LANDSLIDES AND SLOPE COLLAPSE IN THE ACUMULATION LAKE ZONE GURA APELOR

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Abstract Impression of total inner calm that gives us rigid crust of the earth is misleading.

Research area aims to identify and carry out works to strengthen the movement of portions consisting of rocks on a sloping surface which has product in areas where the soil is composed of different types of clays, with property to swell when soaked in water or result from the operations of freeze and thaw settlement results in the geological field.

Gura Apelor dam, with a tourist area, could lead to major material damage and human losses due to sliding Frequently producers without taking action.

Fig.1 *Separation of rock on the road to the dam Gura Apelor*

1. Introduction

This paper is developed based on the research done in the field to determine the risks of the landslides hazards from the accumulation lake zone Gura Apelor from the Retezat Râul Mare and adjacent fields.

2. Geographic location

The studied perimeter is situated in the Southern Carpathians, in Hunedoara County, specifically within the confines of the village Hateg. At the end of a difficult road is mountainous with steep slopes including high walls of rock, about 47 km away from the city of Hunedoara Hateg, Gura Apelor is huge dam and 400 km by rail from the capital.

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The Râul Mare valley respectively of the Lapusnicul Mare about 1.000 m deep in the Borascu erosion surface bridges, separates the Retezat from the Tarcu and Godeanu mountains to East, Bărbat River and Pilugu River is the true limit of the massive, separating it Tulisa Mountains.

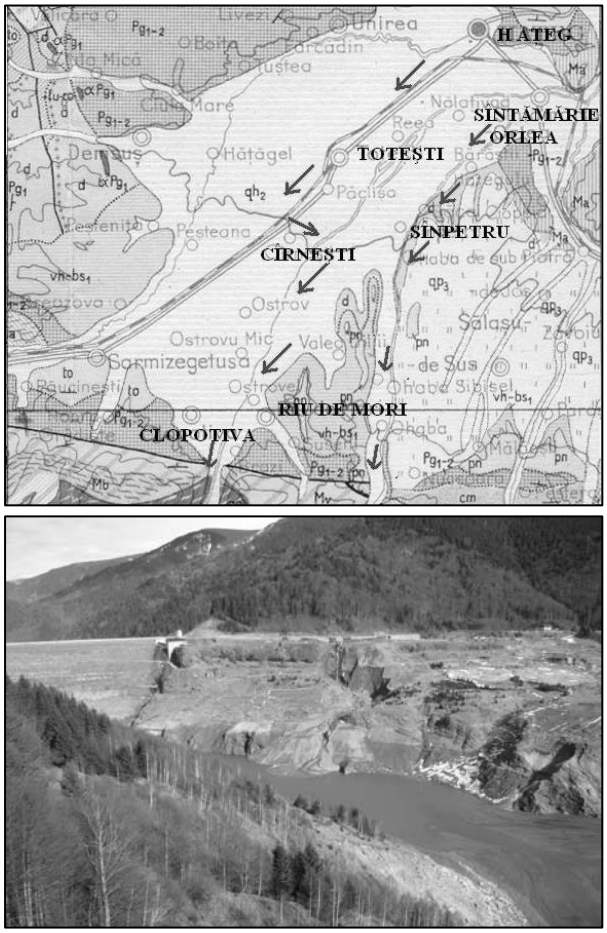


Fig.2 *Location of the studied perimeter overview of the dam during emptying Gura Apelor*

3. The Climate

In the Retezat mountains: you can't find weather stations, the climate is determined by interpolating of the data's obtained from weather stations Parang, Petrosani and Hunedoara.

The massif is located in the path of the west and south-western air masses. At over 2.000m altitude the average annual air temperature is about -2°, -4° C. Toward the altitudes of 1.400- 1.500 m, the mean air temperature are reaching the 2°, -4° C. In the hottest month, July the average air temperature is about 6° C on the highest peaks and about 8°-10° C starting at the upper limit of the forest towards the foot of the mountain. In the

coldest month, January, to over 2.000m the mean air temperature is about -10° C and from the upper limit of the forest it increases to -8°, -6° C.

4. Geological conditions

In terms of geological the area is complex because of so many tectonic units but also of so many types of rocks (sedimentary, igneous, and metamorphic) that exist. As shown in the geological map (fig.3), in the area is distinguished "The lower Danube units". These are made of polimetamorphic formations crossed by granite massive and formations mildly metamorphosed due to pre-carboniferous Paleozoic era.

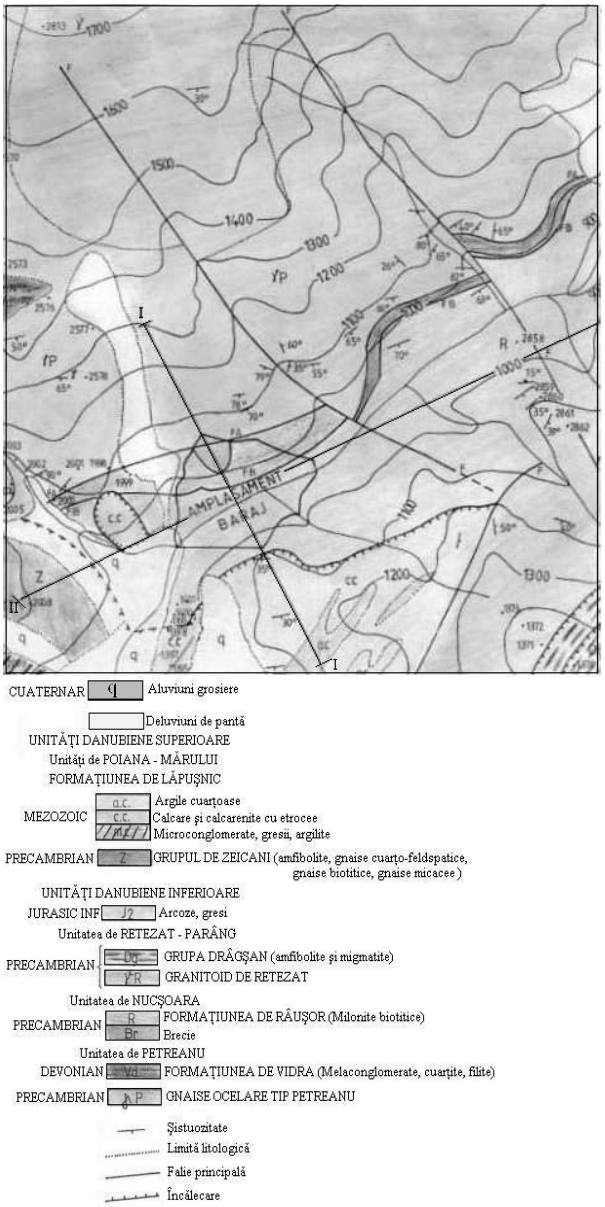


Fig.3 *Geological map of the dam region Gura Apelor and legend.*

In these units we can speak about:

- The unit of Retezat-Parang that has crystalline schists type Dragsan and granite from Retezat.
- The unit of nutmeg is composed of crystalline schists of the formations of Rausor (milon, biotite) and nutmeg.
- The unit of Petreanu with polimetamorphic formation of Bodu crossed by Petreanu gneisses and by the Stone Peak (Varful Pietrei) granite covered of Devonian formation mildly metamorphosed by Vidra.
- Followed then by Mesozoic permo sedimentary blanket, the lower Danube, with limestone, sandstones, clays and many others.
- Upper Danube units are consisted of sedimentary rocks, sometimes mildly metamorphosed and crystalline rocks (gneiss, amphibolites).

In the units are different:

- The Poiana Marului Unit, with formation of Zeicani - green shale and formation Lăpuşnic - quartz and graphite mudstone,sandstone, microconglomerates, limestone.
- The rock from the dam site of foundation contains: hard granitic rocks, compact and less permeable, in the center area (the rocky bed of the river) and on the left side.

5. The tectonic of the study area

The lower Danube units are under the sign of two major elements:

a) the slope from SE to NW of Rausor formation by the Retezat-Parang unit rocks along a line that exist on the right side of the Râul Mare, passing then to NE in the Rausor valleys, City and Nutmeg with the EW direction. The plan of subduction is considered overflowed age.

b) The Râul Mare fissure system that separates between them the lower Danube units of Petreanu and Nutmeg with predominant NE-SW directions and falls to SE. The fissures do not affect the Mesozoic deposits but are covered both the northern and south end of the Alpine tectonic plan from the base of the upper Danube. This system of faults can be alpine foreland, sinalpine, but surely over thrust above the upper Danube.

6. Hydrological and hydrogeological data

Retezat Mountains are characterized by a dense network of rivers, with a rich and permanent flow.

The most important watercourse is the Râul Mare with a pool of 894 km^2 and a length of 65, 8 km.

The area is found as water infiltration and şiroiri dripping in rock crevices and on different sections that cross faults, are streams of water as flows şiroiri and springs fed from the slopes or the lake, popular with debts of about 3 to 5 l / s

The crystalline shale, water infiltration are reduced debt, they usually appeared on the faces of

cracking dripping as weak, and very rarely şiroiri form of springs.

The presence of infiltration water in crystalline shale table caused an alteration and degradation time of intense tectonizate rocks.

Hydrologic point of view based on some mapping in natural openings(streams, torrents, wetting) and depth(drilling, wells, galleries) to achieve a hydrogeological model of the dam were determined the following characteristics: the groundwater lever, permeability, water absorption, water mineralization, and consumption of solid materials necessary sealing the rocks.

The Piezometers has noted two types of aquifers, namely: an aquifer stuck on the slopes, fracture type, irregular in shape, with depths ranging between 5 and 35m and an aquifer stuck in a riverbed, the alluvial layer, at the average depth of 2m.

7. Movements of rocks and erosion processes

Slips affect units of mountainous terrain, is widespread in the Gura Apelor lake.

Fig. 4 *Overview of the Ses River after emptying the dam Gura Apelor*

Under favorable conditions of humidity, with rain and long sharp melting snow layers, are many reactivation of old landslides threatening access roads in the area and new ones appear.

Slips affects the overall dam slope, separated into several compartments with different dynamics. Sometimes they crossed valleys forming natural dams that pose a threat to downstream settlements and land, as was the catastrophe of 1999 in the colony, where there were significant material damage and human lives in Gura Apelor dam, for the cause of uniting natural dam on a creek.

Therefore, the first consideration for such training is draining dams and dam removal water obstacle course.

Fig. 5 *Landslide in the river catchment area Tomeasa River Ses.*

In these mountains of the dam, slopes composed of crystalline schists and volcanic rocks are affected by the collapse of rock and rolling pulse drop accompanied by the formation of different-sized debris.

Fig. 6 *Slips and dislocations of granitic gneiss and clay altered, from the River Ses plain*

Change in time of rainfall and hydrological regime of the hillsides, will have a direct impact on terrain modeling, and the trend of increase in temperature causes some changes in plant blankets.

Fig. 7 *Ruins and wastelands from altered shale*

Rock falls are more numerous during periods of frequent alternations of freezing and thawing as spring. These processes are a danger to the road that crosses the mountainous region, requiring special protection measures.

Due to heavy rainfall and transport operators, the slopes of the Râul Mare Retezat are affected by landslides, leading to displacement of soil and rock masses consistent slopes, along the plans, which are separated from the stable of the hillsides, the called sliding surfaces.

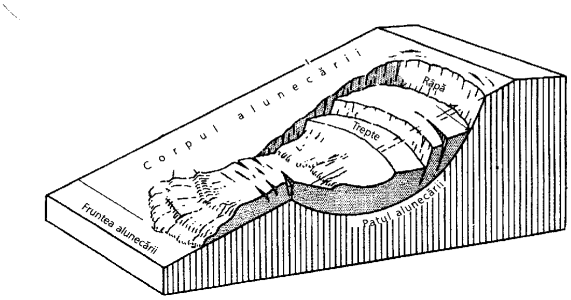


Fig. 8 *Recognition in the field of a landslide*

Causes of landslides found in the study is excess water from melting snow slopes due to heavy rainfall,existing springs, land morphology, nature and structure of rocks.

The categories of items affected by the landslides and debris slope on Râul Mare Retezat are: natural environment, built environment, population, material goods,etc.

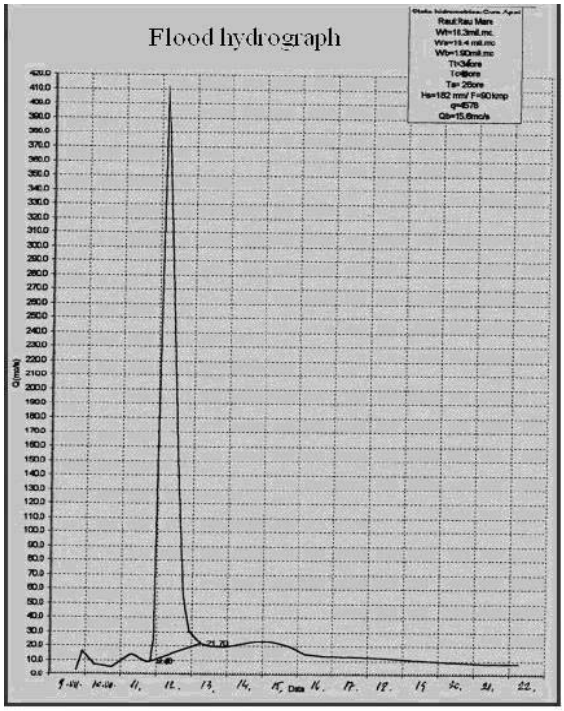
Clues to the presence of some landslides are: steps bump on the slopes, waves on slopes areas, the existence of surface slopes in the form of language, areas with excess moisture on the slopes, springs or diffuse emerging water, especially in the lower half and the areas considered to be slipped. There are also trees with trunks bent in different directions on slopes.

8. Floods and flood

They are natural hazards affecting the network of settlements and land communication routes. Floods are due to heavy rains, melting snow or a combination of two phenomena.

Flood wave propagation is strongly modified by anthropogenic activities.

The most important consequences have the floods with small basins, which are accompanied by a significant increase in a short time of the coarse sediment transport with a direct impact on settlements and ways of communication. Such a flood was produced on 11 July 1999, in the Râul Mare basin, downstream of the dam Gura Apelor, from Retezat Mountains. The flood was associated with an increase of the hydro-geological and morphological processes. It had formed a temporary dam made of tree trunks and fragments of rock on a very small creek, which produced a debris flow that caused 13 casualties, 21 injured and destruction of communication lines for tens of kilometers. Flood was caused by high amounts of rainfall (235.1 mm, Cal, H_2O in Râul Mare hydrometric station), precipitated fallen in the range 8 to 11 July 1999.



Flood hydrograph of 11 July 1999, Great River Retezat (registered INMH, 1999)

9. Conclusions and recommendations

Slips widely grown in relief units of the research area, being favored by the presence of clay and marly rocks, rain regime (which generates a steep slope humidity at certain times of year).

Formation characteristics from this area are very different both in terms of mineralogy and petrography, and also from the fracture system influenced point of view, probably, due to very high voltages metamorphism.

Addressing systemic problems of landslides in accumulation lake area can lead to Gura Apelor:

- causes loss of stability and phenomena that occur in slopes;
- possibility of progressive establishment of cause and effect links that will make a removable sliding material can be partially controlled.

Researches may lead gradually to the specification and detailing sliding and prevent disasters in the area of interest both in terms of tourism and in terms of electricity production.

It recommends a better correlation with the phenomena of building works of nature and design of new types of works, for the safe of the passers.

It should be established and ensures the functionality of the continuous information system, to alert local disaster.

It is necessary to draw up plans for defense against disasters and case studies for landslides in

all bodies with duties and responsibilities on this line.

It is necessary to inform public opinion through the media on areas of potential risk, the imminent production landslides, their effects and the measures taken.

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