THE SOIL COVER :
VERTICAL AND LATERAL MORPHOLOGY AND FUNCTIONING

(extended summary)
by ALAIN RUELLAN

THE SOIL COVER

Soil cover is a continuous **natural body** that has **three spatial and one temporal dimensions.** The main features of the soil cover are of three types :

1- It is formed by **constituents**, mineral and organic, which can be solid, liquid, gazeous.

2- These constituents are **organized** between them, thus forming **structures** which are **specific** of the pedological medium. These structures are the morphological aspect of the soil cover, equivalent to the anatomy of the living being. These structures result from the **history** of the soil cover and from its **actual dynamics and properties**. So, the study of the soil cover structures permits to know about the physical, chemical, biological properties ; it permits to understand the past and the present of the soil ; it permits to make a prevision about the future of the soil cover.

3- The soil cover is in **perpetual evolution** : this confers to the soil cover its fourth dimension which is temporal.

THE STRUCTURE OF THE SOIL COVER

The morphological organization of the soil cover exists at different scales of observation : from the basic assemblages of the particles, that we can observe with the microscope, until the arrangement of the pedological systems at the scale of a landscape. Four types of structures, corresponding to four levels of organization and observation of the soil cover, are particularly important to be described, measured and understood :

1- Elementary organizations = morphological characteristics : these structures assemble the constituents. They are partially visible with naked eyes, partially with the help of microscopes. The main types of elementary organizations are **aggregates** (peds), **voids** (porosity), **cutans, nodules, features of biological activities** ; the observation of the **colours** help to recognize and understand the elementary organizations.

2- Assemblages : these structures are pedological volumes described and interpreted by the associate presence of some elementary organizations. Examples of assemblages : andic, calcic, ferralic, vertic, ... : each one of these assemblages is to be described in terms of specific associations of colours, peds, voids, cutans, nodules, etc....

3- Horizons : these structures are pedological volumes, more or less parallel to the ground surface. An horizon is described by the presence of one or more types of assemblages and by the

relationships between these assemblages. It is also described by its thickness, by its lateral extensions, by its vertical and lateral morphological limits. At the scale of the landscape, an horizon is never infinite : laterally, it disappears or it is transformed in another horizon.

4- Pedological systems : they are defined by the vertical and lateral distributions and relationships of horizons at the scale of the landscape. The structure of a pedological system is described by the horizons that form it : elementary organizations and assemblages of the horizons, vertical superposition and lateral successions of the horizons, kind of limits that separate the horizons.

The pedological studies have, until now, mainly considered the characterisation and the genetic significance of the elementary organizations, of the assemblages, of the horizons and, mainly, of the **vertical superpositions of horizons, named « type of soil», « pedon»**. On the other hand, relatively few detailed studies have been made with regard to the **three-dimensional spatial organization** of the soil cover and with regard to the **historical and actual dynamic** interpretations of the three-dimensional spatial organization. The objectives are to discover and to understand the real **dynamic soil entities**, soil units, at the scale of the landscapes and ecosystems, and the relationships between the pedosphere and the other components of the earth : lithosphere, hydrosphere, atmosphere, biosphere. One of the keys of these studies is the **morphological study of the pedological limits** : limits, transitions, between different types of assemblages that exist side by side in an horizon ; vertical and lateral limits, transitions, that exist between horizons. These morphological studies of the limits have to be interpreted in terms of **dynamic evolution** (history and actual) : a limit is frequently a dynamic one, a **transformation front** where a structure is being transformed in another one.

A morphogenetic soil reference system, as **WRB**, can be constructed on the base of the elementary organizations, the assemblages, the horizons, the vertical superpositions of horizons. It still cannot be constructed, with enough precision and exhaustivity, for the lateral distributions. However, knowing that these distributions exist, they have to be, as often as possible, cited in the definition of the other types of structures : this is being made in WRB, opening the possibility to begin a World Reference Base concerning the pedological systems.

THE PEDOLOGICAL SYSTEMS

In terms of lateral distribution of the soils characteristics, it exists **four** main types of sequences:

1- The lithosequences : the lateral variations are concerned with the variations of the rocks. In these sequences, the vertical differenciations limits are **dynamic limits**, that is they vary as a consequence of the soil evolution : for example, the limits that separate two superposed horizons are, in general, **transformation fronts** showing that one horizon is being formed by transformation of another horizon. But, in these sequences, **the lateral limits are fixed** : they correspond to the rocks limits.

2- The toposequences : the lateral variations are in relation with the topography. In general, in these types of sequences, all the limits (vertical and lateral), between assemblages and between horizons, are dynamic ones. It is very important to study how, and at what speed, the limits evolve.

3- The chronosequences : the lateral variations are determined by the age of the soil cover, that is by the age of the superficies or by the age of the parent materials on and from which the soil cover is formed. The chronosequence can be along a slope, as the example, in North Morocco, of

the development of the calcic horizon in function of the age of the soil cover ; it can be a chronosequence of soil-landscapes, as the example, in French Guyana, of the transformation, on a dune system, of ferralsols to podzols. It is important to note that human activities create, by anthropic soil evolution, new chronosequences.

4- The biosequences : the lateral variations are in relation with the life : animal, vegetal, human.

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