Interactive comment on "Controls of fluorescent tracer retention by soils and sediments" *by* Marcus Bork et al.

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We wish to acknowledge the constructive and helpful comments of the reviewer. The comments identified important areas that required improvement. Below, we described point by point how we will address the comments (in italics) in the revised paper:

General comments

Comment 1: *Some minor language mistakes are present that should anyway be corrected.*

Response 1: We asked an experienced colleague who is a native speaker to check language once again.

Specific comments

2.1. The Substrates

Comment 2: *If you want to investigate the adsorption of uranine and sulforhodamine B by soil, you should consider the soil as an adsorptive material, consequently the soil should be characterized as an adsorptive material. Please, include into the characterization several fundamental parameters such as pore size, BET surface area, density, average diameter, porosity.*

Response 2: We agree with the referee that these are important properties to characterize an adsorbent. However, we have conducted batch experiments where a certain amount of soil is suspended in a liquid and shaken for a certain period, in general until sorption equilibrium. In this type of experiment BET surface area represents the most important control of adsorption processes. In addition, particle diameter is of interest, since the density of sorption sites of a surface is related to particle size (a surface unit of a sand particle has a different number of sorption sites than a surface unit of a clay particle). These two properties are already given in table 2 of the original paper. Pore size, density and porosity are only relevant to assess sorption in column experiments. Since we did not perform column experiments, we did not measure these properties.

Comment 3: *Please, include water-content (you described how it was measured but I cannot find measurement results).*

Response 3: We thank the referee for this very helpful comment. Indeed, we did not report the water contents. We measured the residual water content of air-dried samples since the sorption and the metal oxide data are referenced by the soil mass which had to be corrected by the water content in case it would strongly differ between samples. However, the residual water contents were very low and ranged between 0.1 % (sediment) and 2.2 % (topsoil). Therefore, we decided to omit the correction of air-dried samples by water content and took the air-dried soil mass as reference

instead. In the updated manuscript we will specify which water content we measured exactly, namely the residual water content of the air-dried samples, and we will report the values. Furthermore, we will indicate that we referenced to the air-dried soil in the captures of tables 2 and 4 and figures 2-6 and in the text. Additionally, we will add mean and standard deviation of residual water content in the supplement.

2.3.2 Sorption isotherms of the tracers

Comment 4: *Please, specify the temperature investigated, because this parameter is fundamental for the adsorption processes.*

Response 4: We agree with the referee that temperature is an important parameter for adsorption processes. The batch experiments were conducted at room temperature (approx. $23°C$ +/- $2°C$). We will specify this in the text.

Comment 5: *It is not clear the reason because you investigated the adsorption of tracers by batch tests and not by using column tests, considering the variation of humidity along the column. Please, support your approach.*

Response 5: We thank the referee for this suggestion. Probably, we did not made this point clear enough. Batch experiments have the main advantage that the experimental conditions can exactly be controlled. These experiments are appropriate tools to investigate the influence of single properties independent of preferential flow, porosity etc. Our main objective was to characterize the affinity of solutes to the solid phase independent from transport processes. In the updated manuscript we will include this justification of the chosen experimental setup at the end of the introduction.

Comment 6: *Please, check variation range of concentration of compounds in solution because the ranges specified seem to be different with respect the ones in Figures 2 and 4.*

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Discussion paper

Response 6: With all due respect to the referee, we are not sure if we fully understood the comment. We will list the concentrations in solution and the calculated adsorbed concentrations shown in figure 2 and 4 and the related standard deviations in a table in the supplement. We hope that this makes the point clearer for the referee. As specified in the method section, the tracer concentrations for the isotherm experiments were set to 20-45 μg $\cdot$ L^{-1} (UR) and 400-900 μg $\cdot$ L^{-1} (SRB). This difference was due to the much higher fluorescence intensity of UR. We will include a remark in the figure caption of figures 2 and 4.

3. Results and discussion

Comment 7: *Please, improve comparison between experimental findings and litera-ture data.*

Response 7: We thank the referee for this important suggestion. The linear sorption coefficients found in the literature are summarized in table 1 of the original manuscript. We will add our data to table 1, as was also suggested by referee #2. This will fa-cilitate a direct comparison of our data with existing knowledge. We will also discuss similarities and differences in a revised manuscript.

3.1 Physico-chemical properties of substrates and treatments

Comment 8: *Table 2: It seems that the higher the clay content the higher the lower the specific surface area. I was expected a different trend.*

Response 8: We are grateful for this comment. Obviously, we did not make this point clear enough. This result seems to be contradictory but can be explained by a different quality of the clay fraction of the different adsorbing materials. In particular, the clay fraction of top- and subsoil have different quality. Thus, the number of sorption sites does not only depend on the clay content but also on the type of clay-sized particles. The relation between quantity of clay, specific surface area (SSA) and the composition

of clay is discussed in section 3.4.1 (p.9,l.30-32/p.10,l.1-6) of the original manuscript. Furthermore, the SSA in the topsoil could be lower due to clogging of pores by organic matter, like referee #2 supposed (referee #2, comment 15). We will add this argument to chapter 3.1. and generally, enlarge the discussion in the updated manuscript. We will also support it by relevant literature (e.g. Mikutta et al., 2006b/c).

3.4.1 Sorption of UR

Comment 9: *To be honest, I cannot see the linearity of the increase of the adsorption of UR with clay content in the investigated range (0-10 %).*

Response 9: We agree with referee when we consider the clay content in the range of 0-10%. However, we wrote that the UR adsorption increased linearly up to 3-4% clay (p.9,l.27-28). To make this statement clearer, we will add a linear regression line to figure 6 for UR adsorption up to 2.5% clay addition (see Fig.1 below which is an updated version of Figure 6 in the original manuscript).

Literature

Mikutta, Christian; Krüger, Jaane; Lang, Friederike; Kaupenjohann, Martin (2006c): Acid Polysaccharide Coatings on Microporous Goethites. In Soil Science Society of America Journal 70 (5), p. 1547.

Mikutta, Christian; Lang, Friederike; Kaupenjohann, Martin (2006b): Citrate impairs the micropore diffusion of phosphate into pure and C-coated goethite. In Geochimica et Cosmochimica Acta 70 (3), pp. 595–607.

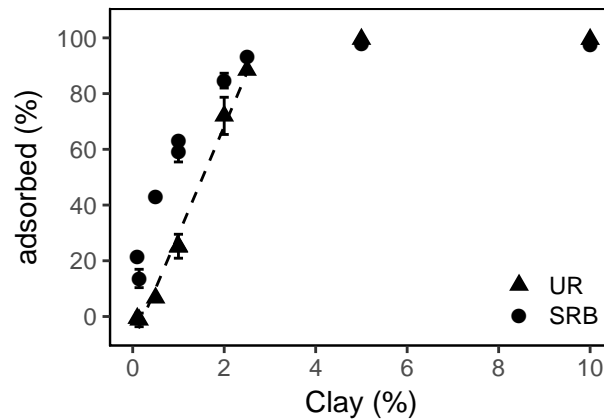
Fig. 1. Adsorbed percentage as a function of the clay content for UR (triangles) and SRB (circles) in the sediment.