12 Toward a New Theory of Podzolization

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Spodosols (Buol et al., 1989) are a major class of soils that tend to develop under climatic, parent material and other conditions that promote formation of a dark-colored organic surface horizon (McKeague et al., 1983). This horizon serves as a source of downward migrating organic chelating agents that attack the mineral fabric releasing structural Al and Fe. Hence, in a well-developed Spodosol profile, the horizons express sharply differentiated patterns due to the transport and deposition of Al, Fe and organic matter (podzolization; Buol et al., 1989).

Studies of soil genesis are developing quantitative data on soil formation processes and their rate of change in response to environmental perturbations and global change phenomena (Yaalon, 1990). Podzolization is of considerable interest with respect to environmental climate change for several reasons. First, Spodosols are prominent in climatic zones (e.g., subpolar Boreal Forests ecosystems) where assumed climate changes, especially temperature, will be sufficient to affect soil processes in detectable ways. Second, many attributes of Spodosols (e.g., spodic horizon) are assumed to develop on a short enough timescale for changes to be detectable. Third, processes operative in podzolization have counterparts or are operative under other pedological processes (Buol et al., 1989). Finally, podzolization theory has received considerable attention and may, therefore, provide an overall index of the quality of our theoretical constructs for assessing sudden change in soil formation processes.

Approaches for studying the dynamic response of soil-forming processes to new environmental conditions are often based on the assumption that solid phase soil attributes preserve a record of soil-forming processes. Thus, it is reasoned that future trends in soil-forming processes will be predictable from an analysis of measurable and observable soil attributes (e.g., spodic horizon). However, several problems underlie the use of soil attributes to interpret environmental change. First, several factors could be responsible for changes in soil attributes (Rosanov & Samoilova, 1990): climate change, geomorphological development of land surface, human impact, and self evolution of natural ecosystems. Second, the physical/chemical mechanisms responsible for many soil attributes have yet to be articulated. Third, measurability does not necessarily imply that changes in an