ORIGIN OF THE ACCUMULATIVE COMPLEX OF RIVER TERRACES

By G. A. MAXIMOVICH

(Communicated by V, A. Obruchev, Member of the Academy, 28. X. 1940)

Accumulative river terraces are a complex formation. In the normal development of the erosion cycle they present a regular succession of alluvial, alluvio-deluvial, eluvio-deluvial (and soil) formations. The terrace accumulative complex or mantle deposits may contain in some more complicated cases glacial (morains), aeolian (dunes, loess), volcanogenous (pumicite, lava sheets) and other (sill trains, etc.) formations.

A detailed study of the first terrace located above the flood plain of the Moulianka river, the left tributary of the Kama, in the region of Molotov, permitted the main phases of the accumulative complex formation to be established on the basis of a genetic analysis of deposits of river terraces. Phases and horizons established in this manner are of general value for the separation of the accumulative complex of river terraces.

Below are described phenomena taking place in a given part of the river. After the river has worked out a profile of equilibrium and the erosion in depth has been replaced by the side erosion, there sets in the deposition of alluvial formations. In the case of the river stem being present in the part under consideration, there takes place an accumulation of pebblebed with sand. A lateral shifting of the river stem is accompanied by the slowing down of the river current. Next is deposited the arenaceous-pebbly material. Then pebbles disappear and are replaced in the vertical direction by sand and argillaceous sand.

Further shifting of the river stem limits the existence of subaqueous conditions only to spring or to periods of abundant precipitations (moderate climate). There begins a transition to the flood plain phase. Subaerial conditions bring about weathering processes, the result being an accumulation of finer particles only. Purely alluvial deposits are replaced in the upper part by alluvio-eluvial deposits. This transition into the flood plain phase is complete as soon, as snow melting produces enough water to cover the area. Deposits of the river bed phase lying at the base of the accumulative complex are lithologically divided into two horizons: horison I consists of pebblebeds and sands, whereas horizon II is made up of sands and argillaceous sands.

Deposition of a fine alluvial material during floods, accumulation of the material brought by rain and snow waters from the upper reach of the river and the watershed, and processes of weathering as well are characteristic of the flood plain phase. The amount and size of particles increases in the deluvial train from the flood plain rim to the rear seam. Besides clay, loams and sand, pebblebed may also occur. Deposits of the flood plain phase constitute the horizon III.

Recommencement of the erosion in depth converts the flood plain into the first terrace located above the flood plain. Subaerial conditions exist now permanently. Only the deluvial material and partly products of aeolian accumulation are deposited on the surface, and weathering processes convert them into eluvio-deluvial formations. The accumulation of volca- nogenic (ash, lava), proluvial, aeolian (dunes), anthropogenous materials is also possible. We confine ourselves, however, to the discussion of typical eluvio-deluvial formations.

On the terrace accumulate either sands or loams or both, this depending upon the character of deposits on higher situated parts. In the given case, on the river Moulianka, there took place the accumulation of loams which are distinctly subdivided into two subhorizons. The lower of the two (IV) is represented by less disintegrated particles; here loams contain less sand particles and are not so porous.

The upper part (IVa) is made up of typical loess (macroporous) loams ([1], [2], [4], [5]). In quarries and exposures these loams are distinguished by vertical joints and are capable of forming abrupt cliffs. No bedding is observed. Pores, tubular voids from grassy vegetation stems and roots are plainly discernible. In the course of a mechanical analysis (after Sabanin) a large number of scraps of vegetable remains was observed floating on water. A system of vertical and horizontal fissures is present in loams; there prevail vertical fissures disappearing at the depth of 1.5–2 m.

These loams were formed in consequence of a slow accumulation of a fine material brought by meteoric waters and partly by wind, under conditions of a vegetable (grassy) cover. Macropores are the result of decomposition of roots and stems of the vegetation. The vertical joint is due to the accumulation of the material in the presence of a grassy cover. The fissility is caused by the presence of a considerable number of colloidal particles. Upon wetting loams swell up and lose their fissures which reappear after their drying up. A certain role is also played by winter freezing of soil moisture ([6]) with the subsequent thawing, penetrating to the same depth as does the fissility.

Loess loams (IVa) made up of the deluvial material, subjected to various weathering processes in the place of its former occurrence as well as on the given terrace, are thinner than the underlying deposits (IV).

This is a rough description of the first period of formation of an accumulative river terrace. Later on, during the formation of a younger terrace located vertically lower, there begins the process of decomposition of the terrace under consideration. The decomposition may proceed by erosion or fall of ground because of undermining of alluvial deposits *(Qal)*, lying at the base of the terrace complex, in the process of meandering.

The second way of the subsequent development of the terrace complex is a gradual wash out of depositions. When the basis of denudation lowers with regard to the rim, there already begins a wash out in the given part of the terrace under consideration, this leading to the formation of a local basis of denudation. The cusp of the given terrace acquires a gentler slope due to erosion. In the course of decomposition the terrace rim (not the initial, but the one formed as a result of denudation) is displaced to the rear seam .The local basis of denudation (the terrace base) shifts along the subjacent terrace from the latter's seam to the rim or to the valley thalweg. Next takes place the formation of the horizons *Qal(el)d* (III) and *Qeld* (IV) of the subjacent terrace. The area of the terrace under consideration is gradually reduced at the expense of erosion of some parts and wash out of others.

Table 1

Phases of development		Conditions of formations	Deposits: Genesis	Horizons	Deposits: Lithological composition		Processes occurring in a part of the terrace	
Erosion and destruction							15. Transition of the terrace into the II terrrace located above the flood plain, III terrace, etc. Gradual destruction of the accumulative complex by wash off, erosion	
Phases of accumulation			*Qp* soil formations	V	Soil		14. Formation of soil. Accumulation of the material washed off from higher located terraces and the watershed	
	E Terrace phase	Subaerial	*Qeld* Eluvio-deluvial deposits	IV	Loess loams, loams	Sands, argillaceous sands	13. Wash off from higher located places. Weathering in the place where the wash off occurs and also on the given terrace. Considerable role of the biochemical and biophysical weathering. Deluvial train at the rear seam 12. Transition into the terrace phase at the expense of erosion in depth	Glacial, aeolian, volcanogenous and other formations are possible
	D Flood plain phase		*Q al (el) d* Alluvio (eluvio)-deluvial deposits	III	Loams, fine sandy loams, sands	Pebblebeds with sand in the deluvial train	11. Total transition into subaerial conditions 10. Accumulation of a fine alluvial material during floods and of the material washed off from terraces located higher and the watershed. A particularly strong participation of deluvial formations in the area of the rear seam 9. Transition into the flood plain phase	
	A River bed phase	Subaqueous	*Q al* alluvial deposits	II	Sands, argillaceous sands		8. Commencement of processes of subaerial weathering 7. The part of the river bed is under water only when the latter is high 6. Further shifting of the river stem, slowing down of the current 5. Deposition of sands, argillaceous sands	
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	Erosion of basic or accumulative deposits						1. Erosion of basic or accumulative deposits	

We considered the presence of loams *Qeld* (IV) in the form of mantle formations of the terrace. If the watershed was made up of sands, sands would have to be considered. The history of formation of the accumulative river terrace was taken in its simplest form. No phenomena associated with, the formation of oxbows with their lake-swamp formations were examined. The possibility of aeolian, proluvial, volcanogenous and anthropogenous formations being present in the horizon IV was only mentioned. It is natural that the terrace section representing the history of the river terrace in the given part, often includes among others these formations as well. But the discussion of all possible cases was beyond our scape. Table 1 contains a scheme of genetic disjunction of the accumulative complex of river terraces.

Department of Dynamical Geology.
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