THE UNESCO SYMPOSIUM ON TROPICAL WEATHERING AT BANDUNG, INDONESIA

by

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In order to exchange scientific information and to review the latest knowledge on Tropical Weathering in its various phases, the UNESCO Field Science Office for Southeast Asia sponsored a symposium on November 17-22, 1969 at Bandung, Indonesia. Thirty delegates representing different scientific and educational institutions from Asia and other parts of the world participated in the conference. The list of the participants was composed of the following:

Prof. J. J. Fripiat, Paboratoire de Physico-Chimie Belgium
Dean Tan Boun Suy, Universite Royale of Kompong, Cambodia
Dr. P. Segalen, Services Scientifiques, France
Dr. T. Seshagiri Rao, University of Agricultural Sciences, India
Dr. H. Ling Ong, Institut Teknologi, Bandung, Indonesia
Dr. D. Muljadi, Soil Research Institute, Indonesia
Mr. Soepratohardjo, Soil Research Institute, Indonesia
Prof. Dr. Go Ban Hong, Central Research Institute for Agriculture, Indonesia
Dr. Achmad M. Satari, Bogor Agricultural University
Dr. T. Sukarna University of Padjadjaran, Bandung
Dr. Ng Siew Kee, Rubber Research Institute of Malaysia
Mr. J. P. Andriesse, Department of Agriculture, Sarawak
Mr. Hew Choy Kean, Oil Palm Research Station, Malaysia
Dr. J. van Schyulenborg, Agricultural University, Netherlands
Dr. Iajuddin Ahmed Dacca University, Pakistan
Dr. Domingo C. Salita, University of the Philippines
Mr. Vichai Boonyawat, Ministry of National Development, Thailand
Prof. G. D. Sherman, University of Hawaii, USA
Dr. V. M. Fridland, Moscow University, USSR.
Prof. Le Khac Pho, Hue University, Vietnam
Prof. S. Prawirohardjo, Indonesian Institute of Sciences
Prof. J. A. Katili, Indonesian Institute of Sciences
Miss Sjamsiah Ahmad, Indonesian Institute of Sciences
Prof. Dr. D. A. Tisna Amidjaja, Institut Tecknologi Bandung
Dr. W. S. Reksodihardjo, BIOTROP/SEAMEC, Bogor
Dr. V. S. Subramanian, FAO Expert, Bogor
Dr. T. C. J. Zwartkruis, Caltex Pacific Indonesia
Dr. F. Fournier, UNESCO Consultant
Mr. F. J. C. Pala, Deputy Director, Unesco Field Science Office
Mr. Pita Niramaya, Unesco Field Science Office, SEAsia

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At the opening session, the Symposium nominated Dr. D. Muljadi (Indonesia), Dr. Ng Siew Kee (Malaysia), Mr. Boonyawat (Thailand), Dr. Domingo C. Salita (Philippines) and Dr. Seshagiri Rao (India) as chairmen for different sessions and Prof. Dr. J. A. Katili as Deputy Director to the Symposium. Dr. F. Fourner served as the Director of the Symposium.

The first working session was devoted to the presentation of the first key paper on "Formation and Transformation of Clay Minerals in Tropical Soils," by Prof. J. J. Fripiat. During the discussion the following points were emphasized: In the tropics, because of higher temperatures and greater evaporation and precipitation, formation and transformation of clay materials by hydrolysis proceeds at a faster rate. It is assumed that the chemical reactions involved in the hydrolysis process is not different from the similar process operating in temperate climate.

In general, the formation and transformation of primary minerals to secondary minerals is through hydration and hydrolysis of the primary minerals. Water in the monolayer capillary pores in the soil is dissociated and acts as an acid forming the hydronium H_3O^+ ion. As far as the formation of polywater is concerned, it is possible that cleanliness of the capillary pores will be one of the factors of its synthesis. It is possible that this polywater has a sheet structure. Exceptions to the dissolution process in the formation of secondary minerals by direct solid phase substitution are few and only possible in the formation of illite from montmorillonite and vermiculite.

As the soil is an open system in which leaching and movement of soil solution would be continuous, an equilibrium between the ions in soil solution and the primary minerals would not be achieved. Consequently there is no relationship in the chemical compositions of the primary parent material and that of the secondary minerals or that of the soil solution. Similarly, in well developed soils, there is no direct correlation of soil fertility and its parent material. However, under direct solid phase transformation, it is possible that lattices of the secondary minerals may be related to those of the primary minerals. This exception is not common.

After this discussion, Dr. Iajuddin Ahmed presented a supporting paper on "Distribution of Mica in the Soils of the Madhupur Tract, East Pakistan. In the distribution of mica, it was noted that only biotite mica was mainly present in the clay fraction. In the silt and fine fractions, both mica and feldspar were present. The higher amount of illite in the top soil was attributed to the synthesis of these minerals *in situ*. This synthesis was brought about by the return of potassium from organic matter. It was also noted that the previous vegetation in this area (top hill) was decidous forest, the potassium content of which was apparently high.

The second key note paper: "Metallic Oxides and Hydroxides in Soils of the Warm and Humid Areas of the World" was presented by Dr. P. Segalen. The following points were brought out: Near the equator, goethite is the dominant iron mineral. Gibbsite is often encountered. Oxides of titanium as well as manganese are locally abun-

dant. Amorphous products are seldom found in yellow soils. Iron is always outside the clay minerals lattice essentially kaolinitic. Concentrations of any of the above mentioned minerals can be encountered in all tabular areas of the equatorial area.

In tropical zone, goethite and hematite are common. Gibbsite is seldom found. Amorphous material are ferruginous manganic. The former are very often responsible for the red colors of the soils. In smooth slopes, whose oxidation-reduction process can interfere, important migrations of iron occur. In acid soils it gathers to form laterite sheets or concretions, nodules, dots, etc. In neutral or alkaline soils, iron is often trapped by 2/1 clay minerals such as montmorillonites. In moderate or steep slopes where these processes do not interfere, soils are red colored (seldom yellow), by amorphous materials associated or not to goethite or hematite.

In the subtropical zone, goethite, associated with amorphous products, appears to be the dominant iron mineral. Gibbsite seldom occurs. Soils are usually well drained down the profile, however, mottled zones rich in concretions are known in Australia and the U.S. The iron content is high. Clay minerals are mostly kaolinitic, but 2/1 minerals such as vermiculite or montmorillonite, containing iron in the lattice or presenting aluminum inter layering often occur.

In the mediterranean zone, soils are dominantly red or brown. The brownish color is due to goethite, the red color is due to goethite and amorphous mineral, seldom to hematite; gibbsite is uncommon. Soils belonging to the well drained areas are red, those to poorly drained ones are brown. Clay minerals are varied: kaolinite, illite or montmorillionite. Concretions are small and scarce. No laterite is known.

Soils containing the highest amounts of iron are those deriving from ultrabasic rock. Weathering gets rid of silica and magnesia and iron accumulates by difference. This happens in Guinea, at Surigao in the Philippines, and in Central New Caledonia where the amounts of iron oxide reach 75 percent. Soils deriving from basalt contain 20 percent and from granites or gneis 12 to 18 percent.

Dr. J. van Schulenborg presented the third key note paper entitled "Weathering and Soil Forming Processes in the Tropics." The author in his thermodynamic calculations considered silica as orthosilicic acid, however, in the case of polymerized silica, the equilibrum equation may not be the same. The plinthite zone is due to dehydration and crystallization of iron moved in. However it may also be due to some transformation of micro structure in the zone. The Fe removal in the profiles of tropical soils is comparatively less than in the temperate regions because of change of accumulation of organic matter in the surface and greater leaching capacity. The plinthite is part of oxic horizon in which Fe, as oxides and hydroxides, is deposited and silica is leached out. Dehydrated Fe is crystallized, but it is necessary to find out whether this hardening of plinthite horizon may not be due to transformation of micro structure.

Four supporting papers were presented in relation to this third topic. It was noted in the paper on the nature of parent rock on soil formation, under similar atmospheric climates (Mr. J. P. Andriesse) that

soil formation, in increasing altitude has interesting consequences. Neither climate nor altitude alone is responsible for the sequence. It seems that both climate and parent material are interacting in such a way that podzolization can become dominant in tropical areas if the parent material is rich in silica. Similarly, laterization can occur in higher latitude if the parent material is basic in character.

The writer presented a supporting paper which he co-authored with Dr. E. V. Tamesis entitled "Some Aspects of Lateritic Soil Formation in the Dahican-Alayao Area, Camarines Norte, Philippines." It was pointed cut that the percentages of the oxides in the different horizons of the soil profile reflect the intense leaching process that has taken place in the area. Depletion of the bases is shown by the fairly low percentages of CaO, MgO, Na_2O and K_2O. Silica progressively increases with depth and suggests slight desilication in the upper horizons. The high concentration of Fe_2O_3 in the uppermost horizon in relation to the lower horizons is the result of its relative enrichment at the expense of the bases. The soils found in Dahican and neighboring places are generally acidic. The pH values range from 4.9 to 5.5 and in both profiles there is a slight increase in acidity with depth. The acidity of the soil is as expected of most humid soils may be attributed to the combined effect of high precipitation and luxuriant vegetation.

Dr. V. M. Fridland presented a supporting paper on the difference between the crusts of weathering and soils developing on acid and basic rocks in the tropics. It was pointed out that mottled coloring in the weathering crust of acid rocks is generally more easily developed than in basic rocks even under good drainage and identical topographical condition. The weathering of acid and basic rocks is also influenced by the structural porosity of the two types of weathering crust. Basic rocks develop into round structural elements whereas acid rocks into angular ones. Therefore these structural irregularities affect the different water regime of the weathering crust and the soils developed on them. The pore sizes of the weathering crust are more subject to the chemical nature rather than the physical character of the acid and basic rocks. As an example, rhyolite and andesite are physically the same but posses different chemical composition; hence they produce different forms of porosity.

The fourth supporting paper which was presented by Dean Tan Boon Suy entitled "Genesis and Evolution of Red and Black Basaltic Soils in Cambodia" pointed out that red basaltic soils of his country have high Al and low Fe content in the surface layer because this soil is formed from basaltic material mixed with sedimentary rock.

The last principal paper was prepared by Dr. G. Donald Sherman on the topic "Mineral Weathering in Relation to Utilization of Soils." He emphasized the fact that mineral weathering by chemical processes is a natural process and is controlled by leaching. With time at constant leaching conditions or weathering with different degrees of leaching will produce a series of weathering stages of which the juvenile, virile, and senile stages can be utilized in the management of soils for crop production; for predicting fertilizer requirements and soil amendmends; for land use planning; and for the conservation of the natural resources for the best benefit of the human and industrial resources.

The land use classification should be done by natural scientist who has an appreciation for economic and social problems. In order to identify those areas of land use the potential for fertility management for the greatest productive return must be done on the soils chemical and physical properties which are fundamentally related to the stage of mineral weathering. Its use would place land use classification on a scientific sound basis and a basis on which natural resource planning can be placed on a defendable position.

The population explosion and the increasing demands placed on land for industrial and urbanization has made it imperative that a plan of land use be developed in order to protect our best productive lands for agricultural production, water conservation and our forest resources. This important function is too often left to social scientists and planning engineers who have no background in the use of any of these resources except as a user. At best they use outmoded provincial land capability index based on texture and not the true capability of the land to produce economically; hence a natural scientist with understanding of economic and social problems will be better qualified to prepare a plan for land use.

This presentation was followed by that of a paper on "Pedogenesis and Soil Fertility in West Malaysia" by Dr. Ng Siew Kee and Mr. Law Wei Min, which introduced a discussion on soil classification. It was pointed out that the Red Yellow Podzolics as recognized in Malaysia were so classified according to the definitions by Thorpe and Smith which is not based on the occurrence of an argillic horizon as introduced in the 7th Approximation. Observations on soils in East Malaysia (Sarawak) show that many of these soils, even recent alluvial soils, had developed in oxic materials which could qualify as oxic horizon and hence these soils could be classified as Oxisols. Nevertheless clay movement is evident in these profiles. As no provision in the 7th Approximation has been made, it was suggested that if the oxic nature of the soils is more pronounced than horizonation, these soils should be included in the Oxisols rather than in the ultisols.

On the last session of the symposium the delegates recommended that UNESCO, in cooperation with other international organization, would undertake appropriate action on the following urgent topics:

1. Facilitate exchange of information and documentation among countries of the region.
2. Promote mass education at the rural level towards better utilization of land resources.
3. Gain a fuller understanding of water cycles, balance and use in the region, with special emphasis on irrigation.
4. Evaluation of soil characteristics which influence crop production with particular reference to fertilizer requirements.
5. Promote and intensify ecological research in different environments and study the effect of large scale deforestation for agriculture and settlements on the physical equilibrum.
6. Develop integrated studies on various natural resources and criteria for defining regional potentialities for development with special attention to land capability mapping.

7. Study erosion in all its aspects with emphasis on problems of flooding and siltation. In this connection and in view of the urgency of the problems, the participants of this symposium strongly recommend that UNESCO will sponsor a symposium on "Erosion, Flooding and Siltation" in South East Asia in 1970-71.

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