TRACKING VERTICAL MOVEMENTS OF THE SURFACE ASSOCIATED TO A CLOSED MINE

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Abstract: *The paper aims to monitor through topographic, planimetric and leveling measurements, the soil stability and to track the constructions within the influence perimeter of Victoria salt mine, in order to protect the surface and objectives in the area.*

The study proposes monitoring by topographic, planimetric and leveling measurements on new longitudinal and transverse landmark alignments so the monitoring encompasses the entire field of influence of Victoria salt mine.

Keywords: *salt mine, stability surface, topographic measurements etc.*

1. Introduction

Extracting salt in Victoria mine was expected to develop on 25 floors, through small rooms and square pillars method.

Following the occurrence of instability phenomena in the access ramp and in the excavations/small chambers of Victoria mine and their rapid development, on 10/29/1992 the operating activity was ceased. At the time, the exploitation was taking place at floor XI.

Victoria mine area of influence is on a mostly afforested slope, with western exposure.

The current configuration of the slope to be considered as the result of long action of natural and artificial factors that through erosion, geodynamic phenomena and human activity, exhibit through extracting activity of underground salt, led to disturbance of the equilibrium state and conferring the current morphologies, manifested by the appearance of fissures, cracks and bumps on the surface of the land. [1]

The stratigraphic nature of the slope, rock formations from the salt massif roof, consisting essentially of sandy clay (surface) and clay marl, played an important role in shaping the land. It should be noted that some slides on the slope are very old, dating back to long before the salt extraction started by mining works in the area. [5]

Regarding the prognosis of instability phenomena which occur at the surface of Victoria salt mine it is considered that they will develop as long as it will be maintained the natural and anthropogenic factors of active geodynamic processes, namely:

- unfavorable geomorphological conditions;
- lithological nature of the roof layers (predominantly clay with low shear
- resistance to fracture);
- lack of appropriate protective vegetation cover;
- existence of underground mine voids.

2. Material and Method

The purpose of time tracking of the lands and constructions in the Victoria mine area is to obtain information in order to ensure the stability of both the land and the buildings in the area, an assessment of environmental conditions to prevent various natural accidents or prevention by reducing material losses, prevention of losses and environmental degradation.

Works on the monitoring station at Victoria mine, Slanic Prahova salt mine aim the extension, supervision, conduction of land checks and its maintenance, necessary to track and analyze the land and buildings developments by carrying out quarterly topographic measurements on:

- ground terminals;
- landmarks;
- topographic marks placed in the foundations of buildings.

Thus, the paper proposes continued monitoring by planimetric and level topographic measurements on the locating system consisting of:

- old locating system which was developed starting 1994;
- current locating system, consisting of three alignments, to which it will be performed extension works of the locating system, so monitoring coveres the entire area of influence of Victoria mine.

Precision topographic measurements conducted on landmarks in time have an important role in the concept of tracking (surveillance) of surface deformations and building stability in Slanic Prahova salt mine area, Victoria mine.

The terrain tracking network was developed in order to determine the movements of landmarks planted in Slanic Prahova slat mine area, Victoria Mine by executing topographic measurements and their recording and processing in several stages. [5]

Based on topographic measurements executed on landmarks placed in the ground or on constructions, it is aimed the determination of deformations and displacements that occur in the area of influence of Victoria mine and displacement directions of the landmarks (vertical movements).

In the area of influence of Victoria mine were conducted topographic measurements and visual observations from a number of 166 landmarks. Topographic measurements were performed both on benchmarks planted in the ground and also on topographic marks placed in the foundations of buildings. [5]

For conducting the topographic leveling measurements, it was applied the method of middle, high-precision geometric leveling, executed both ways, was taken as a reference benchmark, RN Slanic Prahova railway station landmark, of the Black Sea quota system, using Leica DNA 03.

3. Results and Discussions

To determine vertical displacements (immersion in time and total immersion) were used 3 cycles of measurements: measurement zero (03/22/2014), measurement 1 (06/26/2014) and measurement 2 (09/20/2014).

The following are the results achieved following the terrain measurements, immersion in time and total immersion between 03.22.2014 -09.20.2014 (Table 1).

Table 1 Immersion in Time and Total Immersion between 03.22.2014 - 09.20.2014

Crt. No.	Landmark	Immersion in time [mm] - 06.26.2014-09.20.2014	Total Immersion [mm] 03.22.2014-09.20.2014
1	L1	-5.7	-6.9
2	L2	-9.2	-10.2
3	L3	-33.1	-32.4
4	L4	-21.4	-28.9
5	L5	42.1	-50.5
6	L6	-23.7	-34.3
7	L7	-60.7	-66.9
9	L11	-96.6	-189.2
10	L12	-101.1	-187.5
11	L13	-101.7	-170.3
12	L14	-80.9	-155.2
13	L15	-67.4	-131.9
14	L16	-48.9	-87.0
15	L17	-48.8	-89.0
16	L18	-53.7	-86.7
17	L19	-48.0	-65.9
18	L20	-27.8	-36.8
19	L21	-31.7	-27.8
20	L22	-30.4	-41.9
21	T1	0	-0.2
22	T2	-0.3	-2.8
23	T3	-0.9	-0.9
24	T4	-18.7	-29.2
25	T5	-17.9	-27.3
26	T6	-52.4	-57.7
27	T7	-60.9	-74.6
28	T8	-50.5	-89.6
29	T9	-56.3	-93.8
30	T10	-99.5	-146.4
31	T12	-82.2	-168.8
32	T13	-97.0	-182.6
33	T14	-92.7	-178.8
34	T15	-93.0	-169.3

Landmarks of the median and hill top area, area for grazing, presents significant morphological changes highlighted by bumps, tears, cracks and landslides and due to these phenomena that occur frequently, high values of immersions are recorded (Fig. 1).

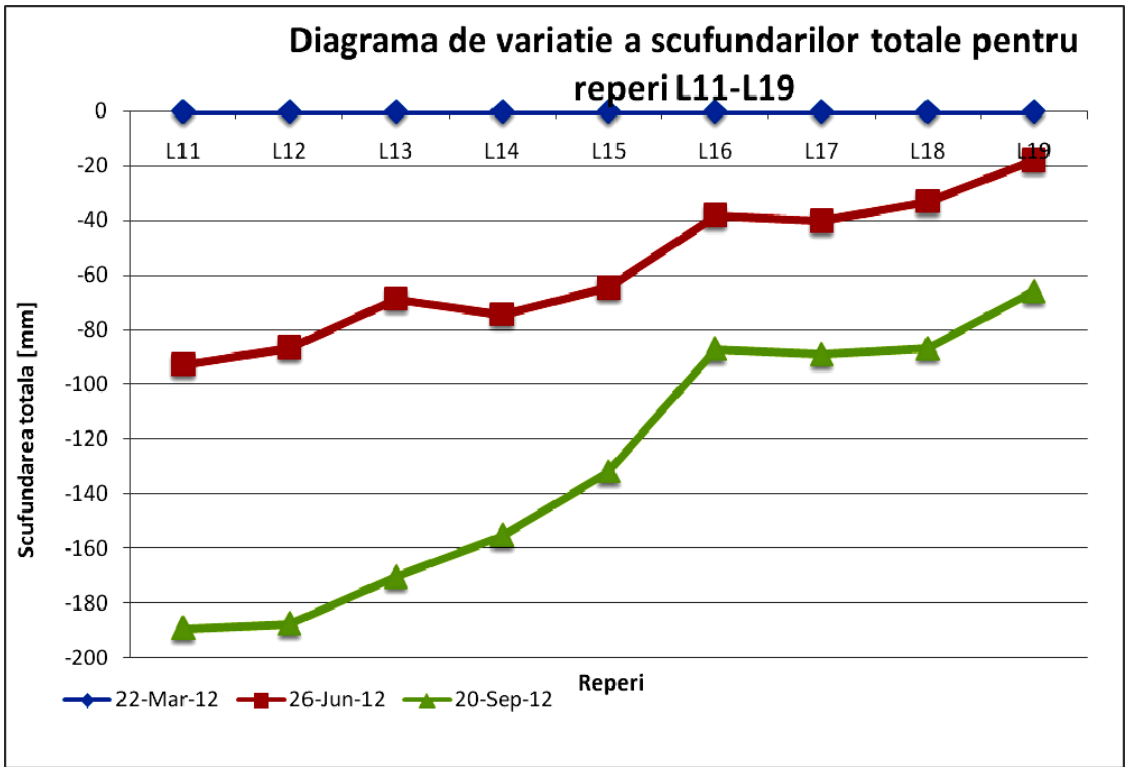

Fig. 1. Evolution of Landmarks Displacements for the Period 06.26.2014-09.20.2014

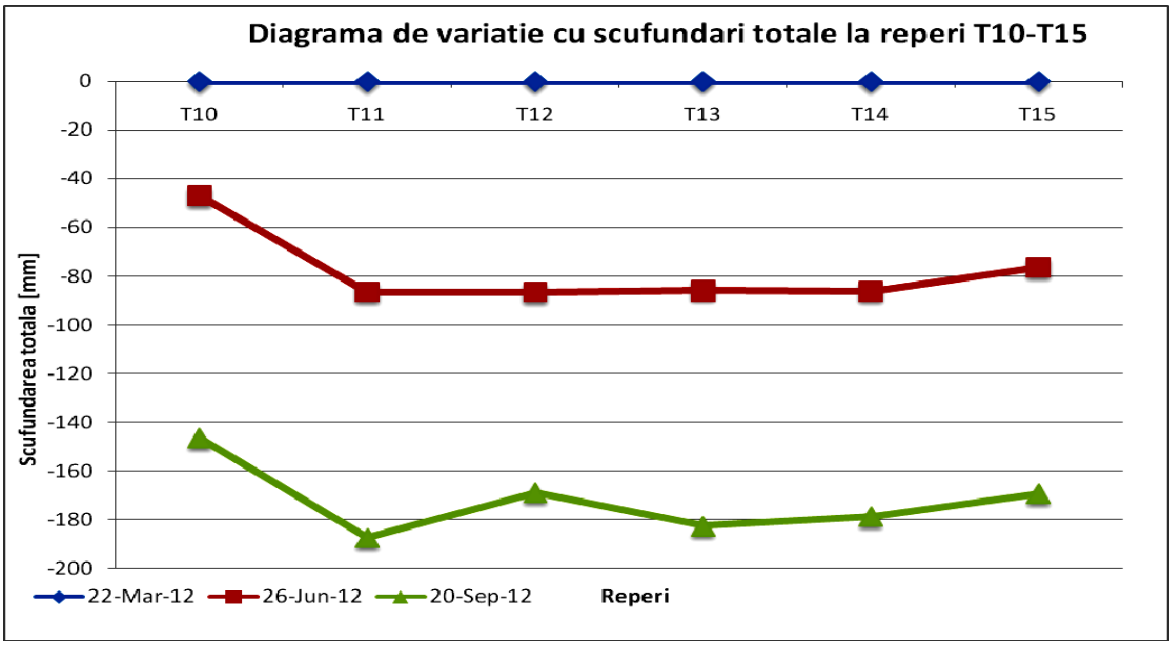

Fig. 2. Evolution of Landmarks Displacements for the Period 03.22.2014-09.20.2014

The variation charts indicate that these landmarks on these two alignments placed in the middle area of the influence field of Victoria mine, are in a continuous vertical displacement, registering maximum immersion in a short period of time (Fig. 2).

Maximum vertical displacements (time immersion from June to September 2014 and total immersion from March to October 2014) were recorded at landmarks placed in the middle area of the influence field of Victoria mine (Table 2, Fig. 3).

Table 2 Time immersion from June to September 2014 and Total Immersion from March to October 2014

Crt. No.	Landmark	Immersion during June – September 2014 [mm]	Total Immersion during March - October 2014 [mm]
1	L11	-96.6	-189.2
2	L12	-101.1	-187.2
3	T13	-97.0	-182.6
4	T14	-92.7	-178.6
5	L13	-101.7	-170.3
6	T15	-93.0	-169.3
7	T12	-82.2	-168.8
8	L14	-80.9	-155.2
9	L15	-67.4	-131.9

Fig. 3. The surface associated to Victoria - Slanic Prahova mine

4. Conclusions

As a result of topographical measurements carried out on the surface related to Victoria mine, were observed increases of immersion to the central part, that is, toward the salt massive, where the dynamics of instability processes and phenomena are increased.

Landmarks of the median area and of the hill top, area for grazing, presents significant morphological changes highlighted by bumps, tears, cracks and landslide, due to these phenomena that occur frequently high values of vertical movement are recorded. [5]

Vertical displacements determined through topographic methods used on monitored landmarks in the central area of the influence field indicate instability of the land. [3]

Following the immersion values obtained in the four traced reports are highlighted on the situation plan, three areas labeled A, B, C where the dives recorded are maximum and the morphological changes of land are continuous.

In the area of landmarks from the central region, remain phenomena of land degradation, which are evidenced by:

- small depression areas with water poddles;

- landslides;

- cracks, cuts;

- uneven ground.

5. References

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