An important distinction can be made among soils according to whether variable-charge colloids or permanent-charge colloids control ion exchange reactions. This distinction is important in a discussion of S nutrition of crops in the tropics because variable-charge soils—soils in which the sign and magnitude of charge on the solid phase are determined by the chemical environment—sorb significant amounts of \( \text{SO}_4^{2-} \) if soil pH is low (Probert & Samosir, 1983). Variable-charge colloids dominate most soils of the humid tropics.

Weathering and leaching desilicate soil-forming materials, enriching them with hydrated oxides of Fe and Al. Variable-charge colloids are constituted of materials such as these, together with kaolin clays and organic matter.

If soil pH is low, variable-charge colloids develop positive charge. If soil pH is sufficiently low (i.e. below the zero point of net charge) the charge becomes net-positive. Positive charge makes \( \text{SO}_4^{2-} \) retention possible. Although some degree of \( \text{SO}_4^{2-} \) sorption is possible for variable-charge colloids with net-negative charge, soils which contain substantial quantities of adsorbed \( \text{SO}_4^{2-} \) almost always are near or below the zero point of net charge. For most highly weathered surface soils this is near pH 5; although subsoil materials, because they contain less organic matter and more oxides, may sorb an appreciable quantity of \( \text{SO}_4^{2-} \) in the range 5.5 to 6.0. These conditions prevail in soil profiles throughout much of the humid and subhumid tropics and subtropics and sometimes extend into the Temperate Zone also.

As conditions now stand, S deficiencies are encountered frequently in the humid tropics although the problem is not as widespread or as severe as might be expected. Conditions would be more critical than they are if it were not for \( \text{SO}_4^{2-} \) retention by variable-charge soils which buffer the S supply in such situations.