THE SPATIAL AND TEMPORAL DIMENSION OF THE CLIMATIC FACTOR IN THE DYNAMIC OF MORPHOGENETIC PROCESSES

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Abstract: All geomorphological processes are part of an own spatial and temporal scale which is closely related to other processes and phenomenon of nature. Such processes are the geomorphologic processes which occurred million years ago or belongs to the recent history of the earth, affecting large geographic areas or has a local impact. Also a relief form must be analysed through the report among the factors which generated the form in a certain temporal sequention.
Seen through the lens of their dynamic, the geomorphological processes were and still are conditioned by two main factors: the tectonic and the climate. The aim of this paper is to show the spatial and temporal dimension of the climate, with examples from western Romania.

Key words: time, space, climate, geomorphological processes, Western Hills

The climate, as a generator of energy and substance for the gormorphic system, is the main triggering factor and supporter of the rhythm and intensity of morphodynamic processes. Its impact within the dynamic of geomorphic system must be analysed at different spatial and temporal scales.

Veyret (1998) differs, under the spatial aspect, *large morphogenetic processes*, those which affects in the same manner large geographic areas and are the results of major climatic changes and *local morphogenetic processes* which affects limited spaces and are the results of climatic variations or climatic events.

Through the lens of the same climate-process report, under temp[oral aspect, the cited author distinguishes:

- Periodic phenomena which has a seasonal character

-Chronic phenomena which in turn could be without periodicity, accidentals, caused by climatic events (heavy rains) or could have repeated periodicity

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The dynamic of geomorphoplogical processes is characterised by the variation of intensity and frequency. The existence of this discontinuity was highlighted by Erhart (1956) who using the term “biostasy” defines stable periods which could be interrupted by “ruptures” or thresholds. These thresholds reveals climatic, biological, human changes.

The climatic changes are characterised by the variation of the frequency and intensity in time, with various effects upon morphodinamic processes. The analyse of climatic phenomena could be made at different spatial and temporal scales. In this respect Mahara (2006) identifies these changes thus:

-the climatic change “assume a long term change of the climate and the time scale is thousands of years”, giving as an example the ice-age and the inter ice-age periods. Other authors called them *climatic fluctuations* which could be ancient or recent

Ancient climatic fluctuations “are accompanied by geologic time and requires a transformation of the flora and fauna and also major morphological changes”; their reconstitution being made with the help of fossils and correlated deposits. Related to the Western Hills, the climate in Dacian period was suitable for erosion processes (under the circumstances of a stable tectonic conditions) having as a result the formation of the general level of erosion, between 325-280m.

The sudden change of the climate at the end of Dacian period and the beginning of the Levantine period caused a “break” (threshold) in the evolution of morphogenetic evolution, in terms of deepening of hydrographic network and the fragmentation of the existing level of erosion. Although the tectonic movements were active they did not had a unitary character in the entire hilly area because of the uneven fragmentation of the crystalline base into blocks with a different rising or sinking rhythm. Thus we consider that the deepening process of hydrography into the general level of erosion was possible under a dry climate with the predominance of linear erosion.

Once the transition to a wet climate, in Levantine, under the increasing of erosional processes on the slopes and the predominance of lateral erosion and fluvial accumulations was possible the achievement of valley level of erosion, situated today in the “interior” of large fluvial valleys, between 260-200m.

Recent climatic fluctuations (from Quaternary), characterised by the succession of, glaciar and inter-glaciar phases had “introduced” a certain rhythmicity in the manifestation of morphodynamic processes. Thus the cold climatic phases (Günz, Mindel, Riss, Würm) imposed as main morphogenetic factor the ice, the results of their actions being visible in high mountains as cirques, valleys, moraines.

Durin inter-glaciar phases, under the increase of temperature, the rivers took the role of main morphogenetic agent, under the retreat of the glaciers. The expression of climatic fluctuations in the first part of the Quaternary are the fluvial terraces. The rivers from the western Romania have four terraces and also four glacisis (Berindei I., 1977)

Climatic oscillations are, according to Mahara (2006) manifestations with a length of few hundred or thousand years. Such oscillations were frequent in tardiglaciarthe last part of Wurm and in Holocene under the alternation of cold and wet periods (boreal), warm and wet (atlantic), warm and dry (sub-boreal), cold and dry (sub-atlantic). These climatic oscillations could be found in the variation of morphogenetic processes from the flood plain expressed by the alternation of linear erosion and lateral erosion or accumulation.

The proof is given by flood plain deposits (bulky at the base and fine in the upper part), the existence of a layer of tree trunks, partially fossilised, at the base of flood plain deposits. The soil and archeological studies (Dumitrascu, Berindei, 1977) beside the fact that they confirm the climatic oscillations from the Holocene, clearly shows the "fossilisation" of the bed of the flood plain (the formation of flood plain deposits) at the beginning of the Bronze Age. The reappearance of linear erosion took place under climatic oscillations from the end of the Holocene and the appearance and intensification of human activities.

Under the same wet climatic conditions was possible the occurrence of the massive landslides from Lăzăreni, Betfia, Oradea.

Some authors calls the climatic oscillations as historical fluctuations. Vernet (1998) distinguishes a series of minor fluctuations after the year 1000 and denotes them as follow:

- 1000-1250 – relatively "sweet" climate
- 1250-1400 – the disturbed period
- 1400-1650 - colder climate
- 1600-1850 – cold climate – The Little Ice Age
- 1850-1940 – re-warm of climate
- 1940 – present – a slight warming of the climate

The impact of these climatic "fluctuations" (oscillations) is "less felt", they could cause the re-arrangement of some valleys, the triggering of some landslides, water erosion on slopes a.s.o.

Climatic variability is a exceptionally climatic process with a relatively reduce influence upon geographic areas namely wet or dry periods of some months. Called also as *seasonal accidents*, they could cause exceptionally erosions, landslides, floods a.s.o. Such examples are the flods from 1932, 1970, 1980 caused by the superposition of heavy raining and sudden melt of the snow and also the landslides from 1998.

The effect of the alternation of dry periods (Western Hills between 1992-1994) with wet periods (1995-1999) could be found in the re-activation and intensification of some geomorphological processes on slopes: gully erosion, landslides a.s.o.

Short morphogenetic crises are associated with short term climatic changes (meteorological events).

The *meteorological events* are known as *crises* and are manifestations of the weather on short terms, with high intensity, with small time and space size. Such examples are torrential rainfalls, tornadoes, sudden warming which cause rapid snowmelt. These phenomena are "generators" for water erosion, for surface erosion, for concentrated water erosion on slopes with a final result of the appearance of rills and gullies.

Such processes are very clearly observable on ……………………..

Brundsen (1990) defines *extreme crises* as events which change the existing order and could produce new morphogenetic systems.

Veyret (1998) shows the importance for the geomorphology of "back period" (repetition) of such crises because it allows the setting of the speed of evolution of relief forms.

The impact of meteorological events is amplified by the human activity, namely in the field of land use and protection of them.

Such a meteorological event took place in 1997, June, 14-15, when during 16 hours fell in the mid part of Barcau river (at Suplacu de Barcau) between 16-0-180 mm of rain concentrated on two periods (according to two cloud nucleus). Concentrated upon a small area, dominated by slopes (Valea Frumoasa) the effects of the rain were disastrous: losses of goods and human lives. On the third terrace of Barcau river, the areas cultivated with corn and grapes, were heavily affected by 0.80 cm gullies and the materials were transported and deposited on the second terrace of the river. The calculations made showed that the total volume of eroded, transported and deposited materials was around 300 q.m.

Same effect had also the sudden snowmelt associated with heavy rains in February 1999 when, during one day, the temperature increased with 25^0C (-11^0C in 19 of february 1999 to $+14^0$C in 20 of February in Săcueni) The a two days period of rains followed. On a frozen surface the runoff was maximum and the thawed and soaked soil slipped over the marly-clay surface. The process took place on nine different areas and the surface of affected area was around 100 hectars.

Conclusions

In conclusion one could say that the climate, through its energy and material features, could impose the type of morphogenetic agents and also the intensity of specific processes. The impact of the climate must be also analysed at different time ans space scales according to the size and time evolution of the analyzed area.

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