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## ***Interactive comment on “The low temperature hyperalkaline hydrothermal system of the Prony bay (New Caledonia)” by C. Monnin et al.***

### **Anonymous Referee #2**

Received and published: 30 June 2014

#### General Comments:

This manuscript presents an interesting study of the water chemistry of a unique hyperalkaline hydrothermal system in the Prony Bay of New Caledonia. This system is an exciting example of alkaline fluids produced by serpentinisation reactions with meteoric water in ultramafic rocks that in turn react with coastal seawater to form spectacular brucite-carbonate structures at different sites in the Prony Bay. This is the first example of such a system that forms at a marine-terrestrial interface. Similar alkaline systems associated with the alteration of ultramafic rocks have been found at the Lost City hydrothermal field near the Mid-Atlantic Ridge (pure marine, ridge system) and in the Mariana forearc (marine, subduction setting) as well as at a number of continental sites (pure meteoric systems), such as in California, Oman, N. Italy, Bosnia, and Turkey.

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Such systems have received increased attention in the past few decades because of the associated high concentrations of hydrogen and methane that can sustain diverse microbial communities in environments with limited CO<sub>2</sub> and nutrients and which may be analogous to early Earth environments or conditions on other planets. Thus, the Prony Bay system is of general interest to a wide range of Earth scientists.

This study is part of a larger sampling and analyses campaign resulting from the HY-DROPRONY cruise which took place at the end of 2011. The authors indicate that they will present and discuss the gas data in a separate paper. Although not mentioned specifically, one assumes that the mineralogical data and geomicrobiological studies will also be forthcoming. This study focuses on the chemistry of the major elements at 6 sites of high pH discharge, which show large variations in pH, salinity and dissolved components as a result of variations in the degree of mixing with coastal seawater. The authors then calculate mineral saturations to constrain the conditions of brucite and carbonate formation in this distinct alkaline environment. A clear discussion of the link between fluid chemistry and microbiology is not given, and hence one may question its impact from publication in Biogeosciences.

#### Specific Comments:

The data and calculations made in this study are a valuable contribution to a better understanding of the controls on alkaline fluid compositions associated with the alteration of ultramafic rocks at low temperatures. The presentation and the discussion of the chemistry of the major constituents of the hydrothermal fluids are straightforward and provide a good example of the influence of mixing of two (or three) distinct fluids and changes associated with mineral precipitation.

The discussion of the chemical data concentrates primarily on the controls on the variations in pH, Mg, Na and Cl at the different sites – i.e, mixing and Mg-Ca mineral precipitation. It would have been nice to see a more detailed discussion of the DIC and sulfate data and the implications of these, as well as the volatiles, for microbial activity.

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Since this manuscript is intended for Biogeosciences, a discussion of the relevance of the study for microbiology would make it more attractive. In addition, a discussion of the mineral reactions in the ultramafic rocks (serpentinisation processes) that lead to the alkaline compositions and particularly to the “Ca-OH-type” fluids was missing. Although there is a slight increase in temperature of the outflow fluids compared to ambient conditions, it is questionable if the term “hydrothermal” is truly appropriate for this system.

Paper Title: Because the paper essentially focuses on the fluid compositions and does not truly give an overview of the alteration processes, I would suggest changing the title to emphasise the fluid chemistry and importance of serpentinisation processes, for example: “Fluid chemistry of the low temperature hyperalkaline hydrothermal system of the Prony Bay (New Caledonia).

Note: “Prony Bay” is a proper name, and “Bay” should be capitalised throughout the text.

Introduction: the Lost City hydrothermal system is NOT an example of weathering of ultramafic rocks. It is, however, an example of a hydrothermal system controlled by serpentinisation processes (at T 100-150°C) in a marine environment. If the Prony Bay fluids are controlled by weathering processes (a process that is different than hydrothermal reactions at elevated temperature), then this should be discussed in more detail in the paper.

Figures: The size of the figures, the symbols and labels in Figures 5, 6, 7 and 10 are too small to be useful for any printed version of the manuscript (and need to be magnified greatly in a PDF version). It would be nice to re-draw these in a larger format. Was the composition of “standard seawater” measured in the Prony Bay? Were any analyses made of rain or river water that feed this system? It would be good to include at least the seawater end-member composition in Table 2.

Technical and typographical corrections:

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Abstract: Page 6223, line 7: change “have been collected” to: were collected

Introduction: P. 6224, L. 22: see comment above about using the term “weathering” P. 6225, L. 20: The use of the word “present” is incorrect here. Use “have” instead.

P. 6226, L. 4: change “have been collected” to: were collected

Section 3.2: P. 6230, L. 25: change “details” to “detail” P. 6231, L. 10: Replace “associated to” with “and”. NB: in English, something is associated with, not associate to...

Section 4.1: P. 6232, L. 1: Delate “has” – i.e., Garnier (1981) measured...

Section 4.2: P. 6232, L. 16: Gas bubbles WERE observed – not “have been”.. P. 6232, L. 8: Change to: During the fall 2012, we installed temperature recorders P. 6232, L. 22: replace “that at” with “than at”

Section 4.4: P. 6234, L. 9: UNCLEAR what is meant by “merely contain anything but calcium and hydroxide” – same problem again on Page 6240, Line 11. Please reformulate the sentence to make it clear what you mean. P. 6234, L. 20: replace “for” with “from”

P. 6234, L. 27: UNCLEAR what is meant with “limitation”. Do you mean: the upper limit of pH in low temperature serpentinising environments remains an open question? Or something like that? P. 6235, L. 12: delete “comprised” P. 6236, L. 25: change “allow taking into account” to allow us to take into account P. 6237, L. 6: what is “prenset” typo for “present”?

Section 5.2 Reformulate paragraph in Lines 13-16. Not proper English.

Section 6: Change Discussion and conclusions ... (i.e., plural) P. 6241, L. 17: change “has been” to “was” P. 6241, L. 23: Poorly formulated: The tide effects are not sensitive...” P. 6241, L. 29: Change “evidenced by” to “indicated by”

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