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Interactive comment on "Relationship between microstructures and resistance in mafic assemblages that deform and transform" *by* Nicolas Mansard et al.

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In this manuscript the authors describe shear deformation experiments performed on mafic rocks with four different compositions. The authors infer that if reaction and nucleation rates in the assemblages are fast, the experiments show no peak stress and deform at lower stresses than experiments where the nucleation rates are slower. A faster nucleation of reaction products is assumed to be caused by the presence of water inside the minerals of the starting material. When the reaction products form fine-grained interconnected layers the experiments show a strain weakening. In contrast, when the reaction products are coarser grained and have a poor connectivity

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the experiments show a steady-state or a strain hardening. The experiments highlight the importance of reactions during deformation. The results indicate that the ability of minerals to react will determine where the strain is localized. With ongoing strain, the grain size and connectivity of the reaction products will determine if a large weakening occurs.

The manuscript is well-written and of excellent scientific quality. The results, discussion and conclusion are presented in a clear, concise and structured way. The quality of the figures are high. I have some minor comments below, and I suggest the manuscript is accepted with minor revisions. I hope the comments are useful.

Line 175: Why did you do experiments on the Mg-rich assemblages with a long and a short run-in time? In the results you mention that the experiments with a longer run-in show systematic weakening after peak stress. I guess this is because the assemblages have a longer time to react? This is later not mentioned in the discussion.

Line 489-490: did you compare the experiments of Fe-rich and Mg-rich assemblages at low shear strain to see if indeed the Fe-rich samples contain more reaction products at the beginning of the experiment? This would strengthen your argument that the lack of peak stress and initial lower stresses in the Fe-rich samples is due to the faster nucleation rate in these samples. Related to this comment: can the initial lower stresses in the Fe-rich assemblages not be due just to the higher water content inside the starting minerals compared to the dry minerals in the Mg-rich assemblages?

Minor comments: Line 216-217: you talk here about the amph rich shear bands in the Fe-rich opx + plag assemblage but then refer to figure 3c which is belonging to the amph + plag assemblage. Line 478: how did you estimate the amphibole content in the samples? This is not mentioned in the methods. Line 481: for completion it would be nice to have a number of the amphibole content in the Mg-opx + plag assemblage. In Fig 5b, d and f it seems to be quite an amount. Fig. 11: How did you measure the opx2+plag2+amph grain sizes in the Mg-rich opx + plag samples? Did you use

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EBSD maps as well for this, in the methods you mentioned you only use EBSD maps to determine the amph grain size. When I look at fig 10a it is not clear to me how you can determine the grain size from these BSE images. The same for the cpx in the amph + plag and pure amph samples.

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