

Interactive comment on “The origin and role of biological rock crusts in rocky desert weathering” by Nimrod Wieler et al.

Anonymous Referee #1

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General comments The manuscript: "The origin and role of biological rock crust in rocky desert weathering" by Wieler et al. is focused on the origin and role of rock biofilms in cavernous weathering in arid and hyperarid climate. Authors use multiple techniques to reveal the origin of biocrust and its effect on evaporation rate and thus weathering. Manuscript contains valuable information and its worth of publication. The answer to questions 1-15 in review instruction is positive, except the critical comments mentioned below. Please take into account that I am not expert on DNA techniques nor on statistical processing of such data, so I can not reliably review chapters 2.6, 2.7 and 3.3 from biological point of view in required depth. These chapters seems to be however clear and makes sense to person from other scientific branch.

Specific comments (P1 L12 means 1 page 12th line) It is unclear which portions of

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honeycombs or tafoni surfaces were sampled for biogenic rock crust (BRC). Was is the outer surfaces or hollows (cavities)? From P2 L5 it seems that just outer surfaces are covered by BRC, but it is not clearly stated. It should be spelled out more clearly if BRC is missing in caverns or if it covers whole surface of tafoni. P1 L32 reference at the end of sentence is needed P2 L26 Fungi and algae are reported as common constituent of BRC by Slavik et al (2017)-cited in document P3 L1 there should be few more sentences given on characterization of limestone and dolomite: sedimentation settings, diagenesis, lithology, whether these rocks act as aquifer or aquitard, into which degree the water from rain infiltrates to them vs. surface runoff dominates P3 L4 rather than P/PET 0.05-0.005 you should write this ratio for both studied localities respectively (to show the difference between them). This ratio is in one of supplementary tables, but it should be also directly in the text. P3 L10 these samples were taken from 1) narrow walls of tafoni, 2) hollows of tafoni, 3) outer surfaces, which are not covered by tafoni or 4) inner material below tafoni hollows? This should be clear. Similarly for each method used is important which of these four types of material you used P3 L29 you mention measuring of porosity in direction normal and perpendicular to bedding. This is good idea, but please report also results from both measurements (table 1). Currently the direction is not distinguished there. Measured samples were without crust, with crust or crust itself? It should be more clearly spelled out in this (and also other) method(s), whether the underlying rock or crust was tested! If crust was not measured it will be valuable to measure the crust as well and compare it to underlying rock. P3 L30 It is generally recommended to do about 20 readings by Schmidt hammer per single obtained value. Your 20 measurements per lithology means 20 readings (1 value) or 20 sites measured each by 20 readings? Please specify. Also in further text you use "elasticity" (P5 L23), "surface penetration resistance"(Table 1). This cannot be measured by Schmidt hammer, but it could be possibly derived by some formula. Did you measure it by other device? (Please characterize the device) or did you calculated that from rebound value of Schmidt hammer (then please provide the formula and reference). The terms "penetration resistance" elasticity of material should be unified in text

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and tables, if they describe the same measured parameter. P4 L4and6 really it was $\delta^{18}O$ in H_2O ? I would expect O in CO_2 gas not H_2O vapor. The sample is carbonate not water. Please check. P4 L7-8 Really SMOW was used? All values seems to be referenced to PDB standard to me (Fig. 2). Please check. P4 L17 What do you mean by “incubated”? bacteria were introduced to rock? P5 L16 “crusts were restricted to atmospherically exposed. . .” please change “atmospherically exposed” to more proper description. Do you mean that crust was missing in bottom of hollows? Or deeper below surface? This should be more clear. P5 L17 vs L19 Statement is not consistent. In first sentence you speak about weathering MORPHOLOGY in second you speak about weathering RATES. So if morphology is the same, this does not necessarily mean their rates are the same as well. I am afraid that this if fact not challenges the model. P5 L29-32. Text is unclear, please rewrite. P6 L35 “clogging the pores on the surface of the rock and thereby minimizing capillary rise”. This statement is confusing. In fact the smaller the pores, the higher the capillary rise. The reason why biota affects capillary water is not the diminishing the size of pores but the presence hydrophobic organic matter. So please mention rather hydrophobicity here as explanation. P6 L42 Slavik et al 2017 reports DECREASE of hydraulic conductivity and capillary water absorption by 15-300 times and 2-33 times, respectively. So cited statement that BRC does NOT affects water transport rates is wrong. Only diffusion of water vapor was not effected by crust based on Slavik et al 2017. But in your case it could be the same situation: lowered evaporation is not necessarily due to low diffusion of vapor (only few if any well designed studies indicated that biocrust is capable even to affect vapor transport). Far more probably the decreased evaporation rate (which you observe on crust) is due to fact that capillary front is pushed below surface due to hydrophobic organic matter and thus diffusion occurs via more thick dry surface layer in case of BRC sample compare to bare rock core (longer diffusion path means far lower evaporation rate). Until the vapor diffusion is measured via BRC and bare rock and both rates are compared on your samples (e.g. by wet cup technique) it is impossible to say if evaporation rate is lowered by (i) lower diffusion rate or (ii) due to different geometry of capillary front. This

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will be very valuable to test. P7 L13 From which depth the samples were taken? P8 L28and29 Sentence not clear. “. . .composition and function.” of what? P9 L4 please specify which “microscale conditions”

Technical correction (P1 L12 means 1 page 12th line) P1 L13 replace “hard lime” by “limestone” P3 L12 if UVSoil had 3 samples, there should not be “UVSoil 1-12” but rather “1-3” P4 L10 Use rather “Evaporation experiment” then “Desiccation experiment” P5 L12 replace “weathering features” by “Cavernous weathering features” to be clear which weathering features you mean. P6 L8 please replace 2.5 Ga by 2.5 Ma P6 L14 there should be rather “In” then “between”. The sentence is not much clear (it is unclear if values are concerning BRC, underlying rock, or both; but clearly not the boundary between them - Fig 2). Fig. 2 please add PDB standard to horizontal axis of fig. a Fig. 3 please replace “desiccation” by “drying”

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