

Adam Mickiewicz University
Quaternary Research Institute
Poznań

Zbigniew Zwoliński

MORPHOGENETIC ACTIVITY OF OVERBANK FLOWS
ON THE PARSETA RIVER FLOODPLAIN,
THE POMERANIAN LAKELAND;
GENERAL OUTLINE

INTRODUCTION

In 1979—1982 research was carried out of the activity and effects of overbank flows in four selected sections of the Parsęta floodplain: Storkowo, Krosino, Dębczyno and Bardy. The Parsęta is a lowland meandering river, and its drainage basin occupies the central part of the Pomeranian Lakeland.

The field work comprised observations of flood water flows on the floodplain, morphological mapping, and sedimentological investigations of alluvial covers. The collected documentary material was enriched with numerous ground and aerial photographs.

The results of the field and laboratory investigations of all overbank flows of the Parsęta river and their effects in the four-year period were used for a synthetic elaboration of the model of a hypothetical flood passing through a floodplain (Zwoliński 1985). The aim of this paper is the presentation of the concluding results of the synthesis, i.e. a model of overbank flow illustrating the morphogenetic activity of flood waters on a floodplain.

THE MODEL OF THE OVERBANK FORMATION OF A FLOODPLAIN

The hydrological analysis of all the overbank flows as well as morphogenetic processes and their morphological and sedimentary effects, justifies the conclusion that within the Parsęta floodplain, in a period of several years, there occurs an ordered sequence of morphogenetic flood events. It is a response to the tendency of the same processes to

repeat in space and time and of their effects to overlap. Repeating tendencies in the river activity over a longer period of time can be treated as processes of cyclic erosion and sedimentation. Therefore, the following sequence can be put forward of hydrological and morphogenetic events of a flood with a single culmination for lowland meandering rivers:

first phase — the rise of floodwaters in the river channel and of groundwaters within the floodplain; erosive modification of floodplain edges (i.e. bank erosion);

second phase — the inundation of the floodplain; the erosion (breaches, crevasses, chutes) and redeposition (chutes and terrace channels) of older terrace sediments and the accretion of natural levées and meander sand covers;

third phase — adjustments of the overbank flow pattern to the floodplain morphology (a) and the flood peak (b); the role of erosion is in inverse proportion to adjustments of the floodwaters to the floodplain environment (morphology, vegetation, etc.); the transport over the floodplain surface and along chutes and terrace channels remains dominant; sediments are deposited as crevasse splays, terrace ribbons, sand shadows, deltaic and alluvial cones, and in oxbow lakes and in swamps; the accretion of meander scroll ridges;

fourth phase — the initial fall of floodwaters, changes in the overbank flow pattern; as a general rule, erosion plays no part and the processes of transport undergo reduction; the maximum intensity of deposition in different flood forms, especially chutes, terrace channels, crevasse splays, sand shadows, deltaic and alluvial cones, and oxbow lakes and swamps;

fifth phase — a gradual cessation of the overbank flow; transport ceases with time; the final deposition of the material carried onto the floodplain; erosive modification of newly formed alluvial covers and ebb channels;

sixth phase — decantation of the finest mineral and organic particles in floodplain depressions and a wave-like motion of stagnant waters (a), post-flood transformation of sediments and forms in subaerial conditions (b).

One can ascribe relative intensity of the main morphogenetic processes: erosion, transport and accumulation, to the distinguished flood phases. These dependences are shown graphically in Fig. 1. The duration time of the particular phases as well as the progress of the curves can vary and they depend on the nature and operation of floods. What is striking is the crossing of the curves in the third and fifth phases of the overbank flow. It follows mainly from the character of erosive processes, which are of local and little importance during the peak flow and immediately after it. The crossing of the erosion, transport and accumulation curves in the third phase indicates an equilibrium state in the magnitude

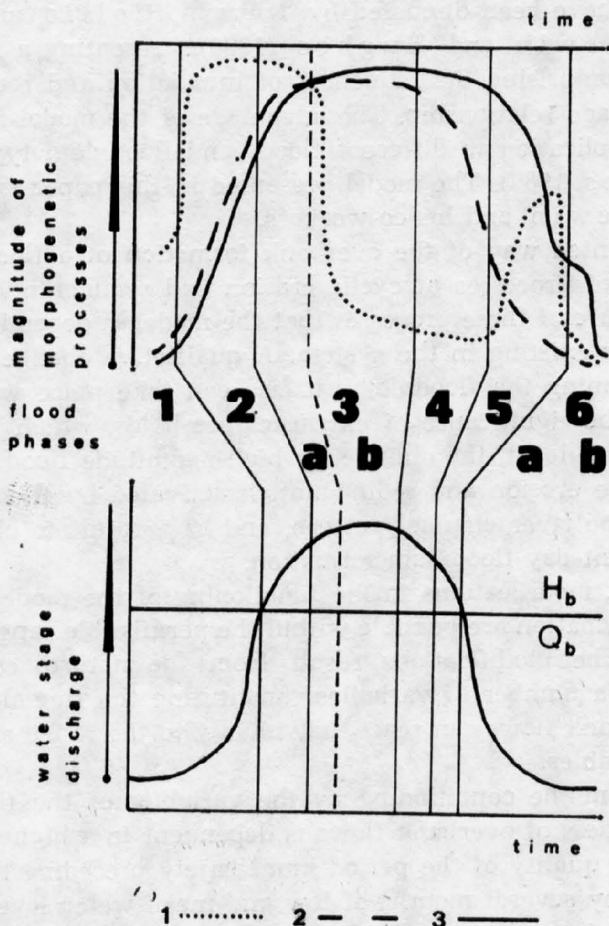


Fig. 1. Magnitude of main morphogenetic processes on a floodplain in relation to hypothetical flood phases. Key: 1 — erosion, 2 — transport, 3 — accumulation, H_b or Q_b — bankfull stage or discharge

of these processes. This point defines the final moment of the adjustment of the overbank flow pattern to the floodplain surface. The location of this point on the diagram can, of course, vary. The accumulation curve, in turn, is dominant almost throughout the whole flood period. It is connected with the modern aggradation tendency of the Parsęta river (Zwołński 1983).

CONCLUDING REMARKS

The construction of a model of the morphogenetic activity of floodwaters on a floodplain requires a number of methodological assumptions, of which the most important are hydrological ones. Recently, such

assumptions have been discussed by Lewin, Collin and Hughes (1979) and Lewin and Hughes (1980), presenting a flood inundation model comprising the sequences of inundation and recession in the inundation-stage relationship. The advantage of the model is the possibility of its application to different floods and floodplain types (Lewin and Hughes 1980). The model presented in this paper is an extension of that of Lewin and his co-workers.

The presented way of the overbank formation of a floodplain works as a system of processes of cyclic erosion and sedimentation. It follows from the nature of these processes that the model is dependent on intrinsic thresholds existing in the system. A qualitative change in the cyclic processes forming the floodplain surface can take place with a gradual increase of the significance of extrinsic thresholds, which include changes of the base level, the climate, or high-magnitude floods. The system of progressive erosion and sedimentation activated by them can lead to changes in the river channel pattern, and as a result to changes in the way of present-day floodplain formation.

Naturally, modifications in the functioning of the model of overbank floodplain formation are possible within the permissible range of intrinsic thresholds. The modifications result from the nature, conditions and operation of a number of variables constituting the fluvial system. Particular overbank flows can react individually to the range and magnitude of these variables.

Apart from the conditioning by the variables of the fluvial system, the effectiveness of overbank flows is dependent to a high degree on the duration and quality of the period immediately preceding the flood. If it is preceded by several months of low and mean water levels, its erosive and accumulative effectiveness is very high. In the case of a period of continuing high water levels, the flood is only limited to inundation of the floodplain with a possible slight morphological touch-up or a thin silt coat. The possibility of the occurrence of a quasi-unproductive overbank flow is allowed by the model of accumulative flood effects on a floodplain described by Goner, Kijowski and Zwoliński (1984). A special case is the inundation of the floodplain by groundwaters as an effect of their rising caused by a high stage of floodwaters still confined in the river channel. This inundation is unproductive and can only be confined to the redeposition of superficial silts. It must be admitted that the presented model works differently when the flood has more than one peak flow. Then, successive peak flows can bring about changes in the morphological and sedimentary results of the first culmination, the effects of the successive flows growing weaker and weaker, and less and less distinct on the floodplain surface. However, regardless of the type of modification of the proposed model of the overbank floodplain formation, field observations suggest that it finds a satisfactory confirmation

in the style of floodplain architecture formation of a number of meandering rivers of the Polish Lowland.

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Zbigniew Zwoliński

DZIAŁALNOŚĆ MORFOGENETYCZNA PRZEPLYWÓW POZAKORYTOWYCH NA TERASIE ZALEWOWEJ PARSEŃTY, POJEZIERZE POMORSKIE

Streszczenie

Wyniki czteroletnich badań przepływów pozakorytowych Parsęty i ich efektów stały się podstawą do syntetycznego opracowania modelu hipotetycznego wezbrania, przepływającego przez terasę zalewową nizinnej rzeki meandrującej (rys.). Dla pojedynczej kulminacji rysuje się następująca sekwencja zdarzeń hydrologicznych i morfologicznych:

1) podnoszenie poziomu wód wezbraniowych w korycie rzeczonym i wód gruntowych w obrębie terasy zalewowej; erozyjna modyfikacja krawędzi terasy zalewowej;

2) zalewanie trasy zalewowej; erozja i redepozycja starszych osadów terasowych i nadbudowywanie wałów przykorytowych i meandrowych pokryw piaszczystych;

3) dostosowanie układu przepływu pozakorytowego do morfologii terasy zalewowej (a) i kulminacja wezbrania (b); zmniejszanie znaczenia erozji; transport dominuje na powierzchni terasy zalewowej i wzdłuż koryt przelewowych i terasowych; osady są deponowane w postaci glików krewasowych, wstęg terasowych, cieni piaszczystych, stożków deltowych i aluwialnych, w starorzeczach i na obszarach bagicznych; nadbudowywanie wałów łąch meandrowych;

4) początkowe opadanie wód wezbraniowych, zmiany w układzie przepływu pozakorytowego; erozja nie odgrywa roli a procesy transportu ulegają redukcji; maksymalna intensywność depozycji w różnych formach powodziowych, szczególnie

korytach przelewowych i terasowych, glifach krewasowych, cieniach piaszczystych, stożkach deltowych i aluwialnych, starorzeczach i obszarach bagiennych;

5) stopniowe zanikanie przepływu pozakorytowego; z upływem czasu zanika transport; ostateczna depozycja materiału dostarczonego na terasę zalewową; erozyjna modyfikacja nowo złożonych pokryw aluwialnych i koryt odpływowych;

6) dekantacja najdrobniejszych cząstek mineralnych i organicznych i falowanie wód stagnujących (a); powezbraniowa transformacja osadów i form w warunkach subaeralnych (b).