

## SOME ASPECTS OF ALLUVIAL TRANSIT AND CLOGGING OF ACCUMULATION LAKES IN THE TROTUS HYDROGRAPHIC AREA

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### INTRODUCTION

The problem of alluvial transit across watercourses presents great theoretical and practical importance. The outflow of alluvia represents the effect of the erosive activity exercised by running waters and reflects the erosion potential of the hydrographic network, with direct effect upon the general evolution of the forms of relief and of the geographical morphology, in general.

The analysis of the regime of alluvial outflow can offer precious information on the local and regional conditions of denudational processes, determined, in their turn, by environmental conditions (geology, relief, hydro-climatic and biogeographical factors) and by the dimensions of the anthropic impact.

From a practical point of view, the knowledge of solid transit is of vital importance in projecting complex arrangement or flood protection works. There are numerous cases of accumulation lake clogging (respectively, of decrease in their efficiency and effectiveness), of water supply sources for utilities and irrigation or dragging canals, of exacerbation of the riverbed erosion).

The problems caused by that watercourse arrangement without prior knowledge of the negative side effects imposed a different approach to the concept of arrangement itself. Some of the above-mentioned aspects have been already noticed in the Siret hydrographic basin in other studies (Olariu, 1988a, 1988b, 1992, 1997), (Olariu si colab.1999a). In this paper, we propose the analysis of a series of solid outflow values collected from a number of 10 hydrographic stations, considered as representative for the Trotus hydrographic basin, where measurements of alluvia are made (H,Q,R).

### CONDITIONS OF FORMATION AND REGIME OF SOLID OUTFLOW IN THE TROTUS HYDROGRAPHIC AREA

The Trotus River, having a reception basin surface of 4456 square kilometers, is situated in the East-central part of the Oriental Carpathian belt, close to its curvature; as the fourth affluent of the Siret River, there is a great variety of all genetic factors of solid and liquid outflow.

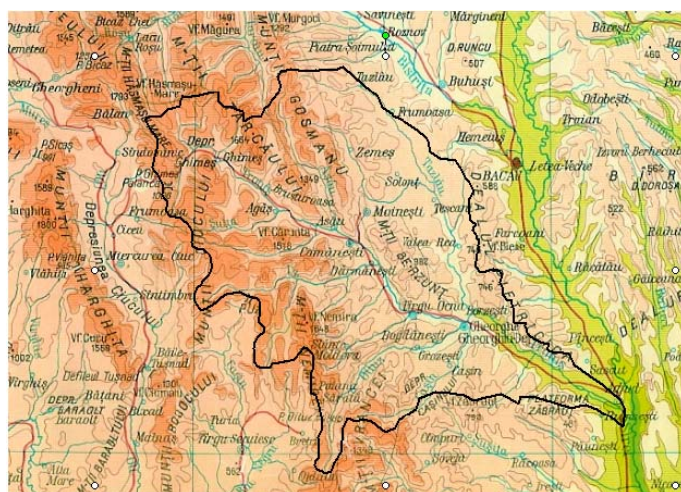


Fig. 1 The geographic position of the hydrographic basin of the Trotus river

The form of the hydrographic basin is slightly oblonged to the NW-SE and its dimensions are:

115 km in length and maximum width of 68 km. This position places it in full continental-temperate climate,

where the climatic conditions are seasonal and present variations for longer periods and torrential precipitations.

Air temperature variation in the Trotus hydrographic area is circumscribed in the context of subalpine climate on the highest peaks, föhn effect on the slopes and sheltering or thermic inversions in depressions and valleys.

The alluvial flow (in suspension or dragged) expresses the morphogenetic potential of a hydrographic basin; the alluvial regime is much more variable in time and space than that of the liquid outflow. Besides factors that determine the water outflow variability, factors which are maintained in the case of alluvia, there are other influential variable elements: lithology (types of rocks, hardness, structure, resistance to erosion), vegetation (types of vegetation, coverage), anthropic impact (riverbed arrangement, border consolidation, ballast deposits exploitation, agricultural systematization), slope morphology whose size influences the intensity of geomorphological processes on the areas which represent a source for solid materials.

The climatic factor is highly visible in connection with other natural elements. The climate is submittable to altitudinal and latitudinal zonality, depending on the gradual descent of forms of relief from the west to the east.

The height, the position and the orientation of the main forms of relief, in relation with the general circulation of the atmosphere, impose the basic climatic characteristics: climates specific to the mountain, plateau, hill and plain areas, each of

them conditioning the volume of precipitations and their territorial spread.

The role of vegetation and soils in the process of solid flow is also essential. In the mountain area (1600-1000 m), the soil is composed of cambisols with numerous enclaves of spodosols. In the Subcarpathian zone, the soils are clayey-illuvial, pseudoeredzine and alluvial, whereas in the western part of the Tazlau Depression, there appear intrazonal soils represented by soils in formation (recent fine or thick alluvia with a high capacity of infiltration and subterraneous water circulation), such as redzine type, pseudo-redzines and halomorphic soils.

All along watercourses there appear higrophile vegetation and alluvial soil.

### THE CHARACTERISTICS OF THE ALLUVIAL OUTFLOW REGIME IN 1950-2002

The hydrometrics of alluvia in suspension has begun systematically in 1950 and has spread ever since. At the present, in the Trotus hydrographic area, there are a number of 21 hydrometric stations (with H, Q etc. measurement programs), of which 10 survey the alluvia in suspension from this geographical areal.

The criteria of representativity chosen refer to the geographical situation in which the hydrometric stations are found (in the mountain, plateau, hill and plain areas, where the share of foresting is also considered), the anthropic impact dimensions and the role of the Poiana Uzului accumulation and of the hydrotechnical works, as well as the character of maximum erodability of this area. The analyses refer to turbidity, the specific element of alluvial transit.

Table 1. Data referring to the outflow of alluvions in suspension in the Trotus hydrographic basin

| No | River  | The hydrometric station | Surface (km <sup>2</sup> ) | Average altitude Hm | Q mc/s | R Kg/s | Turbidity ρ(gr/l) |
|----|--------|-------------------------|----------------------------|---------------------|--------|--------|-------------------|
| 1  | Trotus | Lunca de Sus            | 89,2                       | 1140                | 0,77   | 0,11   | 0,143             |
| 2  | Trotus | Goioasa                 | 765                        | 1052                | 641    | 4,32   | 0,674             |
| 3  | Trotus | Tg Ocna                 | 2084                       | 924                 | 16,3   | 14,0   | 0,859             |
| 4  | Trotus | Vranceni                | 4077                       | 734                 | 35,2   | 34,4   | 0,977             |
| 5  | Asau   | Asau                    | 196                        | 951                 | 2,07   | 1,28   | 0,618             |
| 6  | Uz     | Valea Uzului            | 160                        | 1070                | 1,70   | 0,21   | 0,124             |
| 7  | Uz     | Cremenea                | 340                        | 1070                | 3,95   | 0,39   | 0,098             |
| 8  | Oituz  | Ferestrau               | 263                        | 810                 | 3,17   | 1,63   | 0,514             |
| 9  | Tazlau | Scorteni                | 417                        | 574                 | 3,37   | 6,07   | 1,80              |
| 10 | Tazlau | Helegiu                 | 984                        | 520                 | 6,85   | 13,0   | 1,90              |

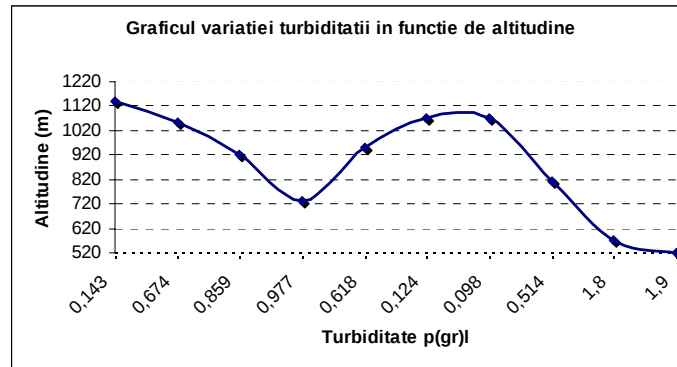


Fig. 2. Graph of turbidity variation depending on altitude

In order to determine the effect of the anthropic impact upon the alluvial outflow, we have considered the series of average multiannual values for the period 1950-2002. In this context, we noticed that the period 1968-1991 is characterized by a slight increase in the alluvial debits in suspension, as a result of the complex watercourse arrangement works of the ballast deposit exploitations); there was also a 1.5 times-increase in liquid outflow. After 1991, there were registered much lower values, partly due to the reduced liquid outflow (severe draught periods) and the decrease in the anthropic impact.

With a view to observing the ratio of natural and anthropic factors in conditioning the regime of alluvial outflow, figure 3 represents the graphs of water turbidity variation at one of the hydrometric station,s taken as representative for its position: upstream or downstream the Poiana Uzului accumulation (Goioasa and Vranceni)

The interpretation of the diagrams leads to the following conclusions:

- In the case of larger rivers, that drain different geographical areas and on whose courses there were situated ballast-pits, the effects of anthropic impact are visible, that is, for the periods when larger quantities of ballast were exploited, the turbiditutes were higher. Such influences were noticeable at the Vranceni hydrographic station on the Trotus river.
- In the higher mountain areas, that were not affected by any works in the watercourses, or had only little intervention, there is not recorded significant increase in turbidutude over the period 1968-1999; on the contrary, some continuity over time is being preserved. In exchange, there have been important increases at the Goioasa station over the past ten years. Considering that, for this period, the liquid debits have been situated under the multiannual average, we may suppose that these increases in tubidutude can be the direct result of forest activity intensification.

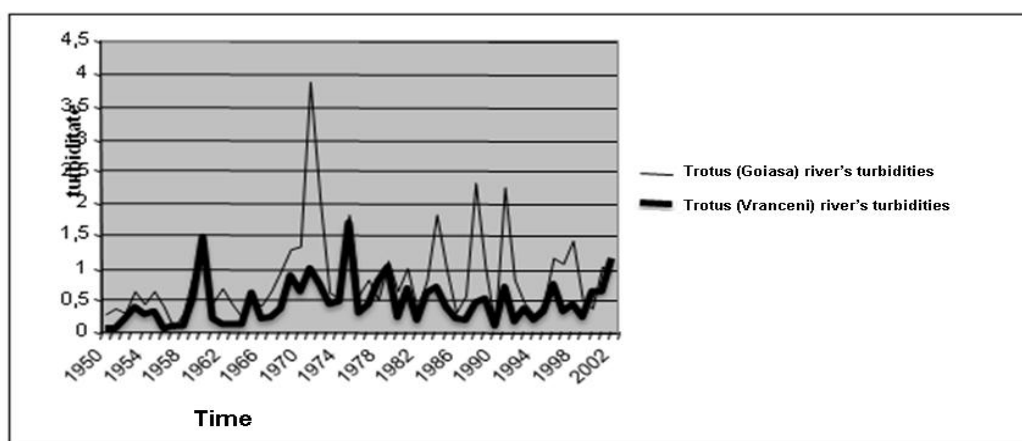


Fig. 3. Graph of turbidity variation of the Trotus river at the Goioasa and Vranceni hydrographic stations

The above-presented data show that, in the alluvial formation and trasportation processes, the anthropic presents a higher impact than the liquid outflow. In the case of alluvia, the riverbed works

and the exploitation of ballast resources determine significant increase in turbidity, whereas accumulation lakes diminish the solid transports.

As far as dragged debits are concerned, there is no direct measurement in the hydrometric network. However, we can appreciate that, depending on the river dimensions, they can amount up to 1/10-1/12 from suspensions, and even more in the case of torrents.

The greatest flow of solid debits in the Tazlau subbasin is of 4.15 t/ha/year. This lead to the

clogging of the Belci accumulation on its lower course, for a relatively short period of time, at an average annual rate of 2.8% (see table 13) . The volume of this accumulation decreased from 12 mil.mc. in 1962, la 5,97mil.mc. in 1986 and to 2,90 mil.mc in 1991. The Belci accumulation was destroyed during the flooding of 28/29 July 1991.

Tabel 3. The clogging situation of of the accumulation lake in the Trotus hydrographic river basin

| No | River  | Name of lake  | Volume miimc | Quotient of accumulation | Clogging degree | Periodad (years) | Average yearly clogging rhythm |
|----|--------|---------------|--------------|--------------------------|-----------------|------------------|--------------------------------|
| 1. | Tazlau | Belci         | 14,6         | 0,034                    | 83,3            | 25               | 3,33                           |
| 2. | Uz     | Poiana Uzului | 90           | 0,674                    | 5,11            | 20               | 0,25                           |

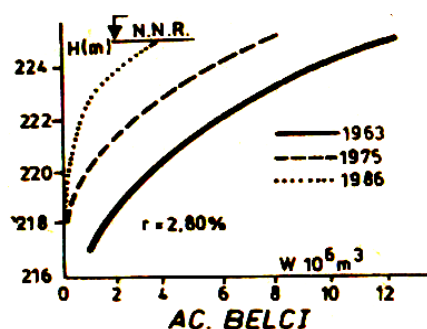


Fig. 4. The graph of the Belci accumulation lake clogging

The process of clogging of accumulations is conditioned by several factors, of which we can mention:

- The energy and the degree of relief fragmentation in the hhydrographic basin correlated with the geological structure and composition;
- The share of foresting;
- The organization of agricultural plots;
- The stage of development of erosion control and torrent arrangement works;
- The period of the year when flooding is produced, respectively, the phenological state of vegetation;
- The regime of water and alluvion flow;
- The degree of riverbed arrangement.

As we can observe, for the last 10-15 years, several factors of the ones listed above have registered a negative evolution: deforesting on even more extensive areas, uncontrolled soil cultivation, the lack of slippery slope arrangement works, etc.

## ABSTRACT

The water and alluvion outflow regime displays a significant natural variation, characterized by a certain cyclicity overlapped by the anthropic pressure exercised by water usage. If the situation of liquid outflow seems fairly simple, the one of alluvions is rather complicated. This is what led the authors towards analysing the cycle of

effective solid outflow, from the perspective of the anthropic impact dimensions.

The interval 1950-2002, for which there are registered a series of direct yearly values partially extrapolated, has been divided into three periods:

- a. 1950-1967, with natural outflow and reduced anthropic pressure;
- b. 1968-1991, with richer natural outflow and extremely visible anthropic impact;
- c. 1992-2002, characterized by reduced natural outflow (influenced by some periods of draught in the summer) and a slightly diminished anthropic impact, observable in the case of the accumulation lakes.

All accumulation lakes register clogging phenomena whose rates depend upon their positioning in different geographical areas (mountain, hill, plain) and the watercourse disposal (isolated or waterfall).

## CONCLUSIONS AND SOLUTIONS

In the multitude and great variety of factors that control alluvial transit, the anthropic impact introduces new elements as complex as they are contradictory. As a result, the monitorization and analysis of solid deposits needs to be done with maximum responsibility taking into account:

- a. The physical-geographical characteristics of the Trotus hydrographic space and its particular hydroclimatic peculiarities resulting from its positioning in an area submitted to a continuous process of decontinentalization, characterized by serious discontinuities in the water and alluvions drainage regime;
- b. The strong anthropic impact upon the riverbeds and the hydrographic basins, with a serious decline since 1990;
- c. The present deficiencies of alluvial hydrometrics and the lack of supervision of the ones dragged or sedimented.

These factors and particularly anthropic pressure variation may represent criteria for establishing the cyclicity of the alluvial flow regime.

As far as the solutions we proposed are concerned, we consider that the attention of the specialists should be drawn towards:

1. re-analysing the representativity of the monitorized sections of alluvial overflows.

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