaţiunilor saline din Carpaţi 1:1500000 şi profile în text, An. Min. Rom., vol. VII, p. 361-369; 393-397; 505-512; 529-539, Bucureşti;
81. Voiteşti, I. P., (1934), *Noţiuni de geologia zăcamintelor de sare*, Rev. Muz. Geologic Mineralogic al Univ. din Cluj, V, nr. 1, pg. 1-85, Cluj-Napoca
82. Voiteşti, I. P., (1943), *Sarea regiunilor carpatice româneşti*, Bucureşti
83. Watson E., Slaymaker O. (1966), *Mid-Wales, a survey of geomorphological sites*. Department of Geography, University College of Wales, Aberystwyth, 92 p.
84. Wimblendon, W. A. P., Andersen, S., Cleal, C. J., Erickstad, L., Gonggrijp, G. P., Johansonn C. E., Karis, L. O., Suominen, V., (1996), *Geological World Heritage: Geosites – a global site inventory to enable prioritization for conservation,* In Proc. IL Symp. European Association for the Conservation of the Geological Heritage, Mem. Serv. Geologico d'Italia.
85. ***, (2005), *Documentaţie de atestare a "Staţunii Turistice Balneare Cojocna",* Consiliu Judeţean Cluj
86. ***, (1997), *Studiu hiidrologic în perimetrul masivului de sare Ocna Mureş,* S.C. MINESA ICPM S. A., Cluj-Napoca