Wimolnan Kanket 2005: Properties of the Clay Fraction of Alfisols and Ultisols in Thailand. Doctor of Philosophy (Soils), Major Field: Soil Science, Department of Soil Science. Thesis Advisor: Associate Professor Anchalee Suddhiprakarn, Ph.D. 165 pages. ISBN 974-9832-28-0

Alfisols and Ultisols from one hundred and seven sites in Thailand were used as representative samples for the study of properties of clay fraction of Alfisols and Ultisols in Thailand. Composite samples of topsoil (0-50 cm) and subsoil (50-100 cm) were used. Laboratory analyses of soil samples for several physical, chemical and mineralogical properties were conducted according to standard methods. X-ray diffraction (XRD), X-ray fluorescence (XRF), transmission electron microscopy (TEM), inductively coupled plasma mass spectroscopy (ICP-MS) and N_2-BET were used. The Statistica program was used to carry out principal component analysis to ascertain relationships among analytical parameters and soils.

The study on minerals in clay fractions was conducted on one hundred and seven selected Alfisols and Ultisols in Thailand. XRD was used to identify and quantify clay minerals in the samples. The results revealed that minerals in their clay fraction are kaolin, illite, quartz, smectite, anatase and inhibited vermiculite. Kaolin and quartz are present in every profile, but illite, smectite, anatase and inhibited vermiculite are present only in some profiles. With kaolin having small size and defected structure as the major clay mineral species and small amounts of vermiculite, inhibited vermiculite, and illite in the soils, the fertility status of these soils is moderate. Kaolin alone contributes substantially on capacity to retain cations in some of these soils.

Kaolin is the most abundant clay mineral in these soils and is present in all samples. About 80% of the samples have more than 70% kaolin in the clay fraction. Illite and inhibited vermiculite comprise less than 25% and 10%, respectively of the clay fraction. Quartz and iron oxides are present in most samples but in minor amounts. Deferrated kaolin samples of the Ultisols reveals minor amounts of inhibited vermiculite, quartz and anatase as general contaminants which have an average chemical composition of 403 g kg^{-1} Al_2O_3, 550 g kg^{-1} SiO_2, 25.3 g kg^{-1} Fe_2O_3, 15.6 g kg^{-1} TiO_2 and 4.65 g kg^{-1} K_2O on an ignited basis. Appreciable concentrations of Mn, Co, Ni, Cu, Zn, As and Pb are present and most of the Ni, Cu and Zn in the original clay fraction persist in the deferrated kaolin concentrate indicating that these elements may occur in the kaolin structure. The kaolins exhibit a variety of crystal morphologies ranging from sub-micron euhedral, hexagonal plates to anhedral plates and tubes. Their specific surface area ranges from 15.9 to 61.4 m^2g^{-1} (mean = 44.9 m^2g^{-1}) and is inversely related to crystal size. The cation exchange capacity of the kaolins ranges from 7.2 to 23.4 cmol kg^{-1} and surface charge density from 0.16 to 0.99 C m^{-2} but values of the latter are sensitive to the presence of contaminants. Structural Fe_2O_3 ranges from 13.1 to 44.8 g kg^{-1} and the increase in kaolin-defects towards the soil surface is associated with an increase in the amount of structural iron.

Concentration and distribution of major elements (Al, Ca, Fe, K, Mg, Mn, P, Si and Ti) and trace elements (As, Co, Cr, Cu, Ga, Li, Mo, Ni, Pb, Se, V, Zn and Zr) in these Alfisols and Ultisols as well as other soil properties were investigated. Factor analysis was used to interpret the large data set and to determine their profiles and geochemical spatial trends. The relative abundance of major elements as indicated by median is as follows: Si>Al>Fe>K>Ti with lesser amounts of Mg, Ca, Mn and P. Trace element concentrations in these Alfisols and Ultisols are in order Zr, Cr, V, Zn > Pb, Li, Cu, Ni > Ga, Co > As > Se, Mo. The median value by horizon indicates that trace elements are concentrated in the topsoil than that in the subsoil. Clay content, organic matter concentration and cation exchange capacity exhibit significant correlations with both major and trace elements for these soils. Concentrations of major and trace elements particularly Al, Fe, Mn, P, Si, Ti, Co, Cr, Cu, Ga, Ni and Zn are strongly correlated with the clay content and organic matter whereas some elements such as Al, Fe, Mg, Co, Cu, Ga, Ni and Zn are correlated with cation exchange capacity of the soils. But, they have no correlation with soil pH. In general, most of elements especially heavy metals (As, Cd, Cu, Ni, Pb, Se and Zn) in Thai Alfisols and Ultisols are within the mean of worldwide soils and not high enough to cause pollution problems.

The fertility status of these soils is moderate. With proper management practices particularly adopted in the Tropics, these soils can be used extensively for economic crop production. And based on these findings, nature of these minerals in clay fraction should be carefully considered in soil-fertilizer management for intensive crop production on these soils.

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