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Earth Surface Dynamics Discussions

Interactive comment on "Multiple controls on sediment grain properties of Peruvian coastal river basins" *by* Camille Litty et al.

Anonymous Referee #1

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This paper analyses variations in fluvial grain size along the western Peruvian margin. The overall idea behind the paper is interesting, and there are many significant research questions as to what controls spatial distributions of grain size through fluvial systems. However, I think that there are two main ways in which this paper needs to be improved. The first is a clearer presentation of the multiple interacting processes that explain the expected changes in grain size. The second is a more robust analysis of the data and more consideration of its limitations.

One of the main issues that I have with this paper is that it lacks a clear explanation of how the different factors that are meant to influence grain size operate, both in the introduction and throughout the discussion. For example, it is stated that increased uplift will be expected the increase grain size, but the causal mechanism is not described. Other explanations are sometimes vague. There is also a difficulty in separating out the

different mechanisms; for example, smaller basins seem to be correlated with lesser uplift, hence it is not obvious which of these two factors is more important. Another issue is that the paper seems to alternate between assuming that downstream fining is caused by abrasion and that it is caused by selective transport, without any explicit consideration of which process is likely to be more important, or the implications of one process being dominant. (A relevant paper for the discussion of abrasion processes is Sklar et al., 2006.) Overall, I would have liked a greater sense of the underlying processes that control grain size, how they interact with each other, and the relative importance of the different factors.

I also have some queries about the way in which the data were collected and analysed. The authors do not state how the locations in the different river basins were selected (other than the presence of the highway). My concern is that they are attempting to compare grains sizes that are collected from different relative locations within the basin, and are therefore not comparing like with like. For example, if the basins all had the same rate of downstream fining but the samples were collected from different locations within the basins, then the analysis would show differences between the basins that are not actually there. The authors need to consider this as a possible source of variation within their results. It would be useful to consider sample location as a function of total basin length, and also to normalise the distance to the knickpoint. There is also the question as to whether these basins are in a form of equilibrium or whether the grain size might actually reflect transient processes such as a coarse sediment slug progressing through the basin. I think that you need more discussion of the literature on controls on downstream grain size; at present the relevant papers are only referred to in passing at the start of the introduction.

Some other aspects of the analysis could also be clarified: what were the channel morphologies, how representative are the selected bars, how large were the individual images, how were grains selected within the images, how were grain outlines identified (automated or manual analysis), was any attempt made to verify the grain size data

produced, why were 500 extra grains used for grain shape, and what are the error bars on D50/D84/D95 (and hence are the identified differences significant)? The lack of a clear hypothesis early on means that some of the analysis comes across as a bit of a fishing expedition, with lots of correlations on different data groupings being undertaken, and only the significant ones being presented. I think that you need to be more thorough about this analysis, for example through multiple or stepwise regression.

Comments by line: 10: Overall the abstract could be more specific and provide some more evidence for the various claims.

53: To what extent are these different factors interrelated?

55: Make it clearer how this information about the general setting is related to the overall aim of understanding grain size.

78: Be more explicit about why uplift produces larger clasts.

79: You describe both N-S and E-W variations; which are most important for your study?

97: I'm surprised that erosion is nearly zero (line 89) given this high precipitation.

122: Be more specific about uplift rates.

125: Is five sites enough to identify trends?

196: Calculate sorting parameters to quantify these trends.

176: Suggests that you are downstream of the gravel-sand transition? Does the transition occur in other basins?

195: It would be useful to calculate stream power, as this would enable you to look at the combined impact of slope, width and discharge.

201: Is the relationship significant?

202: Was this analysis done for the other basins too?

209: Overall there are many competing ideas in the discussion, and it's not clear which are most important.

213: Use a sorting parameter.

216: This is the first mention of sediment sources; this needs to go earlier in the paper.

225: Note that rivers can also adjust to changes in uplift by changing other factors such as width, morphology and the amount of sediment cover.

244: What is the mechanism that relates different flood characteristics to different grain sizes?

257: What is your evidence?

273: How does the size of this fracture network compare to the grain sizes?

287: This argument would be stronger if you presented the lithological characteristics of your grains, which you could identify from the photos. Or state that they are all identical within each basin.

288: Note that you only have information on 2D grain shape not 3D.

296: Which idea do you think is more correct?

300: Is this consistent with the geological variations?

321: I'm still not entirely clear what you mean by a 'geomorphic' control.

323: But much of the earlier discussion has referred to abrasion.

Table 1: Add an indication of where the site is relative to the knickpoint and within the basin. It would help to also present distances normalise by total basin length.

Table 3: Give sorting values.

Figure 1: Add basin outlines to maps B and C.

Figure 2: Add the channel.

Sklar, L.S., Dietrich, W.E., Foufoula-Georgiou, E., Lashermes, B., Bellugi, D., 2006. Do gravel bed river size distributions record channel network structure? Water Resour. Res. 42. doi:10.1029/2006WR005035

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