

Interactive comment on “Ion’s association in soil and vadose zone of Azov-Black sea region” by A. A. Batukaev et al.

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The authors have shown the role of the association of ions in water solution as a driving force for mass transfer, especially (particularly) carbonates, in soil and saturated zone. It seems that this approach has the future. There are comments.

1. In addition to the processes disclosed in the article, no less important has untouched by authors the lateral transfer of substance in landscapes and watersheds basins. The article does not reflect this important aspect of the dynamics of matter in the biosphere. On this basis, authors should indicate whether the broader perspective of the approach developed.

Answer We fully agree with the reviewer that lateral transfer of substances in landscapes, watersheds is the most important aspect of matter dynamics in the biosphere.

C1

Moreover, this aspect we are studying for a long time, we have an interesting theoretical generalizations on the issue of transfer of matter in the three-dimensional continuum and soil aeration zone. However, when writing on the article we meant the problem of lateral coordination of spatially inhomogeneous soil structure to be considered in a separate publication. Nevertheless, we understand that it is our intention comes form the material we offered to discussion in the article, and, of course, it is absolutely obvious to the referee. We take the reviewer’s remark as a wish for more detailed interpretation of the material that will perform in the final version of the article. To the section "Discussion" of the article we add the following text:

Along with the laws of the salt’s dynamics for the individual layers of soil profile, is important the lateral transfer of substances in landscapes, watersheds. The developed approach is closely related to these objects due to the fact that, given the association of ions in the soil solution, assessment of the likelihood of substance mobility in landscape and watershed is significantly higher than previously thought.

2. An important motive of the peer-reviewed article – the dynamics of the composition of the solution in relation to moisture of soil, vadose zone, saturation zone. According to the authors, a transfer of substances is noticeable even at the very low soil moisture. However, this fact is not disclosed. Authors should examine their data and theoretical generalizations in terms of formation in considered disperse systems, not only the solid stream of mass transfer, but also the micro-basins of the solution.

Answer We agree with the reviewer that it is insufficient to characterize the transfer of substances in the soil and unsaturated zone only, operating a continuous flow of water transfer and the substance contained. In fact, as the humidity reduces in the mass transfer zone, the actual transfer of the water and the substance becomes more discrete. One reason for the flow discontinuity is the difference between thermodynamic potential of water in individual capillaries, on soil internal surface, the variation of water surface curvature at the interface of "liquid phase – solid phase". We add to the section "Discussion" of article final version the following text:

C2

The dynamics of solution composition is related to moisture of soil and aeration zone. According to simulation fulfilled, the transfer of substances in the soil and the vadose zone is noticeable at low soil moisture content. From this point of view, the transfer of a substance in dispersed systems should be considered not only from the standpoint of the unbroken mass transfer flux, but also taking into account the formation of micro-basins of solution. As the humidity reduces, the mass transfer zone of the actual transfer of water and dissolved substances becomes more discrete. The reason for discontinuity of the flow is the difference of water thermodynamic potential in individual capillaries, inner surfaces of soil, water surface curvature variations. On subsequent wetting of soil the agent of transfer does not pass the dissolution stage, but quickly enters into geochemical transfer process with the first portions of additional water. The micro-basin formation, on the one hand, is useful as a source of plant nutrients, but, on the other hand, it is dangerous in terms of easy loss of useful substances from the soil and vice versa – the receipt of unwanted substances.

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