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Hydrology and Earth System Sciences Discussions

Interactive comment on "Weathering rates and origin of inorganic carbon as influenced by river regulation in the boreal sub-arctic region of Sweden" *by* J. Brink et al.

Anonymous Referee #2

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In general 30% difference in weathering rates of various pristine river catchments is not uncommon. See for example (Bluth and Kump 1995; Gislason et al. 1996; Gaillardet 1999). However, weathering rates for a given lithology (e. g. White and Blum 1995,) and single catchments with one lithology have without exception been shown to increase with runoff (Gislason et al. 2006).

In this study two large river catchments, one relatively pristine the River Kalix (24 000 km2) and the other controlled the River Lule (25 000 km2), are compared, in order to study the effect of damming the Lule river. Overall catchment temperature is the same, 1 °C. Precipitation and runoff in the Lule catchment (698 mm and 559 mm) is

greater than in the Kalix catchment (554 mm 391 mm). Lithology is similar in both catchments; dominated by granite and gneiss but the percent of carbonates is higher in the Lule; over 4%, compared to 0,1% in the Kalix catchment. The weathering rates of carbonates have been shown to be more than order of magnitude faster than the one of granite and gneiss (Meybeck 1987).

Because of the large difference in runoff and with some contribution from the lithology differences one would expect the chemical weathering rates to be significantly higher in the Lule than the Kalix. This is not the case; the silicate weathering rate is 30% higher in the Kalix than in the Lule.

This is the major finding of the paper, and the authors suggest it is because of the construction of the dam in the Lule River.

This study is important because it evaluate the effects of erecting a dam within a catchment. Furthermore, it is important because of the size of the catchment, similar air temperature, vegetation and lithology, but variation in runoff.

I recommend publication of this manuscript with moderate revision. The text could be shortened significantly, introduction could be made more to the point along the lies I have written above.

Specific comments.

Figures. Fig. 1. Use larger fonts. I can not read the figure text.

Fig. 2. The dissolution rate of aluminium silicates e.g. feldspars and basaltic glass has been shown to increase at fixed pH and temperature with the addition of oxalic ligand (Oelkers and Schott 1998; Oelkers and Gislason 2001). This was explain by the ability of organic ligands to complex Al3+ at pH less than 7, and thereby enhance dissolution of feldspars and glasses. This could explain the observed correlation between the Si and TOC in figure 2 and the enhanced weathering rate in the lowlands, increased residence time in contact with rocks at elevated organic ligand concentration in the

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lowland soils.

Fig. 4. Enlarge the figure. The end member composition of the carbonate used for mixing is significantly different from the one of Gaillardet et al. 1999. Way is that?

Table 1. What is referred to as mean runoff is in fact mean discharge. I suggests changing specific discharge to runoff in the table. I world like to see one more significant figure for the mean temperature value of the catchments.

Table 2 is in fact Table 3 and vice versa.

Table 4. How many samples are behind the river moth data , samples from 1985-2003? I this average of several samples? The same applies to all other samples in the Table.

Text.

Introduction page. 558 ...Other significant factors controlling the weathering regime in a river catchment is temperature, specific runoff (Berner and Berner , 1996) and physical erosion (Gaillardet et al. 1999).... I suggest you add to this sentence ...lithology (e. g. Meybeck 1987), vegetation and glacier cover (e. g. Gislason et al. 1996; Moulton et al. 2000) and the age of the catchment rocks (Gislason et al. 1996; White and Brantley 2003).

Chapter 2.2, top of page 562 and end of the paragraph. Refer to Table 3 rather than Table 2.

The chemical reaction on top of page 556 is not balanced. 2 is missing in front of the albite.

Beginning of the last paragraph on page 568. ...In Table 6... should be changed to: In Table 5....

Last paragraph on page 570 the authors refer to Table 5 should be changed to Table 4.

Additional references.

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Gislason, S. R., Arnórsson, S., and Ármannsson, H. (1996). Chemical weathering of basalt in SW Iceland: Effects of runoff, age of rocks and vegetative/glacial cover. American Journal of Science, 296, pp. 837-907.

Gislason, S. R., Oelkers E. H. and Snorrason Á. (2006). The role of river suspended material in the global carbon cycle. Geology 34, 49-52.

Oelkers E. H. and Schott J. (1998) Does organic acid adsorption effect alkali feldspar dissolution rates? Chem. Geol. 151, 235-246.

Oelkers E. H. and Gislason S. R. (2001) The mechanism, rates, and consequences of basaltic glass dissolution: I. An experimental study of the dissolution rates of basaltic glass as a function of aqueous Al, Si, and oxalic acid concentration at 25° C and pH = 3 and 11. Geochim. Cosmochim. Acta 65, 3671 - 3681.

Interactive comment on Hydrol. Earth Syst. Sci. Discuss., 4, 555, 2007.