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Comment on esurf-2022-71

Peter Finke (Referee)

Referee comment on "Feedbacks between the formation of secondary minerals and the infiltration of fluids into the regolith of granitic rocks in different climatic zones (Chilean Coastal Cordillera)" by Ferdinand J. Hampl et al., Earth Surf. Dynam. Discuss., https://doi.org/10.5194/esurf-2022-71-RC1, 2023

Review of Hampl et al, Feedbacks between the formation of secondary minerals and the infiltration of fluids into the regolith of granitic rocks in different climatic zones (Chilean Coastal Cordillera)

The authors define 2 possible mechanisms that either result in a deep weathering zone (both formation of secondary minerals and swelling of transformed clay minerals leads to fracturing and deeper infiltration, positive feedback) and a shallower but more intensively weathered zone (fracturing may occur, but formation of secondary minerals and higher clay mineral content also leads to blocking of pores and reduced infiltration, negative feedback). The depths of the weathering zones are hypothesized to be linked to the climate (precipitation surplus) and the intensity of weathering is inverse to the depth of weathering.
This well-written manuscript is an important extension to existing insights because it focuses on the depth and intensity of weathering, and not only the strength of weathering, as a function of climate.

To my opinion, there are a few issues that would benefit from more discussion in this manuscript:
(i) in terms of the processes, the production rate of swelling clay minerals and the fracturing rate by weathering of some Fe-bearing minerals, triggered by climate, lead in the hypothesis behind this research to either positive or negative feedbacks. The processes themselves are not different between the 2 extremes sketched (i.e. fracturing dominates or pore blocking dominates), rather the process rates, and intermediate situations may also exist, e.g. close to the equivalence point. Schaller&Ehlers (2022) inventoried whole-profile (often quite shallow) CDF's for different annual precipitation amounts, a.o. for similar sites in Chile. García-Gamero et al, 2022, fig.10, linked these whole-profile CDF's back to the Albrecht (1957) curve and found a pattern of response to precipitation which could in the current manuscript be discussed, linking precipitation to the underlying processes. As in the current manuscript precipitation is either 346 (LC) or 1927 (NA) mm.y-1, only fairly extreme points in this continuum are sampled and I wonder how the authors envisage intermediate situations in terms of precipitation (e.g. at 800 mm).
(ii) In NA and LC exposure to oxygen is different because the fracturing in LC leads to "open" fractures while in NA these are less "open". This leads to higher oxydative stress in LC, producing FeIII-minerals. Fracturing could on the other hand also lead to higher

contact area and residence time of infiltrating water in NA, which will increase weathering as appears from CDF and delta CIA. This could be added to the discussion.
(iii) The type of clay minerals, either newly formed or transformed, leads to swelling behavior (CF) or pore-blocking behavior (NA). What is the linkage to the (Si-rich) parent materials studied here (which are somewhat different, c.f. lines 373-376). Also the clay content (higher in NA) is stated to have a clear influence. I would appreciate some discussion on (a) to what degree are the mechanisms portabe to other rock types? and (b) are the differences in clay content a function of the degree of weathering or of the parent materials?

Refs:
1. Albrecht, W.A.: Soil Fertility and Biotic Geography, Geogr. Rev., 47, 86, 47, 86–105, https://doi.org/10.2307/212191, 1957.
2. García-Gamero, V., Vanwalleghem, T. Peña, A., Román-Sánchez, A. and Finke, P.A.: Modelling the effect of catena position and hydrology on soil chemical weathering, SOIL, 8, 319–335. https://doi.org/10.5194/soil-8-319-2022, 2022.
3. Schaller, M. and Ehlers, T.A.: Comparison of soil production, chemical weathering, and physical erosion rates along a climate and ecological gradient (Chile) to global observations, Earth Surf. Dynam., 10, 131–150, https://doi.org/10.5194/esurf-10-131-2022, 2022.

Details:
l.383: in NA nutrient recycling is more important than uptake of nutrients released by weathering: It could be specified that the higher precipitation will likely lead to higher biomass production by plants in NA, which will produce more litter, stimulate its biogenic decay and thus enhance nutrient cycling in the biologically active zone. A similar mechanism is already mentioned in 5.2.2 in the context of production of acidity via CO2-release.
l.387: Al(OH) > Al(OH)3