



Discovering the essence of soil

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Abstract

Science, and what it can learn, is constrained by its paradigms and premises. Similarly, teaching and what topics can be addressed are constrained by the paradigms and premises of the subject matter. Modern soil science is founded on the five-factor model of Dokuchaev and Jenny. Combined with Retallack's universal definition of soil as geologic detritus affected by weathering and/or biology, modern soil science emphasizes a descriptive rather than an interpretive approach. Modern soil science however, emerged from the study of plants and the need to improve crop yields in the face of chronic and wide spread famine in Europe. In order to teach that dirt is fascinating we must first see soils in their own right, understand their behavior and expand soil science towards an interpretive approach rather than limited as a descriptive one.

Following the advice of James Hutton given over two centuries ago, I look at soils from a physiological perspective. Digestive processes are mechanical and chemical weathering, the resulting constituents reformed into new soil constituents (e.g. clay and humus), translocated to different regions of the soil body to serve other physiological processes (e.g. lamellae, argillic and stone-line horizons), or eliminated as wastes (e.g. leachates and evolved gasses). Respiration is described by the ongoing and diurnal exchange of gasses between the soil and its environment. Circulatory processes are evident in soil pore space, drainage capacity and capillary capability. Reproduction of soil is evident at two different scales: the growth of clay crystals (with their capacity for mutation) and repair of disturbed areas such as result from the various pedo-perturbations. The interactions between biotic and abiotic soil components provide examples of both neurological and endocrine systems in soil physiology. Through this change in perspective, both biotic and abiotic soil processes become evident, providing insight into the possible behavior of ancient prebiotic soils. Furthermore, the physiological approach sheds light on the emergence of new soil components (e.g. spodic horizons) as ancient prebiotic soils adapt to a plethora of biotic carbon compounds. Other emergent soil properties and behaviors can be linked to the kinds, frequencies, order and intensities of various ubiquitous pedo-perturbations.