# CONSIDERATIONS REGARDING THE OVERALL STABILITY OF VOIDS CREATED IN SALT MASSIFS FOLLOWING EXPLOITATION BY DISSOLUTION

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**Abstract.** The main objective of the research is, as obvious from the title, the study of the stability of the affected regions by dissolution using wells, rock salt from Romania in order to reduce risks to the environment, people and property in areas of influence and higher capitalization, in safety conditions, of the deposits.

**Keywords**: stability, salt mining, risk reduction.

## INTRODUCTION

Salt exploitation by wet means (dissolution) is an extraction method commonly used with a high efficiency and it represents the production of a salt solution (brine) in the underground (room dissolution) and then the collecting and bringing it to the surface for evaporation, and purification. In Romania, the exploitation of salt in solution is practiced in mining exploitations Ocna Mureş (Field II of wells Ocna Mureş and field of probes Războieni), Ocnele Mari (field of probes Ţeica and field of probes Lunca), Târgu Ocna (Gura Slănic) and Cacica. Along with the occurrence of dissolution voids, in the salt massive occurs an imbalance, the rocks in the vicinity of the openings of dissolution tend to converge towards it, this way subsidence phenomena take place adjacent to the land surface corresponding to these exploitations. The evidence of instability phenomena (bumps, crumblings, potholes, damaging some buildings located in the influence area) is encountered at all wet salt mines in Romania. The presence of such manifestations imposed performing numerous topographical observations, monitoring and topographic studies, in a word a complex monitoring of affected salt deposits by dissolution exploitation.

Instability phenomena manifested on the surface lands adjacent to wet salt deposits, are not necessarily due to operating exploitation activity, at the basis of their occurrence could stand also other causes such as the property of land to change its volume due to increase or decrease in humidity, dissolutions from the backs or flanks of salt massifs due to the contact with water in aquifer horizons, groundwater and reservoir tectonics.

## MATERIAL AND METHOD

In order to ensure stability (both during exploitation and after its completion) in case of salt exploitation by kinetic dissolution using probes are applied methods of operating with "individual probes", case in which the probes are located in an ordered network and between gaps are placed safety pillars. Pillars cannot prevent, in time, the occurrence of phenomena of subsidence, situation highlighted by the topographic monitoring carried onto the surface of the land. The main factors contributing to maintaining or destroying the overall stability of salt deposits exploited by kinetic dissolution are:

- Geological and hydro-geological characteristics of the deposit of salt;
- Shape, size and distribution of voids related to the surface of the salt deposit;
- The shape and dimensions of pillars;
- Mining method applied.

The combined effects of all these factors are reflected by dissolution irregularities, creation of hydraulic links between wells and accidental union of the dissolution voids. The stability of dissolution voids is closely linked to the behavior in time of the resistance elements, pillars and floors of ceiling, related to the applied exploitation method.

## RESULTS AND DISCUSSIONS

On the pillars between the probes and on the marginal pillars act compression static efforts, due to their own weight and due to the geological charge of the deposit and the surrounding rocks, the lithostatic pressure, respectively the geological load gives rise inside the supporting pillars to certain tensions, according to their shape and size, as well as the geological and petrographic characteristics of the salt deposit [3].

In general, in all fields of probes, the form of the dissolution voids is different from the projected shape (circular), this being due, above all, to the lack of homogeneity of the salt deposits. Exceeding the projected range due to technological reasons or to reasons directly related to the deposit (the presence of sterile intercalations), creates the possibility of achieving the hydraulic links among the goals of dissolution, while helping to reduce the lift of pillars. Insulating fluid used in order to steer the dissolution phenomenon does not solve the whole problem, it especially ensuring the dissolution control at the ceiling of the dissolution void. [3] Irregular shape of the dissolution holes causes significant changes in terms of the division of tasks and strains in the pillars. Irregular dissolutions may ultimately lead to subsidence, situations encountered in Ocnele Mari (Field II), Gura Slănic (Groapa Burlacu), Ocna Mureş (Lake Plus).

Accidental union of the probes designed to work individually by making hydraulic connection between them is an undesirable phenomenon but, once produced, it does not stop them, they can still work well either as individual probes or in battery. The main causes leading to accidental union of the voids may be geological or related to the technological process, geological causes can sometimes cause the onset of technological ones. The presence of sterile intercalations or the change in salt quality, changes speed and dissolution direction, activating it in uncontrollable and unwanted directions. Also, the presence of a very smooth strip of very homogenous salt between the two dissolution goals causes its rapid dissolution, thus making the connection between the two goals of dissolution. Technological causes could be turning off the probes for a long period of time or failure to lift the casing in time. With the appearance and development of the gaps created by salt exploitation activities due to the convergence of the gaps and deformation of the resistance elements, appear movements which can be transmitted to the surface, their extent depending on the volume and geometry of the openings, depth or distance from the surface up to the average depth of the dissolution voids. The degree of damage to the terrain also depends on mining method applied, method of operation in batteries, especially in canals leading to significant impairment of deposit and surface stability, immersion speeds for these methods being 2-4 times faster than for the exploitation through individual probes [4].

## CONCLUSIONS

Salt deposits in Romania are characterized by geological, hydro-geological and economic conditions specific of each case and because of this the risks of triggering destructive phenomena are different from one reservoir to another.

Salt deposits are characterized by geological, mining, hydrological and tectonic different conditions; therefore, also the adopted exploitations methods vary from deposit to deposit. In case of salt deposits, the main factors contributing to increased instability voids created by mining and consequently the amount of land related to the area of influence of these are: the solubility of salt in fresh water, the presence and movement of freshwater on the back and inside the salt massif, the depth of voids from the surface, physical and mechanical characteristics of the massif and surrounding rocks [1]. Deformability of the rock in general, and rock salt, in particular, depends on the depth at which they are, of the petrographic nature, of the physical factors such as temperature, pressure, size and duration of action of tectonic forces. After the way in which these factors interact, the same rock behaves either as a plastic environment or a rift environment.

Salt deformations can be associated with salt movement under the combined influence of the two mechanisms, diapirism and isostasy, and also of each mechanism individually. This salt behavior makes the salt deposits that it formed to be tectonically affected and metamorphosed. Extracting salt represents the human activity with the highest environmental impact. Exploitation method through dissolution using probes creates inside the salt massive systems of gaps of different shapes and sizes, causing changes in the size and direction in which lithostatic efforts act. The size and distribution of the stresses represents otherwise, the cumulative effect of several natural factors (physical-mechanical, chemical and petrography of salt tectonics, geomorphology, hydrology and seismicity of the zone, rainfall, vegetation, organisms and microorganisms that characterize the area) or human factors (artificial watercourse change, deforestation, the distortion of landscape, overloading of slopes, vibration, voids created from exploitation activities).

By processing all these information and based on geological reasoning obtained following the research carried out, it will be reached a precise delineation of areas affected by discontinuities and accurate solutions on ensuring the stability of mining constructions. As a result, knowledge of the characteristics of the links existing in the massive rock, created by geological and tectonic phenomena, it becomes necessary to carry through the exploitations in good conditions [1].

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