Nattaporn Prakongkep 2008: Comparative Mineralogy and Chemistry of Lowland Soils in Thailand. Doctor of Philosophy (Soils), Major Field: Soil Science, Department of Soil Science. Thesis Advisor: Associate Professor Anchalee Suddhiprakarn, Ph.D. 177 pages.

Seventeen widely distributed paddy soils from Northern, Northeastern, Central Plain and Eastern parts of Thailand were studied. Illite is the dominant clay mineral in Northern part of Thailand, while smectite is the dominant clay mineral in the Central Plain. The Greene-Kelly test shows that most of the charge of the smectites originated in the tetrahedral sheet for seven of the eight smectites examined so that most smectite is beidellitic. The layer charge of the smectites was estimated from the monolayer to bilayer transition associated with exchange with n-alkylammonium ions and ranges from 0.31 to 0.38 charge units per half unit cell formula. The structural formula of calcium saturated soil smectite in the Lop Buri Vertisol was determined by total chemical analysis to be $(Ca_{0.38}K_{0.01})(Si_{6.83}Al_{1.17})(Al_{3.20}Fe^{3+}_{0.80}Fe^{2+}_{0.01}Mg_{0.19})O_{20}(OH)_4$. Soil dominanted by beidellite will fixed K much more readily than montmorillonitic soils. Beidellite is the dominant clay mineral in Thai paddy soils of the Central Plain therefore special fertility management practices need to be adapted if the efficiency of potassium and ammonium fertilizers is to be increased or use of slow-release fertilizer may help increase fertilizer efficiency on beidellitic soils. From a classification point of the smectite-rich Thai paddy soils should be in a beidellitic family instead of smectitic.

Kaolin is the dominant clay mineral in other Thai paddy soils. The kaolin dominant clay fractions show a variety of crystal morphologies including anhedral, subhedral platy and euhedral hexagonal crystals. Thai paddy soil kaolins have a low degree of structural order (crystallinity) together with a small crystal size. Thai paddy soil kaolin properties may relate to parent material and wet conditions. The structural order may decrease due to the long wet period of Thai paddy soils.

This study has determined the elemental composition of uncontaminated Thai paddy soils, and identified whether variations in chemical composition within and between profiles are sedimentological in origin, or due to pedogenic processes. The chemical composition of the paddy soils is highly diverse. In comparison to typical values for soils worldwide, the median concentrations of Zn, Rb, Sr, Pb, As and Cd in Thai paddy soils are lower, concentrations of Si, Al, Fe, K, Ca, Mg, Na, Mn, Ti, S, V, P, Li, Ni, Cu, Ga, Co, Ag, Be and U are comparable and concentrations of Cr are higher. Factor analysis indicates that the compositions of individual horizons in each soil are highly diverse resulting in substantial overlaps in composition between different horizons and soil profiles. The large variations of chemical composition within and between Thai paddy soils are due to the presence of discrete depositional layers within soil profiles with differences in texture of the soil controlling the variations in chemical composition.

For the micromorphological properties, the macroporosity of topsoils of coarse textured soils is less than in subsoils because of puddling. However, the macroporosity of topsoils of the finer textured soils with a high smectite content is larger than for subsoil because of cracking. The most important and distinctive morphological properties of paddy soils are redoximorphic features. The pedofeatures of Thai paddy soils include clay coatings, carbonate and iron oxide concretions and nodules depending on parent material and cyclic wetting and drying. The chemical compositions of the clay coatings and mottles are quite similar to that of the matrix, whereas the chemical compositions of nodules and concretions are quite different indicating that they did not form *in situ*. The Si to Al ratio of these transported nodules and concretions is as the same as for kaolin whereas the clay matrix has a composition reflecting the smectite or illite-rich composition.

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