SCIENCE DU SOL n° 1986/1 - p. 107-108 - PLAISIR-FRANCE

OXIDISOLS IN SOME PACIFIC ISLANDS ENVIRONMENTS

Stages in their formation

M. LATHAM [1]

(Science du Sol n° 1983/3-4)

Oxidisols are made of metallic oxides and hydroxides and contain hardly any argillaceous phyllites. They form the most advanced stage of the ferrallitization process. They are frequent in the Pacific Islands on rocks devoid of quartz : ultrabasic and basic volcanic rocks.

1 - This study has ben conducted in New Caledonia — on ultrabasic massifs in the West Coast and on volcanic deposits on limestone, in the Loyalty Islands — and in Fiji — on andesite in Lakeba, on basalts in Taveuni and on volcanic deposits on limestones in Kabara. The methods used are classical morphological examinations, and physico-chemical and mineralogical analysis.

2 - **Ferritization** : accumulation of iron oxides and hydroxides up to more than 60 % of Fe_2O_3 — occurs on ultrabasics.

a) It can be a *direct process* in the perhumid climate of the high altitude in New Caledonia. Finely cristallized goethite is the major soil component (Table I). It can reorganize to form nodules in the upper horizons. In a thin cortex, which surrounds the unweathered rock, poorly cristallized ferro-silico-magnesian complexes can be found, but they do not show special features on R X diffractograms.

	SiO_2	Al_2O_2	Fe_3O_3	MgO	He	Go	Se	Sm	T
Direct Ferritization									
A (0-10 cm)	3,1	2,3	71,0	0.5	—	++++	—	—	—
B (40-60 cm)	2.9	4.7	70.0	0.5	—	++++	—	—	—
C (80-82 cm)	5.0	4.7	67.0	0.7	—	+++	—	—	—
Indirect Ferritization									
A (0-10 cm)	2.5	5.9	78.8	0.5	++	++	—	—	—
B (50-60 cm)	2.2	1.9	77.8	0.8	+	+++	—	—	—
C (150-160 cm)	40.4	0.8	13.3	30.8	+	+	+	+++	+

He : Haematite - Go : Goethite - Se : Serpentine - Sm : Smectite - T : Talc.

Table I : Chemico-mineralogical composition of Ferritic Soils.

b) The major process observed in these massifs is an *indirect ferritization* at altitude lower than 1,000 m, under more contrasted climates (2,000 mm rainfall/year). A weathering horizon, rich in smectite, serpentine and pyroxene lithorelicts, is formed. It is topped by iron rich (70-80 % Fe_2O_3) horizons made of well crystalized goethite and haematite. Reorganization of these ferruginous products forms ferrans, nodules and hardpans.

3 - **Allitisation :** accumulation of more than 60 % of metallic oxides and hydroxides with more than 30 % of free Al_2O_3 — occurs on volcanic basic rocks.

a) It can be a *straight process* with allophane as intermediate product. This has been observed in Taveuni under very high rainfall (3,000 m rainfall/year). Between ava blocks, soil containing gibbsite, haematite and goethite are observed. Allophane

1) Presently Director of IBSRAM, P.O. Box 109, Bangkok 10900, Thailand.

is found in the cortex. In Loyalty Islands and in Kabara, this process occurs on volcanic deposits on limestone under contrasted climate (1,500 mm rainfall/year). On recent depostis, allophane is formed whereas on older deposits only oxihydroxides are present (Table II).

	SiO_2	Al_2O_3	Fe_2O_3	CaO + MgO	Bo	Gi	He	Go	Al	Ka
Strainght Allitisation										
Taveuni (B)	1.9	41.5	23.5	0.21	—	++	++	++	+	—
Loyalty old deposits (B)	0.6	45.6	25.3	1.1	++	++	++	++	—	—
Loyalty Recent deposits	5.5	23.9	13.9	6.2	++	—	—	—	+	—
Complete Allitisation										
Lakeba :										
A (20-30 cm)	0.5	48.5	18.0	0.1	++	++	++	++	—	—
B (100-120 cm)	4.0	40.9	27.5	0.1	++	++	++	++	—	+
C (400-450 cm)	38.4	31.2	13.5	0.26	—	—	+	+	—	+++

Bo : Boehmite - Gi : Gibbsite - Go : Goethite - He : Haematite - Al : Allophane
Ka : Kaolinite.

Table II : Chemico-mineralogical composition of Allitic Soils.

b) A more *complete allitisation process* can take place with the formation of clays of the kaolinitic group. This is case of Lakeba, on volcanics, under a contrasted climate (2,000 mm rainfall/year). On a Kaolinitic C horizon with traces of montmorillonite, a B horizon, made of metallic oxides and hydroxides with traces of Kaolinite, develop whereas the A horizon contains only metallic oxides and hydroxides.

4 - The rainfall plays a significant role in the desilification of these rocks. The internal drainage is very good and in most cases a vertical water circulation due to a karstic evolution of the landscape, overcomes the lateral water circulation.

Thus, under very high precipitation, only amorphous transitions are found between the rock and the oxidic horizons, whilst some clays of the kaolinitic, serpentinic and smectitic group can be observed as intermediate products under more contrasted climates.

So, in these rocks devoid of quartz, the normal pedogenetic product are metalic oxides and hydroxides. The formation of kaolinite or other clay minerals appear temporary if not impossible. The rainfall is the main factor of desilicification but a limestone environment, and the high pH which is involved, may be a secondary factor.

N.B. — This work has later been extended by a petrologic study of the soils derived from ultrabasic rocks and has formed the subject of a thesis : M. LATHAM (1985) : Altération et pédogenèse sur roches ultrabasiques en Nouvelle-Calédonie - Genèse et évolution des accumulations de fer et de silice en relation avec la formation du modelé. Doct. Etat Dijon - 331 p. - Etudes et Thèses ORSTOM.