Earth Surf. Dynam. Discuss., 1, C383–C387, 2013
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Earth Surface Dynamics Discussions
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Interactive comment on "Linking process and product in terrestrial carbonates using a solution thermodynamic approach" *by* M. Rogerson et al.

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Received and published: 9 December 2013

Many thanks for your excellent and forgiving review of my first version of this manuscript. I have attempted to respond to every point raised, and number the responses according to the paragraph they appear in.

Several comments are shared between reviewers, and in these cases I respond in the first instance they are raised and refer back to this response on subsequent occasions.

Reviewer 2 – Alex Brasier

Paragraphs 1-3) We thank the reviewer for his positive comments, and refer to reponses to Reviewer 1 for specific points on Methods.

4) Presentation of SNI and proper identification of certain sites. For SNI, I refer to Reviewer 1 comment 10. We have provided temperature and relative Gibbs Free Energy for each system in the relevant sections.

5) Generalization of facies. We acknowledge the generalization of the facies we describe, but we hope the Reviewer and Editor realise that a detailed analysis of every single system would require the paper to be very much longer. We would like readers to see these descriptions as a starting point, to be challenged, elaborated on and made useful in the full range of contexts our work is relevant to. With this in mind, we expect to find specific petrological features like feather crystals ultimately to be identified as belonging to one specific Class of deposit. However, we would prefer the growing community of specialists in this area to come to this view collectively, and see little benefit from us laying down "How It Is" didactically at this stage. We have included an explicit reference to a separate study readers may find useful for each of the four main classes.

6) Methods. See responses to Reviewer 1.

7) Abstract – definitions of chemical sediments and high temperature and recommendation to investigate biochemical processes in isolation. We have clarified what we mean by associated chemical sediments (e.g. calcretes, speleothems) and high temperature (>40oC in this instance). We do not recommend investigation of biochemical processes in isolation, merely that focus is given to them (see Reviewer 1, Comment 3).

8) An example of the Dunham scheme working. We have provided one.

9) Rather old "recent" classifications. The reviewer is absolutely correct – similarly, 2 authors of this MS were aged 12 when this paper was published. Sadly, we are not aware of more recent efforts that are similarly general and so use "recent" in the relative sense (as in the Neoproterozoic was more recent than the Palaeoproterozoic).

10) Labwork in Pedley 1990 or Ford and Pedley 1996? Ford and Pedley 1996 refers

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to Pedleys original “Butyl Tank” experiment (Pedley, 1994), which is one of the first experimental studies done on this subject.

11) Yellowstone and several others are hotter than 60oC. This is true. Its is also true that most are cooler than 60oC. Laterally passing from a “travertine” to a “tufa”. This is an important philosophical point, but we doubt it has a clear answer. We propose here usage of the term “tufa” for a suite of observable features that together provide a diagnosis that the water was moderately oversaturated and at <30oC. Clearly, in any carbonate hot spring these properties will be achieved at some point downstream of the spring. Strictly speaking, for cool water systems the source of ions is a different question and one better solved geochemically than sedimentologically / petrologically. We suspect that – ultimately - our suggested classes will require further splitting to permit cryptic classes like “geothermal tufa” to be erected on the basis of specific criteria.

12) Phrasing of several sentences. We have amended these to make them easier to follow.

13) Saccharides? Yes, we have changed this.

14) Precipitate not precipitation? No, this time our original is correct. Deviate? Yes, that word does work better. “It”. We have clarified. Remain not remains. Correct, we have amended. Specifically not specific. Correct, we have amended. Marine stromatolites? Yes, we have added the word “marine” for clarity.

15) Section 1.2.4 is too cryptic. We have made this section less cryptic, and removed the offending words.

16) Methods. See response to Reviewer 1. We use K for the mathematics, but present oC for some outputs. This simply reflects that we anticipate some of our audience will be more comfortable with this unit. We provide justification for this strategy in the paper now.

17) Thermophiles not thermophyles. Searched and replaced

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18) URL and disparate. The URL has now been created, and will be brought to full function as soon as possible. We have amended the text.

19) Water data and badly linked table. Water data has been added for each case study. We do not find that temperature is a first order control on DGr, so we are not clear how the Reviewer is intending us to link it to the discussion of classes. We have put the temperature boundaries onto Figure 3 to assist with linked this figure to table 2, however.

20) Missing Comma. Added. “Any” too general. Changed to “extensive”. Split sentence? We have split the sentence, and elaborated on the chemical forcing happening in these systems. Permitting the reaction. Clarified. Palisade crystals. We have elaborated a little. Palisades (cf. “columnar fabrics”) in speleothems are now considered to reflect growth under rather stable and equilibrium conditions. They probably do reflect competitive growth, but rather than speculate on specific crystallographic mechanisms we have elected to refer the reader to a more detailed discussion of the problem (Frisia et al., 2000).

21) Acqua Bora. Water data has been added to the case studies.

22) Section 3.2. We have re-written this section, and hope it is now clearer.

23) “Host Waters” and “Such Waters”. No, these are the same waters. We have tidied the text a little, but the scientific case here is perfectly feasible. The argument put forward in the text is that even when the water is not toxic, macrophytes and invertebrates can still be excluded by the high precipitation rates. This is well demonstrated in the case of Brook Bottom (one of our case studies) where carbonate surfaces lack significant biofilms, but the adjacent soils support lush turf (and cattle) despite soil pore waters at the same pH as the stream. Even below the carbonate deposit itself, buried soils support a fully-developed microbiological ecosystem despite the pore waters being indistinguishable from stream water (Burke et al., 2012). The streamwater is clearly not in itself toxic, and it is the precipitation system that restricts the ability of biota to

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colonise the stream bed.

24) Most widespread form of terrestrial carbonate. This is a good point. We have amended the text, and added a reference.

25) 30oC is on the low side. We are advised that each macrophyte has its own preferred range, but for most taxa the physiological limit is found between 30 and 40oC. We thus propose this as a “buffer zone” between the tufa and travertine classes. Hopefully, future research will help clarify where this boundary lies. “Laminites” not descriptive enough. We have now elaborated, and hope this is now more helpful.

References

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