Earth Surf. Dynam. Discuss.,
doi:10.5194/esurf-2016-26-RC2, 2016

Earth Surface Dynamics Discussions

Interactive comment on "Impact of sediment-seawater cation exchange on Himalayan chemical weathering fluxes" *by* M. Lupker et al.

Anonymous Referee #2

Received and published: 7 July 2016

This study presents a large dataset of cation exchange capacity and exchangeable cation concentration measurements in Ganges and Brahmaputra (G-B) suspended sediment samples. The authors use these measurements to tackle the very important and still unanswered question of the influence of exchangeable cations bound to river sediments to the global long-term carbon budget. They find that the exchange reactions between G-B sediments and seawater have only a minor influence on the impact of silicate weathering on the long-term carbon cycle. More precisely, the main important results of this study are:

1. G-B Surface sediments have a higher CEC compared to coarse sediments. 2. Ca and Mg are the dominant adsorbed cations compared to K and Na. 3. The proportion of exchangeable cations do not change with the grain size of the sediments. 4. Cation exchange flux with seawater lead to a decrease by 16% of the dissolved Na flux and

an increase of 5% of the Ca and Mg flux to the Indian ocean. 5. Only 10% of the alkalinity related to weathering of Na-K silicates can lead to carbonate precipitation through cation exchange.

This study is a very important step for improving our understanding of the influence of cation exchange reactions on the long-term carbon cycle. The arguments and conclusions proposed by the authors are well exposed and very convincing. The quality of the data and measurements is good and the paper is well-written. Therefore, for those reasons, I recommend that this very interesting study should be published in Earth Surface Dynamics journal with only very minor revisions.

My major suggestion for the authors would be to add a paragraph to discuss in what extent the adsorption of the major cations on G-B sediments can influence the accuracy of the method for determining silicate weathering flux, which is based on dissolved Ca/Na and Mg/Na ratio (e.g. Gaillardet et al., 1999). Indeed, it has been recently suggested (e.g. Tipper E., 2015 AGU conference abstract) that the selective adsorption of the major cations to river sediments can significantly fractionate the Ca/Na and Mg/Na ratio of the "measured" dissolved load relative to the Ca/Na and Mg/Na of the initially dissolved cations. In that case, using the measured Ca/Na and Mg/Na ratio to calculate silicate weathering rates can lead to underestimated or overestimated silicate weathering flux calculations. Considering the low proportion of adsorbed cations relative to the total dissolved cations, the answer is probably going to be that the adsorption processes in the G-B do not fractionate significantly the Ca/Na and Mg/Na dissolved ratio, but I think that this would be a good addition to the current manuscript.

In addition to the point discussed above, here are some minor additional comments and questions about the rest of the manuscript:

Page 3 Line 17: what about dolomite dissolution? G-B sediments contain more dolomite than calcite (Lupker et al., 2012) and the CoHex solution is only saturated with calcite. Would you expect any dolomite dissolution during the CEC determination

experiment?

Page 3 Line 24: did you try to make a second leaching step with CoHex, on at least one sample, in order to check whether all exchangeable cations have actually been exchanged with Cobalt ions during the experiment?

Page 4: please give the proportion of exchangeable cations compared to the total proportion of cations dissolved during silicate weathering (exchangeable + dissolved).

Page 5, line 31: report only the date under brackets for the citation

Page 6, lines 9 and 12: please use the symbol "$\times$" instead of "x"

Page 6 line 28: remove the second bracket on the date of the citation

Table 2: Replace "echangeable" by "exchangeable"

Interactive comment on Earth Surf. Dynam. Discuss., doi:10.5194/esurf-2016-26, 2016.