

## ***Interactive comment on “A multi-parameter hydrochemical characterization of proglacial runoff, Cordillera Blanca, Peru” by P. Burns et al.***

**Anonymous Referee #1**

Received and published: 17 November 2011

This paper presents major ions and stable water isotopes from a glacierized catchment in the Peruvian Andes. Such data is much needed because changes in glacier water quantity and quality are important for the local population and because we currently have limited knowledge on glacier hydrology and hydrochemistry in the tropical regions. Unfortunately, this paper does not bring us any substantial new data or scientific progress. Its aim and sampling strategy are quite similar to the study by Fortner et al. (2011), using data from July 2009 instead of data from July 2008. In fact, I find it somewhat odd that data and results from Fortner et al. (2011) simply have been ignored; especially since all authors (except one) are co-authors on Fortner et al. (2011). Why hasn't this data been implemented?

Also, the simple two-component mixing model and the use of stable water isotope

C1350

values do not bring us any significant new knowledge in relation to our current understanding (e.g. Mark and Seltzer, 2003; Mark and McKenzie, 2007; Baraer et al., 2009). Fortner et al. (2011; p. 1800) suggest a number of relevant research directions for future glacio-hydrological studies in the Cordillera Blanca, but this study does not follow any of these. I do hope the authors may find the data useful in a long-term study of hydrochemical variations (perhaps correlated with glacier mass balance or meteorological data), but I see no reason to publish the data in a separate paper that does not provide some scientific progress.

Specific comments:

Introduction: The readers should be informed on what specific progress this study aims to achieve. The primary objective is similar to the primary objective of Fortner et al. (2011).

2486, 21: Use the same nomenclature as in previous publications. It took some time to make sure that Quilcayhuanca is the same river as Rio Quilcay (Fortner et al., 2011), and Quil-R and Quil-L have others names in Fortner et al. (2011).

2488, 4: There should be a sentence on agricultural activities (livestock, irrigation, etc.). The influence of these on hydrochemistry should be discussed later in the paper.

2489, 9: Not the exact time of sampling in the tables, as significant diurnal variations in concentrations and ion/ion ratios are common in glacial streams. Thus, if samples only are collected during the afternoon, they may not be representative for the mean diurnal concentrations or ion/ion ratios. This representativeness could have been addressed by sampling over a 24 hours cycle.

2849, 10: Was Fe(III) analyzed? This is not mentioned in the abstract.

2489, 17: What was sampled every hour for 24 h?

2489, 21: Was the specific conductance temperature-corrected (20 or 25 Celsius)?

C1351

2489, 26: Mention detection limits, accuracies and precisions of anion and cation measurements.

2489, 27: Table 2 shows that most samples have a HCO<sub>3</sub> concentration of 0.00. What did you do when the anion charge was higher than the cation charge? And how do you explain negative charge balances?

2491, 4: Why is the hydrochemistry model by Baraer et al. (2009) not used in this study?

2491, 7: The finding that Na is not a conservative tracer is one of the most interesting findings in this paper, although the authors do not comment on this. Fortner et al. (2011) assume that Na is conservative and use Na to normalize cation data. Does the finding that Na is not conservative compromise the results of Fortner et al. (2011)?

2491, 17: Discharge measurements were not mentioned in the Methodology section. How and when were they conducted? What was the accuracy and precision?

2491, 25: Tranter (2005) does not represent 'most glacial environments', but only a few selected study sites.

2493, 12-13: Discharge should have been measured in combination with spec. cond. and shown in Figure 5.

2493, 21: Anderson et al. (2003) were not the first to show this. Reference to some of Dave Collins' work would be more appropriate. Also, look in the literature for studies that examine proglacial changes in hydrochemistry rather than comparing with glacier meltwater studies.

2493, 24-25: Is the postulate that '... this study should have a greater solute concentration because streams draining to this site have a much lower pH ...' supported by literature or data?

2493, 26: How many hours do you estimate it takes for meltwater to travel, let's say,

C1352

from the middle of the ablation area to the Quil Bel Conf site (including retention time in proglacial lakes)? Does this estimate support the conclusion that glacial meltwater peaks at the Quil Bel Conf site at 1430 hours?

2494, 2: Is this 'molar' composition or 'average by mass' composition?

2494, 2: I am not sure this average composition is meaningful. The samples are collected at different times and places, so what does the average composition represent?? What does it say that HCO<sub>3</sub> constitutes 1% of the anion composition, when most samples have no HCO<sub>3</sub>?

2494, 11-18: The comparison to Tranter (2005), Faure (1998) and Brown (2002) seems irrelevant. Again, what is actually compared here? It will be much more relevant with a comparison to samples from 2008 (Fortner et al., 2011), other samples from the Rio Santa basin, and other sites with similar sulfide-rich geology.

2494, 22: Biotite vermiculization would also release K, which does not seem to be very abundant in these waters.

2494, 25: Delete the references to Faure (1998) and Fortner et al. (2011).

2495, 6 and elsewhere: Why do you discuss carbonate dissolution in relation to this study? As there are no carbonates and the water contains no HCO<sub>3</sub>, carbonate dissolution seems irrelevant in this context.

2495, 16-20: Show the statistics behind these correlations.

2496, 26-27: How was it determined that there is a net removal of P by organic matter in these streams?

2497, 26-27: Where does Si come from in high-temperature natural waters?

2499, 12: Table 8 is referred to before Table 7.

2499, 18: Rephrase 'a similar, but more complex, model ...'.

C1353

2499, 9: I was surprised to see that Ca, Mg and SO<sub>4</sub> were conservative tracers (2491, 7). This deserves a discussion on reaction rates, potential precipitation and physio-chemical weathering of suspended particles.

2500, 28: Why is it 'between' 27% and 38%?

Tables 2 and 3: Why is the results for Fe(III) not shown?

Tables 6 and 7: D-excess is shown in these tables, but it is not presented and discussed in the text.

Fig. 2: Mention in the caption where site 25 is located.

Fig. 3: This figure is not needed.

---

Interactive comment on The Cryosphere Discuss., 5, 2483, 2011.