Chapter 12

Kaolin–Serpentine Minerals

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The kaolin–serpentine group consists of two distinct chemical subgroups of minerals that share a common structure but have contrasting properties, modes of formation, and occurrences. Both are 1:1 phyllosilicates. The kaolin subgroup is dioc-tahedral, while the serpentine subgroup is trioctahedral. The kaolins have almost exclusively Al as the octahedral cation, while the serpentines contain Mg, Fe, Mn, Zn, and Ni as divalent octahedral cations in addition to Al and Fe as trivalent cations.

Kaolins are abundant in soils because they are not easily weathered, are formed in soils, and are frequently inherited from the soil parent material. As a result of these characteristics, one of the kaolin minerals, kaolinite, is probably the most ubiquitous phyllosilicate and is the most abundant phyllosilicate in highly weathered tropical soils. Members of the kaolin subgroup have low cation exchange capacity (CEC) but are important sources of anion exchange. Kaolin minerals have low physical activity depending on the particle size, which can vary from thin flakes of fine clay to coarse books of sand size. These minerals dilute other more chemically and physically active clays and provide chemical and physical stability to soils. Relatively pure deposits of kaolinite are of great economic importance for coating paper and for use as stable components in many industrial products.

Serpentines from rocks have quite diverse chemical and physical properties. Serpentines have not been frequently investigated in soils. Where they occur in oxidized soils, they are inherited from the soil parent material and are not known to form in soils. Serpentine-derived soils are characteristically poor media for plant growth. Serpentine-containing rocks are used as construction materials for their color. The serpentine mineral chrysotile is one of the fibrous minerals used in the material commonly known as asbestos. Asbestos has been used widely in industrial and residential applications, principally for its thermal properties and resistance to high temperatures, but is now considered an environmental hazard due to its potential carcinogenicity. Chrysotile may not be as harmful as other fibrous minerals marketed as asbestos.

Because of the widely differing properties and occurrence, the kaolin subgroup minerals will be discussed first, followed by a separate discussion of the serpentines.