

Review of Del Sol et al 2020 “Structural control on fluid flow and diagenesis:...”

By Geoffrey Rawling

This is a well-written paper that summarizes incredibly detailed field observations of the relationship between deformation bands (DBs) and cementation. The figures are very well done. There are only a few comments on language and grammar.

My main comments on this paper is that it needs restructuring for brevity and focus or change in emphasis. As it is the paper is a good discussion of two interesting field sites and a reasonable model for how the structures and cementation at these sites formed. However, as a paper in an international journal, I think it needs to be more broad.

I think there needs to be some explicit statements in the introduction and conclusions about what new insights are provided by this study and how they are relevant to outstanding questions relating to the control of fluid flow by deformation bands. Are fundamental questions being answered? Are ideas proposed elsewhere given a more robust foundation? I think a focus on how the observations presented are relevant to, or support, proposed processes for cementation as discussed in section 7.3 would be good. But prior to all of this, there needs to be some discussion of what the outstanding questions are and why the reader should care about them.

I think these changes would give the paper much more focus and attract the readers interest immediately. The observations in the paper should be limited to those that are relevant to these questions and or are genuinely new. The maps and thin section figures are impressive and the descriptions complete and accurate but I found myself saying “What is new here? Is all this detail needed?” Many papers have contained such detailed observations of deformation bands and cements. What is essential to make the point?

As explained below some of the conclusions are vague. What data could help strengthen them? Recommendations are made that other workers should use the types of data presented here. How? A discussion of these two points would also strengthen the paper in my opinion and give it a wider audience.

As an overall recommendation I suggest accept with moderate to major revision. Perhaps resubmittal and another review is necessary if there are major changes.

Line numbers:

50. “Fluid flow mechanisms...” I don’t agree. The next 20 plus lines describe numerous studies addressing the effects of dbs on fluid flow, so it seems fairly well understood to me and heavily

studied. And see the discussion and number of references listed in section 7.3. To justify the sentence in quotes I recommend stating clearly and explicitly exactly what is not currently understood and how the present study addresses and clarifies these problems.

Figures 1 and 2. Clarify what is meant by DB azimuth. Is this strike or dip direction? The azimuths range from +/- 90 relative to what geographic direction?

171. I would find it much clearer if you would use the average strike or dip direction to refer to the DBs rather than EESSWWNNWWE. Sorry, that's what it looks like on the page! You have calculated the mean orientations of the distributions in Figs 1d and 2d, so you could use them in the text.

244. Same comment as line 171. Reference to Figure 11b here should probably be 6b?

305. The microstructural observations that follow here are exhaustive. To my mind all of these features have been described elsewhere in studies of DBs. What is new here? What is relevant and essential to the main points and arguments of the paper? If it is not relevant then it can go in a supplement and or briefly summarized. It seems to me that many of the microstructural observations could be replaced by permeability data and other hydrogeologic data by these authors (from their other papers?) or summarized from the literature. Such data are much more relevant to the hydrogeological model proposed in Sections 7.3 and 7.4.

591. Do you mean to say "...decrease of hydraulic conductivity dominates over the flow velocity increase caused by porosity reduction....."

624. I don't think hypotheses is the right word here. The field observations tend to confirm the theoretical flow simulations and experiments etc. I think this should be emphasized more in the paper overall and mentioned in the introduction. The three mechanisms described in this section have been invoked in other field studies and/or examined in the laboratory, and field observations in this study suggests that they are all relevant and or viable as possible explanations for the cement distributions.

634. it would be good to add a line or two somewhere about basic interpretation of cathodoluminescence colors for those who aren't familiar.

676. Add a reference to the measurements of DB hydraulic properties, or better , add the data to the paper as suggested above.

700. Can you expand on this? Are there any microstructural characteristics of the cement that would allow interpretation of its growth direction?

685 – 715. In general this discussion about the Bollene site seems reasonable but not definitive and rather underwhelming. E.g., Statements like “most likely” and “probably”. Can you rework it to say what is known about the flow patterns and diagenesis definitively versus not. What about the three mechanisms described in section 7.3. Which do you think are applicable here (and at the Italy site), or would that just be total speculation? What additional info would be necessary to better understand the flow patterns and how they are controlled by the DBs and the resulting cement diagenesis. I.e., what could be a future research direction here?

726. I would say enhance rather than increase porosity reduction etc....

733. How would you include this information in a fault seal analysis. Give an example...it seems some sort of upscaling would need to be involved. E.g., Spatial density or proportion of cemented rock per unit area or length of fault? Something else?

740. Again, give an example. If someone is working with seismic data to do a fault seal analysis or reservoir engineering study how does the present study help them predict where the reservoir compartments are arranged etc. Elaborate.

756. As noted above, I would say that the field observations support three mechanisms that have been proposed previously as relevant to the precipitation of cements around DBs.

763. Comment at line 685 in the text, apparently I missed this discussion in the text. Perhaps that section can be rewritten to more clearly state this. But then there should be some discussion as to why the difference between the applicable mechanisms at the two sites. Something about the host rocks, db microstructures, regional geology, regional flow patterns during cementation etc