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Interactive comment on "Application of clustering techniques to study environmental characteristics of microbialite-bearing aquatic systems" *by* R. Dalinana et al.

R. Dalinana et al.

v.petryshyn@gmail.com

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The first reviewer made two main criticisms of the manuscript, both of which we feel we have addressed with the work outlined below:

First, the reviewer did not understand the inclusion of seawater as a negative control, as microbialites are found in two marine locations (Shark Bay, Australia and the Bahamian Bank). While we understand the reviewer's point, we specifically used values for open seawater, not the restricted, hypersaline values in Hamelin Pool , or the values from the shallow channels of Highborne Cay, which is a back-reef lagoon, protected from the open ocean by barrier islands (e.g. Reid et al., 1991; Visscher et al., 1998; Dupraz

et al., 2006). The Bahamian microbialites, while in contact with open marine water and not in the hypersaline conditions of Shark Bay, form at 37-40 ppt salinity (Dill et al., 1986). Open ocean chemistry favors carbonate precipitation (Ω>1 for both calcite and aragonite), however well-developed marine microbialites are only found in two specific, restricted locations, therefore we cannot conclude that general ocean chemistry is responsible for microbialite formation. Measurement of carbonate saturation in the Bahamian microbialites finds it to be 2-5x that of normal seawater (Visscher and Stolz, 2005). For these reason, we used 'average open seawater' as our negative control. However, this was unclear in the manuscript, we would clarify the text (Section 2.2.3) to point out the geochemical differences between average seawater and the specific chemistries of the two marine settings that currently harbor microbialites.

We greatly appreciate the second comment from this reviewer, who suggested we look at the ways in which multiple chemical parameters (such as the vital pH-alkalinity-Ca triplet) may be assessed statistically. In order to do this, we combined features using principal component analysis (PCA) to get a linear combination of our variables. Then clustering on the PCA components. Ba was omitted from this analysis because of its many missing values. Including Ba would have dropped many sites from the analysis. Results (figure 7, attached) agree with the previous finding of the manuscript - 2 or 3 clusters are forming, with Mono Lake being one, Kiritimati being another one, and the rest in 3rd cluster. In addition to the generation of Figure 7, the accompanying text would be added to the manuscript in section 3.2 (Clustering):

"To see whether not one, but a combination of features can lead to a different clustering we used principal component analysis to derive a linear combinations of variables at hand. Principal component analysis (PCA) is a standard statistical technique for reducing dimensionality of the dataset to a few components explaining most of the variability in the data. In order to be able to apply the technique we omit Ba from this portion of the analysis due to its many missing values. As seen from Table 3, 3 components explain 92% variability in the data. From magnitude of the loadings, we see that the first component contains information from all dimensions except pH, Si, and Alkalinity 2nd component is mostly drive by pH and Alkalinity; 3rd component has the largest loading for Si. Table 4 contains the components and loadings. Then, aforementioned k-means with partial distance is performed on the 3 resulting components. The scree plot (Figure 7) shows that similarly to previous findings we see 2 or 3 clusters in the data. Cluster assignment also remains the same: Mono lake sample forming one cluster, Kiritimati samples forming second cluster, and all other observations forming 3rd. If repeat this exercise with two clusters, Kiritimati and all others form the two groups. This exercise confirmed clustering we have seen with using k-means directly on the features. “

Refernces: Dill, R.F., Shinn, E.A., Jones, A.T., Kelly, K., and Steinan, R.P., 1986, Giant subtidal stromatolites forming in normal salinity waters. Nature, v. 324, p. 55-58.

Dupraz, C., Pattisina, R., and Verrecchia, E.P., 2006, Translation of energy into morphology: Simulation of stromatolite morphospace using a stochastic model. Sedimentary Geology, v. 185, p. 185-203.

Reid, R.P., and Browne, K.M., 1991, Intertidal stromatolites in a fringing Holocene reef complex, Bahamas. Geology, v. 19, p. 15-18.

Visscher, P.T., Reid, P.M., Bebout, B.M., Hoeft, S.E., MacIntyre, I.G., and Thompson, J.A., 1998, Formation of lithified micritic laminae in modern marine stromatolites (Bahamas): The role of sulfur cycling. American Mineralogist, v. 83, p. 1482-1493.

Visscher, P.T., and Stolz, J.F., 2005. Microbial mats as bioreactors: populations, processes, and products. Palaeogeography, Palaeoclimatology, Palaeoecology, v. 219, p. 87-100.

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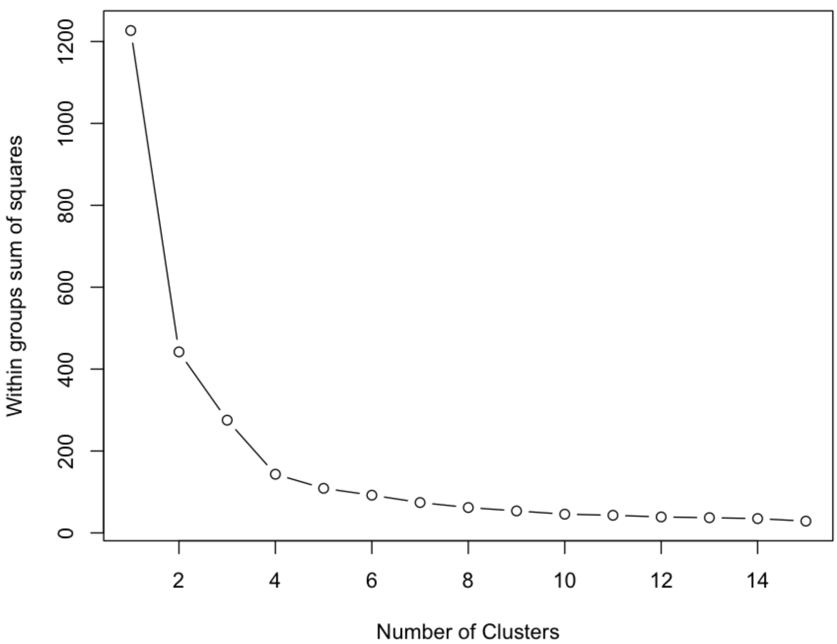

Fig. 1.