



Pedo-luminescence in Structural Gradients of Soil Profile

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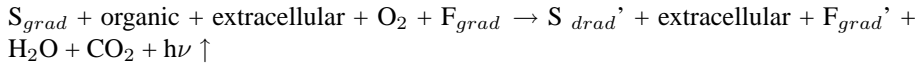
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A contemporary paradigm of soil fertility is based on chemo-kinetic theory of humification (Orlov, 1996), where the dynamical conversion of organic residues into humus is governed by the concentration of reacting components: humidity, temperature, response of soil solution, redox potential. It should be stressed that chemical, biological, microbiological components of soil profile being only the required “mechanical” inclusions, but absolutely insufficient for understanding the essence of principal mechanisms of formation or decomposition of humus, are not taken into consideration. According to the concept of geo-chemical energy of life of soils as a component of universal planetary structural shell, the Biosphere (Kovda, 1980), the rate of humus layer formation is a function of life cycles recurrence frequency. On the other hand, it is generally recognized that main conversion and utilization of the energy of the Sun involve the mechanisms of biological activity of individual organisms (microorganisms, plants etc.), and the essence of abiogenic mechanism is associated mainly with chemo-catalytic process. In addition it is obvious that intensity of heat- and CO₂ – evolution from soil is indicative of possible energetic additional feeding of both biogenic and abiogenic mechanisms of organic matter oxidation, formation (decomposition) of humus.

The objects of our investigations were samples soils from various depth horizons, as well as buried (evolutionally conserved) soils. In obtained spectral results maxima, pointing to possible absorption at λ_{max} -395, 422, 455, 528, 544, 568, 650, 682, 690, 713, 728 nm, were observed at $\lambda_{emission}$ -684, 825 nm in fluorescence excitation spectra of soil samples from various depth horizons. In fluorescence spectra maxima were revealed at λ_{max} -510-520, 645, 682-684, 776, 795, 820, 854 nm. This may point

to possible participation of soil-structural units with adsorbed of them components of degraded electron-transport chains of biochemical compounds of plant cells, of a part of energy of soil organic matter oxidation into the energy of electron excitation with its further degradation as luminescence of red and near red fared spectral range for continuous maintenance of pedocatalytic process. Based on previously developed model mechanism of energy cinversion within the concept of structural and functional gradients it is possible to set up:



1 matter enzymes enzymes

where: S_{grad} – is a structural gradient, F_{grad} – is functional gradients before and after (S_{drad}' , F_{grad}') reaction reflecting the mechanisms of soil respiration; $h\nu \uparrow$ – is a light of red, near infrared spectral range.

Experimental data obtained enable us to suppose that conversion of energy on pedo-luminescence type in structural gradients of soil profile may combine structural-functional units into oxidation of a part of organic matter may occur trough pedo-energetic mechanism. Soil profile as a whole is likely to be presented as a set of gradients: structural (Zaitsev, 2001) – micellular-biochemical units (paracels). Including pedo-vacuoles separated by pedo-membranes with electron-transport chains localized on them and functional (energy of red and near infrared spectral range, electronic excitation gradients, where masse-exchange, the oxidation of organic matter, is occurred. Thus, along with the processes of vital activity of the living organisms and biogenic (abiogenic) oxidation of organic matter pedo-luminescence in structural gradients of soil profile energetic factor of pedo-catalytic processes of oxidation of organic matter and CO_2 respiration.