

Preliminary study of weathering crust for changing plantation

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Abstract. In Vietnam, weathering crust has been intensively studied from different aspects. However, this paper is the first attempt to study on changing plantation. The following methods are used: analysis of weathering factors in natural balance; geochemical method for studying the major and trace elements; comparing weathering crust with the standard one on which a known assemblage of plants is well developed. The results reveal that: the feralite weathering crust is suitable for litchi, longan and some others; the magalite weathering crust on the karst field is suitable for tea, coffee, sugar-cane, etc.; the saprolite weathering crust is suitable for bamboo group; The ferosialite weathering crust, depending on the bedrock, is suitable for many different tree groups; The sialite weathering crust is suitable for Cinnamon, *Illicium Verum*. These study results may be supplemented to achieve a sound orientation in changing plantation.

Keywords: Weathering crust; Plantation change; Hoa Binh Province.

1. Introduction

Vietnam is a humid tropical country where the weathering process is strongly developed, leading to rapid and extensive formation of weathering crust.

After the work of Fritland [1], weathering studies in Vietnam were intensively carried out and their results have not only theoretical but also practical significance in prospecting mineral resources.

However, a change of plants, one pressing demand of current socio-economics makes a new orientation in weathering study. Since the depths of most industrial and fruit plant's root have been beyond the pedological study, which is limited in the surface soil layer, this new

orientation requires a new approach with appropriate methods. Our preliminary study is focused on:

- Setting up the weathering crust types on different bed-rocks;
- Studying on the composition of major and trace elements in each weathering crust type;
- Studying on some characteristics of geochemical environment and pedological agro-chemistry;
- Commenting the suitability of weathering crust types for plant groups.

2. Methodology

First of all, it should be noted that the viewpoint supported by many researchers is that soil and weathering crust have an interrelationship. The pedologists regard a

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weathering crust as "mother substance" of soil. Some researchers regard the process of altering bedrock into weathering crust and into soil as soil-forming weathering (however, there is also soil-destroying weathering such as: denudation, erosion, etc.). The soil layer overlies directly on weathering crust is regarded as the top zone of weathering crust with the lower limit at a depth rooted by low-order plants. This viewpoint is applied in this study.

In this study, the following methods were used:

- + Synthetic method: to analyze the weathering factors such as: bedrock, relief, climate, vegetation, etc. [2] in order to specify the types of weathering crust and their stability in natural balance. By using this method, the study results could be visualized on a map and a cross-section.

- + Geochemical method: since the chemical reaction exponentially augments with the increase of temperature, the chemical weathering is the main process in tropical region. The use of geochemical method permits to analyze compositional alteration and geochemical contents of weathering crust types. The study results are commonly presented in the form of table and scheme showing the alteration of chemical contents.

- + Comparative method: is widely used in sylvio-agriculture in order to define the weathering crust in plant area and then use it as a base to compare and make recommendation for the study area.

3. Study results

Theoretically, analyzing the weathering factors allows us to remark:

- The bedrock is an independent factor and it is the primary material source of weathering crust. The others, such as relief, climate, vegetation, etc., have an interrelationship and

act together on bedrock.

- In a definite place only one factor plays the key role (the others are dependants) in formation of weathering crust.

- The forming factors of weathering crust are also the protectors, which keep the weathering crust stable in natural environment.

The preliminary result is applied in defining and mapping the weathering crust (at the map scale of 1:50,000) for some districts of Hoa Binh Province: Kim Boi, Lac Thuy, Luong Son, Ky Son, Cao Phong, and Hoa Binh Town. Based on the weathering crust research, the suitability of land for changing plantation structure is also assessed.

In addition, along with other attributes, such as relief and landuse, the weathering crust is also used for making the map of orientation of sylvio-agricultural development for Huong Hoa District (Quang Tri Province) at scale of 1:50,000 [3]. This map permits to evaluate and define the appropriate crops composition for the study area.

Geochemical method is used for analyzing the main components for weathering crust formation such as SiO_2 , Al_2O_3 , Fe_2O_3 , etc. in order to define the geochemical type of weathering crust (ferrosialite, feralite, sialite,...). The method is also used for analyzing the trace and nutrient elements relating to plants. Each geochemical type of weathering crust may be suitable for a certain kind of plants and less suitable or even not suitable for the others.

Based on the study results, some preliminary comments can be made as follows:

- The feralite weathering crust is suitable for fruit trees, such as litchi, longan, etc. (Fig. 1).

- The magalite weathering crust on the karst field is suitable for tea, coffee and hesperidium (Fig. 2).

- The saprolite weathering crust is suitable for bamboo group (Fig. 3)

- The ferrosialite weathering crust, depending on the bedrock, has diversified suitability, especially, the weather crust on the effusive

rock is suitable for many different tree groups (Fig. 4 and 5).

- The sialite weathering crust on granitoid rock is suitable for Cinnamon, *Illicium Verum* (Fig. 6).

Thus, defining the geochemical type of weathering crust can help to effectively define plantation structure.

The study of trace elements, on one hand, lets to know their behaviors in weathering process, showing their capacity of accumulation or dispersion in the weathering zones. On the other hand, the contents of trace element themselves show their excess or deficiency in soil. Therefore, we can adjust by increasing or decreasing an appropriate amount of trace elements in fertilizers. For example, the Mangan (Mn) content in magalite weathering crust, is commonly higher than in the other weathering crust. Mn is an important trace element for plant nutrient, so this weathering crust is suitable for different sorts of plants, especially for hesperidium.



Fig. 1. Longan on feralite weathering crust in Hoa Binh Province.



Fig. 2. Tea on magalite weathering crust in Hoa Binh Province.



Fig. 3. Bamboo on saprolite weathering crust in Son La Province.



Fig. 4. Fruit tree on ferosialite weathering crust in Hoa Binh Province.



Fig. 5. Litchi on ferosialite weathering crust in Hoa Binh Province.



Fig. 6. Fruit tree on ferosialite weathering crust in Hoa Binh Province.

This study result was applied to determine the plantation structure and to recommend the appropriate cultural measures for some districts of Hoa Binh Province [4].

The comparative method (in the same natural condition and monitor the result during the experiment) is applied widely in sylvio-agriculture. If not possible to do like that, the simple way is to compare the weathering crust of the study area with the specific area where the plants well developed. This gives high economic effectiveness.

In the first step of the study process, two areas are selected for comparison: the litchi and longan area of Luc Ngan (Bac Giang Province); the orange and sugar-cane area of Nghia Dan (Nghie An Province). In both areas, the synthetic and geochemical methods are applied.

In the selected areas, we define the weathering factors (bedrock, relief, and vegetation), features of weathering section, material composition of weathering crust. These data are regarded as "standard" for comparing with the newly studied areas, which have similar conditions.

The result of the study is used to compare with the weathering crust in the districts of Hoa Binh Province in order to define the suitability and to recommend the plant species for the specific area.

4. Conclusions

- Correctly defining the geochemical weathering crust type based on the synthetic study of weathering crust factors and geochemical study of major components, which play important role in determining crops structure.

- As a first step, the study concludes some preliminary remarks on the suitability of weathering crust for groups of cultivated plants.

- Study of trace elements in weathering crust also contributes to determining the

suitability of weathering crust for tree species, as well as indicating the excess or deficiency of trace elements in soil, being base for rational fertilization.

- Introducing the weathering crust types and other attributes into map of sylvio-agricultural orientation as well as determining the weathering criteria in map of landuse suitability are necessary for changing the plantation structure.

The above mentioned results should be supplemented and expanded in a larger scale, making a sound orientation, to meet the present socio-economic demand.

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