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Interactive comment on "Impact of grain size and rock composition on simulated rock weathering" *by* Yoni Israeli and Simon Emmanuel

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Review of the article "Impact of grain size and rock composition on simulated rock weathering" by Israeli and Emmanuel Cornelius Fischer Helmholtz-Zentrum Dresden-Rossendorf, Institut f. Ressourcenökologie, Abteilung Reaktiver Transport (Leipzig)

The paper by Israeli and Emmanuel focuses on an interesting and important topic, i.e., the impact of grain size and crystal reactivity on rock weathering. The authors present an interesting pool of data based on simulation results. They include into the simulation heterogeneous material that mimics two types of domains and of domain boundaries that are characterized by high vs. low reactivity, respectively. In doing so, the simulation results are analyzed with respect to the material loss over time, proportional to

the reaction rate. The combined parameter variation of grain size and surface reactivity is then utilized to get deeper insight into the importance of chemical weathering (dissolution) vs. chemo-mechanical weathering (dissolution plus grain detachment). As the authors already state in the manuscript, the reacting grains or domains do not show any internal heterogeneity such as defect structures etc. The contrast in defect density would add additional constraints to the evolution of material flux from the reacting surface [1]. Nevertheless, the presented results add important quantitative insight that can be utilized for several applications, or for the explanation of quantitative results of case studies. The specific case of different types of minerals is highlighted in the paper already. Moreover, this study continues the detailed previous observations of the authors about the phenomenon of chemo-mechanical rock weathering [2]. The main results of the present study towards this question are new interpretations about geometric constraints quantifying the impact of grain size on the overall rock weathering rate due to chemo-mechanical weathering. The authors discuss in the paper how such impact is controlled by so-called reactive boundaries and their density in the material under investigation. Additionally to the thought about contrasting defect density mentioned above, one could additionally think about interpretations that highlight contrasting and preferred crystal orientation, implemented by the presented approach of several domains. In that sense, the geometric approach highlighted in this manuscript offers potential for multiple applications in the weathering community.

References: [1] Fischer, C., Kurganskaya, I., Luttge, A., 2018. Inherited control of crystal surface reactivity. Applied Geochemistry 91, 140-148. [2] Emmanuel, S., Levenson, Y., 2014. Limestone Weathering Rates Accelerated by Micron-Scale Grain Detachment. Geology 42, 751-754.

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