OBSERVING AND MAPPING THE ROCK STREAMS AND QUARRIES IN SOME MASSIFS FROM THE ROMANIAN CARPATHIANS BY MEANS OF SATELLITE IMAGES

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Abstract: At the alpine and mountain levels (where the rock outcrops) of the Romanian Carpathian Mountains, frost wedging is the cause for the dislocation of rock fragments and for their gravitational movement on the slopes, and consequently for the formation of rock torrents and streams (active talus cone). It is worth mentioning that rock torrents are frequently associated with avalanches during the months of March – April – May. Such natural hazards can function as geomorphological risk processes because they affect or they are likely to affect forests (forest destruction at the upper limit under the pressure of the continuously expanding streams or forest sectioning by rock torrents and avalanches), transport infrastructure (particulary roads, it is the case of the national road “Transfăgărâsan” situated at over 2000 m), skiing areas (in the Bucegi and Fagaras Mountains), tourist facilities (chalets, hotels etc.). Some geomorphological risks are also connected to the exploitation of construction rocks (especially limestone) in large quarries. We are referring to those cases in which the quarries become sources of slope materials with negative consequences on forests and on different types of construction (in the Bucegi Massif, in the Rucăr – Bran pass). These processes and their consequences can be observed and mapped by means of satellite images. The recordings of LANDSAT 7 that we used were corroborated with topographical maps at a scale of 1:25.000. The application was concentrated on some Carpathian units through selective case studies: the Bucegi Massif, the Rucăr – Bran pass and the Piatra Craiului Massif.

Key words: rock streams, quarries, satellite images, Carpathians

1. Introduction
In this paper there are presented the possibilities offered by satellite images for observing and mapping on the rock streams and quarries from Romanian Carpathians. Such natural geomorphological risk processes, the rock streams affect infrastructure, tourist facilities, skiing areas etc.

Some geomorphological risks are also connected to the exploitation of construction rocks (especially limestone) and useful minerals in large quarries.

These processes and their consequences can be observed and mapped by means of satellite images. The recordings of LANDSAT 7 that we used were corroborated with topographical maps at a scale of 1:25.000. The application concentrated on some Carpathian units through selective case studies: the Bucegi Massif, the Rucăr – Bran pass and the Piatra Craiului Massif.

In these special geomorphological maps and designs we delimited areas of different types of risks. These documents are realized for setting up and protection projects of the specified mountain region.

2. Rock streams – specific geomorphic processes in periglacial level of the Romanian Carpathians. Landscape changes and induced risks.

The periglacial shaping system has the greatest extension in the alpine level of the Southern Carpathians (Transylvanian Alps), which are the highest mountains of the Romanian Carpathians;
a. Physical-geographical background of periglacial processes (crio-nivation) in the alpine level of the Southern Carpathians:

Basic climatic parameters:
- average annual temperature: -2,6 … 0°C
- number of frozen days: 190 – 267 / year
- average annual precipitation: 1200 – 1400 mm / year
- the length of the snow layer: 180 – 218 days
- the number of the average annual frost cycles: almost 100 days

Geological bed:
Crystalline schist with intrusive granite represent the lithologic bed and the characteristic structure is the overthrust. There are sedimentary formations at the eastern and western ends (mainly limestone and conglomerate) often upstanding synclinals.

Morphologic bed:
Areas of erosion (platforms of erosion); structural area and structural and tectonic – structural slopes (on upstanding synclinals); erosion slopes; Pleistocene glacial landforms (ridges, glacial cirques and valleys, moraines); Pleistocene and Holocene periglacial landforms which are created on glacial landforms (stone seas, laced ridges, talus cones and trains, nivation cirques and niches etc.)

Green coverlet:
Alpine and subalpine vegetation

b. Gelifraction and abrupt slopes (gravitation) causes rock falls and rock streams:
gelifraction causes rock cracking, dislocation and fragmentation, and abrupt slopes cause gravitational movement of rolling or translating fragments, and rock streams forming.

c. Morphologic structure of a rock stream:
- reception basin (the reception of decomposed material (A)
- transport channel (B)
- talus cone (C)

Figure 1: Western slope of Piatra Craiului Massif affected by rock falls and rock streams
(Digital Model SRTM and LANDSAT 7 Image)
d. Landscape changes and induced risks:
- disintegration of alpine and subalpine vegetation;
- cutting off the forests;
- lowering the highest limit of the forest because of the talus cones and trains pressure;
- favoring the avalanches (rock streams may be corridors for avalanches);
- endangering the infrastructure: roads, cable transportation

e. Technical measures to diminish the processes and the induced risks:
- to interfere, if it is possible, with the most active sources of rock fragments (talus, detritus) (place which give the most disintegrated material);
- to fix the rock streams and the active detritus which are a real danger for roads, funiculars and other infrastructure components;
- in the Southern Carpathians, the most important works of this kind were made along the “Transăgărășanul” national road, which crosses Făgăraș Mountains at over 2000 m altitude; the results are partially.

3. Quarries, at the origin of highly risky mass movements
a. Quarries in the geographic landscape of the Romanian Carpathians:
- gaps in the geologic and geomorphic slope equilibrium;
- starting places of some mass movement processes (landfalls, landslides) which are often very risky;
- sources of slope materials: block falls, rolling, landfalls;
- areas of environment degradation (especially vegetation), depreciation of landscape beauty;
- some quarries are quite within protected areas (natural parks, national parks)
b. Quarry categories in the Romanian Carpathians
- construction rocks quarries (especially limestone): Lespezi (in exploitation), Zănoaga (closed) – Bucegi Mountains, Bucegi Natural Park; Mateiaș (in exploitation) – Dragoslavele – Rucăr – Bran Corridor; Bicaz Chei (in exploitation) – Hășmaș – Cheile Bicazului National Park;
- useful mineral quarries: Călimani (sulphur, closed) – Călimani Mountains, Călimani National Park; Roșia Poieni (copper, in exploitation) – Apuseni Mountains; Anina (bituminous schists, closed) – Aninei Mountains

c. The perspective of the quarries in the Carpathians Mountains
- Closing some quarries and ecological reconstruction of that areas together with the limitation of the mining industry and a rigorously application of the EU’s environment protection standards: Călimani quarry, Anina Quarry
- Mining limitation to present-day areas for the quarries which are situated within the protected areas: Lespezi quarry, Bicaz Chei quarry
- Open new quarries will be allowed only by a strict harmonization of economic and ecologic studies (by a real evaluation of the ecological impact). This is case of the Roșia Montană gold quarry project (Apuseni Mountains), which is the biggest one in Europe.

4. Conclusions
The geomorphological risk from Carpathian Mountains represent un important topic for Romanian geographers. In their investigation are used, complementary, the satellite images. These documents have been used by us for observing and mapping of the rock streams. We are content about the results. These can be destined for the development and protection projects of the different areas from Romanian Carpathians.

References:
http://edcftp.cr.usgs.gov (SRTM Digital models)