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Biogeosciences Discussions

Interactive comment on "Can Mg isotopes be used to trace cyanobacteria-mediated magnesium carbonate precipitation in alkaline lakes?" *by* L. S. Shirokova et al.

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The first major concern of this reviewer is that we based our conclusion that Mg isotopes cannot be used to track biologically mediated precipitation of hydrous Mg-carbonates on the results from experiments with one genus of bacteria (Synechococcus sp.). We think that these results can be extended to all cyanobacteria in general. Our recent work on another cyanobacteria, Gloeocapsa sp. performed in experimental Mg, HCO3- - bearing solutions yielded very similar isotopic shift between carbonate mineral and aqueous solution in case of biologically-induced and abiotic (inorganic) precipitation (Mavromatis et al., 2011, GCA, in press). The cellular organization of two

cyanobacterial species is totally different: Synechococcus sp. is represented by individual cells in the form of coccies whereas as Gloecapsa sp. Form large associates of 2 to 5 cells enclosed together in a rigid polysacchiridic capsule. In addition, the two species exhibit dramatically different features of biocalcification: Synechococcus sp. posses a self-protection mechanism again uncontrolled encrustation (calcification) at the cells surface (Martinez et al., 2010) which is absent in Gloeocapsa sp. (Bundeleva et al., 2011, and Bundeleva, 2011). Finally, other bacterial species such as Plankthothrix sp., and another strain of Synechococcus sp. (Mavromatis et al., 2010, 2011) yielded the ïĄĎ26Mgsolid – liquid during hydrous Mg carbonate precipitation very similar to that of Salda lake culture (Synechococcus sp.B8901) and Gloeocapsa sp. Given that all studied cyanobacterial species largely present in Salda lake water and stromatolites (this study and Braithwaite and Zedef (1994, 1996) we feel that the conclusion is applied to dominant types of cyanobacteria in modern stromatolites of alkaline lakes. We added the necessary explanation in the Discussion as recommended by the reviewer.

Bundeleva, I.A.: Modélisation expérimentale de la precipitation des minéraux carbonates lors de l'activité bactérienne. These Doctorat de l'université de Toulouse, 273 pp, 2011. Bundeleva, I.A., Shirokova, L.S., Pokrovsky, O.S., Bénézeth, P., Balor, S.: Experimental modeling of calcium carbonate precipitation by cyanobacteria Gloeocapsa sp. Geobiology, submitted, 2011. Martinez, R. E., Gardes, E., Pokrovsky, O. S., Schott, J. and Oelkers, E. H.: Do photosynthetic bacteria have a protective mechanism against carbonate precipitation at their surfaces? Geochim. Cosmochim. Acta 74, 1329-1337, 2010. Mavromatis, V., Pearce, C., Shirokova, L.S., Bundeleva, I., Pokrovsky, O.S., Bénézeth, P., Schott, J.: Magnesium isotope fractionation during inorganic and cyanobacteria-induced hydrous magnesium carbonate precipitation. Geophysical Research Abstracts, EGU General Assembly 2010, Vol. 12, EGU2010-11616-1, 2010. Mavromatis, V., Pearce, C., Shirokova, L. S., Bundeleva, I. A., Pokrovsky, O. S., Benezeth, P. and Oelkers, E.H.: Magnesium isotope fractionation during inorganic and cyanobacteria-induced hydrous magnesium carbonate precipitation, Geochim. Cosmochim. Acta, in press, 2011. Mavromatis, V., Shirokova, L.S., Bundeleva, I.,

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Pokrovsky, O.S., Bénézeth, P., Oelkers, E.H., Gerard, E.: Biomineralization of hydrous Mg carbonates in the Salda Lake, SE Turkey: New insights from stable Mg isotopes. EGU, Vienna, Geophysical Research Abstracts 2011, Vol. 13, 1598, 2011.

The second remark of this reviewer is that the abstract does not adequately portray all that is useful in this paper. He/she suggested editing the abstract via including the information from the last three pages of the text, and we revised the abstract accordingly. We also moved up the final sentence of the abstract as recommended.

General technical comments: We corrected “Mg-carbonates” instead of “magnesium carbonates” ; delta 26 Mgmineral-solution instead of delta 26 Mgsolid-solution, defined and used throughout the text the term “stromatolite” as recommended. The reviewer inquired about the possibility of incorporating the electronic supplementary material into the body of the paper. Biogeosciences allows having large dataset published as ESM and we would like to use this option for presenting the primary chemical analyses data which are not interesting for general reader. Both portrait and landscape figures can be incorporated in the manuscript should it be published in the final version.

We carefully edited the number of decimal places for delta 26Mg in tables and corrected as recommended. Note that when presenting the range of isotopic values, we tried to minimize the number of decimal places. Given that the 2 sigma value is always reported in Tables 2 and 3, these numbers are rigorously defined.

The reviewer suggest to use the terms “more positive” and “more negative” instead of “heavier” and “lighter” and we corrected the text accordingly.

We converted Figures 9 and 10 in black and white as recommended.

We took into account all specific technical comments noted by reviewer. We added references where requested, changed “mineral carbonation” to “mineral CO2 sequestration”. We explained that the most significant stromatolite growth occurs in warmer waters and at higher solar radiation during the summer and as such, water samples

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were collected during September 2010 when the water temperature was the highest. As recommended, we reported the range of delta values for the internal and external parts of stromatolites and the littoral sand, and included the chemical formula for brucite.

The reviewer suggested to "to speculate on dypingite saturation state even if we can't calculate it because it is a major phase precipitated in their experiments." This is useful remark; however, the first precipitated phase is nesquehonite, not dypingite. As such, the major solution changes occur during nesquehonite formation whose supersaturation index is discussed. Chroococales sp. was a misprint, we meant Synechococcus sp.

We corrected all noted misprints in Tables and Figures.

We thank anonymous reviewer No 1 for very constructive and insightful review.

Interactive comment on Biogeosciences Discuss., 8, 6473, 2011.