Biogeosciences Discuss., 12, C5601–C5603, 2015
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Biogeosciences Discussions
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Interactive comment on "Unusual biogenic calcite structures in two shallow lakes, James Ross Island, Antarctica" *by* J. Elster et al.

Anonymous Referee #1

Received and published: 22 September 2015

First, the microbial mats should be described more thoroughly. I don't see the microbial mats in Fig. 8. These micrographs (recorded under cross polars, which is not mentionned) only show the minerals, and it is impossible to see the claimed microbial mats – dark zones may simply represent pure epoxy resin. At least plane polarized photomicrographs of the same zones should be added to show, e.g. green-pigmented mats. It would be better to use fluorescence techniques (e.g. Gérard et al. ISMEJ 2013,. . .) to clearly shown the microorganisms. Also, I'm not convinced with the rock pictures that the dark surface of the rocks is dark because of the presence of cyanobacteria, since the basaltic rocks would also be darks: could the cyanobacteria be very thin and transparent? Or do they have very dark pigments? Microscopy pictures of the cyano and algae are lacking in the paper. In Fig.7b, arrows should be used to better distinguish mucilage and filaments. It is claimed that "The regular leather biofilm

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structure with distinct cyanobacterial-microalgal composition and incorporated mineral grains is a modern analogue of some of the oldest well-described 10 Archean stromatolites (sensu Allwood et al., 2006)." – this is wrong, there is no similarity at all. Paleoarchean stromatolites do not show trapping and binding, they only show alternance of carbonaceous laminae and silica/carbonate laminae, which is not observed in your modern samples as you apparently only have a single mat layer with scarce carbonate precipitation.

Second, the finding of the carbonates spicules is very interesting and well documented and should be discussed in more depth. Many references are cited on carbonates precipitated from evaporation: do any of those resemble the spicules (I guess not, which could be a biogenicity argument)? Moreover, a tubular hollow is shown in Fig. 8d in a carbonate spicule and claimed as a cyanobacterial filaments: abiotic carbonates may form hollow mineral tubes without requiring the presence of a filament of cells (Fan & Wang, Advanced Materials, 2005). More importantly, the surface textures of the spicules, interpreted as "worn" etching figures can also be interpreted as primary structures: in Fig. 9 I see a new type of mesostructured carbonate crystal formed through highly oriented growth of micro/nanocrystals: see the references below showing and discussing in vitro and biotic growth of mesocrystalline structures. In general, mesostructured crystals strongly suggest growth in presence of organic matter, such as mucilage.

Benzerara, K., Meibom, A., Gautier, Q., Kaźmierczak, J., Stolarski, J., Menguy, N., & G.E. Brown, J. (2010). Nanotextures of aragonite in stromatolites from the quasi-marine Satonda crater lake, Indonesia Speleothems, Travertins and Tuffs (pp. 211-224): Geological Society, London, Special Publications.

Cölfen, H., & Antonietti, M. (1998). Crystal Design of Calcium Carbonate Microparticles Using Double-Hydrophilic Block Copolymers. Langmuir, 14, 582-589.

Cölfen, H., & Antonietti, M. (2005). Mesocrystals: Inorganic Superstructures Made by

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Highly Parallel Crystallization and Controlled Alignment. Angewandte Chemie International Edition, 44, 5576 – 5591.

Lepot, K., Compère, P., Gérard, E., Namsaraev, Z., Verleyen, E., Tavernier, I., . . . Javaux, E. J. (2014). Organic and mineral imprints in fossil photosynthetic mats of an East Antarctic lake. Geobiology, 12, 424–450.

Pedley, M., Rogerson, M., & Middleton, R. (2009). Freshwater calcite precipitates from in vitro mesocosm flume experiments: a case for biomediation of tufas. Sedimentology 56, 511-527.

Perri, E., Tucker, M. E., & Spadafora, A. (2012). Carbonate organo-mineral micro- and ultrastructures in sub-fossil stromatolites: Marion lake, South Australia. Geobiology 10, 105–117.

Minor comments:

"lake water was mostly formed by detached benthic species; no substantial phytoplankton developed in the lakes." – is that published elsewhere (please cite) or not (maybe show pictures of floating microorganisms) "When the biofilm gets dry, the net of precipitated micro fortified mucilage mixed with soft mineral particles and crystals of calcium carbonate is visible (Fig. 6g, h)." – what is the structure of calcium carbonate crystals in the dried mats (upper part of fig 6g), and how does it compares with the spicules? Also, what do you mean by "soft mineral"? "Studies based on field or laboratory experiments have shown that some cyanobacteria and algae are able to tolerate prolonged periods of desiccation." – please cite these studies "The segregation of Ca2+ and HCO−3 between ice and the residual solution depend on the freezing rate and hydrogen – oxygen isotope fractionation" – I don't understand this sentence. Do you mean that H/O isotope fractionations can distinguish biotic and freezing-related precipitations?

Interactive comment on Biogeosciences Discuss., 12, 13593, 2015.