The stone-line as a key to former surface processes. An example from the lower Zaïre

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A systematic study of weathering profiles in the Lower Zaïre (fig. 1) (Stoops 1967) has shown that they consist of three different units, from top to bottom : the α -layer, or cover, the β-layer or stone line, and the γ-layer or in situ weathering residue, including the saprolite, overlying the saprock and/or fresh rock. The β -layer can mostly be subdivided in two sublayers, the upper part, or β_1-layer, composed of transported, partially allochthonous material (quartz fragments, rounded hard sesquioxidic nodules derived from different parent materials covered by a patina, stone implement) and the lower part, or β_2-layer, consisting of iron oxyhydrate nodules of uniform origin, becoming more angular and less hard with depth (Stoops 1968). When overlying a mottled clay, a gradual transition between mottles and nodules is observed. No allochthonous elements are found in the β_2 -layer, and some features of the parent rock (e.g. quartz veins, chert bands) are clearly in situ. In most cases, a close relation exists between the material of the β_2-layer and that of the γ-layer. An autochthonous origin of the β_2-layer is evident. The nature of the β_1-layer however (nodules with patina, allochthonous elements, prehistoric tools) point to a former surface layer. This assumption is corroborated by the fact that lateral transitions to terrace gravels were observed in valleys.

Profiles containing a β_2 -layer are found mainly in the older geomorphological landscape units, such as the basins of the Kwilu and Lufu rivers. Their genesis may comprise following steps : weathering of the rock and formation of a soil with plinthite under moist tropical conditions, followed by a period of erosion due to dryer climatological conditions. During the latter process the upper part of the profile is removed (most probably till the top of the more resistent plinthite) and ferruginous gravel formed near the surface as a result of the irreversible hardening of the mottles. Allochthonous material may be added to the surface by sheet wash or by human activity (stone implements of Lupembian age) giving rise to the β_1-layer.

The origin of the overlying cover seems less evident : an eolian origin can be ruled out because the close petrographical and mineralogical relationship between the cover and the parent rock, and because of its grain size distribution. Also a colluvial origin is not probable, as the α-layer even covers the top of many hills, and as its composition can change over short distance, when the lithology of the immediate underlying bedrock changes. The most probable hypothesis is the construction of the α-layer by termites, extracting the material needed for their nests from deeper layers. This explains both the close relation between the composition of the α- and the γ-layer, and the compaction of the β_2-layer, visible by a closer spacing of the gravels towards the surface and a downward bending of the quartz veins or chert bands. The cover contains tools of Tshitolian age.

In the Crystal Mountains and in the region of Matadi and the Mayumbe, the β_2-layer is mostly absent, except on some older plateaus. Most probably erosion has been more severe here in recent times (incision of the Zaïre River) so that the β_2-layer and the material that could give rize to it (mottled clay) was removed. This hypothesis is confirmed by the fact that soil material here is less weathered, indicating a rather complete erosion of the superficial layers. The stone-layer comprises therefore only a β_1-layer, consisting of resistent rock fragments, mainly relatively fresh veinquartz. As a result of the incision of the Zaïre River, a more accentuated relief with relative steep slopes was formed. Colluviation is therefore an active process, which can explain, for the region of the Crystal Mountains, the formation of both the stone line and the cover, without the necessity of a termite intervention.

From the characteristics of the different layers, their position in the landscape and their relation to terrace deposits and planation levels, a correlation between geomorphological processes, soil formation processes and a relative time scale could be deduced (table I). It is clear that soil formation s.s. and formation of soil material regularly alternated.

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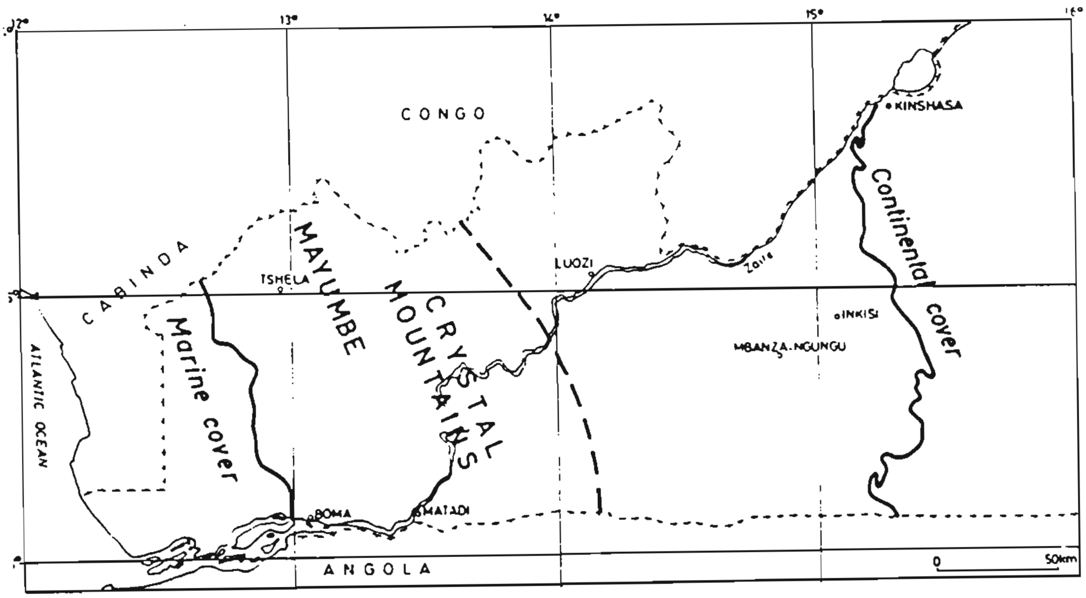

Figure 1 : Map of the Lower Zaïre. The studied area is situated between the marine cover (in the west) and the continental cover (in the east).

Geomorphological processes	Pedogenetic processes	Prehistoric tools	Local stratigraphy
linear erosion anthropogenic erosion	actual pedogenesis	Iron Age, late Tshitolian	Kibangien (humid)
	formation of cover by termites	Tshitolian (± 10.000 BC)	Léopoldvillien (semi-arid)
weak erosion, formation of - sandy terraces - planation level in tributary valleys	local truncation of soil till stone layer		
	gleyification - - - - - - - - - - - - - - - - formation of cover by termites	Young Lupembian	
strong erosion, formation of - lower terrace - planation level	transformation of plinthite mottles to nodules formation of stone layer truncation of profile till mottled clay	Old Lupembian (± 38.000 BC) Prelupembian	
	formation of soil with plinthite		Njilien (humid)

Tableau 1 : Correlation table.